

FILE NAME: Johns-Manville (JMA)

DATE: 1966-1967

DOC#: JMA005

DOCUMENT DESCRIPTION: Report - Asbestosis Fact and Fancy with
Cover Letters, UC Berkeley

7944N

UNIVERSITY OF CALIFORNIA, BERKELEY

BERKELEY • DAVIS • IRVINE • LOS ANGELES • RIVERSIDE • SAN DIEGO • SAN FRANCISCO



SANTA BARBARA • SANTA CRUZ

SCHOOL OF PUBLIC HEALTH

EARL WARREN HALL
BERKELEY, CALIFORNIA 94720
June 17, 1966

W. Clark Cooper, M.D.
Clinical Professor of Occupational Medicine
University of California
School of Public Health
Berkeley, California 94720

Dear Clark:

We are writing the preliminary program for the 19th Annual Meeting of the A.A.O.M. to be held in San Francisco in February, 1967. The paper which you have expressed a willingness to present will appear on the program as "Asbestosis: Fact and Fiction" and is scheduled for the February 8th Scientific Session at 11:10 a.m. We are allotting 50 minutes for your paper and hope that your presentation will take no more than 30 minutes. General discussion will be called for immediately after the paper is presented; Dr. Kenneth Smith has been asked to open the discussion. Please let me know if you will require any type of projection equipment.

I have been asked by Dr. Boucot Sturgis, the Chief Editor, to inform you that the A.M.A. Archives of Environmental Health is the official journal for publishing the papers that are presented. We would urge you to prepare a manuscript and submit it to her for publication. Also, Dr. Jack Schulte, Chairman of the Publications and Fellowship Committee and Member of the Editorial Board of the Archives, has expressed his willingness to assist the speakers in the preparation and submission of their manuscripts.

You will be identified in the list of Scientific Program Participants as follows:

W. CLARK COOPER, M.D.
Clinical Professor of Occupational Medicine
University of California
School of Public Health
Berkeley, California 94720

We would like the information in the preliminary program to be as precise as possible. Could we hear from you regarding its accuracy?

Best regards,

Sincerely yours,

Irving R. Tabershaw, M.D.
Chairman, Program Committee
19th Annual Meeting, A.A.O.M.

IRT:js
cc: Dr. Kenneth Smith

1744 M

UNIVERSITY OF CALIFORNIA, BERKELEY

BERKELEY • DAVIS • IRVINE • LOS ANGELES • RIVERSIDE • SAN DIEGO • SAN FRANCISCO



SANTA BARBARA • SANTA CRUZ

SCHOOL OF PUBLIC HEALTH

EARL WARREN HALL
BERKELEY, CALIFORNIA 94720

June 24, 1966

Dr. Kenneth Smith
Johns-Manville Corporation
22 East 40th Street
New York, N. Y. 10016

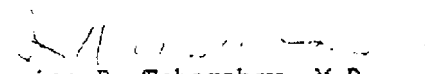
Dear Dr. Smith:

You can see by the enclosed copy that Dr. W. Clark Cooper will present a paper entitled, "Asbestosis: Fact and Fiction" at the 19th Annual A.A.O.M. Meeting in San Francisco in February.

Approximately 10 minutes will be allotted for a general discussion of each paper. Would you be willing to open the discussion of Dr. Cooper's paper by taking 3 to 5 minutes to comment on the pertinence of the subject matter to the practice of occupational medicine?

Your participation in the program would be appreciated very much.

Sincerely yours,


Irving R. Tabershaw, M.D.
Chairman, Program Committee
19th Annual Meeting, A.A.O.M.

IRT/lis

7944 K

July 7, 1966

Dr. W. Clark Cooper
University of California
School of Public Health
Earl Warren Hall
Berkeley, California 94720

Dear Clark:

I have just received an invitation from Irving Tabershaw to open the discussion of your paper on asbestosis at the A.A.O.M. meeting in San Francisco next February. Naturally, I accepted with enthusiasm for I shall look forward to learning more about the subject from your presentation. I would be very grateful if you could give me a copy of this paper before presentation, along with any comments which you would like to make so that I can be prepared to open the discussion along proper lines. Incidentally, if you could tell me the date and time of our appearance for the presentation, it would be appreciated.

On another subject, I would like very much to know about your visit to our plants in the Los Angeles area, whether or not you were able to visit other companies, and how the whole study is progressing in general. Please let me know if I can be of any assistance in any way whatsoever with your project.

Sincerely,

Kenneth W. Smith, M.D.
Medical Director

7444H

UNIVERSITY OF CALIFORNIA, BERKELEY

BERKELEY • DAVIS • IRVINE • LOS ANGELES • RIVERSIDE • SAN DIEGO • SAN FRANCISCO



SANTA BARBARA • SANTA CRUZ

SCHOOL OF PUBLIC HEALTH

EARL WARREN HALL
BERKELEY, CALIFORNIA 94720

July 29, 1966

Kenneth W. Smith, M.D.
Medical Director
Johns-Manville Corporation
22 East 40th Street
New York, N. Y. 10016

Dear Ken:

Your letters were here when I returned this week from a brief vacation and trip to Cincinnati. I am pleased that you will be able to participate in the discussion at the A.A.O.M. meeting next February and hope that I will be able to develop enough new information to warrant this updated presentation.

LeRoy Balzer and I had an excellent visit to Southern California three weeks ago when we saw the thermasbestos and fiber glass operations. Mr. Paddock and Mr. Robinete at Long Beach and Mr. Rust and Mr. Shelmire at Corona could not have been more friendly and cooperative. We learned just what we needed to make our environmental studies and occupational histories in insulating workers more meaningful.

Our program is slowly getting under way. We have reconstructed the population of insulating workers in Local 16 of the Asbestos Workers Union as of and since January 1, 1946, and are attempting to find out what has happened to them. All current members are being interviewed and examined, with one of the major objectives being to obtain information on their working histories and exposures to all types of insulating materials, whether or not they engaged in installed marine insulation, handled amosite, tore out old insulation, etc. We have a good working relationship with both the unions and with the Association of Western Insulating Contractors. We have also begun environmental studies, first in the local apprentice school and now at two large-scale construction projects. I will not go into details as to what will be done with all this information other than that we hope to have a longitudinal study, based upon the rather limited information (age, time of entry into the industry, etc.), of the men who worked any time between 1946 and 1966. We also hope to set the stage for a prospective longitudinal study based upon the more complete information we are obtaining in our interviews and environmental studies. The Seattle, Spokane, and Portland unions want to be included--I have been up there and have corresponded with them, indicating our interest and intent to work with them. I have also kept in touch with Dr. Norwood at Hanford and our present schedule will take us into the northwest in September.

I am also interested, as are so many others these days, in finding more about the asbestos bodies, real or apparent, that can be found in lung juice and sputum. We are collecting smears and tissue from consecutive autopsies at

Dr. Kenneth Smith
Page two
July 29, 1966

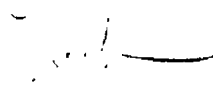
San Francisco General Hospital, are collecting sputum from a variety of sources, and have a number of things we hope to do with the bodies we detect.

I have located a number of cases in the Bay Area diagnosed as dying with pleural or peritoneal mesothelioma and am attempting to find out (1) the validity of the diagnoses, (2) whether or not there has been any pattern of association with asbestos, and (3) if there has been a pattern of association, what kind.

I had a good visit with Lewis Cralley last week and am looking forward to following it up with another trip late in August. George Wright was out last month, Paul Gross is to be in town next Wednesday and Thursday, the X-ray panel for the PHS study will be here September 26, and Cliff Sheckler is also coming out in September. Communication is beginning to flourish, and when you are next in the Bay Area, be sure to call us up and let us arrange to get together.

With best wishes,

Sincerely yours,


W. Clark Cooper, M.D.
Research Physician
Occupational Health

WCC/lis

cc: Dr. Cralley

→ P.S. Have you seen the diatomite study followup report yet? While the version prepared for Vienna is a very brief summary of the full report, I think it has been very worthwhile a project, and the report is an interesting one (if I do say so myself).

1176

August 8, 1966

Dr. W. Clark Cooper
Research Physician, Occupational Health
University of California, Berkeley
Earl Warren Hall
Berkeley, California 94720

Re: Asbestos Survey
California

Dear Clark:

Many thanks for sending me your very complete and informative letter concerning this survey. I am very pleased to note that your plans for the program are progressing satisfactorily. Please remember that if I can be of any help in any way whatsoever, do not hesitate to contact me. I expect to be on the Coast some time later this year and will stop in to see you.

As an addendum to your letter of July 29, you asked if I had seen a copy of the diatomite study followup report? As a matter of fact I have been out of the office for a considerable length of time and find it rather difficult to sort out the mail which has come in. As yet, I have not seen this report and I do not expect to go to Vienna. Therefore, if you do have a spare copy of the report which I could have, I would be very grateful to receive it. If you have no spare copies, please let me know where I might obtain one.

Many thanks for all your help.

Sincerely,

Kenneth W. Smith, M.D.
Medical Director

7944F

UNIVERSITY OF CALIFORNIA, BERKELEY

BERKELEY • DAVIS • IRVINE • LOS ANGELES • RIVERSIDE • SAN DIEGO • SAN FRANCISCO



SANTA BARBARA • SANTA CRUZ

SCHOOL OF PUBLIC HEALTH

EARL WARREN HALL
BERKELEY, CALIFORNIA 94720

August 31, 1966

Dr. Kenneth W. Smith
Medical Director
Johns-Manville Corporation
22 East 40th Street
New York City, New York 10016

Dear Ken:

I do not have a final copy of the diatomite followup report, but I believe Lewis Cralley should be able to furnish you one. It contains the basic conclusions, although space limitation required us to leave out many of the supporting tables. I am sure you would like to see them some time. I am trying to get the material in shape for publication, but other more pressing matters keep getting in the way.

I had a phone call this afternoon which indicates that Cliff Sheckler and John Gadway will be visiting us on September 16, and we are looking forward to discussing with them our work with insulating workers.

I hope that we will have a chance to get together some time this fall or winter.

Best wishes, as always,

Sincerely yours,

A handwritten signature in cursive script, appearing to read "W. Clark Cooper".

W. Clark Cooper, M.D.
Clinical Professor and
Research Physician
Occupational Medicine

WCC:js
cc: Dr. Cralley

7944 J

January 16, 1967

Dr. W. Clark Cooper
University of California, Berkeley
School of Public Health
Earl Warren Hall
Berkeley, California 94720

Dear Clark:

The time for the A.A.O.M. meeting in San Francisco, February 8, is approaching rapidly, and I must make some travel plans. Could you please tell me where and when the meeting will be held as I am not a member of the Academy. Also, in order to open the discussion intelligently I would appreciate a preliminary copy of your paper or some remarks about what you are going to say so that I shall not have to speak ad lib immediately after your presentation. I expect to be in San Francisco the day before the meeting and do you think it advisable to get together on this subject.

Sincerely,

Kenneth W. Smith, M.D.
Medical Director

77440

UNIVERSITY OF CALIFORNIA, BERKELEY/

BERKELEY • DAVIS • IRVINE • LOS ANGELES • RIVERSIDE • SAN DIEGO • SAN FRANCISCO



SANTA BARBARA • SANTA CRUZ

SCHOOL OF PUBLIC HEALTH

EARL WARREN HALL
BERKELEY, CALIFORNIA 94720

January 26, 1967

Kenneth W. Smith, M.D.
Medical Director
Johns-Manville Corporation
Twenty-two East Fortieth Street
New York City, New York 10016

Dear Ken:

I have your two letters of January 16 and will make one reply, hoping that it doesn't confuse those who do your filing.

The Academy meeting will be held in the San Francisco Hilton Hotel on February 8 to 10. I am enclosing a program which covers the time and gives the location of the sessions. I do not have a copy of my paper yet, as I have not prepared the final version; but I will see that you have one in advance of the meeting. What I propose to do is to review briefly the present evidence of the major health effects of asbestos and to point out the many gaps in our knowledge and the hazards of extrapolation. I will emphasize, however, my own feeling that it is not improper to speculate as to the significance of certain findings which we are in the process of studying. I will get this to you in more specific terms for your critique.

The periodic health examination program to which you refer is that run by Dr. Morris Collen of the Permanente Medical Group. I am enclosing a reprint describing the setup. I talked to Dr. Collen this morning and understand that arrangements have been made for visitors on Thursday morning, February 9.

I am looking forward to seeing you; and if you will call me when you get into town, we can arrange to get together sometime on February 7. I hope you will be able to visit us in Berkeley.

Sincerely yours,

W. Clark Cooper, M.D.
Clinical Professor
Occupational Medicine

WCC:js
Enclosures (2)

7944 A

UNIVERSITY OF CALIFORNIA, BERKELEY

BERKELEY • DAVIS • IRVINE • LOS ANGELES • RIVERSIDE • SAN DIEGO • SAN FRANCISCO



SANTA BARBARA • SANTA CRUZ

SCHOOL OF PUBLIC HEALTH

EARL WARREN HALL
BERKELEY, CALIFORNIA 94720

February 2, 1967

Dr. Kenneth Smith
Medical Director
Johns-Manville Corporation
22 East 40th Street
New York, N. Y. 10016

Dear Ken:

I am enclosing a draft of the paper I will present next Wednesday at the American Academy of Occupational Medicine meeting. It is approximately as I plan to give it.

I will look forward to seeing you on Tuesday. We should have a chance then to talk over the work we are doing, and I can get your comments on the paper.

Best wishes,

Sincerely yours,

W. Clark Cooper, M.D.
Clinical Professor
Occupational Medicine

WCC/lis

Enclosure

Handwritten notes:
Dr. Johnson
L. L. Brown

Handwritten signature:
Dr. Johnson

ASBESTOSIS: FACT AND FANCY

W. Clark Cooper, M.D.

PROLOGUE

I will preface my remarks by making it plain that I will not be confined by the title on the program. On the one hand I will not limit discussion to asbestosis as the term is commonly used, but instead will range over all the health effects of asbestos. And as for separating fact and fancy, that implies more discrimination than I can bring to bear; and as was sung in the Pirates of Penzance, "What is life without a little poetry in it?"

INTRODUCTION

The resurgence of interest in the asbestos minerals as environmental hazards to health during the past few years is something of which most of you are aware. It reflects the tremendous increases in world production of asbestos and the impact of successive indications of association between asbestos and pulmonary fibrosis, bronchogenic carcinoma, diffuse mesotheliomata and other malignancies, with the more recent demonstration of asbestos or asbestoid bodies in presumably non-exposed populations.

To refresh your memories, I have slides showing the major types of asbestos and also two or three tables indicating trends in world production

*Prepared for presentation at the American Academy of Occupational Medicine, San Francisco, California. February 8, 1967.

and the amounts that have been imported into the United States. This is background material to indicate the magnitude of the problem. It is only recently that there has been a real appreciation of the many variables involved in these relationships and the real complexity of the problem.

ASBESTOSIS

The first facts to be discussed will be those relating to asbestos pneumoconiosis, the disease that has come to be known as asbestosis. No one disputes a cause-and-effect relationship here; but we are still woefully deficient in our knowledge of pathogenesis. Are all forms of asbestos equally hazardous? The evidence is against this.

Chrysotile disappears more readily from the lungs and in animals seems to be less fibrogenic. The prominence of pleural calcification varies from area to area and type to type. For example, in Finland, Raunio has recently reported a review of 600,000 chest films which show that in communes where anthophyllite mines are located up to 9.0% of films showed pleural calcifications, whereas in other parts of East Finland not bordering on producing communes the prevalence was only 0.5% per thousand. Nothing comparable to this has been reported in other asbestos mining areas.

A second question regarding asbestosis relates to its prevention by industrial hygiene. Is it true that all that is needed is the application of currently recommended standards for dust control? Most people who have looked into the basis for the present threshold limit value of 5 mppcf for

asbestos, which has stood in the books since 1964, realize that it rests on shakier evidence than most. Midget impinger counts used in arriving at the figure include all dusts; and the asbestos counted is mainly grains, although rarely some fibers are included. A large proportion of asbestos fibers have diameters below the resolving power of the light microscope and are not counted at all. And it is now realized that diameter rather than length is the major determinant of falling speed. Nevertheless, most of us feel that the impinger count is a good indirect measure of dust control and that dust counts averaging 5 mppcf should control asbestosis. Evidence is beginning to develop that this is not true. Wells (1965) reported briefly on his observations over 30 years in asbestos textiles. His view was that multiplying average counts by years of exposure provided a good rough guide and that after 50 to 60 mppcf-years workers began to show evidence of asbestosis. At the TLV, this would be reached in 10 to 12 years. Ferris last year examined insulating workers in a New England shipyard that had been surveyed by Philip Drinker 20 years earlier. Conditions and counts now appeared comparable to those of 20 years ago and were averaged near 5 mppcf. Nevertheless, a large proportion of workers had radiographic asbestosis, which had begun to appear at 10 to 12 years. Marr's counts in shipyards (1964) do not indicate weighted averages above 5 mppcf and our studies of insulating workers bear this out. This strongly suggests that a time-weighted average of 5 mppcf is too high. This is consistent with actual practices in the better asbestos industries. Mitchell (1961), reporting on improved conditions in North Carolina textile mills, cited counts ranging

from 0.4 to 4.6 mppcf. English industries under the Asbestos Industry Regulations have never operated with a numerical standard, instead depending upon enclosure, ventilation and masks to keep exposures as near zero as possible.

There are numerous other questions that one can ask relative to asbestos pneumoconiosis. Have we been too complacent in assuming that the expectoration of large numbers of asbestos bodies is the expected response of an asbestos worker, or is this in the employee really an indicator that we are tolerating too much exposure? I don't think we know the answer. There are also fundamental questions on pathogenesis, on the nature of the pulmonary vascular impairment, and the factors determining susceptibility.

MALIGNANCIES

Asbestos would not be in the headlines these days if only asbestosis, affecting a few hundred miners, millers and insulating workers, were the only problem. It is the more recently demonstrated association between asbestos and malignancies that has created an entirely new series of facts, fantasies, fallacies, and fancies. Let us first look at the evidence.

That there is an increased incidence of lung cancer in many groups of workers exposed to asbestos is a fact. The cumulative evidence from epidemiologic studies that began with Merewether's analysis of causes of death in certified cases of asbestosis in the United Kingdom (1949) is now overwhelming. Table 3. The evidence is not convincing as to the relative importance of different types of asbestos. Chrysotile seems less certainly implicated; and we are looking forward with interest to McDonnell's up-dating of the experience of Quebec chrysotile miners, which several years ago, when analyzed by Braun

and Truan (1958), showed no excess risk. It is of interest here that Jacob and Anspach (1965), who in Dresden a few years ago could demonstrate no increased risk, on bringing their data up to date have shown twice the expected number of cases of lung cancer in men and ten times the expected number in women. Their exposures were mixed, however; but they concluded that possibly partial control of asbestosis had permitted more workers to live to an age where malignancies occurred which in earlier days had masked malignancies. In view of the spreads of dosage and response, I find this an unlikely explanation. We do not now have the answer as to whether the association is truly less for chrysotile than it is for crocidolite and amosite.

The next question, and this will apply to other malignancies to be mentioned later, is whether or not asbestos minerals per se are carcinogenic. A promising area of direct research is aimed at determining the role of the asbestos fibers and fibrils as carriers of trace metals or of carcinogenic chemicals, such as the polycyclic hydrocarbons, to vulnerable sites. The idea of a fibril that can migrate and then become a semipermanent implant is an intriguing one. This falls into the area of speculation, or fancy if you wish to call it that; but one that may prove productive.

Within the past 5 years, there has been ample evidence of the association between asbestos and diffuse pleural and peritoneal tumors or mesotheliomata. Since the first demonstration of a major series of cases, that of Wagner, Sleggs, Marchand in 1960, there have been over 25 reports in the literature. In many of them there have been suggested associations with asbestos, either by

occupational history or demonstration of asbestos bodies in lung tissue sections. Inasmuch as mesotheliomata were regarded as excessively rare tumors until recently, the occurrence of even two or three in a series of asbestos workers becomes statistically significant. Separating fact and fancy here becomes a bit more difficult. First, how accurate are our diagnoses of diffuse mesotheliomata? There is no question but that rigid criteria to exclude primary tumors elsewhere are necessary inasmuch as the histologic characteristics of undifferentiated spreading tumors of the pleura and peritoneum are not always distinctive. Close scrutiny of most series of diagnosed cases results in the exclusion of many of them. Nevertheless, where rigid criteria have been applied, as in the cases studied by Hourihand in London Hospital, the association with asbestos has been strengthened, not weakened. My impression is that it is holding up as additional studies are made. A second question regarding these tumors is whether or not their incidence in the population as a whole is increasing. Here again the impression one gets is that they are, as reviews of cases over the past 10 years or so would indicate that the diagnosis was beginning to be made prior to wider publicity. Third, if there is an association, is it more evident with one form of asbestos than another? Here there is no question but that crocidolite and especially Cape blue crocidolite is the type where evidence is strongest. In this country, reported series have involved mixed exposures, usually including amosite. Claims have been made that because amosite was not used in the United States to any extent before 1935 and since mesothelioma characteristically have very long latent periods from first exposure to diagnosis, that we are either

seeing responses to chrysotile or are seeing only the first cases in an epidemic of effects from amosite. That anthophyllite is not a problem in this respect is strongly suggested by a recent report by Raunio (1966), in which the very high prevalence of pleural calcification in anthophyllite mining areas of Finland was not associated with any increased frequency of cancer of the lung or of malignant pleural or peritoneal tumors. We are left with a strong body of evidence that individuals with light, moderate and heavy exposures to crocidolite or to mixtures of amosite and chrysotile show tumors of a type that is much less common in the general population. The total frequency is quite low; but as of now death certificate data are quite misleading due to incorrect diagnoses.

Studies in animals by Wagner in Cardiff and by Smith and others at Fairleigh Dickinson College have led to production of mesothelial tumors in hamsters in which various types of asbestos were introduced intrapleurally. The difficulty in preventing cross contamination in laboratories has complicated some of these animal studies, so that differences in response to different types of asbestos and co-factor remains unclear. Nevertheless, the carcinogenic potential of asbestos minerals is confirmed, although the role of co-factors has not been settled.

FERRUGINOUS BODIES

The final question is: is it true that from a fourth to a half of the general population harbors asbestos fibers in its lungs? The basis for such a statement is the fact that a number of studies of routine consecutive autopsy specimens in recent years have demonstrated "asbestos bodies", or as Gough

would prefer to call them, "mineral-fibre-bodies," or Gross "ferruginous bodies." As far back as 1928, Stewart had shown that smears of the cut surface of the fresh lung at autopsy would reveal large numbers of asbestos bodies in the asbestotic. If any one tried this in a supposedly unexposed population before Thomson's studies in South Africa in the 60's, it was not published. Thomson et al. (1963) showed 26.4% in 500 consecutive autopsies in Cape Town, and later in 27.2% in 500 autopsies in Miami. Other studies are shown in Table 4. The facts that have emerged from these are:

(1) Morphologically and in staining properties, these meet all criteria for asbestos bodies; (2) In no studies so far published, have there been supporting data to indicate whether all, most, or some of the bodies were asbestos; (3) In most series, about 80 to 90% of the positive reports were on the basis of relatively few asbestos bodies per case; (4) In those with many bodies, there were often occupational or residential clues as to a source of asbestos and they were most commonly in males; (5) In none of the series, all small, where correlations were attempted with diagnosis, was there any apparent association with malignancies or other specific causes of death; (6) There is ample evidence in the literature that so-called asbestos bodies can be found in workers with exposures other than asbestos, e.g., graphite workers, soft coal miners, diatomaceous earth workers, etc; (7) Ferruginous bodies can be produced experimentally in guinea pigs with other dusts, e.g., brucite, aluminum, silicate. Presumably they represent a non-specific response to any relatively insoluble fibrous material in the lungs. Speaking to this, Cooke in 1927 said, ". . . there is no reason why any fine spicula of mineral should not have colloidal matter deposited around it and become molded into a

curious body. But as no other mineral dust is fibrous, this occurrence must be so rare as to be negligible from a diagnostic point of view."

The question now, is Cooke's statement of 40 years ago true today? Or are we adding fibers of many kinds to our environment giving a confusing picture in our human samplers?

If, as is probable, many of the bodies that are being seen are really asbestos minerals, there is need to determine their significance. I think it unwarranted to draw the conclusion from what we now know that they presage an epidemic of neoplasms. It is quite warranted to speculate on the matter, however. It is important not only to positively identify these ferruginous bodies but also to quantitate them in populations with known exposures to various fibrous minerals. If those with small or moderate numbers of asbestos bodies show no detectable ^{increased} risk of disease, then we can feel more secure about those in whom the bodies are scant in number.

It is also important to learn the sources of these fibrous minerals that are found in lungs. The view that asbestos minerals are indestructible is of course untrue--this is a relative term only and we cannot assume that the millions of tons used annually actually enter our physical environment forever. Many are bound indefinitely into products that do not release them; those that are released are subject to the effects of heat, acids and other insults to minerals. Nevertheless, it is important to get a better idea of our asbestos balance, so to speak.

SUMMARY

In summary, with the increasing use and indispensability of asbestos minerals, there has come realization of some very real hazards that must be better defined and controlled. Our present standards for dust control do not appear adequate to prevent asbestosis over a working lifetime, and many segments of industry aggressively attacking the problem have already been using more rigorous standards. The associations between asbestos minerals and malignancies of the lungs, pleura and peritoneum become increasingly convincing. Current efforts must be directed toward better definition of the importance of type, size of fiber and the importance of co-factors. It has been suggested that asbestos fibers act as carriers of carcinogenic metals or other substances to vulnerable sites. The demonstration of ferruginous bodies in from one-quarter to one-half of the lungs examined in consecutive autopsies in a number of cities around the world points to an urgent need for the positive identification of the mineral fibers that are responsible. If they prove to be asbestos, we do not know what point on the dosage response curve is represented and consequently are not now in a position to estimate their significance in terms of human health.

EPILOGUE

I have one final set of conclusions. I think you will notice that I have not conformed to the usual pattern of talks with titles such as the one I was assigned, lining up on the one hand a narrow list of the things

we really know and then decrying the unwarranted and mischievous extrapolations that have been made. Actually, that could have been done here, as I do think many misleading statements have really been made with respect to asbestos. But I think that the more fundamental problem here is one that is a major affliction of occupational health. We often try to emphasize that part of the challenge of our field is that it is at the forefront of medicine and technology, where environmental hazards can first be detected, in view of the relative levels of exposure and the opportunities to study populations at risk. But when relationships are actually suspected and then gradually established, very real and practical implications become immediately apparent. So the speculations, call them fancies if you will, that are part of the normal process of developing new knowledge in other fields become menacing and are misused and misunderstood. Polarization of views and severance of communication is the rule, not the exception. I think that this has been the case history of much occupational disease research in the United States, and I can't say I know how it could be eliminated. I do believe, however, that scientific progress requires both fact and fancy.

REFERENCES

1. Raunio (1966)
2. Wells (1965)
3. Ferris (1966)
4. Marr (1964)
5. Mitchell (1961)
6. Merewether (1949)
7. Braun and Truan (1958)
8. Jacob and Anspach (1965)
9. Wagner et al. (1963)