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CRITICAL REVIEW

Mesothelioma following Exposure to Asbestos: A Review of 72 Cases*

Maxwell Borow, M.D., F.C.C.P.; Alfred Conston, M.D.;
Lawrence Livornese, M.D., F.C.C.P.; and Norbert Schalet, M.D.

Malignant tumors arising in mesothelial tissue have been so rare that until recently they were considered pathologic curiosities. The reputed incidence of primary mesothelioma has varied from .02 to 0.2 percent of all autopsies, with a ratio of 2:1 in favor of the man affected.

In 1957, Wagner et al¹ reported the first large series of patients with mesothelioma from the Cape of Good Hope asbestos fields in South Africa. By 1962, they had collected reports of 87 pleural and 2 peritoneal mesotheliomas.² In all but two they¹ could establish a history of exposure to asbestos dust from either industrial or environmental contact. Subsequently, there were reports of patients with this malignancy from other countries, and in almost every series there was a high association with exposure to asbestos.³⁻⁷

In this country, Selikoff et al⁸ studied 307 consecutive deaths among asbestos installation workers and found 10 deaths caused by mesothelioma. In addition, they noted a high death rate attributed to other malignancies, particularly of the gastrointestinal tract. In 1967, our group⁹ reported 17 patients with mesothelioma, of which nine cases were pleural and the remainder, peritoneal. Since then, we have treated 36 additional cases, making a total of 53 patients. A search through the medical records of neighboring hospitals brought to light another 19 cases, making the total number 72. Fifty-one of these were pleural (71 percent) and 21 were peritoneal (29 percent). Sixty-four (89 percent) of these patients were men, and information of occupational exposure was present for all but nine, where no history was available. Eight of the patients were

women, three of whom had a history of occupational exposure to asbestos, two had environmental exposure to asbestos, and the remaining three had an inadequate history in their medical records. Of this group of 72 patients, there were 68 deaths with autopsies. Four are still living, but with disease.

As has been documented before, our patients were exposed to asbestos 20 or more years before the malignancy appeared. Although most of these subjects smoked two or more packs of cigarettes per day, three were nonsmokers.

Apparently, the incidence of this malignancy is increasing. From 1951 to 1959 there was a total of only four cases. In the first half of the 1960's, the number of cases averaged one to four per year. In the second half, there was a noticeable increase up to eight or nine cases per year.

Since this nearby asbestos mill has been in operation for half a century and has been the source of all of our case material, we wondered if there had been other cases of mesothelioma in which a correct diagnosis had not been made in earlier years. We reviewed all the autopsy records from 1948 to 1963 and found only two cases which now must be considered as mesothelioma. Inasmuch as it has been only a few years since the asbestos industry has instituted measures to reduce the incidence of pulmonary asbestosis, we can expect to see increasing numbers of patients with mesothelioma for the next 20 to 30 years. Then, providing that these health measures are sufficient, there should be a dramatic reduction in the incidence of this malignancy.

CLINICAL FEATURES

The period of exposure to asbestos is known in approximately 35 of our patients and reveals a wide range. Most of these subjects worked from 15 to 35 years in the industry, with an average of 25 years. However, there were five

*From the Somerset Hospital, Department of Medicine, Surgery and Pathology, Somerville, N.J.
Reprint requests: Dr. Borow, 515 Church Street, Bound Brook, New Jersey 08805

patients with less than four years' exposure. Two of these, who were among the youngest patients in our series, 41 and 45 years old, were employed 10 months and 18 months, respectively. They both worked as stock boys, presumably in areas which were not heavily contaminated with asbestos dust. None of the patients who worked fewer than five years showed any radiographic evidence of pulmonary asbestosis.

Our experience has been similar to others in that we have not seen mesothelioma develop simultaneously in more than one serous cavity, although in the later stage of the disease it often spreads to involve other cavities.

Patients with pleural mesothelioma came to the hospital with mild chest pain or a varying degree of pleural effusion. In a few instances the chest pain was moderate to severe, signifying chest wall involvement by direct extension of the tumor. In addition to the pleural effusion or pleural thickening only, there was a varying degree of pulmonary fibrosis. It has been an interesting observation that most patients with mesothelioma, whether pleural or peritoneal, do not have the extensive pulmonary fibrosis radiographically, as shown by those patients with cancer of the lung and asbestosis. Approximately one quarter of our patients with mesothelioma had completely normal findings on chest x-ray films. In many cases, the only clue to the presence of pulmonary asbestosis was the radiographic finding of a calcification on the diaphragmatic or parietal pleura. To many, the presence of these pleural plaques on a chest x-ray film suggests that the patient has been exposed to asbestos, even though other radiologic or clinical evidence or asbestosis is not present.

In 50 percent of the cases, the pleural effusion was straw colored and in the remainder it was serosanguineous to markedly sanguineous. The initial diagnosis was made either by needle pleural biopsy and Pap smear or by exploratory thoracotomy and biopsy. In those patients subjected to exploratory thoracotomy, there was always a membrane of varying thickness on the lung which, depending upon the extent of the disease, was restrictive (Fig 1). The parietal pleura was also involved with a similar process, and in some cases the visceral and parietal pleura were intimately adherent to one another and sometimes could not be separated. To the inexperienced, the process on the lung might appear to be an inflammatory membrane, and on several patients a decortication was in process until frozen section revealed the true nature of the disease. In most situations, decortication was difficult because of the intimacy between the mesothelioma and the lung, although in some cases, the process peeled off without any air leaks.

Patients with peritoneal mesothelioma sought medical attention because of vague abdominal discomfort, weight loss,

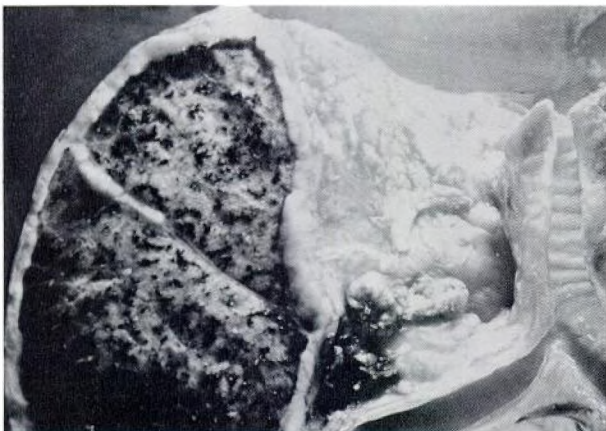


FIGURE 1. Pleural mesothelioma encasing lung.



FIGURE 2. Peritoneal mesothelioma encasing loops of bowel.

or distended abdomen. Most of these patients had ascites, and in a few, an ill-defined thickening of the abdominal wall could be felt on rectal examination. Laboratory workup, x-ray films of the gastrointestinal tract, and other studies were invariably unrevealing except for occasional external compression or rigidity of the large bowel, usually in the rectosigmoid area. The diagnosis was made by peritoneoscopy and biopsy or by exploratory laparotomy. The majority of patients with ascites were found to have small papillary projections studding the visceral and parietal peritoneum, as opposed to the more sheet-like pleural appearance. A striking finding in almost every case was the appearance of the omentum, which was usually contracted, thickened, and most heavily diseased, even when the peritoneal surfaces showed minimal involvement. The ascitic fluid was usually straw colored, although in a few instances it had a syrupy consistency.

In the later stages of this disease, the nodules have coalesced to produce large tumor masses, which eventually obliterate all the free space in the peritoneal cavity. The organs were found embedded in a solid mass of glistening tissue, which on cut surface usually had a mucinous appearance (Fig 2).

With this malignancy, there is rarely invasion of the organs. The growth remains on the surface, and by increasing in size, compresses the lungs or organs of the peritoneal cavity. In a few instances, metastatic disease was found at autopsy, mainly in the liver and regional lymph nodes.

Whereas there can be a gross difference in appearance between peritoneal and pleural mesothelioma, this has not been true microscopically. Histologically, there are two major types of mesothelioma, and both have been found in the pleural and peritoneal locations. The more common variety is the epithelial type in which there are cuboidal or polyhedral cells producing a tubulopapillary appearance or a solid group of cells without a clear tubular formation (Fig 3). Usually there is a fairly uniform cellular structure, but occasionally bizarre nucleated cells can be seen. The other variety is the mesenchymal or fibrous type of mesothelioma in which spindle cells are arranged in an almost fascicular pattern without a stroma of abundant hyaline collagen (Fig 4). Occasionally, the cells may be arranged loosely in indistinct fasciculi or may occur in solid sheets. In many cases there is a mixed histologic appearance in any given area, and often a change from the epithelial to the mesenchymal type in different parts of the same tumor. The tumor cells produce significant quantities of acid mucopolysaccharides, tending to confirm their origin from mesothelial tissue. This material can be assayed chemically in the fluid aspirate. It can also be

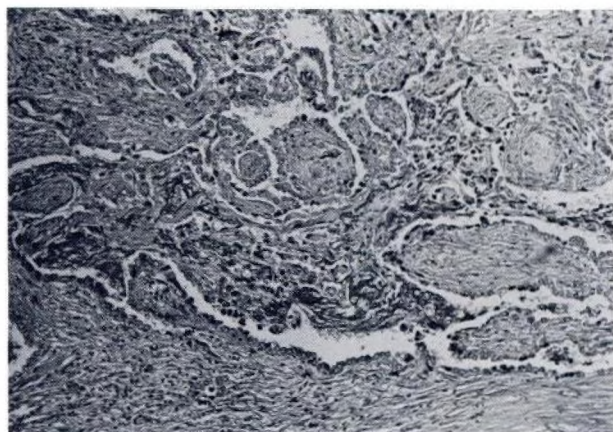


FIGURE 3. Tubulopapillary type mesothelioma.

observed in tissue sections following appropriate histochemical staining.

Clinical Course

Initially, these patients show relatively few symptoms. In about half the cases, there is a fairly rapid reaccumulation of fluid. As the disease progresses, there is coalescence of the tumors with gradual compression of the organs, becoming more symptomatic five to nine months after diagnosis. The patients with pleural mesothelioma first notice their exercise tolerance decreasing, then develop a gradual progressive increase in dyspnea until they become bedridden as the anoxia increases. Death is essentially of suffocation unless a sudden catastrophe, such as inferior vena cava occlusion, occurs. Patients with peritoneal mesothelioma waste away as they, too, develop a progressive exercise intolerance, inanition and weight loss.

Chemotherapy and radiation or combinations of modalities have not altered this course. Many of the patients, especially those with ascites, required very frequent aspirations, even though various therapeutic agents were instilled. As the peritoneal process continued, very distinct masses could be palpated, and eventually in some patients, these masses extended through the abdominal incision or the paracentesis site until they were subcutaneous in location. In general, the patients with peritoneal mesothelioma lived only a few months longer than those with the pleural process, but did so somewhat more comfortably. This difference is attributed to the ventilation perfusion problems that exist in patients with pleural disease. As the mesothelioma expands in the pleural

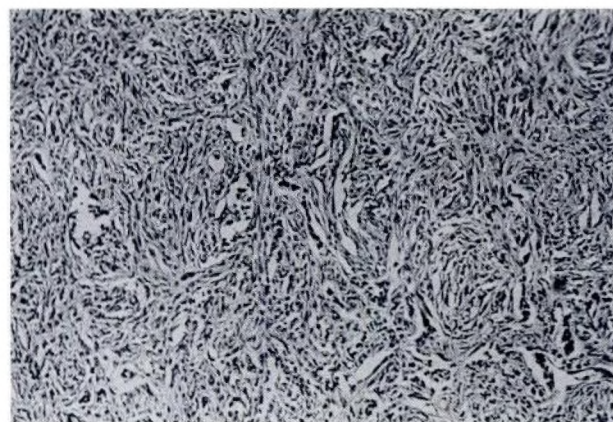


FIGURE 4. Mesenchymal type mesothelioma.

cavity, it compresses the lung, and although there is a decrease in pulmonary flow through that organ, a significant right-to-left venous-arterial shunt develops, which adds further to the patient's anoxia. Since the malignancy extends to the opposite pleural cavity only late in the disease, it has been postulated that if the diseased lung should be removed, this venous-arterial admixture of blood could be prevented.

Accordingly, a recent patient, thought to have very localized disease, was subjected to an extrapleural pneumonectomy with pleurectomy, followed by intracavitary nitrogen mustard and cobalt radiation. However, three months later he had contralateral involvement and died five months from the time of diagnosis. This patient's rapid deterioration suggests several possibilities. One is that the pleura is a natural barrier for preventing the spread of this disease until late. Another consideration is that this patient had pre-existing involvement of all of his mesothelial tissues. It has also been our experience that pleurectomy to prevent the recurrence of effusion has actually lessened the longevity of these patients.

Unlike the experience of Whitewell and Rawcliffe⁷ who have reported that 26 percent of their 52 patients with this disease lived over two years and one was still living after four years, our median survival has been 15-16 months, with none of our patients surviving over 19 months, with the exception of one patient who died 2½ years later. Our results are comparable to most other reported series of malignant mesothelioma. We treated patients with radiotherapy in combination with multichemotherapeutic agents, such as cyclophosphamide (Cytosan), nitrogen mustard, 5 fluorouracil actinomycin D or radioactive materials. There was no evidence of any amelioration of the disease other than occasional relief from pleuritic pain. Therapy did not prolong the longevity of the patients. Because of the bleak outlook with current forms of therapy, we have begun a series of experiments designed to test both a variety of chemotherapeutic agents as well as any immunologic aspects of this neoplasm. Fresh biopsy material has been supplied for both *in vitro* and *in vivo* culture. This work is being conducted by several agencies and will be the subject of a report at a later date.

DISCUSSION

Selikoff,¹⁰ in conjunction with the Asbestos Worker's Union, has been observing approximately 600 employees who have worked at least 20 years in this particular asbestos mill, until 1959. Approximately 200 died, and of this number, 90 were admitted to our institution. From this group, there were 48 autopsies, and in 26 (55 percent) the patients were found to have some type of malignancy. Table 1 shows the distribution of these malignancies. Forty-two other patients from this group had major or minor surgical procedures, and 19 (45 percent) were found to have a malignancy. A total of 45 of 90 patients (50 percent) had developed malignancies. This is an extremely high mortality from cancer, when one considers that the overall population mortality from malignancy is approximately 16 percent. An additional seven patients died from the pulmonary-cardiovascular complications of pulmonary asbestosis. Four of the patients in the autopsy group also had a second primary malignancy. These malignancies are not recorded in the Table as they were

Table 1—Clinical Data of 90 Patients with Pulmonary Asbestosis*

	Malignancy, Location				
	Lung	Mesothelioma	G.I.	Other	
48 Autopsies					
26 Ca. (54.2%)	7	8	7	4	3 pancreas 1 kidney
42 Surgical Procedures					
19 Ca. (45.2%)	7	2	5	5	1 tongue 1 bladder 1 lymphoma 2 rhabdomyosarcoma
Total 45 Ca. (50%)	14	10	12	9	

*Of 600 asbestos workers who worked at least 20 years in the industry up to 1959, 200 have died. Ninety of these patients were treated in one hospital.

incidental and not the cause of death. The high incidence of gastrointestinal malignancies in patients with asbestosis makes one wonder if the ingestion of asbestos fiber can be detrimental. Fibers have been demonstrated in a number of tissues, including parietal pleura, gastric and intestinal mucosa, spleen and liver.

It has been shown by Selikoff et al¹¹ and Doll¹² that the risk of lung cancer among asbestos workers is from six to ten times the expected rate. Like mesothelioma, there is a time interval between the initial exposure to asbestos and the onset of the pulmonary malignancy. This latent period is similar to that seen with mesothelioma, averaging 20 to 30 years. However, there does seem to be a difference in the amount of exposure needed for the production of these malignancies. It is our impression that the worker who has the longer exposure to asbestos and thus the greater degree of pulmonary asbestosis, is more apt to develop bronchogenic carcinoma than the worker with lesser exposure who is more likely to develop mesothelioma. This reasoning is substantiated by the age difference in patients developing the two malignancies. The average age of the patient with mesothelioma is 54 years, while the average age of the patient with bronchogenic carcinoma is approximately 10 years older.

Unlike other series in which there have been a significant number of patients with mesothelioma who had only an environmental exposure to asbestos, we have only two proved cases of paraoccupational exposure. The remainder of our patients had an industrial history. The failure to find patients with neighborhood exposure has been surprising to us as there had been, until the last several years, significant air pollution, with asbestos fiber over certain sections of a densely populated area in the vicinity of the asbestos mill.

Another disturbing feature in our series is the overwhelming predominance of men who developed mesothelioma within the industry. Historically, women have been employed for almost half a century in this mill and have worked in one of the dustiest areas of the plant, namely in textiles. Yet we have only one woman with mesothelioma who worked in this division. This again is in contrast to the series from England where there is a high incidence of mesothelioma among female textile asbestos workers.

The perplexities involving mesothelioma and asbestos exposure are not solely confined to our series, but seem to occur all over the world. Investigators in other parts of our globe have examined the distribution and frequency of mesothelioma and have always found a strong relationship between the presence of this disease and exposure to asbestos fiber. Most of the cases have occurred in South Africa where the fiber is mined or in the United Kingdom where the fiber is processed, and in this hemisphere in the mining fields of Canada and the processing mills of the United States. There have also been cases reported in Germany where there is a significant asbestos industry. In the Netherlands, 22 of 25 cases of mesothelioma were associated with employment in a shipyard using asbestos products for insulation.¹³ Despite a thorough search, no mesotheliomas have been found associated with the anthophyllite asbestos production in Finland.¹⁴ One would therefore question whether these malignancies are due to one or more specific varieties of asbestos fiber.

There are six different varieties of asbestiform fibrous minerals, and among these there are striking differences in chemical and physical composition. All are silicates, crystalline in nature, and characteristically are divisible into very small fibrils. Chrysotile, which is the most commonly used fiber in North America, and anthophyllite contain greater amounts of magnesium than either crocidolite or amosite, which contain more iron. In the United States and United Kingdom, chrysotile and crocidolite, and amosite to a lesser degree, are used in the various asbestos milling processes, so that workers are exposed to all three, although in different proportions. There is some documentary evidence suggesting that chrysotile is less carcinogenic and causes less pulmonary fibrosis than the other fibers. Nevertheless, it has been shown clinically and experimentally that Chrysotile is a factor in the development of mesothelioma.

In the asbestos mill where our patient series originates, chrysotile is the main fiber used, although in some of the processes crocidolite is also present. As

far as can be determined, chrysolite is the only fiber used in the textile division. It is interesting to note that all the cases of mesothelioma in our group have occurred since the asbestos mill has been using predominantly chrysolite.

These paradoxes are repeated in other geographic areas. For example, the distribution of mesothelioma in South Africa is puzzling. In the mining and milling of crocidolite in the Northwest Cape, there has been unusually high incidence of mesothelioma from both occupational and environmental exposure. Two hundred miles away, in the Transvaal region where the same kind of fiber is mined, there have been no reported cases of mesothelioma. Both mines have been in operation for the same period, using similar mining procedures and techniques. Sluis-Cremer¹⁵ has studied the geographic and environmental differences in these two areas and has not been able to explain the absence of mesothelioma in the Transvaal region. Other than the mineralogic differences between the two areas (there is some amosite present in the Transvaal area), he found no variation in the intensity or length of production of these fields or in the extent of environmental pollution and incidence of pulmonary asbestosis.

It would seem that these discrepancies, both from our own study as well as others throughout the world, indicate that there is some element in addition to asbestos which is essential in the development of mesothelioma. It seems likely that there are other factors which act as cocarcinogens with asbestos to produce these malignancies. Selikoff^{18,10,11} has pointed out that cigarette smoking is a cofactor together with asbestos for the production of bronchogenic cancer. Only 3 of our 70 patients with mesothelioma did not smoke.

In a recent report from the Mayo Clinic, Oels et al¹⁶ reported 37 patients with diffuse pleural mesothelioma, only 10 of whom had a definite or probable history of exposure to asbestos and in only 11 of whom asbestos bodies were found. Experimentally, it has been demonstrated that a few foreign materials other than asbestos, such as diatomaceous earth¹⁷ and polyurethane,¹⁸ when instilled in the pleural cavity of animals, can induce mesothelioma. Despite these few isolated cases, the association of asbestos with mesothelioma is so overwhelmingly strong that one must consider the asbestos fiber with one or more cofactors as direct causal agents in the development of mesothelioma.

Attention has been directed to the incidence of asbestos bodies found in the lungs of nonindustrial workers living in major urban areas. Reports from Pittsburgh,¹⁹ Montreal,²⁰ New York,²¹ Miami,²²

Israel,²³ and Belfast²⁴ have revealed that with direct examination of lung tissue or juices pressed from such tissues, there is a greater than 25 percent incidence of asbestos bodies in the general public. Wright²⁵ and others argue that not all of these bodies represent coated asbestos fibers. It seems reasonable to assume that if they are found in a person who has a history of exposure or possible exposure to asbestos fiber, they are indeed asbestos bodies.

The quantitative estimate of a number of structures found in the lungs of the general public is a small fraction of the number found in the lungs of those who had been occupationally exposed. The questions which arise and have yet to be answered are: if these structures truly represent asbestos fiber, are they sufficient in quantity to produce a health hazard, and will increased use of asbestos in the manufacture of products increase public environmental exposure? At present, there does not seem to be any health hazard for the general public. Most of the asbestos products with which they come in contact have asbestos which is tightly bound and not liberated into the air. It is for the mill worker and industrial worker, who are exposed to asbestos products where the fiber is loosely bound and can readily escape into the air, that the health hazard exists. For the protection of this segment of our society, which numbers three to four million workers, including not only those in the asbestos industry, but those in other industries where loosely-bound asbestos products such as insulation are used, it will be necessary to establish safety measures to reduce the fiber content in the air, and to determine what other factor or factors act with the asbestos to produce these malignancies.

REFERENCES

- 1 Wagner JC, Sleggs CA, Marchand P: Diffuse pleural mesothelioma and asbestosis exposure in North Western Cape Province. *Br J Ind Med* 17:260-271, 1960
- 2 Wagner JC: Epidemiology of diffuse mesothelial tumors: Evidence of an association from studies in South Africa and United Kingdom. *Ann NY Acad Sci* 132:575-578, 1965
- 3 Mancuso TF, Coulter EJ: Methodology in industrial health studies. *Arch Environ Health* 6:210-226, 1963
- 4 Hourihane DO: The pathology of mesotheliomata and an analysis of their association with asbestos exposure. *Thorax* 19:268-278, 1964
- 5 Enticknap JB, Smither WPJ: Peritoneal tumors in asbestosis. *Br J Ind Med* 21:20-31, 1964
- 6 Newhouse ML, Thompson H: Epidemiology of mesothelial tumors in the London area. *Ann NY Acad Sci* 132:579-588, 1965
- 7 Whitewell F, Rawcliffe M: Diffuse malignant pleural mesothelioma and asbestos exposure. *Thorax* 26:6, 1971
- 8 Selikoff IJ, Churg J, Hammond FC: Relations between exposure to asbestos and mesothelioma. *N Engl J Med*

- 272:560-565, 1965
- 9 Borow M, Conston A, Livornese L, et al: Mesothelioma and its association with asbestosis. *JAMA* 201:587-591, 1967
 - 10 Selikoff IJ: Personal communication
 - 11 Selikoff IJ, Churg J, Hammond EC: Asbestos exposure and neoplasia. *JAMA* 188:22, 1964
 - 12 Doll R: Mortality from lung cancer in asbestos workers. *Br J Ind Med* 12:81, 1955
 - 13 Stumples, Meyer: Asbestos bodies and mesothelioma. *Ann Occup Hyg* 11:283, 1968
 - 14 Kiviluoto R, Meurman L: Results of asbestos exposure in Finland, Proceedings of International Conferences on Pneumoconiosis, Department of Mines, Republic of South Africa, 1969, to be published
 - 15 Sluis-Cremer GK: Asbestosis in South Africa: Certain geographical and environmental considerations. *Ann NY Acad Sci* 132:215-234
 - 16 Oels HC, Harrison EG, Carr DT, et al: Diffuse malignant mesothelioma of the pleura: A review of 37 cases. *Chest* 60:564-570, 1971
 - 17 Smith WE: Personal communications
 - 18 Hueper WC: Cancer induction by polyurethane and polysilicone plastics. *J Natl Cancer Inst* 33:1005, 1964
 - 19 Utidjian MD, Gross P, de Treville RTP: Ferruginous bodies in human lungs: Prevalence at random autopsies. *Arch Environ Health* 17:327, 1968
 - 20 Andilvel WM: The incidences of asbestos bodies in the lungs at random necropsies in Montreal. *Can Med Assoc J* 95:1179, 1966
 - 21 Berkley C, Langer AM, Boden V: Instrumental analysis of inspired fibrous pulmonary particulates. *Trans NY Acad Sci* 30:331, 1967
 - 22 Thompson JG, Graves WM: asbestos as an urban air contaminant. *Arch Pathol* 81:458, 1966
 - 23 Polliack A, Sacks MI: Prevalence of Asbestos bodies in basal lung smears. *Isr J Med Sci* 4:223, 1968
 - 24 Elmes PC, McCaughey WTE, Wade EL: Diffuse mesothelioma of the pleura and asbestos. *Br Med J* 1:350, 1965
 - 25 Wright GW: Asbestos and health in 1969. *Am Rev Resp Dis* 100:467-479, 1969

ANNOUNCEMENTS

15th Conference on Medical Aspects of Sports

The 15th Conference on the Medical Aspects of Sports will be held in Anaheim, California, December 1, in conjunction with the convention of the American Medical Association, November 30-December 1. The theme for the conference is "Health Care for the

Athlete: A Community Concern." For information, please write the Committee on the Medical Aspects of Sports, American Medical Association, 535 North Dearborn, Chicago 60610.

Tenth Annual International Postgraduate Course: Pulmonary Function in Health and Disease

The Tenth Annual International Postgraduate Course on Pulmonary Function in Health and Disease will be held December 3-6 in the auditorium of Louisiana State University School of Medicine, New Orleans. Dr. Howard A. Buechner is chairman of the course, being sponsored by the American Thoracic

Society, American College of Chest Physicians, LSU New Orleans and Shreveport, Tulane University, the Alton Ochsner Medical Foundation and the American Lung Association of Louisiana. For information, please write the Louisiana Thoracic Society, Suite 1504, 333 St. Charles Avenue, New Orleans 70130.

Pediatric Respiratory Disease Course of the Pacific

The National Cystic Fibrosis Research Foundation will present a course on "Pediatric Respiratory Disease" on board the cruise ship, Spirit of London, during a 7-day cruise from Los Angeles to Puerto

Vallarta and Mazatlan, Mexico and back to Los Angeles, December 8-15. For information, contact Mrs. Rose Schlichter, Lung Association of L. A. County, 1670 Beverly Blvd, Los Angeles 90026.

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