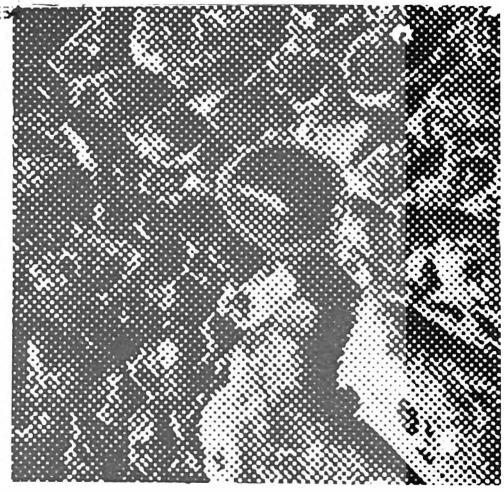
NIOSH

the Federal Coal Mine Health Program in 1976



U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
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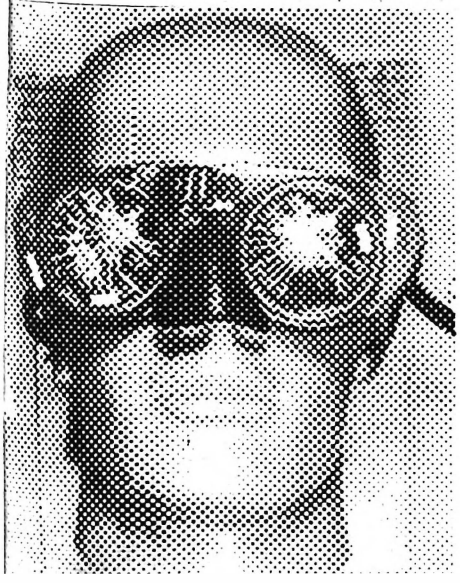

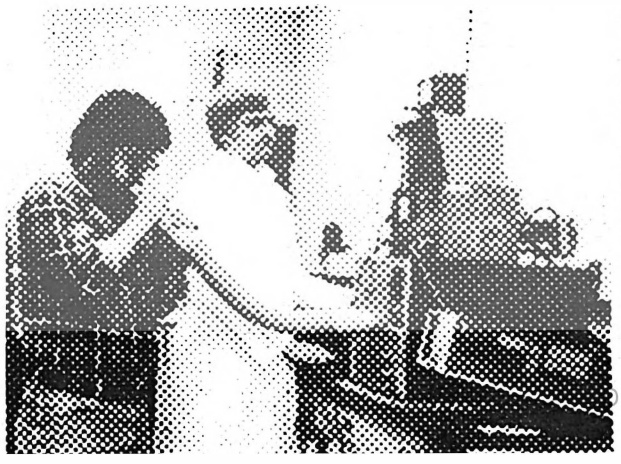

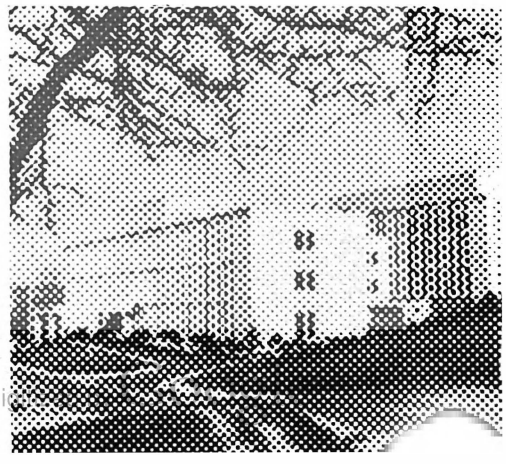

THE FEDERAL COAL MINE HEALTH PROGRAM IN 1976

SEVENTH ANNUAL REPORT OF HEALTH ACTIVITIES UNDER THE FEDERAL COAL MINE HEALTH AND SAFETY ACT OF 1969

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health

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CONTENTS

SUMMARY

The National Institute for Occupational Safety and Health (NIOSH) discharges certain duties of the Secretary of Health, Education, and Welfare as mandated by the Federal Coal Mine Health and Safety Act of 1969 (P.L. 91-173). These duties include providing coal miners the opportunity to receive periodic chest X-ray examinations, paying for autopsies of deceased miners and former miners, conducting extensive research in pulmonary disease, testing and certifying monitoring and safety equipment used in mines, and advising for the setting of occupational health standards in the coal mining industry.

NIOSH funding for the 1976 reporting period (January 1 through September 30, 1976) totaled $3.3 million. This included $937,000 for the Medical Examinations and Autopsy Program; $720,000 for Clinical and Rehabilitation Research; $848,000 for Engineering Research; $510,000 for Epidemiology and Industrial Hygiene Research; and $285,000 for Laboratory Research and Services.

Medical service programs conducted under the Act provide physical examinations, including a chest roentgenogram (X-ray), for working miners. Costs of these examinations are borne by the coal mine operator. Figures for the 1976 reporting period show that 98.6% of the miners examined had no evidence of pneumoconiosis (major category 0) and approximately 95% had no evidence of nonpneumoconiotic abnormalities.

However, the miners examined during the reporting period were generally newly employed in the coal industry. In fact, 84.5% had worked in coal mines for less than 5 years, and 93% for less than 10 years. While a very low prevalence of coal workers' pneumoconiosis normally would be expected in such a group, it is not indicative of the disease prevalence in the general population of underground coal miners. During the two open periods, or "rounds," of examinations since 1970, X-ray evidence of coal workers' pneumoconiosis was found in 10% to 15% of the miners examined.

During the 1976 reporting period, 256 autopsies were submitted for evaluation and paid for by the Department of Health, Education, and Welfare.

Research directed to improving the health of coal miners included evaluating the effect of occupational exposures on lung function, detecting occupationally-induced abnormalities in the lungs, providing for the early detection of coal-related diseases, and producing a greater understanding of the mechanisms of pulmonary disease and the response of the lungs to coal mine pollutants.

Work was begun to install a computerized system for interpretation of chest X-rays. It is hoped that this system will be able to rapidly separate the X-rays of normal lungs from those of abnormal lungs, thus allowing more efficient use of radiologists in interpreting those films which do show evidence of pneumoconiosis and other abnormalities.

Since complete studies of lung mechanics are not feasible in the screening of large numbers of workers, other methods of early detection of pulmonary impairment are currently under study. Mixtures of helium and oxygen are being used in breathing tests, and this method may detect functional abnormalities in the small airways. Approximately 250 subjects have been studied using this

technique and, if evaluation shows it to be useful, the technique could lend itself to use in field studies of large groups of workers.

NIOSH physiologists are studying the mechanism by which chemiluminescence (a light-producing reaction) is induced in scavenger cells of the lung by exposure to foreign particles. This technique may be useful in studying the effects of many potentially toxic particles on the lungs.

During this reporting period, 36 respirator models were approved for routine coal mining and emergency mine rescue uses. One coal mine dust personal sampler unit was tested and approved. In support of the approval and certification of respirator programs, NIOSH purchased, on the open market, samples of NIOSH approved or certified products and tested these samples for compliance with NIOSH performance regulations. Where compliance was not found, the manufacturer was required to cease claiming the device was approved or certified until it had corrected the deficiencies and adjusted its quality assurance program.

Other research initiated during this reporting period dealt with the following subjects:

1. the effects of diesel exhaust on coal miners' health,
2. the physical and environmental factors that contribute to coal workers' pneumoconiosis,
3. the development of sampling protocol to complement the National Study of Coal Workers' Pneumoconiosis (3rd Round),
4. the evaluation of the impact of psychological, behavioral, and organizational factors upon the safety performance of coal miners, and
5. the investigation of the unusually high incidence of middle ear pathologies found in coal miners.

During this period, one of the major involvements of NIOSH in the coal mining standards activity was in the preparation of revised standards for airborne contaminants, noise measurement, and improved sanitation. In March 1976, the Department of the Interior (DOI) published revised regulations (30 CFR 71.202) which require reduction in the maximum exposure to asbestos at surface coal mines and surface worksites of underground coal mines to 2 fibers per cubic centimeter of air for a time-weighted 8-hour daily exposure, and 10 fibers per cubic centimeter of air for any 1-hour exposure per 8-hour day.

MEDICAL SERVICE PROGRAMS

X-RAY EXAMINATIONS OF UNDERGROUND COAL MINERS

Section 203 of the Federal Coal Mine Health and Safety Act mandates that the operator of a coal mine shall cooperate with the Secretary of Health, Education, and Welfare in making available to each miner working at an underground coal mine before December 30, 1969, a chest X-ray at intervals not to exceed 5 years. The Act also specifies that a miner who begins work subsequent to December 30, 1969, shall be given an initial chest roentgenogram soon after employment, a second roentgenogram 3 years later, and a third 2 years later, if the second showed evidence of pneumoconiosis.

Since the passage of the Act, miners employed in underground coal mining prior to December 30, 1969, were offered the opportunity to receive one chest X-ray examination during each of two open periods, or rounds, of examinations. Plans are being made for future rounds, and a draft of the regulation (Part 37 of Title 42, Code of Federal Regulations) governing the examinations was made available for public review on October 26, 1976. Comments from the public have been solicited and a final draft of the proposed, revised regulation is scheduled for completion in 1977.

The required examination consists of a posteroanterior chest roentgenogram, an identification document, and an occupational history questionnaire. All chest X-rays are interpreted for pneumoconiosis via the 1971 ILO-U/C classification system which provides for identification of the type and profusion of small opacities and the type and size of large opacities which appear on the chest radiograph of a coal miner who has pneumoconiosis. Small opacities are defined as being less than 1 cm in diameter. Their profusion is categorized as category 0, 1, 2, or 3, a scale of increasing density. Large opacities are greater than 1 cm in diameter and are commonly referred to as complicated pneumoconiosis or progressive massive fibrosis (PMF).

Since July 27, 1973, NIOSH has required that every chest roentgenogram receive a first interpretation in accordance with the 1971 ILO-U/C classification system before submission. If the physician who initially interprets the X-ray is an "A" reader, then NIOSH resubmits the roentgenogram to a "B" reader, whose reading is final. A physician demonstrates proficiency and is certified by NIOSH as an "A" reader by properly classifying six roentgenograms (two without pneumoconiosis, two with simple pneumoconiosis, and two with complicated pneumoconiosis) or by completing, after June 15, 1970, a course approved by NIOSH. A physician is certified by NIOSH as a "B" reader after passing an examination developed by Johns Hopkins University under contract for NIOSH. During 1976, a new "B" reader examination was developed requiring the demonstration of proficiency in detecting any chest X-ray abnormalities, in addition to pneumoconiosis. Table 1 shows the number of "A" and "B" readers and facilities certified each year since 1973.

Table 1. The number of facilities, "A" and "B" readers certified by NIOSH, and coal mine operators with approved plans who participated in the X-ray examinations program since 1973.

Year	1973	1974	1975	1976
Facilities	164	77	31	17
"A" Readers	977	80	6	8
"B" Readers	63	18	0	2
Approved Coal Mine Operator Plan	613	336	344	241
Miners Whose X-Ray Examinations Were Covered by A Plan	3,190 (47%)	42,865 (94%)	26,635 (94%)	13,582 (94%)
Miners Whose X-Ray Examinations Were Not Covered by A Plan (arranged by NIOSH)	3,546 (53%)	2,849 (6%)	1,571 (6%)	939 (6%)

Operators who chose to do so arranged for the examinations of their miners by submitting plans to NIOSH for approval. The plans, among other things, stipulated that the operator would not solicit a physician's roentgenographic interpretations or other findings concerning any miners, that the examination would be made at no cost to the miner and at a convenient time and place for the miner, and that persons administering the examination would keep the medical information confidential. Table 1 also shows the number of plans approved by NIOSH since 1973, the number of miners whose examinations were covered by an operator's plan, and the number of examinations which were arranged by NIOSH. The data show that since 1974, 94% of the miners examined were covered by an approved plan.

X-ray facilities which participated in the X-ray examinations program were eligible to participate if they demonstrated to NIOSH an ability to take high quality chest roentgenograms. To have been been eligible to participate, a

facility must have submitted to NIOSH at least one roentgenogram of acceptable quality and an acceptable radiograph of a plastic test object from each of their X-ray units.

Particular emphasis has been given to maintaining the high quality of the chest roentgenograms submitted to NIOSH. It is well known that, regarding simple pneumoconiosis, overexposed or dark films tend to be assigned lower categories of profusion, and underexposed or light films tend to be overread. The percentage of unreadable radiographs has decreased from 2.3% since the beginning of the Second Round of examinations in 1973 to less than 1% in 1976 (Table 2).

Table 2. Percentage of films found to be unreadable by "A" and "B" readers.

Date	"A" Readers	"B" Readers
July 27, 1973, to March 31, 1975	0.03	2.3
March 31, 1975, to December 31, 1975	1.2	1.4
January 1, 1976, to September 30, 1976	0.0	0.6

The number of roentgenograms interpreted for pneumoconiosis is presented in Table 3 by X-ray category and State for the period January 1 to September 30, 1976. The data show that very little pneumoconiosis (less than 2%) has been found, presumably because most miners who were examined had just recently entered the coal industry. Of all the miners examined during this period, 84-1/2% had worked less than 5 years in mining and 93% had worked less than 10 years.

Table 3. The number of roentgenograms with findings of coal workers' pneumoconiosis reported to miners from January 1 to September 30, 1976.

	X-Ray Category						
	0	1	1	2	3	Complicated Pneumoconicsis	Total
		NO TR	TR*				
Alabama	147	1	0	0	0	0	148
Colorado	205	0	0	0	0	0	205
Illinois	200	0	0	0	0	0	200
Indiana	72	2	0	0	0	0	74
Kentucky	1,940	24	8	1	0	0	1,973
Maryland	10	1	0	0	0	0	11
Ohio	644	4	1	1	0	0	650
Pennsylvania Anthracite	3	0	0	0	0	0	3
Pennsylvania Bituminous	1,503	10	6	4	0	0	1,523
Tennessee	3	0	0	0	0	0	3
Utah	330	0	0	0	0	0	330
Virginia	484	11	2	2	0	0	499
West Virginia	3,444	42	5	4	0	2	3,497
Wyoming	134	0	0	0	0	0	134
Total	9,119	95	22	12	0	2	9,250
Percentage**	98.6	1.0	0.2	0.1	0.0	0.02	100.0

*Transfer Rights, as defined in Section 203(b)(1) of the Act (Pl 91-173)

**Totals may not equal 100 due to rounding

Significant roentgenographic findings other than pneumoconiosis are reported to the miner and to his or her designated physician. Table 4 shows the number of roentgenograms in which "A" and "B" readers found evidence of cancer, tuberculosis, emphysema, and other disease.

Table 4. The number of roentgenograms with findings other than pneumoconiosis reported to miners from January 1 through September 30, 1976.

Finding	"A" Reader Number	"A" Reader Percentage*	"B" Reader Number	"B" Reader Percentage*
Cancer	67	0.46	0	0.00
Tuberculosis				
Active	4	0.02	1	0.00
Activity Uncertain	16	0.11	164	1.33
Emphysema	39	0.27	31	0.25
Abnormal Cardiac Size	19	0.13	38	0.31
Other Findings	280	2.00	452	3.70
No Findings	13,849	97.02	11,560	94.39
Total	14,274	100.00	12,246	100.00

*Totals may not equal 100 due to rounding

AUTOPSY SERVICE

Section 203(d) of the Act provides for the autopsy of any deceased miner or former miner regardless of whether the miner dies in a coal mine. NIOSH pays up to $200 to any pathologist for an autopsy performed and properly submitted to NIOSH according to the specifications published on May 14, 1971, in the Federal Register (42 CFR 37.200).

Figure 1 shows the number of autopsies paid for by NIOSH since 1971. The number of autopsies received has been similar each year since 1972, with the exception of 1974, when approximately twice as many cases were evaluated than in any other year. This was because, with the increase in the number of autopsies from 1972 to 1973, there was an insufficient number of personnel to process the payment for the autopsies performed in 1973, so that the 1974 figure actually includes some cases performed during 1973. This situation has since been rectified and 1975-1976 figures reflect experience for those years.

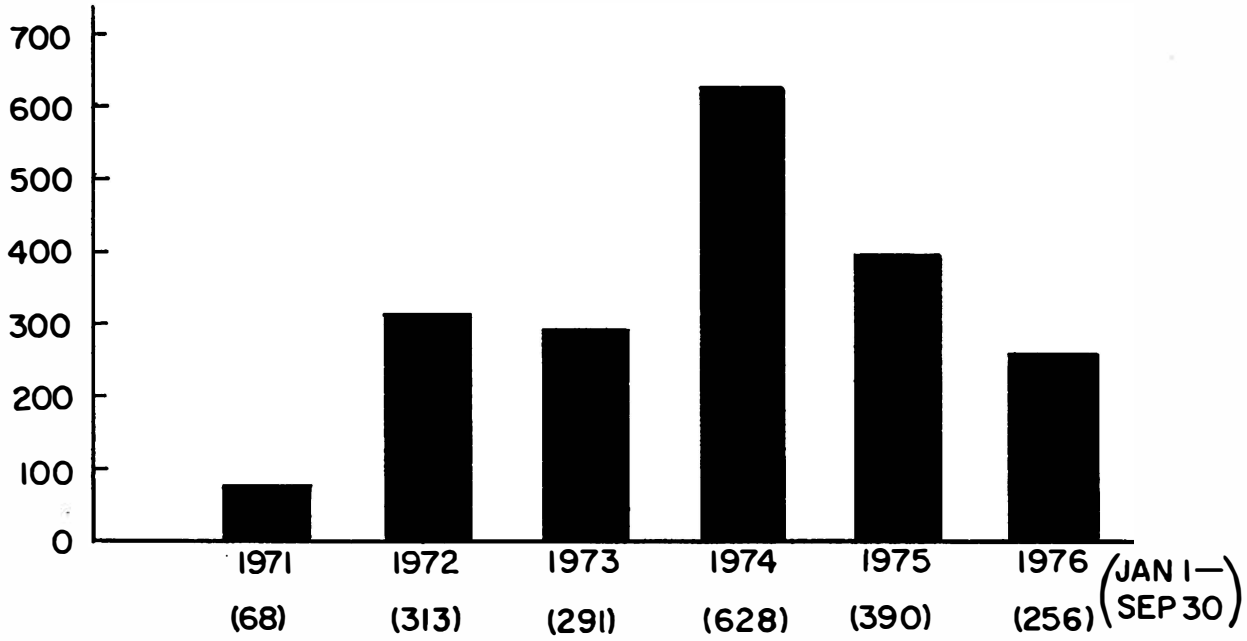

FIGURE 1. Number of Autopsy Evaluations by Year.

Autopsy service is provided by law and a considerable amount of research was done on selected cases submitted to the National Coal Workers' Autopsy Service (NCWAS) in the area of elemental and particle analysis. The techniques of scanning electron microscopy combined with back scattered electron imaging to delineate particles of high atomic number, and energy dispersive X-ray analysis to determine the elemental composition, resulted in a series of papers, presentations, and a book chapter on the characteristics of inhaled coal dust. Back scattered electron imaging makes discrimination between the coal dust and other mineral components of coal mine dust relatively easy. For example, silica particles can be rapidly identified and quantitated in a section of lung tissue, and this can be correlated with the histopathology.

COAL MINE HEALTH RESEARCH ADVISORY COMMITTEE

The Coal Mine Health Research Advisory Committee was established by the Federal Coal Mine Health and Safety Act of 1969 to advise the Secretary of Health, Education, and Welfare on matters relating to coal mine health research, including grants and contracts to support research. The committee consists of 14 persons knowledgeable in the field of coal mine health research, and, in addition, the Director of the Bureau of Mines, or his delegate; the Director of the National Science Foundation, or his delegate; and the Director of the National Institutes of Health, or his delegate (see Appendix D for list of members).

The Committee met twice in 1976, on March 26 and September 24, in Rockville, Maryland. Committee members reviewed the progress of coal mine health research projects under way in the National Institute for Occupational Safety and Health and provided comments and advice to NIOSH staff scientists on the planning and conduct of research. Further research was advised to:

1. more accurately correlate X-ray findings with disease pathology and with disability,

2. define criteria for diagnosis of coal workers' pneumoconiosis, and

3. improve film quality and roentgenographic interpretation in disease determination.

During the year, special attention was given to the following subjects:

1. Implications of the comparison of findings between the First and Second Rounds of the National Study of Coal Workers' Pneumoconiosis medical examinations.

2. The autopsy program required by the Federal Coal Mine Health and Safety Act of 1969.

3. Pulmonary function studies in coal miners, using different methods to assess the lung function in various stages of disease.

4. Development of computer-assisted roentgenographic interpretation of pneumoconiosis.

5. New and ongoing research projects under way at the Appalachian Laboratory for Occupational Safety and Health.

6. Relationship of developing lung disease to efficacy of dust control in coal mines.

7. Approval or disapproval of research grants (four disapproved, one approved).

8. Investigations of possible potentiating effects of diesel emissions and coal mine dust.

RESEARCH

One means by which NIOSH fulfills its responsibilities under the Federal Coal Mine Health and Safety Act of 1969 is by performing research relating to the health and safety of coal miners. Research is performed by evaluating the effect of occupational exposures on lung function, detecting occupationally-induced abnormalities in the lungs, providing for the early detection of coal-related diseases, and producing a greater understanding of the mechanisms of occupational respiratory disease. These and related studies are reported in this section for the period January 1 through September 30, 1976.

SPIROMETRY

Because spirometry (the measurement of the breathing capacity of the lungs) continues to be the most widely used method for evaluating the effect of occupational exposures on lung function, NIOSH has been concerned with establishing standards for instrumentation and technique for this test. When comparing results of spirometry on groups of subjects, consistent dynamic response of the systems used to measure the volumes and flows of each group is a very important consideration. A forced expiratory volume simulator has been developed which can reproducibly provide both gas flows and electrical signals simulating flow-volume curves from normal subjects and from subjects with respiratory diseases. This system can be used to standardize equipment so that results obtained in different laboratories and field studies can be directly compared.

Based on studies with the simulator and analysis of data obtained during the National Study of Coal Workers' Pneumoconiosis (in which spirometry was performed on over 9,000 subjects during each of two examination rounds), a draft of guidelines for equipment and techniques used in spirometry has been written and submitted to the Occupational Safety and Health Administration (OSHA). Work is now beginning on similar guidelines for the single breath diffusing capacity of the lung and the closing volume or single breath nitrogen test.

DETECTING ABNORMALITIES

In a continued effort to determine the most sensitive method for detecting occupationally-induced abnormalities in lung function, various parameters of the forced expiratory flow-volume curve were compared between four groups matched for age and height, and selected from the approximately 9,000 working coal miners studied in the Second Round of the National Study of Coal Workers' Pneumoconiosis. The groups consisted of smokers and nonsmokers with or without symptoms of bronchitis. Results showed that various flow rates offered little advantage over the forced expiratory volume in 1 second (FEV_1) or FEV_1/FVC (forced vital capacity) ratio in separating the groups, except that flows at higher lung volumes were sometimes helpful in differentiating bronchitics from nonbronchitics. Estimation of total lung capacity (TLC) by a radiographic

method showed that smokers had an elevated TLC and residual volume compared to nonsmokers, and that relating flow rates to absolute lung volumes revealed decreased flows in smokers at all lung volumes (a fact not apparent from the flows related only to expired volume). This study confirmed the use of FEV and the FEV_1/FVC ratio as indices of occupationally-related pulmonary dysfunction, but it also suggests that, where possible, estimation of absolute lung volumes may add to the ability to detect pulmonary impairment.

One problem with measurement of TLC on large numbers of X-rays is the time required. NIOSH has begun work to install and evaluate a computerized system for interpretation of chest X-rays. It is anticipated that the system will ultimately be useful in measurements of TLC on large numbers of X-rays taken in epidemiologic studies and also in screening out the large number of normal films taken in studies of dust-exposed populations. This would allow more efficient use of radiologists in interpreting those films which do show evidence of pneumoconiosis.

EARLY DETECTION

Recent emphasis in pulmonary medicine has been on methods for early detection of pulmonary dysfunction, especially that in small airways of the lungs (2mm or less in diameter) which can be significantly affected without demonstrable alterations in standard spirometry.

Previous studies at NIOSH on nonsmoking miners have suggested both obstruction of small airways and loss of elastic recoil as possible pathogenetic factors in coal workers' pneumoconiosis (CWP). Lung mechanics in 20 nonsmoking coal miners were compared with those in 11 nonminer controls. Abnormalities in two tests felt to reflect the function of small airways (closing capacity and dynamic compliance) were found in the miner group; however, these could have been produced by either the obstruction of small airways or regional inhomogeneity of elastic recoil. Other findings (no difference in the resistance in upstream airways or closing pressure between miners and controls and a static pressure-volume curve shifted to the left in miners) suggest the latter mechanism. This may be related to the focal emphysema sometimes seen in CWP.

Since studies of lung mechanics are not feasible in the screening of large numbers of workers, other methods of early detection are currently under study. Maximal expiratory flow rates are dependent upon both the inherent tendency for the lung to collapse (elastic recoil) and airways resistance. At low lung volumes, the pertinent resistance seems to be in small airways where flow is laminar rather than turbulent. Because laminar flow is affected by gas viscosity but not density, flow rates at low lung volumes breathing helium-oxygen mixtures (which are more viscous but less dense than air), when compared to flow rates breathing air, are thought to reveal abnormalities in the area of small airways. This test is being evaluated. Miners with X-ray evidence of pneumoconiosis are being compared to nondust-exposed controls. If this test is

found to be useful, it may lend itself to use in field studies of large groups of workers and can easily be repeated after variable periods of exposure to potentially damaging materials in the work environment. Approximately 250 subjects have been studied using this technique, but comparisons between miners with X-ray evidence of pneumoconiosis and nondust-exposed controls have not yet been completed.

Although subtle abnormalities in given functions of an organ system may serve as useful indications of disease, the net effect of these abnormalities on the ability to function at work and in other daily activities is of primary concern to the individual. Exercise testing is useful from this viewpoint in that it evaluates overall functioning of the cardiovascular and pulmonary systems. An ongoing project has been the use of bicycle exercise at less than maximal levels to determine the applicability of this form of exercise in detecting early impairment of the pulmonary system, relating impairment to type and category of pneumoconiosis, separating dysfunction of the cardiovascular system from the pulmonary, and objectively measuring disability. In this project, a modification of the Cotes method (oxygen consumption vs. heart rate at submaximal exercise levels) has been used to study approximately 80 subjects to date.

The Cotes method procedure is noninvasive and requires only collection of expired gas and measurement of respiratory and cardiac rates. Because studies of nondust-exposed subjects are still incomplete, no conclusions can yet be reached as to the ability of this test to detect abnormalities in the miners. However, the test has proven relatively easy to perform and seems suitable for use even in older aged groups and in those with fairly severe impairment. Some difficulty with leg muscle fatigue (producing exercise limitation) has been encountered and seems related to the use of cycle exercise as opposed to walking on a treadmill.

CHEMILUMINESCENCE

Removal of foreign substances from the alveoli by alveolar macrophages is a major defense mechanism of the lung. Methods for quantifying phagocytic activity have generally been laborious and time-consuming. Recent work suggests that a chemiluminescent response (light production) of alveolar macrophages, when exposed to foreign particles, may be related to phagocytic activity. Because this response can be quantified in automated scintillation counters, it would simplify studies of factors affecting phagocytic activity. NIOSH physiologists have demonstrated that the chemiluminescent response of alveolar macrophages increases when they are exposed in vitro to increasing concentrations of foreign particles and decreases when they are exposed to certain metabolic inhibitors.

Further studies are under way to attempt to determine the mechanism by which chemiluminescence is induced in macrophages by foreign particles and its exact

relationship to phagocytosis. If measurement of chemiluminescence proves to be acceptable as a means of quantifying phagocytic activity, it will be applied to study the effects of potentially toxic particles on alveolar macrophages.

SMOOTH MUSCLE RESPONSE

Because bronchial smooth muscle function may be altered in CWP, a model for studying the effects of coal dust on smooth muscle is being developed. Measurement of the response (to various agents) of smooth muscle from the trachea of dogs, after exposure of the muscle to coal dust in vivo, is the proposed method. In preparation for this, studies are being conducted to establish the mechanisms of the normal response of this muscle to such agents as acetylcholine and epinephrine. Work already accomplished has shown that acetylcholine acts both via electromechanical coupling (depolarization of the muscle membrane) and pharmacomechanical coupling (movement of calcium ions across cell membranes). The relative contributions of these two mechanisms to the overall contraction is dependent on the concentration of acetylcholine used, but in all cases pharmacomechanical coupling accounts for the majority of the response.

GAS-LIQUID LUNG INTERFACE

The liquid material lining the alveoli and airways, known as surfactant, has a profound effect on the pressure-volume characteristics of the lung due to its effect on the surface tension at the gas-liquid boundary. The possible relationship of alterations in the amount or properties of surfactant to the physiologic derangements seen in many disease states is not known. Studies already completed at NIOSH have shown that air is trapped within excised rats' lungs which are ventilated for several cycles. Experimental conditions which should minimize airway closure during the inflation-deflation cycles (constantly positive transpulmonary pressure throughout the lung) still resulted in gas trapping. This is consistent with the formation of bubbles in the lung which either themselves account for the trapped gas or result in effective occlusion of airways on deflation, thereby preventing egress of gas.

Because the liquid material lining the airways and alveoli is directly exposed to any inhaled particles, it is possible that one mechanism for alteration in lung function by occupational exposures is a change in the character of the surfactant system. It is proposed to use the technique of measuring gas trapping to study the effect of various inhaled agents on the gas-liquid interface of the lung.

MORTALITY STUDY OF COAL MINERS IN THE UNITED STATES

During the 1976 reporting period, a continued follow-up of 3,730 Appalachian coal miners and approximately 3,700 coal miners examined for West Virginia workmen's compensation was done. This involved arranging for searches to be

made by Postmasters, Social Security, Internal Revenue Service, and various State drivers' license bureaus to determine the vital status of these persons. As additional deaths are confirmed, death certificates will be obtained.

Results of a comparison of cause of death of coal miners as reported on autopsy reports and on death certificates were made available to the National Center for Health Statistics and to the College of American Pathologists. These data will be used as background data in further studies of this nature.

Work was done on a multiple cause-of-death classification, using various coal mining groups as a population.

ANIMAL RESEARCH STUDIES

Statistical analyses of pulmonary function data derived from a 4-1/2 years' inhalation study of monkeys exposed to bituminous coal dust have been completed. They corroborate observations during the duration of the experimental exposures of the presence of small airways obstruction, presumably as a result of the deposition and retention of the coal dust. A comprehensive final report summarizing the numerous biologic indices investigated is expected to be completed in 1977.

A second major program completed was one designed to study the hazards of coal tar in producing bronchogenic carcinoma and other cancers. Results of an 18-month inhalation study of coal tar aerosols at 10 mg/m^3 reveal lung squamous cell carcinoma in all 38 male rats and 31 of 38 female rats, and an increased incidence of alveologenic carcinoma in two strains of mice. In addition, the coal tar was separated into acid, base, and neutral fractions and tested for carcinogenic activity. Seven neutral subfractions were tested and, of these seven, two produced gross skin tumors in mice. There was no evidence, however, of metastasis or invasiveness. Histopathological evaluation of tissues will be performed and a final report prepared in early 1977.

DIESEL ENGINES IN COAL MINES

During the 1976 reporting period, NIOSH inaugurated a study of coal mines that utilize diesel engines in underground mining operations. Four mines will be selected during 1977 for a detailed evaluation of diesel emission exposures. The environmental data from these surveys will be used, in conjunction with epidemiological results, in an attempt to determine the effect diesel emissions have on coal miner health.

PROSPECTIVE STUDY OF EX-MINERS AND NEW MINERS

NIOSH is conducting a prospective study of 400 new miners and 400 ex-miners to determine what factors, both physical and environmental, contribute to coal workers' pneumoconiosis. The study will be conducted on miners in the Morgantown, W. Va. area, and will continue for a 3-year period.

After NIOSH identifies the miners, the study will be conducted in two parts. First, ex-miners will be included in a detailed medical study so as not to bias prevalence rates of respiratory diseases in the U.S. coal industry by studying only a survivor group. New miners will also be included in a detailed medical study to gain a prospective knowledge of changes in respiratory status on miners not previously exposed to coal dust.

The second part consists of environmental characterization studies to provide data on the new miner's exposure to mine air contaminants. NIOSH, working cooperatively with the Mining Enforcement and Safety Administration (MESA), has developed the study design and has contacted union representatives and management to solicit cooperation in the study.

THIRD ROUND COAL

Planning was initiated and has been completed regarding the development of a revised protocol for the Third Round of the National Study of Coal Workers' Pneumoconiosis. Thirty-four coal mines which participated in either the First Round or Second Round or both rounds of this epidemiologic study are included in the sampling plan. Moreover, three additional mines have been included to insure proportional representation in the basic mining areas of the country. An additional six mines with less than 100 employees each have been selected also to represent this segment of the industry. Examinations of approximately 12,000 men will consist of standard posterior-anterior and lateral chest films, air spirometry, the administration of a respiratory disease questionnaire and occupational and smoking history, and the collection of basic demographic information on the employees. Examinations will begin in FY 78 or earlier. Preliminary talks regarding the Third Round of examinations have taken place with MESA, the Bureau of Mines, selected company representatives, and the United Mine Workers of America.

COAL MINE SANITATION

The Federal Coal Mine Health and Safety Act of 1969 requires the development and promulgation of suitable regulations covering all aspects of sanitation at or in all coal mines. Drafts of the proposed regulations, according to law, have been sent to industry for comment. Discussions were held with the major coal lobbies and major labor unions involved with coal production.

COAL MINE SAFETY RESEARCH

A NIOSH contract study evaluated the impact of psychological, behavioral, and organizational factors upon the safety performance of coal miners. A sample of 1,000 mine personnel selected from 15 matched pairs of high- and low-accident rate mines was surveyed regarding their attitudes toward safety and accident causation, use of safety and health equipment, job safety practices, and related occupational safety issues. The data indicated that keeping good safety records, correcting safety hazards in the mine, having miners wear

protective equipment, and upholding the company's safety record were more important to management in low-accident mines than to management in high-accident mines. Companies in which workers perceived management as having a great concern for safety did, in fact, have better safety records than those where this was not perceived.

HEARING RESEARCH

As a follow-up to the survey reported in "Hearing in the Coal Mining Industry" (NIOSH 76-172), a study has been initiated to investigate the unexpectedly high incidence of middle ear pathologies found in coal miners.

TESTING AND CERTIFICATION

NIOSH tests and approves respirators for routine coal mining and emergency mine rescue uses (in accordance with Part 11 of Title 30, Code of Federal Regulations) jointly with the Mining Enforcement and Safety Administration. Thirty-six respirators were approved during the period of this report.

One coal mine dust personal sampler unit was tested and approved during the same period, in accordance with Part 74 of Title 30, Code of Federal Regulations. Other devices used for hazard measurements in coal mines, such as gas detector tubes and sound level meters, are certified by NIOSH under the authority of the Occupational Safety and Health Act of 1970.

In support of the approval and certification of respirators programs, NIOSH purchased, on the open market, samples of products approved or certified by it and tested these samples for conformance to the performance requirements in NIOSH regulations. Where a lack of conformance was found, the manufacturer was required to cease claiming the device approved or certified until it had corrected the deficiencies and adjusted its quality assurance program.

NIOSH is preparing additional certification and testing programs to ensure coal mine health and safety. These include testing and certification of noise dosimeters, direct-reading gas and vapor meters, and personal protective equipment. Self-contained self-rescuers, developed under Bureau of Mines contracts and proposed by MESA as replacements for current self-rescuers, will be tested by NIOSH early in fiscal year 1977. NIOSH also tests other personal protective devices utilized by coal miners. These devices are tested for their conformance to applicable American standards. NIOSH issued reports on tests of welder's filter plates and face shields during the period covered by this report. Tests were also conducted during the same period on women's safety toe shoes, flexible fitting goggles, safety spectacles, and eyecup goggles. The tests and published reports of the tests provide the user with valuable information, indicate to MESA where problem areas exist, and identify to manufacturers where product improvements are necessary.

COAL MINE STANDARDS

REVISING STANDARDS

During the 1976 reporting period, one of the major involvements of NIOSH in the coal mining standards activity was in the preparation of revised standards for airborne contaminants, noise measurement, and improved sanitation. In March 1976, revised regulations (30 CFR 71.202) were published which required reduction in the maximum exposure to asbestos at surface coal mines and surface worksites of underground coal mines to 2 fibers per cubic centimeter of air for a time-weighted 8-hour daily exposure, and 10 fibers per cubic centimeter of air for any 1-hour exposure per 8-hour day. These standards provide for increased protection against asbestos exposure, especially for construction workers and welders.

The new standards would require a revised schedule for sampling respirable coal mine dust for high-risk occupations, the substitution of area sampling for personal sampling for nonhigh-risk occupations, better "quality control" for dust samples, a reduction of the silica standard to 50 micrograms per cubic meter of air, and incorporation of NIOSH recommended standards for airborne contaminants in place of the American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit values.

The revised noise measurement regulation would allow the use of integrating sound level meters (noise dosimeters) to determine noise exposure levels. This revision is desirable because integrating noise dosimeters, not generally available when the original regulations were promulgated, are now the accepted measurement tools. The sanitary standards will specify the drinking water criteria developed by the Environmental Protection Agency and provide for better sanitation in bath houses and change rooms.

In June 1976, a contract was awarded to investigate the types of emergency medical situations which occur in coal mines. The results of this contract will aid in drafting revised regulations concerned with first aid supplies, training, and emergency medical care and vehicles.

INTERIM COMPLIANCE PANEL

The Interim Compliance Panel was established as an independent Federal entity pursuant to Section 5 of the Federal Coal Mine Health and Safety Act of 1969 (Public Law 91-173). Its function was to provide temporary relief for individual underground coal mine operators from the otherwise mandatory standards for mine levels of respirable dust and for the operation of nonpermissible electric face equipment (any electrical equipment used at the face of a coal mine, i.e., where the coal is actually extracted, and where the danger of an explosion is greatest). The National Institute for Occupational Safety and Health provided 40% of the support for the Panel since its inception, as well as an official delegate during panel deliberations.

The Act provides that the Panel cease giving noncompliance permits on March 31, 1976. Accordingly, the National Institute for Occupational Safety and Health provided support for the Panel through June 30, 1976, during the disposition of property and reassignment of personnel. Between January 1 and March 31, 1976, the Panel was empowered to issue noncompliance permits only for electric face equipment (Sec. 305 (a) (2) of the Act). Because of the short period of Panel operation in 1976, the reported results of 1975 and 1976 were combined. Throughout the final 15 months of operation, 188 applications for renewal permits were received and acted on by the Panel. Of these, the Panel granted 182 renewal permits and denied 6. Only 32 were of such duration that they expired on March 30, 1976. All significant records of the Interim Compliance Panel are now deposited in the Archives.

APPENDIX A

NIOSH COAL MINE HEALTH CONTRACTS ACTIVE FROM JANUARY 1 THROUGH SEPTEMBER 30, 1976

CONTRACT	HSM-99-73-92
CONTRACT PERIOD	06/30/73 - 05/26/76
FUNDS TO DATE	$465,716
FY 76 FUNDING	$57,133
PROJECT OFFICER	John Hankinson
TITLE	Automated Chest X-ray Classification
ABSTRACT	Develop prototype software support systems for the automatic scanning and computer classification of the profusion and extent of coal workers' pneumoconiosis in chest X-rays.
CONTRACTOR	University of Southern California Los Angeles, California

CONTRACT	210-75-0015
CONTRACT PERIOD	12/02/74 - 05/30/77
FUNDS TO DATE	$118,540
FY 76 FUNDING	$ 65,500
PROJECT OFFICER	James A. Merchant
TITLE	Task Force on Pneumoconioses
ABSTRACT	Develop a task force on pneumoconioses to improve the quality of radiographs taken under the NIOSH coal workers' examination program; conduct a "B" reader conference to maintain the capability of the medical review employed by NIOSH for the coal workers' pneumoconiosis X-ray examinations; and conduct a conference at the end of Round Two of the X-ray program which will review the procedures used and results found.
CONTRACTOR	American College of Radiology Chevy Chase, Maryland

CONTRACT	210-75-0018
CONTRACT PERIOD	01/10/75 - 07/09/76
FUNDS TO DATE	$39,521
FY 76 FUNDING	$13,083
PROJECT OFFICER	James A. Merchant
TITLE	Preparation of a Physicians' Manual for the Treatment of Respiratory Diseases of Miners
ABSTRACT	Form a committee of physicians who are recognized authorities in the field of

	respiratory diseases to develop a manual for use by the primary physician treating respiratory diseases of miners.
CONTRACTOR	American College of Chest Physicians Park Ridge, Illinois
CONTRACT	210-76-S/B0102
CONTRACT PERIOD	10/15/75 - 10/14/76
FUNDS TO DATE	$18,000
FY 76 FUNDING	$18,000
PROJECT OFFICER	Laura J. Andersen
TITLE	Radiologist Film Reading Services
ABSTRACT	Provide for the examination and interpretation of approximately 6,000 chest films of persons who are participating in medical surveys of the NIOSH Division of Field Studies and Clinical Investigations.
CONTRACTOR	Benjamin Felson Cincinnati, Ohio
CONTRACT	210-76-S/B0103
CONTRACT PERIOD	09/17/75 - 09/16/76
FUNDS TO DATE	$26,000
FY 76 FUNDING	$26,000
PROJECT OFFICER	John Hankinson
TITLE	Construction of a Forced Expiratory Volume Simulator
ABSTRACT	Construct, evaluate, and furnish a forced expiratory volume simulator suitable for comparing various models and types of spirometers and flow measuring devices generally used in clinical studies.
CONTRACTOR	Novatek, Inc. Burlington, Massachusetts
CONTRACT	210-76-0114
CONTRACT PERIOD	04/01/76 - 12/31/77
FUNDS TO DATE	$49,010
FY 76 FUNDING	$49,010
PROJECT OFFICER	Phyllis Popovich
TITLE	Proficiency Examinations of Interpreting Roentgenograms for Chest Diseases
ABSTRACT	Develop a statistically valid examination consisting of 125 copies of PA chest roentgenograms which will be the basis for evaluating proficiency of prospective interpreters in the entire ILO-U/C

	classification system for the pneumoconioses and all other significant diseases.
CONTRACTOR	Johns Hopkins University Baltimore, Maryland

CONTRACT	210-76-155
CONTRACT PERIOD	09/30/76 - 09/29/77
FUNDS TO DATE	$45,739
FY 76 FUNDING	$45,739
PROJECT OFFICER	James A. Merchant
TITLE	Pathological Standards for Coal Workers' Pneumoconiosis
ABSTRACT	Upon consultation of eight consultant pulmonary pathological experts, and after a thorough review of the literature, procedures for long fixation, definitions of microscopic pathological standards, and descriptions of pathognomonic X-rays, functional changes will be determined. The following conditions will be defined: (1) focal dose lesions, (2) lesions in Caplan's syndrome and progressive massive fibrosis, (3) pigmentations, (4) chronic bronchitis, (5) emphysema, and (6) vascular changes.
CONTRACTOR	College of American Pathologists Skokie, Illinois

CONTRACT	210-76-0164
CONTRACT PERIOD	06/28/76 - 04/27/77
FY 76 FUNDING	$49,674
PROJECT OFFICER	Derek E. Dunn
TITLE	Prevalence of Middle Ear Disorders in Coal Miners
ABSTRACT	Evaluate the prevalence of middle and external ear disorders in coal miners and the effect that these disorders have on their hearing. The investigation shall also include the examination of the incidence of middle ear disorders in noncoal miners of the same geographic region.
CONTRACTOR	The Eye and Ear Hospital of Pittsburgh Pittsburgh, Pennsylvania

CONTRACT	210-76-0180
CONTRACT PERIOD	06/29/76 - 06/28/77
FY 76 FUNDING	$35,864

PROJECT OFFICER	Nick Fannick
TITLE	Emergency Medical Needs of Coal Mines
ABSTRACT	Review and analyze information on non-disaster emergency medical (including accident-caused) situations in coal mines. The Project Officer will make available to the contractor computerized data collected over the last 4 years. This data will contain: (1) cause of accident, (2) type of trauma, (3) body part affected, (4) age and experience of miner, and (5) location of the mine.
CONTRACTOR	The Orkand Corporation Silver Spring, Maryland

APPENDIX B

COAL MINE HEALTH INTERAGENCY AGREEMENTS JANUARY 1 THROUGH SEPTEMBER 30, 1976

AGREEMENT	NIOSH-1A-76-37
CONTRACT PERIOD	04/20/76 - indefinite
FUNDS TO DATE	$0
FY 76 FUNDING	$0
PROJECT OFFICER	Robert McDonald
TITLE	Cooperative Activities in Occupational Health in Metal and Nonmetal Mineral Industries
ABSTRACT	MESA and NIOSH will consult, cooperate, and collaborate investigations of environmental conditions in metal and nonmetal mines and in occupational health investigations of workers employed in such mines and mills.
AGENCY	Mining Enforcement and Safety Administration Department of the Interior

AGREEMENT	NIOSH-1A-76-44
CONTRACT PERIOD	06/30/76 - indefinite
FY 76 FUNDING	$192,000
PROJECT OFFICER	Bill Jones and Carl E. Ortmeyer Ph.D.
TITLE	Energy-Health Effects Studies
ABSTRACT	This agreement jointly binds NIOSH and TVA in an endeavor to solve OSH problems, develop techniques to redress such problems, scientifically determine criteria and tolerance levels, and develop and propogate methods and devices to neutralize harmful effects from such hazardous exposures. TVA, as the Nation's largest producer of electrical power, will work with NIOSH staff to study, evaluate, and, to the extent feasible, improve occupationally hazardous conditions in the 80,000 square mile TVA region and to buttress those conditions most conducive to health.
AGENCY	Tennessee Valley Authority

AGREEMENT	NIOSH-1A-76-44 Subagreement 11
CONTRACT PERIOD	27 months
FY 76 FUNDING	$97,000 of total $192,000
PROJECT OFFICER	NIOSH - Carl E. Ortmeyer, Ph.D. TVA - Frank D. Faires

TITLE	Subagreement 11 - Epidemiological Mortality Study of TVA Employees
ABSTRACT	The mortality indices of coal-fired steam electric power plants of the TVA is the primary purpose of Subagreement 11. The secondary purpose is determining mortality indices in the TVA work population as a baseline comparison with other energy industries.
AGENCY	Tennessee Valley Authority
AGREEMENT	NIOSH-1A-76-25
CONTRACT PERIOD	11/75 - 04/76
FY 76 FUNDING	$0
PROJECT OFFICER	NIOSH - A. Gudeman BOM - N. Jayaraman
TITLE	Field Evaluation of NIOSH Developed Air-Supplied Respirator for Underground Coal Mines
ABSTRACT	The U.S. Bureau of Mines performed a field evaluation of a hydraulically powered, air-supplied respirator developed under NIOSH contract HSM-99-72-42. Preliminary laboratory testing was performed and field testing covered 1 week of use on a continuous mining machine, with assessment being made of ease of breathing, mask comfort, problems with umbilical cord, problems with mask port, and interference with work operations.
AGENCY	U.S. Bureau of Mines Department of the Interior

APPENDIX C
COAL MINE HEALTH RESEARCH GRANTS AWARDED
JANUARY 1 THORUGH SEPTEMBER 30, 1976

GRANT NUMBER	NAME, INSTITUTION, PROJECT TITLE	AMOUNT
5R01OH00356-06	Robert T. Christenson, University of Cincinnati, "Cellular Response to Coal In Vitro (CWP)."	$75,337
5R01OH00565-02	Franklin D. Schowengerdt, Colorado School of Mines, "Nucleation Properties of Respirable Coal Dust."	$56,361

APPENDIX D

COAL MINE HEALTH RESEARCH ADVISORY COMMITTEE

CHAIRMAN

Allan E. Green, Jr., M.D.
Radiologist
Glenwood Hospital
P. O. Box 1339
W. Monroe, Louisiana 71291

EXECUTIVE SECRETARY

Marilyn K. Hutchison, M.D.
Office of Extramural Coordination
and special Projects, NIOSH, CDC
5600 Fishers Lane, Room 3-14
Rockville, Maryland 20852

MEMBERS

Franklin W. Briese, Ph.D.
Director, Div. of Biostatistics
Department of Epidemiology and
Public Health
U. of Miami School of Medicine
P.O. Box 520875 Biscayne Annex
Miami, Florida 33152

Mr. William A. Burgess
Professor, Dept. of Environmental
Health Sciences
Harvard School of Public Health
665 Hunting Avenue
Boston, Massachusetts 02115

Anne L. Davis, M.D.
Assistant Director
Chest Service
Bellevue Hospital
462 First Avenue
New York, New York 10016

Edgar L. Dessen, M.D.
Hazelton Radiology Associates
Northeastern Building
Hazelton, Pennsylvania 18201

Lorin E. Kerr, M.D.
Dir., Dept. of Occupational Health
United Mine Workers of America
1437 K Street, N.W.
Washington, D.C. 20005

Melba M. Moore, M.D.
Bergstrom Air Force Base
Austin, Texas 78743

Hurley L. Motley, M.D.
Dir. of Pulmonary Function Lab.
Good Samaritan Hospital
616 South Witmer Street
Los Angeles, California 90017

Donald L. Rasmussen, M.D.
Dir., Appalachian Pulmonary Lab., Inc.
306 1/2 Stanaford Road
Beckley, West Virginia 25801

Robert A. Stratbucker, M.D.
President
Health Technology Laboratories, Inc.
1604 Fort Street
Omaha, Nebraska 68110

William L. Sutton, M.D.
Assistant Vice President
Assistant Dir., Corporate Relations
Eastman Kodak Company
343 State Street
Rochester, New York 14650

Howard S. VanOrdstrand, M.D.
Senior Physician
Dept. of Pulmonary Diseases
Cleveland Clinic
9500 Euclid Avenue
Cleveland, Ohio 44106

Russell H. Wilson, M.D.
Clinical Associate Professor
U. of Texas Southwestern Med.
School and Dallas City Health Dept.
1936 Amelia Court
Dallas, Texas 75235

EX OFFICIO

John A. Breslin, Ph.D.
Staff Engineer, Div. of Mining
Research--Health and Safety
Bureau of Mines
2401 E Street, N.W.
Washington, D.C. 20241

Claude J. M. Lenfant, Jr., M.D.
Dir., Division of Lung Diseases
Nat'l Heart, Lung, and Blood Institute
National Institutes of Health
The Westwood Building - 6A18
5333 Westbard Avenue
Bethesda, Maryland 20016

Elijah B. Romanoff, Ph.D.
Program Dir., Metabolic Biology
Div. of Biological & Medical Sciences
National Science Foundation
Washington, D.C. 20550

TERMS COMPLETED JUNE 30, 1976

David M. Anderson, Ph.D.
Mgr. Environmental Quality Control
Bethlehem Steel Corporation
701 East Third Street
Bethlehem, Pennsylvania 18016

Lois T. Ellison, M.D.
Dir., Cardiopulmonary Laboratory
Medical College of Georgia
1459 Gwinnett Street
Augusta, Georgia 30902

Allan E. Green, Jr., M.D.
(Chairman)
Radiologist
Glenwood Hospital
P. O. Box 1339
W. Monroe, Louisiana 71291

Jean E. Todd, M.D.
Navy Regional Medical Center
Portsmouth, Virginia 23708

OTHER CHANGES

(Resigned September 22, 1976)
Robert J. Kelly, M.P.H.
Environmental Specialist
815 West Sixth Street
Anaconda, Montana 59711

(Deceased June 27, 1976)
Clayton G. Loosli, M.D.
Department of Pathology
U. of Southern California
2025 Zonal Avenue (Hoffman 915)
Los Angeles, California 90033

(Ex Officio, Replaced May 20, 1976)
Donald G. Rogich, B.S.
Chief, Div. of Mine Systems Eng.
Bureau of Mines
Department of the Interior
Columbia Plaza, Room 9056
2401 E Street, N.W.
Washington, D.C. 20241

APPENDIX E

SELECTED PUBLICATIONS
JANUARY 1 THROUGH SEPTEMBER 30, 1976

Amandus, H. E., N. L. Lapp, G. Jacobson, and R. B. Reger. 1976. Significance of irregular small opacities in radiographs of coal miners in the U.S.A. British Journal of Industrial Medicine. 33(1):13-17.

Hahon, N. 1976. Counteraction of poly(4-vinylpyridine-N-oxide) on the depression of viral interferon induction by coal dust. Infection and Immunity. 13(5):1334-1342.

Hearl, F. H., and M. M. Roder. 1976. Test procedure for gas detector tube certification. National Technical Information Service, Springfield, Va. PB 251 608/AS.

Lapp, N. L., J. Block, B. Boehlecke, M. Lippman, W. K. C. Morgan, and R. B. Reger. 1976. Closing volume in coal miners. American Review of Respiratory Disease. 113(2):155-161.

McCawley, M. A., and M. M. Roder. 1976. Test procedure for coal-mine-dust-personal-sampler units. National Technical Information Service, Springfield, Va. PB 251 353/AS.

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DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
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CENTER FOR DISEASE CONTROL
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