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# COAL RESEARCH LABORATORY AND ENERGY RESOURCE FELLOWSHIP ACT

GOVERNMENT

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## HEARINGS

BEFORE THE

### SUBCOMMITTEE ON MINERALS, MATERIALS AND FUELS

OF THE

### COMMITTEE ON INTERIOR AND INSULAR AFFAIRS UNITED STATES SENATE

NINETY-FOURTH CONGRESS

FIRST SESSION

ON

## S. 62

A BILL TO ESTABLISH UNIVERSITY COAL RESEARCH LAB-  
ORATORIES AND TO ESTABLISH ENERGY RESOURCE FEL-  
LOWSHIPS, AND FOR OTHER PURPOSES

NOVEMBER 4 AND 5, 1975



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(II)

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## COAL RESEARCH LABORATORY AND ENERGY RESOURCE FELLOWSHIP ACT

TUESDAY, NOVEMBER 4, 1975

U.S. SENATE,  
SUBCOMMITTEE ON MINERALS, MATERIALS AND FUELS,  
OF THE COMMITTEE ON INTERIOR AND INSULAR AFFAIRS,  
*Washington, D.C.*

The subcommittee met, pursuant to notice, at 10 a.m., in room 3110 Dirksen Office Building, Hon. Lee Metcalf presiding.

Present: Senator Metcalf.

Also present: D. Michael Harvey, deputy chief counsel.

### OPENING STATEMENT OF HON. LEE METCALF, A U.S. SENATOR FROM THE STATE OF MONTANA

Senator METCALF. This is a hearing of the Subcommittee on Minerals, Materials and Fuels on S. 62 the Coal Research Laboratory and Energy Research Fellowship Act introduced by the distinguished minority leader and cosponsored by myself and a good many of my colleagues.

It has been said, with considerable justification, that the United States is the "Saudi Arabia of coal". We have an unbelievable quantity of coal underlying the mountains of Appalachia, the farmlands of the Midwest, the Northern Great Plains, the deserts of the Southwest and the tundra of Alaska. We should consider ourselves fortunate indeed at this geologic happenstance.

We must shift our fuel requirements away from dwindling oil and natural gas reserves and uncertain foreign sources. We have come to pin much of our hopes for an orderly transition to a more rational energy policy on our national coal resources.

Nonetheless, there are many problems associated with using coal, problems which often led to its replacement by oil and natural gas in times past. We therefore need to find better ways of mining coal, ways to reduce hazards to miners, ways to extract coal from thick seams, from pitching seams, from very deep deposits, and from very shallow deposits with greater efficiency and with improved conservation of the resource.

We also need to find new methods of removing sulfur and other impurities from coal bound for powerplants. We need to determine with greater assurance if and how surface mining can be carried out so as to protect land and water of ecologically-sensitive areas such as my own Northern Great Plains. We need to achieve new procedures for converting coal into other useful forms of energy. Thus, the need for an

expanded and accelerated coal research program has become so self-evident as to be almost axiomatic.

The Congress has made a real effort—three times—to promote this needed expansion of coal research. First, in 1972, when it passed S. 635 which President Nixon vetoed. Then two more times when it passed the Surface Mining Control and Reclamation Act containing Title III with provisions to establish State mining and mineral resources research institutes. Unfortunately, Congress was frustrated in this effort by two vetoes by President Ford.

Let me say, however, that we have not given up the strip mining struggle, by any means, nor have we given up on minerals research and training.

Today we are addressing ourselves to one facet, coal research, and considering a scaled-down approach.

S. 62 would authorize establishment of five coal research laboratories at institutions of higher learning. These laboratories would be designated by the Director of the National Science Foundation, with provisions for Federal funding for both construction and operation of the labs. Title II of the bill would provide energy resource graduate fellowships numbering not more than 1,500 for each of the next 5 years, in amounts not to exceed \$4,000 per year. The fellowships would be for graduate study and research in areas of applied science and engineering related to the production, conservation, and utilization of fuels and energy.

We are looking forward to hearing testimony today from representatives of the two Federal agencies which carry the greater part of responsibility for coal research—the Energy Research and Development Administration and the Bureau of Mines. Each has contributed much to the effort.

This morning we are going to hear from administration witnesses. Tomorrow, we will hear from some of the sponsors of the legislation and from people who will testify from the academic community and others.

The bill S. 62 and executive reports will be incorporated in the record at this point.

We also have some letters that will be incorporated in the appendix.  
[The text of S. 62 and executive reports follow:]



1 such institution as defined by section 1201 (a) of the  
2 Higher Education Act of 1965; and

3 (3) "Director" means Director of the National  
4 Science Foundation.

5 TITLE I—UNIVERSITY COAL RESEARCH  
6 LABORATORIES

7 ESTABLISHMENT OF UNIVERSITY COAL RESEARCH  
8 LABORATORIES

9 SEC. 101. (a) The Director of the National Science  
10 Foundation, after consultation with the National Academy  
11 of Engineering, is authorized and directed to designate five  
12 institutions of higher education at which university coal re-  
13 search laboratories will be established and operated.

14 (b) In making designations under this section, the  
15 Director shall consider the following criteria:

16 (1) The institution of higher education shall be  
17 located in a State with abundant coal reserves.

18 (2) The institution of higher education shall have  
19 experience in coal research, expertise in several areas of  
20 coal research, and currently active, outstanding pro-  
21 grams in coal research.

22 (3) The institution of higher education has the  
23 capacity to establish and operate the coal laboratories to  
24 be assisted under this title.

1 (c) Not more than one coal laboratory established pur-  
2 suant to this title shall be located in a single State.

3 (d) The Director shall establish a period, not in excess  
4 of ninety days after the date of enactment of this Act, for  
5 the submission of applications for designation under this sec-  
6 tion. Any institution of higher education desiring to be desig-  
7 nated under this title shall submit an application to the  
8 Director in such form, at such time, and containing or accom-  
9 panied by such information as the Director may reasonably  
10 require. Each application shall—

11 (1) describe the facilities to be established for coal  
12 energy resources and conversion research and research  
13 on related environmental problems including facilities for  
14 interdisciplinary academic research projects by the com-  
15 bined efforts of mining engineers, mineral engineers,  
16 geochemists, mineralogists, mineral economists, fuel sci-  
17 entists, combustion engineers, mineral preparation engi-  
18 neers, coal petrographers, geologists, chemical engineers,  
19 civil engineers, mechanical engineers, and ecologists;

20 (2) set forth a program for the establishment of a  
21 test laboratory for coal characterization which, in addi-  
22 tion, may be used as a site for the exchange of coal  
23 research activities by representatives of private industry  
24 engaged in coal research and characterization;



1           (2) provide assurances that the university will pay  
2 from non-Federal sources the remaining costs of carrying  
3 out the program set forth;

4           (3) provide such fiscal control and fund accounting  
5 procedures as may be necessary to assure the proper dis-  
6 bursement of and accounting for Federal funds received  
7 under this title;

8           (4) provide for making an annual report which  
9 shall include a description of the activities conducted at  
10 the coal laboratory and an evaluation of the success of  
11 such activities, and such other necessary reports in such  
12 form and containing such information as the Director  
13 may require, and for keeping such records and affording  
14 such access thereto as may be necessary to assure the  
15 correctness and verification of such reports; and

16           (5) set forth such policies and procedures as will  
17 insure that Federal funds made available under this sec-  
18 tion for any fiscal year will be so used as to supplement  
19 and, to the extent practical, increase the level of funds  
20 that would, in the absence of such Federal funds, be made  
21 available for the purposes of the activities described in  
22 section 101 (d) (1), (2), and (3), and in no case sup-  
23 plant such funds.

## LIMITATION ON PAYMENTS

1  
2 SEC. 103. (a) No institution of higher education may  
3 receive more than \$4,000,000 for the construction of its  
4 coal research laboratory, including initially installed fixed  
5 equipment, nor may it receive more than \$1,500,000 for  
6 initially installed movable equipment, nor may it receive  
7 more than \$500,000 for new program startup expenses.

8 (b) No institution of higher education may receive more  
9 than \$1,500,000 per year from the Federal Government for  
10 operating expenses.

## PAYMENTS

11  
12 SEC. 104. (a) From the amounts appropriated pursuant  
13 to section 106, the Director shall pay to each institution of  
14 higher education having an application approved under  
15 this title an amount equal to the Federal share of the cost  
16 of carrying out that application. Such payments may be in  
17 installments, by way of reimbursement, or by way of advance  
18 with necessary adjustments on account of underpayments or  
19 overpayments:

20 (b) The Federal share of operating expenses for any  
21 fiscal year shall not exceed 50 per centum of the cost of the  
22 operation of coal research laboratory.

## ADVISORY COUNCIL ON COAL RESEARCH

23  
24 SEC. 105. (a) There is established an advisory council  
25 on coal research which shall be composed of—



1 The President shall transmit each such report to the Con-  
2 gress.

3 (d) (1) Members of the Council who are not regular  
4 officers or employees of the United States Government shall,  
5 while serving on business of the Council, be entitled to  
6 receive compensation at rates fixed by the Director, but not  
7 exceeding the daily rate prescribed for GS-18 of the General  
8 Schedule under section 5332 of title 5, United States Code,  
9 and while so serving away from their homes or regular places  
10 of business, they may be allowed travel expenses, including  
11 per diem in lieu of subsistence, as authorized by section 5703  
12 of title 5, United States Code, for persons in the Government  
13 service employed intermittently.

14 (2) Members of the Council who are officers or em-  
15 ployees of the Government shall be reimbursed for travel  
16 subsistence, and other necessary expenses incurred by them  
17 in carrying out their duties on the Council.

18 (e) Whenever a member of the Council appointed  
19 under clauses (1) through (5) is unable to attend a meet-  
20 ing, that member shall appoint an appropriate alternate to  
21 represent him for that meeting.

22 AUTHORIZATION OF APPROPRIATIONS

23 SEC. 106. There are authorized to be appropriated not  
24 to exceed \$30,000,000 for the fiscal year ending June 30,  
25 1976 (including the cost of construction, equipment, and

1 startup expenses) and \$7,500,000 beginning with the fiscal  
2 year 1977 each fiscal year thereafter through the fiscal  
3 year ending June 30, 1981, to carry out the provisions of  
4 this title.

5 TITLE II—ENERGY RESOURCE GRADUATE

6 FELLOWSHIPS

7 PROGRAM AUTHORIZED

8 SEC. 201. (a) The Director is authorized to award under  
9 the provisions of this title not to exceed one thousand five  
10 hundred fellowships for the fiscal year ending June 30,  
11 1976, and each of the five succeeding fiscal years. Fellow-  
12 ships shall be awarded under the provisions of this title for  
13 graduate study and research in those areas of applied sci-  
14 ence and engineering that are related to the production, con-  
15 servation, and utilization of fuels and energy. Fellowships  
16 shall be awarded to students in programs leading to master's  
17 degrees. Such fellowships may be awarded for graduate  
18 study and research at any institution of higher education, li-  
19 brary, archive, or any other research center approved by  
20 the Director after consultation with the Commissioner of  
21 Education.

22 (b) Such fellowships shall be awarded for such periods  
23 as the Director may determine, but not to exceed two years.

24 (c) In addition to the number of fellowships authorized  
25 to be awarded by subsection (a) of this section, the Com-

1 missioner is authorized to award fellowships equal to the  
2 number previously awarded during any fiscal year under this  
3 title but vacated prior to the end of the period for which they  
4 were awarded; except that each fellowship awarded under  
5 this subsection shall be for such period of graduate work or  
6 research, not in excess of the remainder of the period for  
7 which the fellowship which it replaces was awarded as the  
8 Commissioner may determine.

9                   AWARDING OF FELLOWSHIPS

10       SEC. 202. Recipients of fellowships under this title shall  
11 be—

12           (a) persons who have been accepted by an insti-  
13       tution of higher education for graduate study leading to  
14       an advanced degree or for a professional degree, and

15           (b) persons who plan a career in the field of  
16       energy resources, production, or utilization.

17                   DISTRIBUTION OF FELLOWSHIPS

18       SEC. 203. In awarding fellowships under the provisions  
19 of this title, the Director shall endeavor to provide equitable  
20 distribution of such fellowships throughout the Nation,  
21 except that the Director shall give special attention to insti-  
22 tutions of higher education, libraries, archives, or other  
23 research centers which have a demonstrated capacity to  
24 offer courses of study or research in the field of energy re-  
25 sources and conservation and conversion and related disci-





1 each of the five succeeding fiscal years. For payments for  
2 the initial awarding of fellowships awarded under this title,  
3 there are authorized to be appropriated for the fiscal year  
4 ending June 30, 1977, and for each of the five succeeding  
5 fiscal years, such sums as may be necessary in order that  
6 fellowships already awarded might be completed.



## United States Department of the Interior

OFFICE OF THE SECRETARY  
WASHINGTON, D.C. 20240

NOV 3 - 1975

Dear Mr. Chairman:

This is in response to your request for the views of this Department with respect to S. 62, a bill "To establish university coal research laboratories and to establish energy resource fellowships, and for other purposes."

We have reviewed the proposed legislation and recommend against its enactment. We believe that existing authorities are sufficient to meet the objectives of S. 62.

The bill would authorize the Director of the National Science Foundation to provide grants to five state universities, to be selected according to standards and procedures provided in the bill, for the purpose of establishing coal research laboratories. The bill would establish an Advisory Council on Coal Research, headed by the Director of the National Science Foundation and with membership delineated in the bill. The bill would further authorize the Director to award up to 1,500 fellowships a year for graduate study in energy research, for the next six years. Appropriations are authorized by the bill for the coal research laboratories in the amount of \$30 million for the first fiscal year and \$7.5 million for five succeeding fiscal years, and for the graduate fellowship program in the amount of \$11 million per year for six fiscal years.

The Executive Branch of the Federal Government has a strong and continuing interest in seeing that the research and educational capabilities of our mineral universities remain strong, not only to assure rapid and efficient development of our coal resources but also to help improve the self-sufficiency of the United States across the entire range of mineral raw materials. A strengthening is now in progress through the grants and contracts being administered by the Bureau of Mines and other agencies that conduct programs in the energy and minerals fields.

The Bureau of Mines has broad authority for carrying out coal and mineral research programs. This includes the authority, through Public Law 85-934, September 6, 1958, to make grants to educational institutions for the support of basic research. In addition, the Bureau was authorized through Public Law 89-672, October 15, 1966,



to "...enter into contracts with educational institutions for scientific or technological research into any aspect of the problems related to its authorized programs."

The Bureau in recent years has steadily increased funding to universities by grants and contracts in support of research projects. In fiscal year 1975, the Bureau provided almost \$5.0 million to support applied and basic research projects in educational institutions, and roughly another \$1 million in special economic studies and data collection. Figures for 1976 are not yet available, but an increase was projected.

The Energy Research and Development Administration (ERDA) has continued the support, some of it begun through the Bureau of Mines, to educational institutions in coal-conversion-related programs, petroleum, natural gas, and related areas, providing schools with about \$16 million in support of research projects. The National Science Foundation also supports energy-related research. A number of Federal agencies have programs that impact on, or are tangential to, the mineral-and-energy resource situation.

As we see it, one of the major advantages of the existing contracts-and-grants system is that it can help strengthen the research and educational functions of a university while carrying out research in direct support and furtherance of agency programs. Moreover the direct relationship between agency and university that exists under the present established procedures has been found by the Interior Department to be essential to the efficient conduct of its engineering research efforts. Under S. 62, the close relationship between agencies and numerous universities could well be diluted.

On October 27, 1972, a similar bill, S. 635, was vetoed. The memorandum of disapproval read, in part:

"Such an inflexible program would preclude us from taking advantage of the best research talents of the Nation--wherever they may be. The Federal Government's ongoing programs of similar and related kinds of research have provided a flexible and efficient means of meeting minerals problems of the highest national priority and can readily be adapted to continue to do so."

The Federal Government will still continue to support university mining programs. As the Federal Government places more and more emphasis on solving energy problems, thus causing the number of research grants and contracts to universities to increase, the number of students hired to participate on research projects will also increase. This approach to training is preferable to beginning another entirely

new fellowship and research program and would pay off more quickly than the proposed program, with less risk of distortion of the job marketplace.

Private industry is also supporting mining education and training. Through the Minerals Industry Education Association, formed by mining companies, funds are provided for students entering and remaining in mining and metallurgy curricula, with additional funds going to the universities for high school recruitment. Mining companies and mining industry executives have generously endowed colleges of mines with scholarships and student loan funds, as well as some chairs for professors.

Given the growing needs for manpower and mining expertise we are hopeful of some accommodation of this need as a result of the current trend of increasing salaries and better dissemination of information on the desirability of mining engineering careers.

In summary, we feel that sufficient authorities exist to provide whatever energy, mining and coal research effort is necessary. The Department, through the Bureau of Mines, and other Federal agencies, are continuing their concern and monitoring of the adequacy of staffing in all sectors of activity in the energy and mineral fields, including universities, government, and private industry. If further support is to be provided at any time to stimulate interest and achievement in these fields, the Administration will give consideration to existing authorities, organizations, and programs, and to the levels of educational effort where support is needed.

The Office of Management and Budget has advised that there is no objection to the presentation of this report from the standpoint of the Administration's program.

Sincerely yours,

Assistant Secretary

*Rayston C. Hughes*  
Secretary of the Interior

Honorable Henry M. Jackson  
Chairman, Committee on  
Interior and Insular Affairs  
United States Senate  
Washington, D.C.



UNITED STATES  
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION  
WASHINGTON, D.C. 20545

NOV 12 1975

Honorable Henry M. Jackson  
Chairman  
Committee on Interior and Insular Affairs  
United States Senate

Dear Mr. Chairman:

The Energy Research and Development Administration is pleased to reply to your letter of January 21, 1975, requesting our comments on S. 62, a bill "[t]o establish university coal research laboratories and to establish energy resource fellowships, and for other purposes."

ERDA presently has legislative authority and programs which serve to accomplish the objectives of the bill. Thus, we believe that there is no need for S. 62, and we oppose its enactment.

The bill would authorize and direct the Director of the National Science Foundation, after consultation with the National Academy of Engineering, to designate five institutions of higher education at which university coal research laboratories would be established. An Advisory Council on Coal Research would be created to be composed of the Director of the National Science Foundation, the Director of the Bureau of Mines, the President of the National Academy of Sciences, the President of the National Academy of Engineering, the Director of the United States Geological Survey, and six members appointed by the Director of the National Science Foundation, who are knowledgeable in the field of coal research and mining and are representatives of universities, industry, labor, and environmental organizations. Under Title 2 of the bill the Director of the National Science Foundation would be authorized to award up to 1,500 fellowships for the fiscal year ending June 30, 1976, and each of the five succeeding fiscal years. The fellowships would be in those areas of applied science and engineering that are related to the production, conservation and utilization of fuels and energy.

Under the Energy Reorganization Act of 1974, the Energy Research and Development Administration (ERDA) is directed to, among other things, exercise central responsibility for policy planning, coordination, support, and management of research and development programs respecting all energy sources (Sec. 103(1)). This Act also directs ERDA to help assure an adequate



Honorable Henry M. Jackson

- 2 -

supply of manpower for the accomplishment of energy research and development programs, by sponsoring and assisting in education and training activities in institutions of higher education, vocational schools, and other institutions, and by assuring the collection, analysis, and dissemination of necessary manpower supply and demand data (Sec. 103(10)). In addition, the functions of the Office of Coal Research of the Department of the Interior, and fossil fuel energy research and development programs of the Bureau of Mines were transferred to the Administrator of ERDA.

ERDA recognizes that attainment of the national goal of achieving maximum utilization of coal, must be an integrated effort on the part of industry, government, and the universities. At present, ERDA (fossil energy) has active research programs in 37 universities. We are also receiving numerous research proposals each month from universities. We expect to enter into substantial additional contracts in the present year. Thus, ERDA's present and planned activities are indeed supporting coal research and student training at universities. Accordingly, there is no need for S. 62.

The Office of Management and Budget has advised that there is no objection to the presentation of this report from the standpoint of the Administration's program.

Sincerely,

Original signed by  
R. Tenney Johnson

R. Tenney Johnson  
General Counsel



## EXECUTIVE OFFICE OF THE PRESIDENT

OFFICE OF MANAGEMENT AND BUDGET

WASHINGTON, D.C. 20503  
November 24, 1975

Honorable Henry M. Jackson  
Chairman, Committee on Interior  
and Insular Affairs  
United States Senate  
3106 New Senate Office Building  
Washington, D.C. 20510

Dear Mr. Chairman:

This is in reply to your request of January 21, 1975, for the views of the Office of Management and Budget on S. 62, a bill entitled the "Coal Research Laboratory and Energy Research Fellowship Act."

In their reports to your Committee, the National Science Foundation, the Energy Research and Development Administration, and the Department of the Interior have provided their reasons for opposing enactment of the bill.

The Office of Management and Budget agrees with the views of those agencies and, accordingly, would also oppose enactment of S. 62.

Sincerely,

A handwritten signature in cursive script that reads "James M. Frey".

James M. Frey  
Assistant Director for  
Legislative Reference

Senator METCALF. We welcome this morning Dr. Thomas V. Falkie, Director of the Bureau of Mines and Dr. Philip White, the Assistant Administrator for Fossil Energy of the Energy Research and Development Administration and Mr. Robert Allnutt, the Deputy Assistant Administrator for Administration, of ERDA. We are delighted to have you here to discuss this legislation.

As I said in my opening statement, we have made three runs at this. We passed the surface mining bill which was vetoed, not entirely on the basis of this provision of the bill, but this provision went down with the administration veto of the surface mining bill.

#### STATEMENT OF DR. THOMAS V. FALKIE, DIRECTOR, BUREAU OF MINES, DEPARTMENT OF THE INTERIOR

Dr. FALKIE. We appreciate the opportunity to represent the Interior Department here this morning. I have a statement I will submit for the record rather than read it. I would appreciate it if it could be incorporated into the record and I will summarize it.

In summarizing it I would like to refer to some of the charts we have located at the end of the statement.

Senator METCALF. Do you have those charts blown up for display?

Dr. FALKIE. We did not bring them with us, Senator.

Senator METCALF. It might be useful for us to have the charts when we have a markup on the bill. Can you supply them?

Dr. FALKIE. We will supply them when you need them.

Senator METCALF. We will be sure they are returned after they are no longer useful to us. But this material will be incorporated in its entirety in the record.

Dr. FALKIE. I think there is no question coal has to play an increasing part in our energy program in this country. Chart 8 summarizes very briefly the demand for energy sources. The black part of the chart shows imports of natural gas and petroleum are increasing despite the fact that last year for the first time the country had a slight decrease in energy usage.

Chart 9, we have attempted to show coal's part in the energy picture by comparing the usage of coal, in terms of total Btu, in 1950 with 1974 data. The facts are, in 1950, coal supplied some 38 percent of our energy needs and today it is supplying somewhere in the order of 18 percent.

When you go to chart 10 you see what everybody is now coming to realize—that both the resources and the reserves of coal we have in this country are—I guess to put it as we did the other day—coming out of our ears.

Reserves are those materials which are minable by today's economics and today's technology. The fact of the matter is about 90 percent of our fossil fuel reserves are coal.

If you use a 50 percent recovery factor, which is probably on the conservative side, this amounts to something like 219 billion tons of coal that can be extracted by today's technology and today's economics.

This reserve figure is rising constantly as we do more exploratory and developmental work. I happen to have been chairman of the Project Independence Coal Task Force which was an extensive exercise done last year. We are the organization that developed the target of

1.2 billion tons per year that we would need in coal production by 1985. If we attain 1.2 billion tons per year by then, we will still only be producing something like 20 or 21 percent of the Nation's energy needs from coal.

I would like to mention that there are two significant constraints, among others, that relate to the legislation being considered here today.

One, we concluded that manpower—at all levels from the lowest skilled levels up through the managerial, and including engineering levels—could be a significant constraint in preventing us from getting to that 1.2 billion tons per year.

The second is the technology, or the research and development to develop the new technology could itself be a constraint and should be increased. That technology goes all the way from extraction through the processing, through the conversion and utilization stage.

So I have a personal interest in the education business from a standpoint of being an educator on leave of absence from a large university, and being Director of the Bureau of Mines with major responsibilities in the coal area, and also chairman of the coal task force which leaves me to be one of the leading administration advocates for producing and consuming more coal.

The universities have a definite role which consists of two aspects. One is to do some of the basic and supportive research and development to support the mission agencies. The two prime mission agencies in this research and development, are ERDA and the Department of the Interior.

The universities also have a responsibility for providing manpower—not only manpower for the industry but manpower for the Government to do its programs and manpower for the universities and for the support of research and development communities.

The Interior Department has a major role in this effort in the whole mineral and energy area as defined by the organic acts of the various bureaus and the Mining and Mineral Policy Act of 1970.

I would like to point out that in Interior we feel our role goes through the whole cycle of minerals. Not only the energy minerals but the metallic and nonmetallic as well.

Of course you are familiar with Interior's role in the public lands as it relates to the energy problem. This year Interior will be spending somewhat in excess of \$200 million in energy research. Roughly 75 percent of that would be for coal-related research and development and the rest would be in the areas of oil, shale, geothermal and the other energy areas.

We have summarized in chart 12 in a very general way what Interior is doing in coal R. & D.—not only in the Bureau of Mines but in the other agencies of Interior. You can see the Bureau of Mines has about 75 percent of the research and development dollars in Interior directly related to coal and the rest are in such organizations as the Geological Survey, the Fish and Wildlife Service and so on.

Interior's approach is one of looking at it from the standpoint of resource conservation, of developing extraction technology and doing environmental and health and safety work on the extraction phase.

Much of this is done through the universities. Now you asked for us to define the role of the Bureau of Mines and I have attempted to do that by using some of the charts we have here.

Chart No. 1—being a mining engineer I tend to think in terms of flow sheets—shows what the Bureau of Mines and the Geological Survey role is in the mineral cycle. The Survey clearly is involved in the geological or exploration phase of the mineral cycle.

And the Bureau of Mines is the lead governmental agency with regard to extraction research particularly for coal and other metallic and nonmetallic minerals. We also get involved in processing and recycling and in the environmental research dealing with land rehabilitation and other problems.

Down at the bottom of that chart we show, again in a general way, what major mineral science and engineering disciplines are involved in the various parts of the cycle. There are other interior agencies involved in the cycle as well, such as MESA, for example, which is involved in the enforcement phase of the extraction part of the flowsheet.

The Bureau of Mines' mission is threefold, as we have tried to indicate in a general sort of way in figure 2. We are doing scientific and technological investigations on every phase of that part of the flowsheet mentioned previously.

We are collecting and disseminating mineral information and we do analysis and recommendations on U.S. mineral policies and programs.

To do this we have organized very broadly as indicated in figure 3. This shows we have the research and development branch of the Bureau and what we call the supply/demand analysis branch, which is the information and analysis branch.

The tradition of the Bureau of Mines ever since the Bureau was formed has been to locate facilities at or near universities. We have four mining research laboratories, eight metallurgy research laboratories and four field centers for doing mineral evaluation work.

All of these are located at or near large universities most of which are mineral-type universities.

We have shown in figure 4, the location of the Bureau of Mines' operations with respect to the coal reserves and resources of the country. You can see that we have a significant amount of work and a significant number of operations in the coal reserves and resource areas.

Figure 5 will give the committee an idea of the location of the Bureau of Mines facilities with regard to the nearby mineral educational institutions. There are about 20 mineral educational institutions listed. Everyone of the remaining mineral institutions are located within striking distance of one of the Bureau of Mines' major facilities.

The Bureau of Mines has a history of being involved in funding mineral-type universities. In figure 6 we have shown the trends. This was taken from the National Science Foundation's summary of research.

In 1975 we funded over \$5 million to colleges and universities. The total budget figure of \$195 million includes the ERDA part of that research work formerly done by the Bureau of Mines that was transferred to ERDA. This was the utilization and conversion-type research.

In 1976 to the present time, our records show the Bureau of Mines is supporting grants or contracts at about 68 colleges in about 40

different States. The amount, post ERDA, will exceed \$5 million this year. These awards result from the favorable review and evaluation of research proposals and they cover every aspect of the Bureau's broad field of interest in mining including health and safety, environment and advancing mining technology, metallurgy, both the solid waste disposal work and the mineral supply and demand work.

Some of the projects we are supervising were funded before the energy programs were transferred to ERDA and we are still technically supervising some of them.

The point is we expect the funding level to go over \$5 million this year.

In chart 11 we have attempted to show the total research in the Bureau of Mines that is directly related to coal both for 1975 and for 1976 as compared with our total budget. The 1976 budget shown in the chart is as originally submitted by the President and there were some amendments recently proposed by the Office of Management and Budget which are not included.

You can see that mining research is clearly the major part of our budget but we do have coal-related work in some of our other programs: in metallurgy and in some of our engineering and environmental evaluation and demonstration work.

The total this year as originally submitted was on the order of \$84 million worth of coal research.

I would like to say we submitted to the Subcommittee on Energy Research and Water Resources in June, dated June 16, 1975, a more elaborate testimony on our coal research program. I would like to note that in this testimony is a reference in case anybody is interested in more details on the coal research program of the Department of Interior and the Bureau of Mines.

SENATOR METCALF. I see no reason why it should be reprinted but it will be incorporated by reference.

DR. FALKIE. Just reference to it. I did not mean to have it reprinted.

There are other programs we have going in the Bureau of Mines and the Department of Interior which relate to the universities.

In 1971 we established an Office of University Relations to act as a coordinator between our research programs and the universities, especially the mineral universities. Dr. Neldon Jensen at my left is the acting head of that office.

We have extensive work-study, student-trainee programs with universities. We hire students and professors part-time for summer employment. We have postdoctorate programs. We cosponsor symposia, workshops and conferences and we have several grants out to universities to let them and other people participate in helping us to determine our research and development needs.

As a mining engineer and an educator, I am keenly aware of the need for research and education in all of the vital mineral resource disciplines. Research is essential to improve the mining, processing, and utilization of coal if we are going to solve our current energy problems. The country must intensify and expand its efforts and increase the number of qualified personnel not only in coal research but also in research on other mineral fuels as well as all metallic and nonmetallic mineral resources.

The Department of the Interior through such agencies as the Bureau of Mines, the Geological Survey, the Bureau of Land Management, and others has an obligation to, as well as a strong and continuing interest in, the total minerals area.

Part of this awareness focuses on seeing that the research and educational capabilities of our mineral universities are adequate—not only to assure rapid and efficient development of our coal resources but also to help improve the self-sufficiency of the United States across the entire range of mineral and oil materials.

Indeed, a strengthening is now in progress partially through the grants or contracts being administered by the Bureau of Mines and other Interior agencies and among the several agencies that direct necessary coal and other energy related research.

It is our view that through regular appropriations and utilizing existing authorities, the objectives of this bill could be achieved without the necessity of new legislation.

Personally, I am committed fully to having the Bureau of Mines continue to use its authority to support in every way possible the mineral schools to which we must look for both innovative research and a steady supply of trained personnel.

Thank you for the opportunity to appear today, Senator. And we can proceed from here.

Senator METCALF. Mr. Harvey tells me the administration's report on this bill was just received this morning. It will be included in the record at the beginning of the hearing immediately after the bill and before the testimony begins.

Prior to this hearing I talked to Senator Moss and others about this. We are all concerned about your statements that we have a need for additional trained people. I would think that we would all concur with you.

Why wouldn't the fellowship programs in title 2 be helpful for training people even though there were no Federal funds for laboratories in title 1?

Dr. FALKIE. There are some existing fellowship programs already available, Senator. I don't think it is a question of helping. It is a question of the best way to help the universities. I think the strong feeling is that existing agencies have authority to fund contracts and grants and those authorities are adequate.

I think the feeling is the contracts and grants system is perhaps a more effective system than the fellowship system for getting the universities involved in research and at the same time assisting them.

Senator METCALF. There is a shortage of the kind of skilled people that we need. We have failed to train them under the existing program. Isn't that correct?

Dr. FALKIE. The situation has been improving slightly but I think the record will show, as I'm sure you will be hearing tomorrow, the documentation of shortages in this area. Yes.

Senator METCALF. Then shouldn't we do everything possible to try to acquire additional trained personnel through both the grant programs and the fellowship program?

Dr. FALKIE. I don't think there is any question about the fact we should be doing something. And the fact is we are doing something.

I will come back to the statement that there are several ways you can go about doing this. One of the ways is to work through existing authorities in the agencies. Again, repeating myself, but through contracts and grants, particularly a grants system such as we have going now and as other agencies have going.

Senator METCALF. I agree. But that has not been adequate so we have to do more.

Dr. FALKIE. I think what we have tried to show from the Bureau of Mines' standpoint is that we have been trying to do more and the trend, at least numbers of dollars for universities in the country, has definitely been on the upswing. Depending upon what happens with our budget this year, we will continue to increase that trend.

Senator METCALF. Mike, do you have some questions?

Our rules do provide that staff can ask questions so I will turn this over to Mr. Harvey.

Mr. HARVEY. Dr. Falkie, could you comment on the criteria that are in section 101(b) of the bill for selection of the five institutions and also on the criteria for the laboratory programs that are set out in 101(d)?

Dr. FALKIE. I will have to refer to those particular sections—

Mr. HARVEY. What I am concerned about, quite frankly, is whether the criteria coincide with the objectives of the bill. I would assume that if the Congress wanted to enact legislation of this type the criteria set out in the bill should achieve the purpose they have in mind. And that is to set up institutions that cover all the coal regions of the country.

Dr. FALKIE. I think there is no question about the fact there would be some concern and some argument about the number of institutes. As far as the criteria are concerned, I cannot really argue with what is down there. The fact that an institute should be located in a State with one, coal reserves and the organization or university should have experience in coal research and coal education and that it has the capacity to conduct the research.

And there is a certain time limit, a certain type of background required on the part of the institution, to answer your question. I cannot argue with the criteria in there specifically.

Senator METCALF. Some of us have examined the criteria and instead of a dispersion or wide dissemination to the various regions, it would seem the criteria might prohibit the kind of research grants needed to serve the Western part of the United States completely.

Dr. FALKIE. I was going to mention, since you asked the question about the criteria specifically, that it leans toward the utilization and processing side of coal research, No. 1. And perhaps from where we sit in the Bureau, it would be better to lean a little more additionally to the extractive side. I think you will find there are people who feel the bill does not address itself to the metallic and nonmetallics. I am not sure that was the purpose in the first place.

But there are people who are concerned about that aspect of the bill. To get to your question specifically about the Western part of the country, there is no doubt that the Eastern part of the country has been mining coal for, let's say, 100 years and some of the universities including the one I came from have extensive background in coal.

It is also true there are a few universities in the West which have some background in coal but the overall timing and the overall experience factor are not there.

So if you are concerned about that aspect, I think there is probably some validity for that concern.

Senator METCALF. Then should we make up additional criteria to provide for distribution of these units by geographical regions—assign a unit in each separate region?

Dr. FALKIE. I am not sure our position would be any different—

Senator METCALF. I'm not sure your position would be different either but I'm trying to talk to you based on your experience, about some of the problems that have been raised, knowing full well your final position is adverse and antagonistic to the bill.

Dr. FALKIE. Since you have asked that particular question—if you limit the number of schools that you are going to support under any type of legislation or even under existing programs, then you run the risk of, in my opinion—and I guess I can talk now as an educator—

Senator METCALF. Please do.

Dr. FALKIE [continuing]. You run the risk of not helping some of the other universities. The manpower of some of the universities are limited and some are in a position where they are teetering on the fence, so to speak.

And if a few schools were singled out for assistance, I don't think there is any question that some of those which are teetering would be adversely affected if we chose to enact legislation to concentrate our aid at a limited number of schools.

Senator METCALF. You say some of those that are teetering now would be done in?

Dr. FALKIE. Yes.

Mr. HARVEY. If this is the case, would there be some validity then to not limiting that to coal instruction but include general extractive technology?

Dr. FALKIE. We feel the authority and the approach that we are taking is the way to go. We feel we have the existing authority. But just looking strictly from the Bureau of Mines standpoint, we do have a broader interest on the extractive end and there is a definite relationship between extracting coal and perhaps extracting metallic and non-metallics.

The technology is transferable. And our interests are along the broad range in all of the mineral areas.

Senator METCALF. Nevertheless, Dr. Falkie, coal extracting techniques and extracting techniques in the so-called hard minerals, copper and so forth, are considerably different, are they not?

Dr. FALKIE. Yes, they are. I meant some of the technology and some of the equipment are transferable. That does not mean we do not have to identify separate programs and we do, in fact, in the Bureau of Mines. But some of the technology is transferable.

For example, if you are working on noise control for a mining machine, it is usually transferable whether that machine is used in coal or some other area.

Senator METCALF. But some of the technology is completely different.

Dr. FALKIE. Yes. Mining methods, per se, are rather different generally speaking, in hard rock mining as opposed to the room and pillar techniques used in coal mining.

Senator METCALF. And even the exploration techniques are different.

Dr. FALKIE. They are somewhat different.

Senator METCALF. There are substantially different methods of discovery.

Dr. FALKIE. Very definitely. You are referring now to the fact that coal is a wide area, flat bed type of deposit as opposed to the locatable, bulk, small area deposits in which the metallics and many of the non-metallics occur.

Senator METCALF. So from the very time of the initial exploration to the time we decide to put this coal on high tension wires or in railroad cars to send it to be consumed for electric energy, there is a considerable difference between the hard rock techniques and the coal mining techniques.

Dr. FALKIE. In the general mining methods, yes.

Senator METCALF. I don't have any more questions. I think your position is clear. Your position is well stated. I really do not have any criticism this morning to the ongoing programs you have in the Bureau for research and development.

I think, perhaps, if you were to ask for more, that might be an exercise in futility knowing OMB's power to cut and slash in every direction.

You have long been an advocate of the use of coal and the replacement of other fuels in energy sources. Nevertheless, we do recognize that as we have more and more need for energy, we have to have the skills to find and dig it.

[The prepared statement of Dr. Falkie and accompanying charts follow:]

Statement of  
Dr. Thomas V. Falkie  
Director, Bureau of Mines  
Department of the Interior  
prepared (November 1975) for  
The Minerals, Materials and Fuels Subcommittee  
Committee on Interior and Insular Affairs  
U.S. Senate

Mr. Chairman, Members of the Subcommittee:

Thank you for this opportunity to present the views of the Interior Department on S. 62, a bill that would establish university coal research laboratories and energy resource fellowships, among other purposes in several of our coal producing states.

We have reviewed the proposed legislation and the Administration recommends against its enactment.

The bill would authorize the Director of the National Science Foundation to provide grants to five state universities, to be selected according to standards and procedures provided in the bill, for the purpose of establishing coal research laboratories. The bill would establish an Advisory Council on Coal Research, headed by the Director of the National Science Foundation and with membership delineated in the bill. The bill would further authorize the Director to award up to 1,500 fellowships a year for graduate study in energy research, for the next six years. Appropriations are authorized by the bill for the coal research laboratories in the amount of \$30 million for the first fiscal year and \$7.5 million for five succeeding fiscal years, and for the graduate fellowship program in the amount of \$11 million per year for six fiscal years.

As a mining engineer and educator, I am keenly aware of the need for research and education in all of the vital mineral resource disciplines. Research is essential to improved efficiency in mining, and processing, and utilizing coal if we are to solve our current energy problems. The country must intensify and expand its efforts and increase the number of qualified personnel, not only in coal research but also in research on other mineral-fuels, as well as our metallic and non-metallic mineral resources.

Mining is a complex discipline, requiring a combination of specializations. Curricula must encompass geology, mineralogy, ore processing, utilization, rock mechanics, advanced chemistry and mathematics, operations research, the computer sciences, labor relations, land reclamation, mineral economics, and other courses which involve the mining engineer in the total production,

human and ecological system. Mining engineering education, to be complete, is comparable in depth to that required by the medical and legal professions.

The Department of the Interior, through such agencies as the Bureau of Mines, the Geological Survey, and the Bureau of Land Management, has an obligation to, as well as a strong and continuing interest in, the total minerals area. Part of this awareness focuses on seeing that the research and educational capabilities of our mineral universities are adequate, not only to assure rapid and efficient development of our coal resources but also to help improve the self-sufficiency of the United States across the entire range of mineral raw materials. Indeed, a strengthening is now in progress partially through the grants and contracts being administered by the Bureau of Mines, among the several agencies that direct necessary coal and other energy-related research.

It is our view that--through regular appropriations and utilizing existing authorities, the objectives of this bill could be achieved without the necessity of new legislation. I am committed fully to having the Bureau of Mines continue to use its authority to support in every way possible the mineral schools to which we must look for both innovative research and a steady supply of trained personnel.

In our opinion, a major advantage of the contracts and grants system is the help afforded the research and educational functions of a university while assuring mission-oriented support for the Congressionally sanctioned programs of Federal agencies. The grants and contracts awarded by a Federal agency are for research in direct support and furtherance of that agency's programs, which have been approved by the Congress through the appropriations it authorizes. Moreover, the direct relationships between agency and university that exists under the present established procedures has been found by the Interior Department to be not only extremely helpful but actually essential to the efficient conduct of in-house engineering efforts. Under S. 62, the close relationship between agencies and universities that now facilitates progress in mission-oriented research efforts could well be diluted.

On October 27, 1972, a similar bill, S. 635, 92nd Congress, which would have established mining and minerals research centers, was vetoed. The memorandum of disapproval read, in part:

"Such an inflexible program would preclude us from taking advantage of the best research talents of the Nation-- wherever they may be. The Federal Government's ongoing programs of similar and related kinds of research, currently funded at about \$40 million annually, have provided a flexible and efficient means of meeting minerals problems of the highest national priority and can readily be adapted to continue to do so."

The genesis of Federal support for mineral engineering research and training at universities and other educational institutions came within five years of the establishment of the Bureau of Mines. Public Law 283 - 63rd Congress, March 3, 1915, provided for the establishment of "... ten mining experiment stations and seven mine safety stations...the province and duty of which shall be to make investigations and disseminate information with a view to improving conditions in the mining, quarrying, metallurgical, and other mineral industries...contributing to the advancement of these industries..." More than twenty years later, Public Law 591 - 74th Congress, May 15, 1936, authorized the Bureau to "...conduct investigations, studies and experiments on its own initiative and in cooperation with individuals, State institutions, laboratories, and other organizations..." primarily with respect to sub-bituminous and lignite coals. One specific purpose of the new authority was to provide for "... determining and developing methods for more efficient utilization of such (fuels)...for purposes of generating electric power."

Later, through Public Law 85-934, September 6, 1958, the Bureau of Mines was authorized to make grants to educational institutions for the support of basic research. The Bureau was further authorized through Public Law 89-672, October 15, 1966, to "...enter into contracts with educational institutions for scientific or technological research into any aspect of the problems related to its authorized programs."

Within the Department, we look at the various operations that supply the Nation with minerals and fuels as parts of a system. As this chart (Figure 1) shows, the system begins with the geologic identification of mineral or fuel resources and ends, not just with the use of minerals or fuels, but with their recycling for further use if possible and with the restoration of the land from which they came. The first parts of this system are the responsibility of the United States Geological Survey. The province of the Bureau of Mines begins with development and extends through mining, mineral beneficiation, extractive metallurgy, materials development, fabrication, manufacturing, and into the use and recycling of materials and mineral wastes, the restoration of mined land, and the minimizing of other environmental impacts associated with the mining, preparation, and use of minerals and fuels. The regulatory, and technical support functions of the Mining Enforcement and Safety Administration (MESA) come into play in the mineral cycle, wherever the health and safety of workers are involved. The Bureau of Mines, the U.S. Geological Survey, MESA, and several electric power administrations all come under the jurisdiction of the Assistant Secretary, Energy and Minerals. Thus, the minerals programs of the Interior Department cover every aspect of the industrial operations on which America depends for adequate supplies of minerals and fuels. These programs are completely interdependent. Research on mining interfaces with research on mineral exploration, extractive metallurgy interfaces with materials development, with fabrication, and with recycling; and safety enforcement and safety training interface with all of the others.

The Bureau of Mines' field is mineral resources, a field that embraces many scientific and engineering disciplines. Mineral resources, reserves, and products must be considered not only as defined by their geology and chemical structure, but also as influenced by the economics of recovery and transportation and a host of other factors that must be taken into account and integrated to obtain reliable knowledge. This integrative function is a speciality of the Bureau of Mines. A wide range of disciplines is essential to fulfillment of the Bureau's mission, which is summarized in this chart (Figure 2).

The Bureau pursues its mission in two basic ways, as shown in the next chart (Figure 3): Research, and Data Collection and Analysis. The two are closely related. Research aimed at solving specific resource problems may be initiated and guided by an analysis of production statistics, or by a sophisticated economic study of supply-demand patterns. Reflecting the close working relationship between these two halves of the Bureau, there is a frequent interchange of personnel between them.

Bureau research centers and offices are strategically located throughout the United States as detailed in this chart (Figure 4) and many of them are situated in close proximity to our Nation's coal reserves, thus facilitating our work on coal. As shown in Figure 5, we also have, in several instances, close proximity to mining and mineral engineering schools --representing a potential for cooperative research and training effort that we are realizing to the full extent that our funding permits.

Several major departments and agencies of the Federal Government, as well as State Governments, have a significant stake in meeting the growing crisis in mineral engineering education. Virtually every Federal agency has some program that impacts on, or is tangential to, the mineral- and energy-resource situation.

The Department of the Interior has a primary responsibility to ensure that nonrenewable resources are developed and used widely and that all of our natural resources make fullest possible contribution to the progress, prosperity, and security of our country. The establishment of new agencies or the redirection of old ones does not abrogate this basic charge. To a large extent, the Department administers this responsibility, insofar as it relates to mineral and coal resources, through the Bureau of Mines. Consequently, the Bureau has a strong and continuing interest in conducting and supporting applied and basic research on minerals and fuels, and in the establishment and maintenance of a highly-skilled and well-trained work force in that field.

The Bureau in recent years has steadily increased funding to universities in support of research projects. In fiscal year 1975, the Bureau provided almost \$5.0 million to support applied and basic research projects in educational institutions, and roughly another \$1 million in special economic studies and data collection. Figures for 1976 are not yet available, but an increase was projected. Figure 6, shows Bureau of Mines obligations for research and development, by performer from 1963 to 1975.

Coal must play a leading role in the Nation's energy efforts to achieve independence. The projected demands for coal will require a marked increase in production. Because today's mining technology is so complex, an integrated systems approach must be taken to its improvement.

The Bureau's mining research organization has under its direction four field research centers and an environmental field office. Each of these has a specific role in achieving the overall mining research mission. This in-house effort is supplemented by extramural support provided in the form of grants and contracts to universities, nonprofit research organizations, industrial research centers, labor unions, trade associations, and individual mining companies. In this way, the technical expertise available outside Federal Government laboratories is also applied to national needs and problems. Several mining research projects and nearly all of the field demonstrations are conducted in producing mines under cooperative arrangements. Reclamation technology also is being developed and demonstrated at several sites. The total mining research staff is approximately 700. During FY 75, this staff capably managed a research program of over \$95 million.

In carrying out this research and development program, the ultimate purpose of the program and the potential user of its results are kept constantly in mind. The transfer of newly developed technology (Figure 7) from research laboratories into practical industrial use is as necessary to the total success of a research program as the accomplishment of the initial research objective. We therefore place significant emphasis on technology transfer. Through publications, seminars, demonstrations, cost-sharing agreements, and other activities as required we get new developments rapidly known and into use as quickly as possible. Equally important is feedback from all segments of the mineral industry, including labor and management, machinery manufacturers, and mining schools. This helps us to determine research needs so that ongoing and future projects can be directed towards the most important problems. The working relationships that the Bureau has with all segments of the mining industry have been built up over many decades and are indispensable to this transfer process.

The next chart (Figure 8) shows that U. S. energy use has doubled over the past 25 years, with most of the increase being supplied by petroleum and natural gas. The quantity of coal mined and used at present is not substantially different from what it was 25 years ago. Note also the increasing dependence on imports of petroleum, to the point that about one-third of our petroleum supplies in recent years came from abroad.

This chart (Figure 9) shows that in 1950, coal supplied 38 percent of our energy, while in 1974, the figure dropped to 18 percent, although our total consumption of energy more than doubled. That fact, coupled with our recent experience with petroleum and natural gas, helps explain why the Bureau's mission is strongly directed toward facilitating that increased production and use of coal.

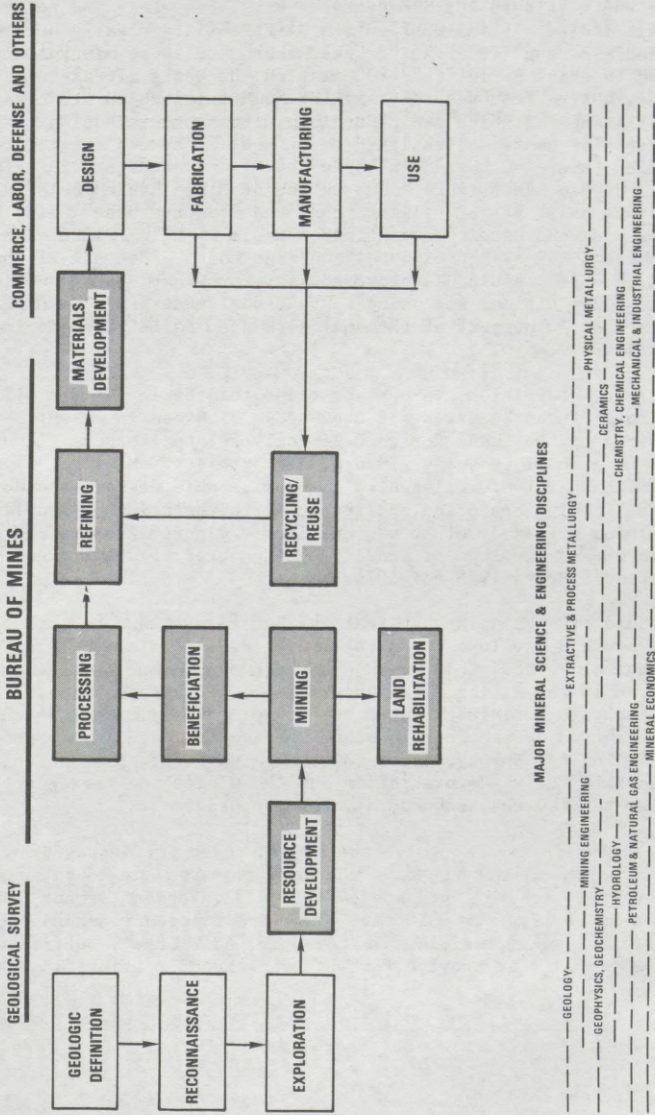
This chart (Figure 10) demonstrates U. S. resources and reserves of fossil fuels. It is important to differentiate clearly between "resources" and "reserves." "Resources" are those mineral deposits known to exist or inferred to exist on the basis of careful geologic study, while "reserves" are smaller quantities which are clearly defined by drilling and which are producible with known technology at approximately competitive costs. Identified U. S. coal resources total more than 1,700 billion tons, and the inclusion of other resources hypothesized to exist would double that figure. The Bureau of Mines has calculated the U. S. "reserve base" at 437 billion tons, the "reserve base" being that coal clearly demonstrated to exist and capable of being mined with known technology and at approximately current costs. Not all of the reserve base, however, could be recovered, as, for example, some of it is in areas under cities, and using conventional underground mining systems an average of 50 percent of the coal in a seam is left behind in the form of pillars.

For your information, we have provided this table (Figure 11), showing the total funds budgeted for the Bureau of Mines in Fiscal Year 1976 compared to the funds for work directly related to coal. You can see that, in mining, coal is being given a high priority. However, all mining operations are interrelated to a considerable degree, and developments in coal mining are often applicable to the solution of problems encountered in mining metals or other nonmetallics. Figure 12 shows the coal-related research and development funding by agency of the Department of the Interior for Fiscal Years 1975 and 1976.

We would like to point out that the Bureau of Mines has other energy-related research and development in coal, oil, gas, uranium, oil shale, and geothermal areas. This work is carried out in our metallurgy research as well as in the mining research programs. We also have an extensive information and analysis activity related to energy. In addition, the energy-related research and development in other Bureaus in Interior is not insignificant. The Geological Survey, Bureau of Land Management, Fish and Wildlife Service, Bonneville Power Administration and the Office of the Secretary all have energy-related research and development programs.

In conclusion, we recognize the growing need for manpower as well as the need for the country to have adequate research and educational capabilities not only to assure rapid and efficient development of our coal resources but also to meet our objective of self-sufficiency across the entire range of mineral raw materials. In our opinion, however, sufficient authority already exists to provide for whatever expanded effort is needed.

# THE BUREAU OF MINES ROLE IN THE MINERAL CYCLE



# MISSION

## SCIENTIFIC and TECHNOLOGIC INVESTIGATIONS

**MINING** - HEALTH AND SAFETY, ENVIRONMENT, PRODUCTIVITY

**MINERAL PREPARATION (PROCESSING)**

**METALLURGY** AND MATERIALS

**CERAMICS**

**RECYCLING**

**MINED LAND RECLAMATION**

**HEALTH and SAFETY RESEARCH**

**USE of EXPLOSIVES and ELECTRICITY**

**CAUSES and PREVENTION of MINE FIRES**

**EFFICIENCY of MINERAL UTILIZATION**

**ECONOMIC DEVELOPMENT**

**CONSERVATION of MINERALS**

## COLLECTION and DISSEMINATION of MINERAL INFORMATION

## ANALYSIS and RECOMMENDATIONS on U.S. MINERAL POLICIES and PROGRAMS

# BUREAU OF MINES

## ALIGNMENT OF FUNCTIONS

### MINERAL AND MATERIALS RESEARCH AND DEVELOPMENT

- MINING RESEARCH  
HEALTH AND SAFETY  
NEW TECHNOLOGY  
ENVIRONMENTAL
- METALLURGY RESEARCH
- HELIUM

### MINERAL AND MATERIALS SUPPLY/DEMAND ANALYSIS

- DATA COLLECTION  
AND ANALYSIS
- ENGINEERING AND  
ENVIRONMENTAL  
INVESTIGATIONS
- WILDERNESS
- RIVER BASIN STUDIES

### ADMINISTRATION



# MAJOR MINERAL EDUCATIONAL INSTITUTIONS AND RELATED BUREAU INSTALLATIONS

STATE	LOCATION	BUREAU OF MINES INSTALLATION	NEARBY MINERAL * EDUCATIONAL INSTITUTIONS
ALABAMA	TUSCALOOSA	METALLURGY RESEARCH LAB	UNIVERSITY OF ALABAMA
ALASKA	JUNEAU	FIELD OPERATION CENTER	UNIVERSITY OF ALASKA
COLORADO	DENVER	MINING RESEARCH CENTER	COLORADO SCHOOL OF MINES
		FIELD OPERATION CENTER	NEW MEXICO INSTITUTE OF MINING & TECHNOLOGY
MARYLAND	COLLEGE PARK	METALLURGY RESEARCH CENTER	---
MINNESOTA	TWIN CITIES	METALLURGY RESEARCH CENTER	MICHIGAN TECHNOLOGICAL UNIV
		MINING RESEARCH CENTER	UNIVERSITY OF MINNESOTA
MISSOURI	ROLLA	METALLURGY RESEARCH CENTER	SOUTH DAKOTA SCHOOL -- MINES
		METALLURGY RESEARCH CENTER	UNIVERSITY OF WISCONSIN
NEVADA	RENO	METALLURGY RESEARCH CENTER	UNIVERSITY OF MISSOURI
OREGON	BOULDER CITY	METALLURGY RESEARCH CENTER	UNIVERSITY OF NEVADA
		METALLURGY RESEARCH CENTER	STANFORD UNIVERSITY
PENNSYLVANIA	ALBANY PITTSBURGH	METALLURGY RESEARCH CTR.	---
		MINING & SAFETY RESEARCH CTR. FIELD OPERATION CENTER	COLUMBIA UNIVERSITY PENNSYLVANIA STATE UNIV
UTAH	SALT LAKE CITY	METALLURGY RESEARCH CENTER	UNIVERSITY OF ARIZONA UNIVERSITY OF UTAH
WASHINGTON	SPokane	MINING RESEARCH CENTER FIELD OPERATION CENTER	UNIVERSITY OF IDAHO
WEST VIRGINIA	MORGANTOWN	MINING ENVIRONMENT DIVISION	MONTANA TECHNOLOGICAL UNIV
			UNIVERSITY OF KENTUCKY VIRGINIA POLYTECHNIC INST WEST VIRGINIA UNIVERSITY

MINING  
METALLURGY  
MINERAL ECONOMICS

\* INDIVIDUAL SCHOOL WITH MAJOR PROGRAMS

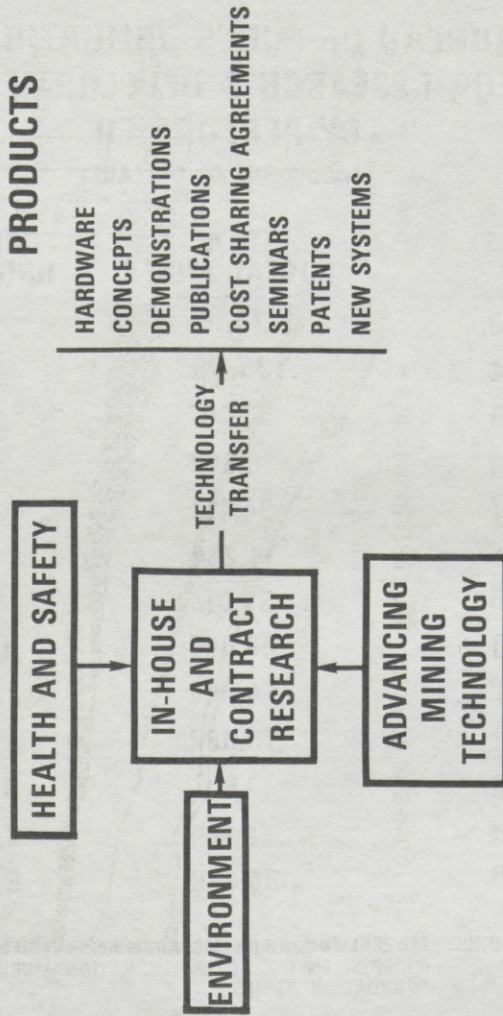
**BUREAU OF MINES OBLIGATIONS  
FOR RESEARCH & DEVELOPMENT  
BY PERFORMER**

(THOUSANDS OF DOLLARS)

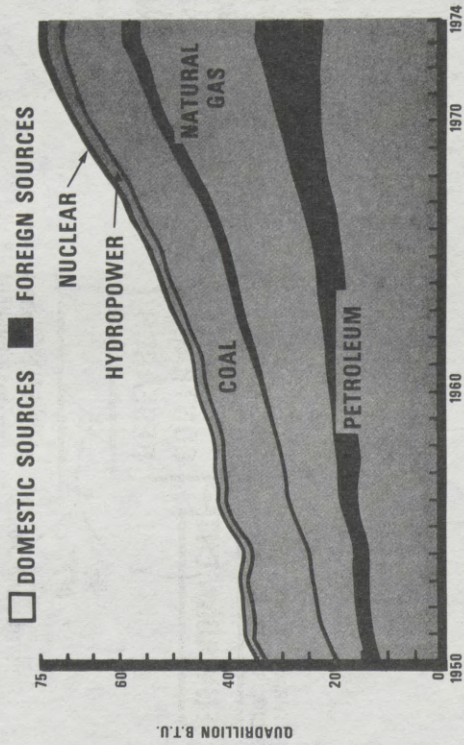
<u>FY</u>	<u>TOTAL BUREAU MINES</u>	<u>COLLEGES &amp; UNIVERSITIES</u>
1963	39,112	4
1964	26,179	10
1965	53,407	5
1966	28,862	
1967	34,412	560
1968	34,244	667
1969	35,018	376
1970	46,457	1,563
1971	60,805	2,440
1972	70,888	2,755
1973	77,507	3,267
1974	90,129	3,000
1975	195,486	5,000

SOURCE: FEDERAL FUNDS FOR RESEARCH DEVELOPMENT AND  
OTHER SCIENTIFIC ACTIVITIES, NATIONAL SCIENCE  
FOUNDATION, SERIES

# PROGRAM INTERRELATIONSHIP



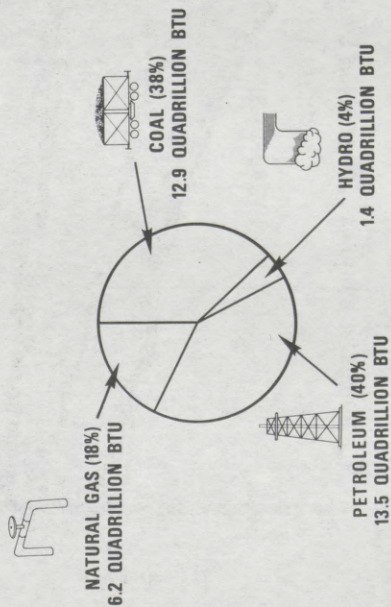
# U.S. DEMAND FOR MAJOR ENERGY SOURCES



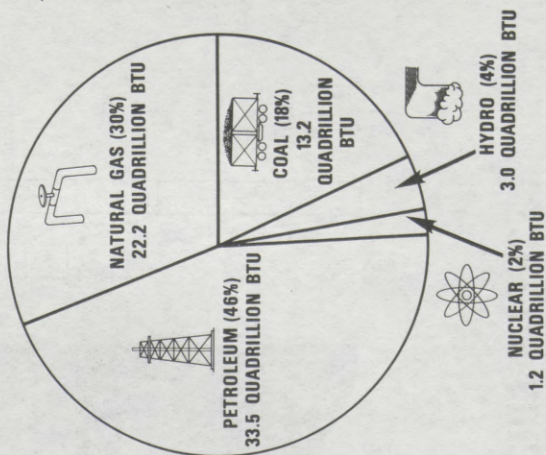
U.S. BUREAU OF MINES

# CONSUMPTION OF ENERGY BY SOURCES 1950 AND 1974

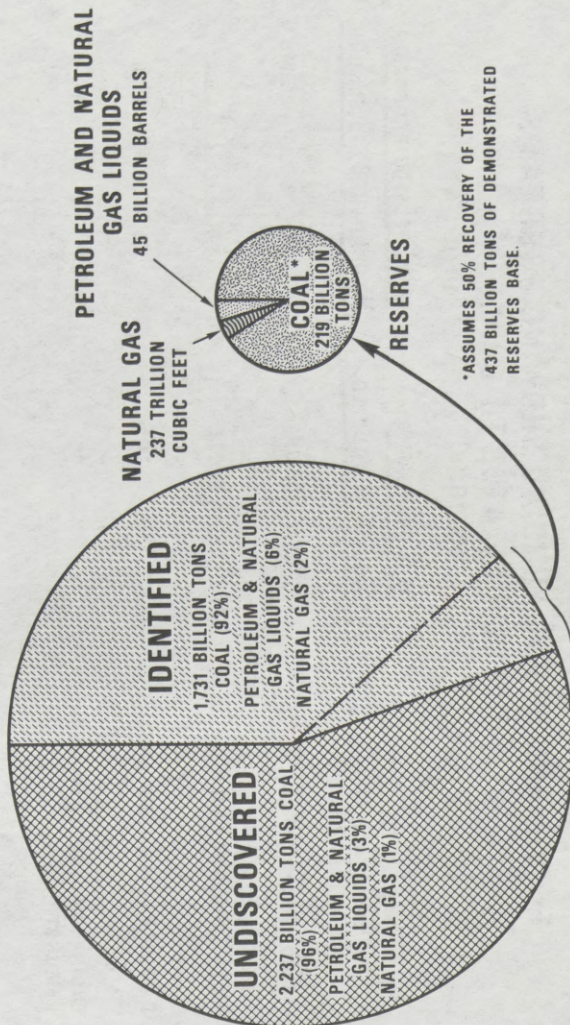
1950 DATA



1974 DATA



# RESOURCES/RESERVES COAL-PETROLEUM-NATURAL GAS



\*ASSUMES 50% RECOVERY OF THE 437 BILLION TONS OF DEMONSTRATED RESERVES BASE.

BUREAU OF MINES AND GEOLOGICAL SURVEY  
OCTOBER 1975

10

**BUREAU OF MINES**  
**FY 1975 AND FY 1976 FUNDING SHOWING PROGRAMS**  
**DIRECTLY RELATED TO COAL**  
**(\$ MILLIONS)**

	<u>TOTAL PROGRAMS</u>		<u>COAL RELATED PROGRAMS</u>	
	<u>75 FUNDING</u>	<u>76 FUNDING</u>	<u>75 FUNDING</u>	<u>76 FUNDING</u>
MINING RESEARCH	89.7	91.0	74.1	73.7
METALLURGY RESEARCH	20.1	27.0	1.6	5.5
DATA COLLECTION AND ANALYSIS	12.4	14.5	1.3	1.0
ENGINEERING, EVALUATION AND DEMONSTRATION	10.0	9.5	6.0	4.1
PROGRAM ADMINISTRATION	1.5	1.4	-	-
<b>TOTAL</b>	<u>133.7</u>	<u>143.4</u>	<u>83.0</u>	<u>84.3</u>

U.S. BUREAU OF MINES

**COAL RELATED R AND D**  
**IN DEPARTMENT OF THE INTERIOR-POST ERDA**  
(dollars, millions)

	<u>FY 1975</u>	<u>FY 1976</u>
BUREAU OF MINES _____	83.0 _____	84.3 _____
GEOLOGICAL SURVEY _____	9.0 _____	10.5 _____
BUREAU OF LAND MANAGEMENT _____	3.1 _____	5.0 _____
BUREAU OF RECLAMATION _____	0 _____	0 _____
FISH AND WILDLIFE SERVICE _____	0.8 _____	2.4 _____
BUREAU OF INDIAN AFFAIRS _____	0.15 _____	0.2 _____
	<u>          </u>	<u>          </u>
TOTAL _____	96.1 _____	102.4 _____

Senator METCALF. Dr. White is next on line.

**STATEMENT OF DR. PHILIP C. WHITE, ASSISTANT ADMINISTRATOR FOR FOSSIL ENERGY, ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION; AND ROBERT F. ALLNUTT, DEPUTY ASSISTANT ADMINISTRATOR FOR ADMINISTRATION, ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION**

Dr. WHITE. I am Philip C. White, Assistant Administrator for Fossil Energy.

Senator METCALF. You'd better read that statement. I have found that if you summarize it, it will probably be longer than the original statement.

Dr. WHITE. I am pleased to comment on S. 62, and particularly so since it concerns activities which are of vital concern to achieving our goals in the fossil energy area of the Energy Research and Development Administration.

The involvement of the universities in an active coal research program and in energy related educational processes is seen as a key element in the long term solution of this Nation's energy problems.

ERDA recognizes that attainment of the national goal to achieve maximum utilization of coal must be an integrated effort on the part of industry, Government, and the universities.

The universities play a unique role in their capability to provide needed scientific information of a basic and exploratory nature, and also by providing an essential supply of trained manpower. In order for a university's research to make maximum contribution to this national goal, its research projects must have technical merit, involve creativity and effect innovation.

For optimum utilization of university talent and for maximum utilization of university results, the research activities of the university should be coordinated with Government and industry R. & D. designed to carry processes from the bench scale through the pilot plant and demonstration plant stages. These later stages establish the technical and economic feasibility of commercializing the process.

Utilizing its background of in-house experience and expertise in the various R. & D. stages, ERDA—fossil energy has sought to coordinate and correlate the coal research activities of universities which it funds with the coal R. & D. it funds at its five energy research centers, and national laboratories, as well as with the coal R. & D. activities of NSF-RANN, Electric Power Research Institute, Bureau of Mines and foreign nations.

Since the creation of ERDA, there has been a new, vigorous coal research program in universities. I would like to describe briefly the fossil energy university program.

In fiscal year 1975, coal research contracts for just over \$16 million were signed with universities. By contrast, contracts in fiscal year 1974 were \$2.8 million. At present, 48 contracts are in effect with 37 universities. These contracts were awarded on a technical merit basis—namely, first on the basis of the peer review to determine technical excellence of the research proposal and second on the need for the information in the overall coal research program. The research involves such topics as determination of coal structure, the science of conversion of coal to

clean gases and liquids, and combustion of coal and generation of electricity including by MHD (magnetohydrodynamics).

There are a significant number of students and faculty involved in these programs: we estimate about 350 students and about 100 faculty members. It is our conviction that the planning and execution of sound research programs is the best basis for training.

At present, ERDA—Fossil Energy has active research programs in 37 universities. We are also receiving numerous research proposals each month from universities. We expect to enter into substantial additional contracts in the present year.

In order to inform the university community of the national energy research program, we in ERDA, in cooperation with the National Science Foundation, have held a series of workshop meetings. The objective of these cooperative meetings has been to discuss the role of the university in coal and energy research. Meetings have been held at Carnegie-Mellon, Ohio State, and Scranton Universities, and the State University of New York at Buffalo. Representatives from a wide distribution of universities attended. The topics and conclusions of each of these meetings have been printed as separate reports and made available to the academic community to inform and provide possible guidance. Copies of these reports are available here.

A very comprehensive review of all of ERDA's programs is being presented to universities in Washington, D.C., November 3 and 4, 1975. This meeting will be attended by approximately 700 vice-presidents for research, deans of engineering, et cetera. At this 2 day meeting, the ERDA Administrator and all assistant administrators will discuss their activities, plans and policies relative to university research.

Another ERDA activity of significance in both coal research and training involves the use of Energy Research Centers which previously functioned as Bureau of Mines Laboratories. Those involving coal are located in Morgantown, W. Va., Pittsburgh, Pa., Grand Forks, N. Dak., and Laramie, Wyo. Each of these is adjacent or at least near university campuses and employ both students and faculty members on a part-time basis. It is believed that this student employment provides a substantial contribution to student training.

The thrust of my testimony is to let you know that present and planned activities of the Fossil Energy division of ERDA are indeed supporting coal research laboratories and student training.

It appears that our programs now underway do serve to accomplish the objectives in S. 62 in creating and supporting a number of university laboratories and therefore it is the position of the Administration that there is no need for S. 62. We oppose the passage of this legislation.

That is the end of my prepared statement. I will be glad to answer any questions and I have a few comments in connection with the previous discussion.

Senator METCALF. Yes, I want your comments on the dialog that took place with Dr. Falkie.

For example, you talk about the meetings held with the universities. This brings up the concern that we have out West that unless we could place provisions in the legislation requiring regional activities, this will be an Eastern oriented program in colleges and areas

as Dr. Falkie mentioned, that had had a long historical tradition of coal mining and research.

Now again in your testimony you talk about ERDA taking over the energy research centers. These energy research centers were distributed on a geographical basis that you took over. That is why you have some out in Grand Forks, N. Dak. and Laramie, Wyo. That seems to point up the concern of Senator Moss, Senator Cannon, Senator Hansen and myself—that a lot of the research is being concentrated in Eastern universities.

Dr. WHITE. I would certainly agree with you, Senator. Historically, this has been the case. The uppermost is probably Grand Forks.

Another I did not mention in the prepared testimony and is just really getting underway is the work at Livermore Laboratories. They have become quite active in areas where they feel they can contribute to our fossil fuel research program and particularly underground technology with the drilling, mining, and making large holes underground.

They are proposing a very substantial program in underground coal gasification. I am going to ask Dr. Mills to confirm. Dr. Mills is director of the Division of Fossil Energy Research.

Dr. MILLS. Yes, the thrust was for oil, shale, and petroleum. And I would add one thing to the statement you have made.

That on the \$16 million Dr. White mentioned contracted for in fiscal 1975, \$6.1 million were with 10 Western universities.

Senator METCALF. I don't want to be parochial about this thing but I think all of us in the West are concerned about the universities in our areas just as easterners are concerned about theirs. I wonder if you could give us a breakdown of where this money is being spent?

Dr. WHITE. We have prepared a table that shows it by universities, the dollar amounts and the contracts. I think it would give a complete picture.

ERDA—FE: UNIVERSITY CONTRACTS ACTIVE ON OCT. 20, 1975

Category	FE-group	Contract No.	Contract University (principal investigator)	Contract title	Total funding		ERDA obligations (fiscal year 1975)	Starting date	Expiration date
					ERDA contract	Plus university share			
Arizona: 2a	UR	1817	Arizona, University of (Dr. J. O. L. Wendt).	Pollutant control through staged combustion of pulverized coal.	\$74,366	\$6,303	\$80,669	Apr. 24, 1975	Apr. 23, 1977
California: 1a	UR	2031	Southern California, University of (Dr. T. F. Yen).	Chemistry and structure of coal-derived asphaltenes.	260,917	10,800	271,717	June 20, 1975	June 19, 1978
4b	MHD	1227	Stanford University (Dr. Robert Eustice).	MHD phenomena at high magnetic fields.	433,930	(c)849,793	1,283,723	July 1, 1972	June 30, 1976
Colorado: 1a	UR	2035	Colorado School of Mines (Dr. A. J. Kidnay, Dr. V. F. Resavage).	Enthalpy measurement of coal-derived liquids.	277,683	30,854	308,537	June 24, 1975	June 23, 1978
1a	UR	2047	Colorado School of Mines (Dr. James H. Gary, Dr. John O. Golden).	Clean solid and liquid fuels from coal.	570,967	63,440	634,407	Sept. 1, 1975	Aug. 31, 1978
4a	E. & S	1526	Denver, University of (Mr. John Gilmore).	Social economic and land use in parts of a Fort Union coal-processing complex.	153,000	(d)58,144	211,144	Sept. 13, 1973	Oct. 12, 1975
Delaware: 1a	UR	2028	Delaware, University of (Dr. Bruce C. Gates, Dr. J. R. Katzer).	Kinetics and mechanisms of desulfurization and denitrogenation of coal-derived liquids.	631,682	237,886	869,568	June 20, 1975	June 19, 1978
Georgia: 1a	UR	4959	Georgia Institute of Technology (Dr. Thomas W. Jackson, Dr. Gene I. Colwell).	Single-wheel gas-turbine topping unit for coal-burning power plants.	25,000	1,320	26,320	July 1, 1975	June 30, 1976
Idaho: 4e	OGST	GO-144028	University of Idaho (Dr. William J. Thompson).	Bubble behavior of the scale-up of fluidized-bed heat exchangers.	46,803	2,910	49,713	Sept. 1, 1974	Aug. 30, 1976
Illinois: 2a	UR	1787	Illinois, University of (at Chicago) (Dr. S. C. Saxena).	Modeling of a fluidized-bed combustor with immersed tubes.	89,016	-----	89,016	May 9, 1975	May 8, 1977
4e	OGST	GO-144018	Northwestern University	Interfacial effects in the recovery of residual oil by displacement.	65,745	3,447	69,192	Mar. 1, 1975	Feb. 29, 1976
Indiana: 1b	UR	2029	Purdue, University of (Dr. N. M. Laurendeau).	Gastrification in pulverized coal flames.	208,491	6,254	214,745	June 26, 1975	June 25, 1978
Massachusetts: 4b	MHD	1209	Massachusetts Institute of Technology (Dr. Jean Louis).	MHD program.	1,291,709	-----	1,291,709	May 21, 1971	July 15, 1975

See footnotes at end of table.

## ERDA—FE: UNIVERSITY CONTRACTS ACTIVE ON OCT. 20, 1975—Continued

Category	FE-group	Contract No.	University (principal investigator to)	Contract title	Total funding			Expiration date	
					ERDA contract	Plus university share	Total cost		
Michigan: 2a	UR	2018	Western Michigan University of (Dr. Thomas Houser).	Fundamentals of nitric oxide formation in fossil fuel combustion.	\$79,981	\$11,619	\$91,600	June 11, 1975	June 10, 1978
Montana: 2c	UR	2019	Montana University (Dr. W. P. Van Meter, Dr. R. E. Erickson).	Environmental effects from leaching of coal conversion by-products.	74,948	17,400	92,348	June 18, 1975	June 17, 1978
4b	MHD	(3)1811	Montana College of Mineral Science and Technology (Dr. V. Griffiths).	Program of MHD power generation research—Pts. A, B, and C.	407,196	-----	407,196	Mar. 18, 1975	Aug. 2, 1978
1a	UR	2034	Montana State University (Dr. Lloyd Berg, Dr. F. P. McCandless).	Catalytic hydrogenation of coal-derived liquids.	156,485	25,148	181,633	June 20, 1975	June 19, 1978
4b	MHD	(3)1811	Montana State University (Dr. Dennis Blackletter).	Program of MHD power generation research—Pts. D, E, F, G, and H.	1,142,098	-----	1,142,098	Mar. 18, 1975	Aug. 2, 1976
New York: 1a	UR	2013	New York State University of (at Buffalo) (Dr. Sol W. Weiler).	Novel catalyst supports for hydrodesulfurization of coal.	243,553	56,187	299,740	June 10, 1975	June 9, 1978
North Dakota: 4c	P	1224	North Dakota University of (Dr. Donald E. Severson).	Premium fuels from Northern Great Plains lignite—Project Lignite.	3,356,600	-----	3,356,600	Mar. 28, 1972	Mar. 27, 1977
Oklahoma: 1a	UR	2011	Oklahoma State University (Dr. B. L. Crynes).	Catalysts for upgrading coal-derived liquids.	214,890	10,750	225,640	June 9, 1975	June 8, 1977
4e	OGST	HO-122120	Oklahoma State University (Dr. Mary Grula, Dr. Edward Grula).	Microbial decomposition of organic wastes under conditions existing in deep wells.	44,512	-----	44,512	June 28, 1972	Oct. 31, 1975
4e	OGST	GO-254005	University of Tulsa (Dr. G. W. Thomas, Dr. P. Buthod, Dr. F. S. Manning).	Kinetics of underground combustion.	24,253	3,392	27,645	Sept. 1, 1974	Aug. 31, 1976
Pennsylvania: 1b	UR	1814	Carnegie-Mellon University (Dr. Anthony L. Dent).	Catalytic synthesis of gaseous hydrocarbons.	206,481	7,592	214,073	May 7, 1975	Feb. 6, 1978
4e	OGST	GO-254006	Carnegie-Mellon University (Dr. C. A. Miller, Dr. T. Fort, Jr.).	Low-interfacial tension and miscibility studies for surfactant tertiary oil-recovery processes.	51,115	2,690	53,805	Dec. 1, 1974	Nov. 30, 1975
1a	P	2003	Lehigh University (Dr. C. W. Clump).	Handling characteristics of SRC (solvent refined coal).	150,000	-----	150,000	June 1975	June 1977

1c.....	UR.....	2030	Pennsylvania State University (Dr. William Spackman).	The characteristics of American coals in relation to their conversion to clean energy fuels.	2, 829, 600	314, 300	3, 144, 000	2, 829, 600	June 26, 1975	Aug. 25, 1979
4e.....	OGST.....	GO-133094	Pennsylvania State University (Dr. S. M. Farouq-Ali).	Computer simulation and economic optimization of underground gasification of coal.	118, 873	3, 700	122, 573	*45, 502	Sept. 25, 1974	June 25, 1976
4e.....	OGST.....	GO-155100	Pennsylvania State University (Dr. E. E. Klaus, Dr. C. D. Stahl).	Tertiary recovery of Pennsylvania grade crude oil with surfactant solutions.	199, 628	-----	199, 628	199, 628	Feb. 1, 1975	Jan. 31, 1976
South Dakota: 4d.....	Gas.....	(1)415	South Dakota School of Mines and Technology (Dr. J. A. Redden).	Acquisition of laboratory data in support of Rapid City coal gasification pilot plant.	382, 318	-----	382, 318	96, 626	Feb. 1, 1971	June 30, 1976
Tennessee: 4b.....	MHD.....	1760	Tennessee Space Institute, University of (Dr. J. B. Dicks).	Development program for MHD direct coal-fired power generation test facility.	8, 150, 792	-----	8, 150, 792	2, 000, 000	Dec. 23, 1974	Dec. 22, 1977
Texas: 4e.....	OGST.....	JO-155040	Gulf Universities Research Consortium (Dr. J. M. Sharp).	Development and analysis of data and information—(on) programs concerned with enhanced recovery of crude oil.	419, 496	-----	419, 496	419, 496	Jan. 29, 1975	Jan. 28, 1976
4e.....	OGST.....	GO-155057	University of Houston (Dr. R. W. Flumerfelt).	Interfacial effects in the recovery of residual oil by displacement.	28, 640	1, 935	30, 575	28, 640	Feb. 1, 1975	Jan. 3, 1976
4e.....	OGST.....	GO-254011	Texas Tech University (Dr. H. W. Parker).	Laboratory determination, leaching rates from oil shale—Simulated in-situ retorting.	61, 500	-----	61, 500	61, 500	Jan. 1, 1975	Dec. 31, 1975
Utah: 1b.....	UR.....	1767	Brigham Young University (Dr. L. D. Smoot).	The influence of mixing on kinetic processes in entrained coal gasifiers.	104, 110	7, 836	111, 946	104, 110	Nov. 29, 1974	Nov. 28, 1976
1b.....	UR.....	1790	Brigham Young University (Dr. Calvin H. Bartholomew).	Alloy catalysts with monolith supports for methanation of coal derived gases.	98, 756	21, 119	119, 875	98, 756	Apr. 22, 1975	Apr. 21, 1977
1a.....	UR.....	2006	Utah University of (Dr. Wendell H. Wiser).	Process for liquefaction and gasification of western coals.	2, 424, 800	235, 200	2, 660, 000	2, 424, 800	May 30, 1975	July 29, 1979
Virginia: 1c.....	UR.....	1231	Virginia Polytechnic Institute (Dr. J. Richard Lucas).	Design optimization in underground coal systems.	537, 600	81, 000	618, 600	283, 500	Jan. 10, 1973	Jan. 9, 1976
1a.....	UR.....	1550	Virginia Polytechnic Institute (Dr. G. H. Beyer).	Stirred-tank reactor coal hydrogenation process.	191, 996	24, 657	216, 656	91, 996	June 15, 1974	June 14, 1977
Washington: 4a.....	Liq.....	(2)496	Washington State University (Dr. George T. Austin).	Pilot plant study for production of useful products from coal minerals.	184, 000	-----	184, 000	30, 000	Sept. 9, 1968	Dec. 1, 1975
4c.....	Liq.....	(2)496	Washington State University (Dr. R. H. Filby).	Application of neutron activation analysis and atomic absorption to the determination of trace elements in a coal-liquefaction process.	45, 000	-----	45, 000	22, 000	Sept. 1, 1974	Aug. 31, 1976

See footnotes at end of table.

## ERDA—FE: UNIVERSITY CONTRACTS ACTIVE ON OCT. 28, 1975—Continued

Category	FE-group	Contract No.	University (principal investigator)	Contract title	Total funding		ERDA obligations (fiscal year 1975)	Starting date	Expiration date
					ERDA contract	Plus university share			
West Virginia:									
1c.....	UR.....	497	West Virginia University (Dr. C. Y. Wen).	Optimization of coal conversion processes.	\$487,808	\$16,06	\$503,873	Nov. 15, 1966	Oct. 31, 1975
2c.....	UR.....	1218	West Virginia University (Mr. Joseph W. Leonard).	A study of coal-associated wastes resulting from the mining, processing and utilization of coal.	1,121,290	27,600	1,148,890	Feb. 4, 1972	July 3, 1976
4e.....	OGST.....	GO-155031	West Virginia University (Dr. Rex Haynes).	Dynamic reflective photoelasticity study of rock fracture mechanics.	28,507	2,984	31,491	Dec. 4, 1974	Dec. 3, 1975
4e.....	OGST.....	GO-155033	West Virginia University (Dr. Sunder Advani).	Structural mechanics simulation associated with underground coal gasification.	14,983	1,446	16,429	Nov. 4, 1974	Nov. 3, 1975
4d.....	Gas.....	GO-155026	West Virginia University (Dr. H. T. Gencsoy).	Design of a high-pressure rotary-piston coal feeder.	24,908	2,765	27,673	Nov. 8, 1974	Dec. 31, 1975
4c.....	Liq.....	GO-155045	West Virginia University (Dr. Joseph D. Henry, Jr.).	Ash removal from coal-derived liquids by extraction of aqueous phase.	24,983	500	25,483	Jan. 1, 1975	Dec. 31, 1975

## Subcontracts:

- (1) = Subcontract to Consolidation Coal Co.  
 (2) = Subcontract to Pittsburg and Midway Coal Co.  
 (3) = Subcontract to Montana Energy and MHD R. & D. Institute.

## Fossil energy categories:

- 1 = U.R. conversion processes:  
 1a = Liquefaction.  
 1b = Gasification.  
 1c = Conversion support research.  
 2 = U.R. utilization.  
 2a = Combustion.  
 2b = Advanced power cycles.  
 2c = Environment and waste utilization.  
 3 = U.R. materials and components:  
 3a = Materials.

## Fossil energy groups (monitors):

- FER program:  
 P = University relations.  
 P = Processes.  
 Other ERDA—FE:  
 MHD = Magnetohydrodynamics.  
 E. & S. = Environment and safety.  
 Liq = Liquefaction.

## 3b = Components

- 4 = Not monitored by university relations.  
 4a = Environment and waste utilization.  
 4b = Magnetohydrodynamics.  
 4c = Liquefaction.  
 4d = Gasification.  
 4e = Oil, gas, and shale technology.

## Gas = Gasification.

OGST = Oil, gas, and shale technology.

Cost-sharing from other ERDA sources:

- (a) = Includes \$25,000 from the State of Colorado.  
 (b) = Includes \$150,000 from Tennessee Valley Authority.  
 (c) = National Science Foundation contribution.  
 (d) = Jointly contributed by:

- (1) Nissco—Iwai American Corp.  
 (2) Placer Amex, Inc.  
 \* Fiscal year 1976 obligations.  
 † Estimated.

Senator METCALF. I think we should mention that as a result of activity by the distinguished majority leader, we have an MHD research program in the State of Montana.

Dr. WHITE. Yes.

Dr. FALKIE. They have had some problems. I am glad to see they are back on the right track again.

Senator METCALF. I hope you will have some understanding and consideration of the problems. It is a small area but in an important research program.

Dr. WHITE. The two titles of the bill in this matter of how many universities—I frankly find myself a little concerned that there might be a bill for five universities who are selected—in the first place, that is a rather arbitrary number. All of us would agree, maybe, that it is the right number but all universities are interested in having this kind of support.

Hardly a week goes by that we are not contacted by a university wanting to set up an energy research center in coal.

The other thing is it seems to me you are setting a precedent in the way of, again, injecting the Federal Government into an area of choosing universities and saying you have been chosen to be a center of coal excellence and we will give you support and your next door neighbor, we will not.

I wonder if this is really a wise thing to do rather than to respond in an evolutionary way where proposals are received by Dr. Falkie, by the National Science Foundation and others for support. That would seem much broader.

I think we all concur in the objectives. We need more emphasis, more training in coal work. But perhaps it would be possible to achieve this something on the order of a Senate or House resolution and the pattern of reporting our progress and increasing the support year by year—perhaps done through one agency designated by Congress—and how we are doing both as to geographic distribution and increasing coal fellowships.

Dr. Falkie has some \$5 million in coal research and now we have 16. This bill would up this to \$60 million and I have some feeling this might be legislative overkill. We all realize we need more. But I wonder if we need it quite that fast and in that amount.

Senator METCALF. I've always been curious about the administration coming in and saying we have a program or we have the authority to launch the programs suggested and, therefore, we are against legislation.

If this legislation is enacted what harm would it do to the various programs you already have in operation?

Dr. WHITE. I can't honestly say I think it would harm them. I think it would be forced structuring the Federal support that would already duplicate what is going on through Bureau of Mines support and other support.

I am not sure that sort of structuring would be useful. Obviously, in terms of the fellowship program there is no harm. Again, I think it is just a case—

Senator METCALF. The fellowship program could be launched without the use of title 1.

Dr. WHITE. If I could save one out, it would be the fellowship one rather than the coal. We do feel very strongly the most useful training

is achieved through participation in research. If you force feed the training effort with a lot of fellowship money that is probably going as grants. I do think you are likely to get a certain divorce from this. It could be grant money for fellowships only tenuously related to the real world of coal extraction, mining, and utilization.

Mr. HARVEY. Dr. White, as I understand what you are saying with respect to selecting institutions, would you agree with Dr. Falkie's comment about selecting some against others?

Dr. WHITE. Yes; the institution not selected would have a more difficult time attracting faculty, students, and perhaps even industrial support as against the sister institution.

Mr. HARVEY. If the Congress feels the present program is inadequate, it seems to me the Congress will not be willing to accept the idea we should not help somebody because somehow that will hurt somebody else. If they feel the present program is inadequate they have got to do something. If two men are starving and you only have enough food for one, you don't withhold it from both.

Would it be better to provide some funding to every institution or perhaps one in every State that met certain criteria so that it was eligible to handle that kind of a program?

Dr. WHITE. I think this would be preferable. I would really hope to see it made not quite that arbitrary. And I'm not sure how you accomplish this, but to have an increase in funding at one institution in each State, and a normal distribution where we perhaps increase the funding for strong institutions like Penn State and the University of Utah which are strong in our program and also increase ones in States that have little or no coal programs.

For instance, Alabama is a coal State and I don't know if we have any program down there. I don't recall one at the moment. I would have to check.

Certainly there are going to be institutions which will be bypassed entirely. Even though they may be instituted, there will not be enough money. I am half way agreeing with you but perhaps in a little different pattern than you suggested of one in each State.

Mr. HARVEY. Is the approach called for in this bill of large initial front end funding to construct and equip and then follow on operating funds for 5-years an appropriate thing to do? If the Congress is trying to encourage that, should they go along with matching funds?

Dr. WHITE. I don't think we can go out and say we could build with federal funds the laboratories and buildings you need to become a center of coal research. Coal is one form of energy. The bill addresses this form of energy but in terms of the States response in training people, there are other forms of energy, solar energy, the solar research institute, obviously the nuclear areas which some universities have responded to very strongly and others have not.

This is part of the whole picture.

Mr. HARVEY. Dr. Falkie, do you have comments on the same question?

Dr. FALKIE. I would like to structure my comments by saying I personally don't think there are enough people, good people, in the universities to staff to the point where the federal government should be trying to establish new types of activities in every state.

I recognize some of the problems in the West. I do feel strongly about your comment about matching funds. I do feel universities ought

to show they have a long, continued and deep interest in whatever they are getting involved in by showing they are willing to put up or shut up, so to speak.

And the way to do that would be through matching funds. I feel very strongly about that. I agree about Dr. White's comments about pouring out large sums of money on facilities. I think that should be done only after very careful consideration. I do not think physical bricks and mortar are necessarily the answer to this problem. So I agree with him on that.

Mr. HARVEY. The sponsors of this legislation have stressed the business of coal characterization because not enough is known about the different characteristics of coal in differing regions.

At the same time the criteria set out in the bill, say that the university has to have a current, active, outstanding program. That seems to me to run counter to that other thrust. There are other regions of this country and I am thinking of Alaska, perhaps the Southwest, and certainly the northern Great Plains region which, perhaps, have institutions that would not meet this criterion.

Dr. FALKIE. I will let Dr. White answer that, except to say there are some universities involved in characterization and one of the biggest needs for characterization of coal is in the conversion and utilization phase.

Dr. WHITE. There is a very large program at Penn State which has been going on for many years approaching \$1 million a year involving many faculty members and students taking coal samples from all over the country, Alaska and all, and trying to characterize them and get all of the pertinent physical and chemical information about them.

It is perhaps not as widely known as it should be, but it is there and available. I certainly concur in your point about this restriction on a current, ongoing research program. There are certainly coal States, my own State of Illinois is one that has abundant coal reserves but I would not say it is characterized as having a strong ongoing program at the University of Illinois that would compare with the University of Utah or particularly Penn State in coal technology.

If you took this bill as it now reads and wanted to include title 1 in the present criteria—and not parlaying to the extent—

Senator METCALF. Nevertheless, Dr. White, the coal fields of Illinois present a problem substantially different from that presented by West Virginia or Pennsylvania or the northern Great Plains area that Mr. Harvey mentioned or other areas. The overburden is different. The geographical location is substantially different. Maybe we should do something to encourage Illinois to get into this business.

The criteria here might prevent such a university from having such an opportunity to participate.

Dr. WHITE. If I didn't make myself clear, I was trying to address myself to that point.

Senator METCALF. I want to clarify that. You were just telling us your own State of Illinois had different characterizations than any of the other regions of America.

Dr. WHITE. It is a significant coal State and had no ongoing university program which would meet the criteria and would not get anything under the present bill.

Senator METCALF. That is exactly what we are pointing out.

I am inclined to concur. We would deprive some areas with essential needs for coal research of an opportunity to participate because they have not traditionally or historically been a part of this research program.

Before you go on, I want to mention that ever since I've been in Congress which is probably longer than I should have been, this business of matching funds is always a problem. I think we should get away from matching at the State level, at the appropriation level in the State. It gives a distorted picture of the actual need for participation.

For instance, if you are in a State legislature and you only have a certain amount, you are inclined to say we will put the money in the road fund because we only have to match a small percentage, rather than in the university research fund, where we have to kick in half or some other fund where we have to put up 75 percent.

I think we should move away from this matching concept and say we want research. We are willing to pay for it. The Federal Government will participate and we hope the local areas will continue to go along.

Go ahead, Mike.

Mr. HARVEY. Would it be feasible or practical from your standpoint to get around the selection problem, perhaps, by providing for consortia of universities to get together. In view of the fact that we only have a limited number of facilities established by the Congress, this would allow them to participate as one.

Dr. FALKIE. I suppose that would be possible. But from my experience in the education business, I would be somewhat less than optimistic that the universities could get together and really cooperate with each other the way they should cooperate for forming consortia.

There are examples of consortia that seem to work adequately but there are, to my knowledge, not very many. Quite frankly, it is hard enough to get two departments to cooperate within a university let alone to get one university to cooperate with another one.

So, I would say, yes, it is a possibility. But my optimism for it is not very high.

Senator METCALF. Thank you very much.

Now, we will have Mr. Allnutt. Do you have a statement?

Mr. ALLNUTT. I do, Mr. Chairman. I will summarize it.

Senator METCALF. The statement will be incorporated in the record.

**STATEMENT OF ROBERT F. ALLNUTT, DEPUTY ASSISTANT ADMINISTRATOR FOR ADMINISTRATION, ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION**

Mr. ALLNUTT. My prepared summaries in some detail ERDA's programs in four areas. I will try to highlight that rather than go through the full statement.

In on-campus R. & D., to give you a size of the program between fiscal 1974 and 1976, the number of R. & D. contracts and grants increased from just over 900 to an estimated 1,200 in this fiscal year and in dollar amounts from \$82 million to an estimated \$150 million in 1976.

Mr. HARVEY. Are all of the numbers total for ERDA? Not just coal?

Mr. ALLNUTT. Yes.

Mr. HARVEY. Could you submit for the record the nonnuclear and then within that the coal?

Mr. ALLNUTT. Yes, I will do that.

ON-CAMPUS R. & D. AT COLLEGES AND UNIVERSITIES, NUMBER OF CONTRACTS AND GRANTS AND OPERATING COSTS FISCAL YEARS 1974-76 (ESTIMATE)

Program	Number of contracts and grants			Operating costs (in millions)		
	Fiscal year 1974	Fiscal year 1975	Fiscal year 1976 (estimate)	Fiscal year 1974	Fiscal year 1975	Fiscal year 1976 (estimate)
Fossil energy development (Coal).....	9 (6)	35 (31)	175 (163)	\$2.1 (1.6)	\$2.6 (2.5)	\$24.8 (22.4)
Solar energy development.....		34	60		3.6	5.9
Geothermal energy development.....	12	31	23	.2	3.4	2.4
Conservation R. & D.....	4	13	17	.3	.3	1.5
Fusion power R. & D.....	58	53	55	6.3	10.7	12.0
Fuel cycle R. & D.....	16	16	21	.4	.4	1.5
Fission power reactor development.....	15	21	23	1.1	1.2	1.2
Biomedical and environment research.....	386	384	390	29.4	35.3	37.1
High energy physics and basic energy science.....	413	404	404	51.1	55.7	58.9
Space nuclear systems.....	1	3	3	.1	.2	.3
Process development.....	3	27	2	.8	2.2	.8
National security-weapons activities.....	11	8	27	.7	.7	3.6
Total.....	928	1,029	1,200	92.5	116.3	150.0

Mr. ALLNUTT. I go on in my statement to talk about special energy training workshops, faculty training programs, and of particular interest to S. 62, masters programs and doctoral programs which in the current fiscal year total \$700,000, which supports about 100 trainees.

Finally, I talk in the prepared statement about the laboratory based university programs in addition to those Dr. White mentioned at the ERDA energy research centers.

ERDA inherited from the Atomic Energy Commission an active program of cooperation between the old AEC national laboratories and the university community. These programs total about \$400,000 for conferences and related services in 1976, \$550,000 in support of graduate research theses; \$650,000 for faculty and postdoctoral research and about \$1 million for student research.

These programs involve in the main summer programs where students and faculty come to the laboratories to use the facilities there.

Finally, I thought the subcommittee might be interested in the flow we are having of unsolicited proposals that Dr. White mentioned in the fossil area.

In the first 6 months of this year there were almost 800 unsolicited proposals to ERDA for research work; 15 percent were declined, one-third have been approved for funding; and just over one-half are under review.

Half are related to solar, geothermal, and advanced energy systems.

Senator METCALF. What is advanced energy systems?

Mr. ALLNUTT. It involves several things. Fusion is an advanced energy system in ERDA's terms. We also include other advanced technologies—longer term systems as opposed to those that have nearer term potential like nuclear fission or solar heating.

Senator METCALF. Coal gasification, would that be an advanced energy—

Mr. ALLNUTT. Not in the terms we use in this area.

Senator METCALF. Fusion which is certainly an advance in energy systems would be a part of your nuclear studies?

Mr. ALLNUTT. That is right, Mr. Chairman; 17 percent of these proposals relate to environmental safety and the remaining one-third are divided evenly amongst fossil—

Senator METCALF. Don't get away from the 17 percent before I can ask you a question.

Coal research would be a part of coal or would it all be safety of nuclear devices?

Mr. ALLNUTT. This would represent work we do across the board including coal and nuclear. Across the board, ERDA's research areas.

Senator METCALF. What I am trying to do in your breakdown, nail down how much you are taking care of coal. A good many of us in the Congress feel that at this time there is too much attention paid to nuclear research and the nuclear approach and not enough to some of these other programs that might be more beneficial or, at least, would be alternate programs for development.

I can remember a few years ago—I know all of you can remember too—when nuclear energy was the whole hope of the energy world. We wouldn't have to build hydroelectric dams, mine any coal or do anything.

That has gone by the board. And the same people talking about not building hydroelectric dams are in here talking about not building any nuclear plants.

It seems to me what we are concerned about is a little broader research from ERDA than concentration on nuclear energy and that is why I want a more specific breakdown than the statistics you are giving me.

Mr. ALLNUTT. I understand your concern. If you will watch our progress over time the pattern will be that the growth areas—if I can use that term—will be in the nonnuclear areas.

If you get into areas like solar energy, which a few years ago in terms of Federal Government support was very small, it is growing very rapidly; similarly in the conservation area—that is where the real growth will be.

These percentages I was giving you are proposals received as opposed to what we ended up funding. Counsel has asked us to submit for the record, and I will, a detailed indication of what was funded, not just what proposals were made but which proposals were funded.

And I will submit that for the record.

Senator METCALF. A detailed description of the various programs being funded.

Mr. ALLNUTT. That is a quick summary of what is in the detailed statement.

I will be glad to answer any questions you may have.

[The table follows:]

U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION,  
Washington, D.C., December 4, 1975.

FOSSIL ENERGY PROGRAM STATUS OF UNIVERSITY PROPOSALS AS OF OCTOBER 1975

SUMMARY		<i>Number</i>
Proposal status:		
Declined -----		52
Approved -----		53
Pending -----		86
 Total -----		 191

Information provided in the attachment includes: names of institution; principal investigator; dollar amount of contract or grant; and status of proposal—APP—Approved, DECL—Declined, and PEND—Pending.

UNIVERSITY PROPOSALS—LISTING BY DIVISION/OFFICE: DIVISION OF ADVANCED RESEARCH AND SUPPORTING TECHNOLOGY

ERDA No. (RST)—Institution: Title	Investigator	Reviewer	Amount	C App.	Status	
					Decl.	Pend.
00001—Auburn University: Chemical and biological monitors for coal solvent pollution.			\$193,000		D	
00002—Auburn University: Chemical and biological monitors for solvent pollution.			200,000		D	
00003—Auburn University: Ecusability of the design of coal quarries to withstand explosion.			384,000		D	
00004—Colorado State University: The use of mycorrhizal plants for revegetation of mining waste sites.					D	
00005—University of Florida: Suppression of carcinogens in coal products.			159,000		D	
00006—University of Florida: Suppression of carcinogens in coal products.			159,191		D	
00007—University of Georgia: New approaches to the utilization of coal for national needs.			248,000		D	
00008—University of Illinois at Urbana: Environmental impact of coal conversion wastes.					D	
00009—Indiana State University: The separation and structure evaluation of lone molecules.					D	
00010—University of Minnesota: Modelling of coal char and gasification reactors.			224,000		D	
00011—Pikeville College: Determination of the basic toxicology of liquification products.			105,000		D	
00012—University of Pittsburgh: Sulfur isotopes in commercial coal.			52,727		D	
00013—University of Pittsburgh: Study on rate of devolatilization of row coal hydrene process.			106,000		D	
00014—University of Tennessee, Knoxville: Carbon 13NMR investigation of coal structure.			125,000		D	
00015—University of Texas at Austin: A study of acid-base complexes in asphaltene and in coal.					D	
00016—Virginia Polytechnic Institute: Coal fuels for internal combustion engines.					D	
00017—University of Washington: The physical properties of western coals.			99,000		D	
00018—University of Alaska: Eurasian utilization of secondary subarctic energy source (peat).	Gottlieb				P	
00019—Ben-Gurion University: Vacuum communication of coals.	Cornet				P	
00020—Brown University: Improved basis for the design of gas and steam turbine.	Cornet				P	
00021—University of California, Berkeley.	D. A. Canonio		515,000		D	
00022—California Institute of Technology: Determination of microscopic atomic structure of surfaces important in catalyzed reactions.					P	
00023—Carnegie-Mellon University: Experimental investigation of fast fluidization as a technique for hydrogasification of caking coals.	M. J. Massey		2,018,026		P	
00024—Villa Maria College: Study of the mechanism of the hydrogen sulfide dolomite reaction.	K. Li		109,832		P	
00025—Case Western Reserve University: Study of coal reactivities.			380,000		P	
00026—University of Colorado: Retorting and physical fracturing of oil-shale or by means of microwave heating.					P	
00027—Colorado School of Mines: Energy balance studies of fossil fuel resources.	Cutlip				P	
00028—University of Connecticut: Selective oxidation of carbon monoxide.	M. Cutlip				P	
00029—University of Connecticut: Grant for mass spec.					P	
00030—University of Connecticut: Electrode polarization status in hot corrosion systems.			92,871		P	
00031—Johns Hopkins University: Methanation mechanisms.	Koski/Kaufman				P	
00032—University of Idaho: Methanation rates with flame-sprayed catalysis.	Thompson				P	
00033—University of Illinois at Urbana: Coal gasification waste water treatment.			238,755		P	
00034—University of Illinois at Urbana: The coal future economical and technological analysis of initiatives to secure fuel supply independence.			450,000		P	
00035—Johns Hopkins University: Fluidized-bed coal combustion research.	W. B. Shippen		50,000		P	
00036—Indiana University, Bloomington: The separation and structure elucidation of coal molecule fragments.			381,000		P	

00037—University of Kentucky: Iron reduction by coal gas.	239, 293	P
00038—University of Kentucky: Development of improved catalysts for coal gasification process.	363, 713	P
00039—University of Kentucky: Hot gas desulfurization.	135, 158	P
00040—University of Kentucky: Definition of hydrogen embrittlement problem in coal conversion units.	161, 052	D
00041—Massachusetts Institute of Technology: Modeling of fluidized-bed combustion of coal.	2, 123, 415	P
00042—McMaster University: Hydrogenation of oxides of carbon.	22, 550	P
00043—Michigan Technological University: Economic study of the production of CH <sub>3</sub> O <sub>2</sub> H and high Btu gas by oxidation of SRC.		P
00044—University of Minnesota: Studies of cyclone separator under high efficiency condition.		P
00045—University of Nebraska at Lincoln: A new small coal furnace.	177, 962	P
00046—New York University: Thermal effects burning material conversion and catalytic processes.	208, 134	P
00047—New York University: Improved spectrographic study of coal conversion.		D
00048—Nova University: Benzene as a gasoline extender.		D
00049—Ohio University: Refractory technology on gasification.		D
00050—Oklahoma State University: Photo hydrogenation of aerocolloidal coal dust.	134, 813	D
00051—Oklahoma State University: An alternate fuels research program. Mass spectrometric investigation of liquid derived from coals.	296, 250	D
00052—Oklahoma State University: An alternate fuels research program. Mass spectrometric investigation of liquid derived from coals.	317, 557	D
00053—Pennsylvania State University: Study of the mineral matter distribution in pulverized coal.		D
00054—Pennsylvania State University: Improved sampling and analytical techniques in coal characterization.		D
00055—Purdue University: Vaporization of liquified natural gas.		D
00056—Rice University: Manganese oxides FUR H <sub>2</sub> S renewal	86, 222	D
00057—Rice University: A proposal to study the cure component vapor pressures, mixture viscosities, etc., for coal liquification plants.	76, 651	D
00058—Rice University: Extension of low temperature methane acid gas V-L-E studies to other studies.		D
00059—Rice University: Thermodynamic and transport properties of gas-liquid and gas-liquid-solid mixtures.	440, 000	D
00060—Rice University: Measurement of equilibrium gas phase concentrations, etc.		D
00061—Rutgers University: Catalyses: Hydrogenation of coal under mild homogeneous conditions.		D
00062—University of Southern California: Studies of coal gasification processes using a molecular beam M. S. sampling systems.	176, 699	D
00063—Southern Illinois University, Carbondale: Mechanism of hydrogenation of possic bonds.		D
00064—Southern Illinois University, Carbondale: Economics of reclaiming strip mine lands.		D
00065—Texas A. & M. University: Characterization of useful organisms and pollutants from fossil fuels by M.S.		D
00066—University of Texas at Austin: Transient spontaneous emulsification as a tertiary oil recovery mechanism.	62, 966	D
00067—University of Texas at Austin: Efficient utilization of Texas lignite by low-temperature carbonization followed combustion in pulverized form.		D
00068—Utah State University: Extended range pollution potential in the western United States.	81, 200	D
00069—Virginia Polytechnic Institute: Processing variable influence on alumina refractories.	124, 930	D
00070—Virginia Polytechnic Institute: Study of the high-temperature abrasion resistance of refractories used in coal gasification.	77, 157	D
00071—West Virginia University: Investigation of coal-water slurring at high temperatures and pressure.	24, 979	D
00072—University of Wyoming: Physics-chemical characteristics reactivities and gasification kinetics of selected western coals for underground coal gasification programs.	50, 000	D

UNIVERSITY PROPOSALS—LISTING BY DIVISION/OFFICE: DIVISION OF ADVANCED RESEARCH AND SUPPORT TECHNOLOGY

ERDA No. (RST-)	Institution: Title	Investigator	Reviewer	Amount	C App.	Status	
						Decl.	Pend.
00073	Brigham Young University: Alloy catalysts with monolith supports for methanation of coal-derived gases.	C. H. Bartholomew		\$98,756	A		
00074	University of Arizona: Pollutant control through staged combustion of pulverized coal.	J. O. L. Wendt		74,366	A		
00075	Carnegie-Mellon University: Catalytic synthesis of gaseous hydrocarbons.	A. L. Dent		206,481	A		
00076	Utah State University: Process for liquefaction and gasification of western coals.	W. H. Wisler		2,424,880	A		
00077	State University at Buffalo: Novel catalyst supports for hydrodesulfurization of coal.	S. W. Weller		243,553	A		
00078	Western Michigan University: Fundamentals of nitric oxide formation in fossil fuel combustion.	T. Houser		79,981	A		
00079	University of Montana: Environmental effects from leaching of coal conversion by-products.	W. P. Van Meter, R.E.		74,948	A		
00080	Oklahoma State University: Catalysts for upgrading coal-derived liquids.	B. L. Crynes		214,890	A		
00081	Oklahoma State University: Enthalpy measurements of coal-derived liquids.	A. J. Kidnay	V. F. Yes	277,683	A		
00082	Pennsylvania State University: The characteristics of American coals in relation to their conversion to clean energy fuels.	W. Spackman		2,829,600	A		
00083	University of Chicago: Modeling of a fluidized-bed combustor with immersed tubes.	S. C. Saxena		89,016	A		
00084	Brandywine College: Kinetics and mechanisms of desulfurization and denitrogenation of coal-derived liquids.	B. C. Gates	J. R. Katz	631,682	A		
00085	Purdue University: Gasification in pulverized coal flames.	N. M. Laurendeau		208,491	A		
00086	University of Southern California: Chemistry and structure of coal-derived asphaltenes.	T. F. Yen		260,917	A		
00087	Montana State University: Catalytic hydrogenation of coal-derived liquids.	Dr. L. Berg		156,485	A		
00088	Mississippi State University: Design of air preheater for MHD powerplant.	D. L. Murphree		637,202		P	
00089	Lehigh University: Centrifugal fluidized combustion of coal.	J. C. Chen	E. K. Levy	315,540		P	
00090	University of Alaska: Characterization evaluation and enrichment potential of Alaska's low-rank coals by washing and dehydration.	P. D. Rao		120,979		P	
00091	Oklahoma State University: Measurement of several thermodynamic properties of coal-derived fluids.	R. L. Robinson		224,920		P	
00092	New York University: An investigation of the fluid dynamics of the fluidized bed packed with heat exchangers.	A. Ferri	Victor Zak	389,355		P	
00093	Rice University: Heat transfer in a fluidized counter-current bed.	Roy Jackson			A		
00094	Washington State University: Fate and behavior of fuel-sulfur in back-mixed continuous combustion.	P. C. Malte		199,116		P	
00095	Purdue University: Optimization of pyrolytic conversion of coal to clean fuel.	W. Summerfield		346,283		P	
00096	West Virginia University: Optimization studies of various coal conversion systems.	C. Y. Wen		171,585		P	
00097	Massachusetts Institute of Technology: GT superconducting magnet (University of Tennessee).	J. Montgomery	W. J. Mornich	1,720,000		P	
00100	Clarkson College of Technology: Nucleation barriers to the condensation of the products of high-temperature combustion.	J. L. Katz		48,764		P	
00103	University of Colorado: Surface tertiary oil recovery.	W. F. Ramirez		106,760		P	
00104	University of Wyoming: Statistical estimation of subsurface coal burn volumes from remote electromagnetic induction resistivity.	Edmund A. Quinicy		60,000		P	
00105	University of California, Berkeley: Catalytic activity of coal mineral matter.	C. E. Hamrin, Jr.		90,860		P	
00107	University of California, Berkeley: On-stream device for determining stress-corrosion cracking characteristics of process environments.	I. Cornet	F. E. Hause	51,450		P	
00109	California Institute of Technology: Fundamental studies related to magnetohydrodynamic power generation.	J. Beauchamp		76,600		P	
00110	University of Denver: Well penetration and stimulation techniques.	R. Williams	R. Edgel	511,105		P	

00113—Drexel University: Improved shape charges for oil well perforation.	D. C. Chou.	81, 365	P
00114—University of Georgia: Transition metalchemistry under high CO pressure an infrared spectroscopic study of catalysis in the Fischer-Tropich reaction.	R. B. King..... A. D. King.	215, 566	P
00115—Texas Tech University: Coal conversion using methanol as a reactant.	W. J. Huffman.	141, 282	P
00116—University of Wisconsin, Madison: Broad-front in-situ gasification method.	Rodolfo V. De La Cr.	85, 600	P
00117—University of California San Diego: Geological and geochemical effects of spontaneous combustion of rocks rich in bituminous matter and/or hydrocarbons.	M. Kastner.	92, 028	P
00118—University of Wyoming: Presentation and analysis of viral technical and economic aspects of in-situ coal gasification.	S. S. Kasakow..... J. H. Mu.	47, 360	P
00119—University of New Mexico: In-situ coal gasification.	H. E. Nuttall et al.	229, 324	P
00120—Purdue University: Static and dynamic experiments to determine strength and wave propagation characteristics of oil shale.	Michael P. Felix.	86, 692	P
00121—Colorado State University: Acoustical properties of oil shale deposits.	M. Andrews.	23, 152	P
00122—University of Utah: An integrated study of the upgrading, use and catalytic processing of Utah shale oils and their basic chemical composition.	Alex G. Ohadi.	808, 366	P
00123—Colorado School of Mines: The utilization of shale oil as a feedstock for steam pyrolysis and petrochemical intermediate production.	Philip F. Dickson V.	157, 011	P
00125—Illinois Institute of Technology: Solids separation in synthetic fuel oil and solvent refined coal processes.	D. Gidaspow..... W. M. Lan.	132, 600	P
00127—University of Illinois at Urbana: Steam-ejector coal pump.	S. L. Soo.	273, 000	P
00128—University of Illinois at Urbana: Suppression of particle elutriation inside fluidized-bed combustor.	B. T. Chao.	163, 305	P
00129—Colorado School of Mines: A mineralogical and geochemical study of the Colorado oil shales.	M. Slaughter.	250, 590	P
00130—University of Texas at Austin: Multi-axial dynamic testing of oil shale cubic samples at simulated in-situ stress.	A. Podio.	257, 785	P
00132—University of Wyoming: Mathematical models of in-situ oil shale retorting.	J. H. George..... N. G. Har.	102, 726	P
00133—University of Pennsylvania: Molecular rheology of aqueous polymer solutions research in tertiary oil recovery.	W. C. Forsman.	126, 765	P
00135—University of Cincinnati: Catalytic liquefaction and hydrogenation.	M. Orchin.	158, 627	P
00139—University of Illinois at Urbana: Energy use for building construction.	J. R. Riter, Jr.	213, 517	P
00139—University of Denver: Thermodynamics modeling of underground coal gasification.	T. J. Klingen.	85, 657	P
00138—University of Mississippi: Investigation of the effects of gamma and electron radiation on the decomposition of coal.	D. J. Kirwan.	117, 000	P
00140—University of Illinois at Urbana: Promotion and control of solid mixing in fluidized beds.	M. M. Chen.	116, 200	P
00141—Oklahoma State University: A study of the possibility of utilizing micro organisms to increase secondary and tertiary recovery of crude oil.	M. M. Gula.	163, 236	P
00142—University of Illinois at Urbana: Agriculture value of sulfated dolomitic and calcitic limestone.	T. D. Hinesly.	40, 860	P
00143—Purdue University: Polytypism and intergranular bonding in sic composites.	H. Sato.	94, 320	P
00144—University of Colorado: The coordination chemistry of palladium (0).	C. Pierpont.	189, 985	P
00145—Texas A. & M. University: Mechanistic study of coal gasification and extinctive conversion processes using radioactive tracers.	Yi Noo Tang.	207, 388	P
00146—University of Cincinnati: Converting waste polymers to fuel oil.	R. P. Chartoff.	285, 211	P
00147—City College: Studies toward improved techniques for gasifying coal.	M. Squires.	1, 836, 327	P
00148—Clemson University: Analytical modeling of practical combustion systems.	G. F. Robinson.	19, 730	P
00149—University of Southern California: Characterization of shale oil asphaltene and its role in upgrading and pyrolysis.	T. F. Yen.	250, 630	P
00150—Covenant College: Ultrasonic investigation of very high density gases.	S. E. Babb, Jr.	79, 354	P
00151—University of Chicago: Conference on research and development in the United States the institutional base.	E. W. Kitch.	83, 400	P

## UNIVERSITY PROPOSALS—LISTING BY DIVISION/OFFICE: DIVISION OF ADVANCED RESEARCH AND SUPPORT TECHNOLOGY

ERDA No. (RST)—Institution: Title	Investigator	Reviewer	Status	
			Amount	C App. Decl. Pend.
00152—University of Texas at Austin: Gulf coast lignite: Geology, utilization environmental aspects.	Charles C. Groat		\$21,454	P
00153—University of Colorado: A feasibility study of the use of nonequilibrium molecular energy distribution in the steam-coal char reaction.	Lee F. Brown		47,360	P
00154—University of Massachusetts: Amherst: Analytical chemical systems for determination of heavy metals and organic compounds in natural waters.	Ramon M. Barnes			P
00155—Virginia Polytechnic Institute: The chemical constituents and molecular structure of coal and chemical reactions during liquefaction.	W. R. Hibbard		1,377,499	P
00156—Dartmouth College: Mid-term technology assessment system: Dynamic simulation model, U.S. fossil energy transition (1975/2010).	D. L. Meadows		654,537	D
00160—University of California, Los Angeles: Studies of ceramic helical expanders for topping cycle service.	B. Moyers		146,000	P
00162—University of California, Los Angeles: Theoretical and experimental investigation of thermal in-situ extraction.	M. C. Branch W. H. Som		180,000	P
00153—University of Tennessee, Knoxville: Carbon-13 NMR investigations of coal structure.	J. W. Larsen		124,815	D
00174—Auburn University: Chemical and biological monitors for coal solvent pollution.	W. C. Heely H. H. Kohl		199,333	D
00177—University of California, Santa Barbara: Direct monitoring of metallic emissions from fossil boilers and in the natural environment.	D. K. Scholfield		150,420	D
00184—University of California, Los Angeles: Studies of coal gasification processes using a molecular-beam mass-spectrometer sampling system.	W. S. Young		176,699	D
00185—University of Illinois at Chicago Circle: Coal gasification plant siting with emphasis on socioeconomic impacts.				D
00192—University of Alabama, Tuscaloosa: Ecophysiological studies of respiration and metabolism in fishes subjected to acid mine drainage.	G. R. Ullsch		126,591	D
00198—Colorado State University: Use of microthizal plants for revegetation of mining waste sites.	M. Reid			D
00199—Oklahoma State Technical Institute: Kinetics of the hydrogen atom reactions with benzene, cyclohexane, and cyclohexene: Hydrogenation mechanisms and ring cleavage.				P
00207—Brigham Young University: Mixing and gasification of coal in entrained flow systems.	L. D. Smoot		104,110	A
00209—Montana College of Mineral Science and Tech.: Program of MHD power generation research—Pts. A, B and C.	V. Griffiths		407,196	A
00210—Montana State University: Program of MHD power generation research—Pts. D, E, F, G and H.	C. Blacketter		1,142,088	A
00211—University of North Dakota: Premium fuels from Northern Great Plains Lignite—Project Lignite.	D. E. Severson		3,356,600	A
00212—South Dakota School of Mines and Technology: Subcontract between Consolidation Coal Co. and SDSM & Tre: Consol C-02-acceptor process.	J. A. Redden		382,318	A
00213—Stanford University: MHD phenomena at high magnetic fields.	R. Eustice		433,930	A
00214—University of Tennessee, Knoxville: Development program for MHD direct coal-fired power generation test facility.	J. B. Dicks		8,150,792	A
00215—Virginia Polytechnic Institute: Design optimization in underground coal systems.	J. R. Lucas		537,600	A
00216—Virginia Polytechnic Institute: Continuous stirred-tank, hydrogenative extraction of coal.	G. H. Beyer		191,986	A
00217—Washington State University: Application of neutron activation analysis and atomic absorption to the determination of trace elements in a coal liquefaction process.	R. H. Filby		45,000	A

00218—Washington State University: Pilot plant study for production of useful products from coal minerals.	G. T. Austin.	184,000	A
00219—West Virginia University: Optimization of coal conversion processes.	C. Y. Wen.	487,808	A
00220—West Virginia University: A study of coal-associated wastes resulting from the mining, processing and utilization of coal.	J. W. Leonard.	1,121,290	A
00221—Lehigh University: Handling characteristics of solvent refined coal.	C. W. Clump.	50,000	A
00222—Colorado School of Mines: Clean solid and liquid fuels from coal.	H. H. Gary.	570,967	A
00223—University of New Hampshire, Durham: Mechanism of fly ash formation in coal-fired boilers.	G. D. Ulrich.	—	A
00224—University of North Dakota: Conversion of solvent-refined lignite into premium liquid fuels.	P. I. Stenberg et al.	—	A
00225—University of Kentucky: Surface structure and mechanisms of gasification catalyst deactivation.	P. J. Recourt.	—	A
00226—University of Kentucky: Catalytic activity of coal mineral matter.	C. E. Hamrin, Jr.	25,000	A
00227—Georgia Institute of Technology: Single-wheel gas-turbine topping unit for coal-burning powerplants.	T. W. Jackson.	—	A
00228—Lebanon Valley College: Hydrogen bonding in asphaltenes and coal.	N. C. Li.	—	A
00229—University of Idaho: Bubble behavior of the scale-up of fluidized-bed heat exchangers.	W. J. Thomson.	51,115	A
00230—University of Pittsburgh: Low interfacial tension and miscibility studies for surfactant tertiary oil-recovery processes.	C. A. Miller.	—	A
00231—University of Houston: Interfacial effects in the recovery of residual oil by displacement (1).	R. W. Flummerfelt.	28,640	A
00232—Northwestern University: Interfacial effects in the recovery of residual oil by displacement (2).	J. C. Slattery, A.A.K.	65,745	A
00233—Oklahoma State University: Microbial decomposition of organic wastes under conditions existing in deep wells.	M. Grula.	44,512	A
00234—Pennsylvania State University: Computer simulation and economic optimization of underground gasification of coal.	S. M. Farouq Oth.	48,573	A
00235—Pennsylvania State University: Tertiary recovery of Pennsylvania Grade crude oil with surfactant solutions.	E. E. Klaus.	199,628	A
00236—University of Texas at Austin: Emulsion stability as related to tertiary oil recovery.	R. S. Schechter, W.H.	24,300	A
00237—Texas Tech University: Laboratory determination of leaching rates from shale oil, restored under simulated in-situ conditions.	H. W. Parker.	61,500	A
00238—University of Tulsa: Kinetics of underground combustion.	—	24,253	A
00239—West Virginia University: Application of remote sensing to interpretation of fracture systems and structural styles in plateau regions: East Kentucky, Southwest Virginia, and Southeast West Virginia (re: fossil fuel extraction processes).	G. W. Thomas.	5,250	A
00240—West Virginia University: Assessment of tri-potential electrical resistivity survey in defining cavities, fracture zones and aquifers.	H. W. Rauch.	5,830	A
00241—West Virginia University: The availability and economics of 002 sources for secondary recovery.	A. Pappano.	24,781	A
00242—West Virginia University: A dynamic reflective photoelasticity study of rock fracture mechanisms.	R. Haynes.	23,507	A
00243—West Virginia University: Structural mechanics simulation associated with underground coal gasification.	S. Advani.	14,983	A
00244—West Virginia University: Simulation of fluid flow associated with underground coal gasification.	G. R. Hopkins.	15,000	A

Senator METCALF. I hope you will have somebody attending the hearing tomorrow when we have the academic people here so you will be able to hear their comments.

[The prepared statement of Mr. Allnutt follows:]

## STATEMENT OF

ROBERT F. ALLNUTT  
DEPUTY ASSISTANT ADMINISTRATOR  
FOR ADMINISTRATION

ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

BEFORE THE  
SUBCOMMITTEE ON MINERALS, MATERIALS AND FUELS  
SENATE COMMITTEE ON INTERIOR AND INSULAR AFFAIRS

NOVEMBER 4, 1975

Mr. Chairman and Members of the Subcommittee:

I appreciate this opportunity to appear before you, and to provide the Subcommittee with additional information on ERDA activities related to the subjects dealt with in S. 62.

As Dr. White indicated in his remarks, ERDA established a Division of University and Manpower Development Programs in August. The basic division staff is in place, and active recruitment for a Director with strong university background is underway. ERDA's Assistant Administrator for Administration is acting as Director until a Director comes on board. Programmatic research by universities will, of course, continue to be the responsibility of ERDA's program divisions. The purpose of the new Division is to coordinate those efforts, to maintain up-to-date records on ERDA's relationships with universities, and to serve as a point of contact on all university-related matters. The new Division also serves as the clearinghouse for all unsolicited proposals from universities. In addition, the new Division will be responsible for

the university liaison and manpower development activities previously assigned to the Divisions of Biomedical and Environmental Research, Physical Research, and Labor Relations.

Dr. White discussed Fossil Energy programs with the university community in some detail. I would like now to summarize briefly ERDA-wide university and manpower programs as they exist today in four specific areas: on-campus research and development; university-based education programs; university-laboratory cooperative programs; and unsolicited proposals from universities.

#### On-Campus R&D

From fiscal years 1974 to 1976, on-campus R&D contracts and grants increased from slightly over 900 to an estimated 1,200, and in annual dollar value from about \$92 million to an estimated \$150 million. Of course, ERDA inherited a large amount of on-going activities in the nuclear area from the Atomic Energy Commission, but we also have sponsored work underway in the fossil areas discussed by Dr. White and in solar and geothermal energy and conservation.

As is evident from the on-campus R&D operating costs and number of contracts and grants, we are utilizing the talents of the university community in a number of ways to cope with energy-related problems. We plan to continue our relationships in most of these R&D directed areas and promote new emphases as well--especially in the non-nuclear areas.

In most instances, ERDA must seek the highest levels of competency and expertise available in the university community. This will frequently be the controlling factor in selecting colleges or universities for research on urgent short-term problems requiring unique skills and expertise.

However, in the interest of developing a broader national base of academic energy research competence, we intend to provide some support for lesser-developed institutions that evidence a clear potential and intent to develop expertise in energy-related areas.

As I am sure the Subcommittee knows, on-campus R&D programs have the dual payoff of producing valuable research results while also providing realistic training at both the undergraduate and graduate levels.

#### University-Based Education Programs

Here ERDA activities fall into three main categories:

Special Energy Training Projects are aimed at meeting multiple short-term training needs. Supporting activities necessary to meet current education and training requirements are carried out under this program, such as development of curricular material, sponsorship of short courses for ERDA and ERDA contractor staff, topical conferences and a visiting lecturer program. For example, a mini-course, entitled "The Environmental Impact of Electrical Power Generation: Nuclear and Fossil," developed through the Pennsylvania Department of Education,

is in use in approximately 30 States. The course was developed as an effort to describe the cost-benefit ratio of the various methods of generating electrical power with particular emphasis on the role of nuclear and fossil sources for near-term requirements.

Examples of other projects supported in this category are: SCORE (Student Competitions on Relevant Engineering) "Energy Resource Alternatives Competition"; and the recent Oregon Conference on "Magnitude and Deployment Schedule of Energy Resources". A study will also be made to determine the feasibility and mechanism of establishing an energy extension advisory service that could serve individuals and smaller communities through seminars, workshops and information on energy matters.

Our support for programs of this type will total about \$450 thousand in fiscal 1976.

Traineeships. ERDA supports outstanding students in study toward advanced degrees in the fields of nuclear engineering, applied radiation protection, and environmental science and engineering.

The graduate traineeship program is necessary to meet the diverse needs for highly skilled professional personnel in the energy R&D programs. Approximately one-half of the traineeship program is planned for implementing MS and PhD traineeships in the environmental health and safety areas, coal utilization and conversion technologies, and energy assessment and evaluation studies. This will provide assistance for a number of graduate students, mostly at the MS level, in the fields

of nuclear engineering and radiation protection, environmental health and safety areas related to energy resource pollutant characterization, monitoring and control. The placement of more trainees at contractor laboratories and facilities for periods of on-the-job training and practical experience will continue to receive a major emphasis. A valuable result of this association is a greater opportunity for eventual employment of these students by ERDA and its contractors. Post-doctoral appointments will be initiated in energy-related areas of interest to ERDA to permit recent PhD's to gain the additional practical experience required.

Our fiscal 1976 program in this area totals about \$700 thousand and will support about 100 trainees.

Faculty Training. Here ERDA assists college and university faculty and high school teachers who are faced with the new demands and challenges of their students and their respective communities on the subject of energy resources, production and its environmental impact. Institutes, short courses and workshops are conducted at selected universities and ERDA Laboratories on such topics as energy conservation, energy resources and alternatives, cost-benefit assessment, water quality, biological consideration of environmental pollutants and others relating to environmental effects.

Workshops of one-to-two weeks duration on "Energy Production - Risk/Benefit Assessment and Environmental Effects" will continue for high school and community college teachers. The level of interest and need for factual information on this complex subject is strongly supported through a review of previous participant evaluation responses. In FY 1975, 28 one-week workshops, 7 institutes, and 14 short courses were conducted for approximately 1,295 faculty. A substantial part of the \$900 thousand program planned for FY 1976 is to implement a series of institutes or workshops for college and university faculty on the subject of coal utilization, conversion processes, pollution control, waste management, energy transportation, distribution and storage and other pertinent topics. Special attention will also be given to educational and information efforts aimed at energy conservation and the more efficient use of energy. These efforts will be conducted in cooperation with all levels of the educational community. Continued use will also be made of unique training resources, staff and facilities available at several national laboratories and energy research centers as well as universities.

#### University-Laboratory Cooperative Programs

Dr. White discussed the role of ERDA Energy Research Centers in research and training. In addition, ERDA sponsors substantial cooperative programs through the national laboratories formerly managed by the AEC.

These programs are designed (1) to increase the interactions and flow of information between universities and ERDA Laboratories, (2) to familiarize academic scientists with energy sciences and techniques, and (3) to stimulate transfer of knowledge from ERDA Laboratories to the academic community for incorporation into their education and training curricula. Graduate and undergraduate students as well as faculty members are assigned to ERDA Laboratories to receive instruction and research exposure in advanced science and technology, using unique equipment and instrumentation unavailable on their campuses.

Included is provision for a special minority-oriented precollege student support program called PREFACE (Pre-Freshman And Cooperative Education). This modest but highly effective activity is specifically directed toward the upgrading of minority and educationally disadvantaged students to college levels, and is administered by ERDA's Office of Equal Opportunity.

University-Laboratory cooperation activities take place primarily during summer months, although some extend into the academic year. Faculty and student appointments tend to be in the one to three month range; laboratory graduate participation stipends cover longer periods and may extend over two or three years. Support consists of stipends, travel, and tuition, as applicable. Amounts vary depending upon the policies of the host laboratory and the responsible managing contractor,

and the status and qualifications of the participants. Faculty stipends range up to \$1,500 per month; students receive up to \$500 per month, plus modest allowances for travel and related expenses.

The University-Laboratory cooperative program is managed by contractor organizations, with overall program direction and budget administration by ERDA.

More than three quarters of the funding is distributed by four contractors: (1) Argonne National Laboratory Center for Educational Affairs, (2) Associated Western Universities, and (3) Northwest College and University Association for Science, and (4) Oak Ridge Associated Universities.

Our fiscal 1976 program in these areas totals \$400 thousand in conferences and related supporting services, \$550 thousand in support of graduate research theses, \$650 thousand for faculty and post-doctoral research, and \$1 million for student research.

#### Unsolicited Proposals

ERDA encourages the submission of unsolicited research proposals from university principal investigators consistent with the specific mission and objectives of a particular program, as well as team research of inter-and-multidisciplinary nature which includes the participation of faculty and students. Study of the broader socio-economic, environmental and legal aspects of energy resources and utilization will be encouraged as either an integral part of a scientific and technical proposal, or separately.

During the first six months of ERDA's existence, we received nearly 800 unsolicited proposals from universities. About 15 percent were declined, nearly one-third have been approved for funding, and just over one-half are under review. The Subcommittee may be interested in the program areas to which these early proposals related: half related to solar, geothermal and advanced energy systems, about 17 percent related to environment and safety; and the remaining one-third were divided evenly among fossil energy, conservation and atomic energy programs.

Mr. Chairman, we expect the university community to play an essential role in ERDA's research and development activities. We will treat them as professional partners in this effort. The organizational structure and mission of universities can provide for: (1) an examination of multiple research areas which are concerned with not only scientific and technical considerations, but the broader environmental, socio-economic, and legal inputs which impact on energy utilization and resources; and (2) the education and training of young people in energy-related occupations which are needed by the Nation to cope with short- and long-range problems.

It is important to recognize that university activities supported by ERDA must be relevant to ERDA's mission and compatible with the interests, strengths and activities of the university. We will encourage

and respect a university's ability to plan and manage research, educational training and other activities toward stated objectives and within the constraints mutually agreed upon by ERDA and the university.

The ERDA mission demands involvement by all sectors of society--and the colleges and universities can contribute a great deal toward realizing our national energy objectives.

Mr. Chairman, this completes my prepared statement. I hope this information is useful to the Subcommittee in its deliberations. I'll be happy to respond to any questions you may have.

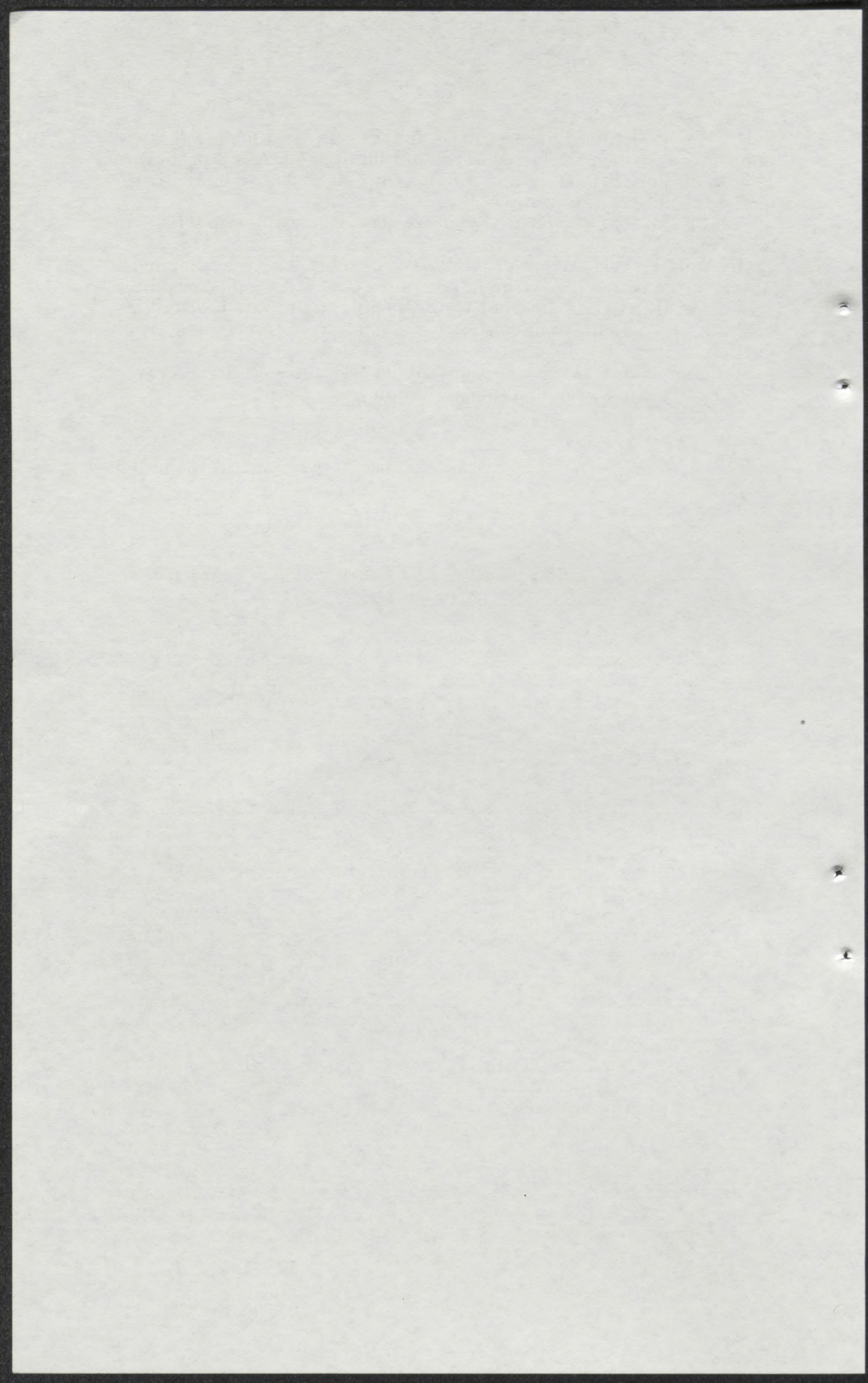
Dr. WHITE. I would like to correct for the record—I made a decimal point mistake when I referred to \$60 million for fellowship programs. It is \$6 million. Fifteen hundred fellowships at \$4,000 each. My arithmetic was not very accurate.

Senator METCALF. You say you are having a conference here in town today?

Dr. WHITE. Yesterday and today. It is going on at the Shoreham. A very large turnout. A large number of university people attending.

Senator METCALF. I am glad you were able to appear. I will allow you to get back to your conference. Thank you for coming, your participation and help and good luck.

[Whereupon, at 11:22 a.m. the hearing was recessed, to reconvene Wednesday, November 5, 1975, at 10 a.m.]



## COAL RESEARCH LABORATORY AND ENERGY RESOURCE FELLOWSHIP ACT

WEDNESDAY, NOVEMBER 5, 1975

U.S. SENATE,  
SUBCOMMITTEE ON MINERALS, MATERIALS AND FUELS,  
OF THE COMMITTEE ON INTERIOR AND INSULAR AFFAIRS,  
*Washington, D.C.*

The subcommittee met, pursuant to notice, at 10 a.m. in room 3110 Dirksen Office Building, Hon. Lee Metcalf presiding.

Present: Senators Metcalf and Hansen.

Also present: D. Michael Harvey, deputy chief counsel.

### OPENING STATEMENT OF HON. LEE METCALF, A U.S. SENATOR FROM THE STATE OF MONTANA

Senator METCALF. The subcommittee will be in order. This is a continuation of hearings on S. 62, the Coal Research Laboratory and Energy Resource Fellowship Act. Our first witness this morning is an old friend of the committee, a former member of this committee and an outstanding advocate of this act. We welcome you here this morning, Senator Moss. You have a prepared statement, go right ahead.

### STATEMENT OF HON. FRANK E. MOSS, A U.S. SENATOR FROM THE STATE OF UTAH

Senator Moss. Thank you, Mr. Chairman, Senator Hansen. I am pleased to be before this committee as always and I am here because I am most interested in this bill, S. 62, which was introduced by the distinguished minority leader, Mr. Hugh Scott, for himself and nine of our colleagues, of which I am one. The purpose of the bill as you know, is twofold—first, to establish five coal research laboratories supported by Federal funds, and second, to authorize 1,500 energy resource graduate fellowships. The need for such legislation is clear and compelling.

Our coal resources are the world's most abundant. One half of the known coal reserves on Earth lie within our borders. Coal comprises 90 percent of America's domestic fossil fuel supply. However, despite its vast abundance here, coal accounts for only 17 percent of our annual energy consumption.

In sharp contrast to coal, our Nation's oil and gas reserves are small and dwindling. At best we can only expect domestic oil and gas reserves to last about 50 more years. Production of both these fuels has been declining even though domestic demand continues to grow.

The Nation's uranium reserves are too small to carry us beyond the end of the century. Of course, it is possible that commercial development of a breeder reactor will enable us to power nuclear generating plants almost indefinitely. Unfortunately, there are still questions about the wisdom, safety, and practicability of running the country on a plutonium economy. The breeder, while holding great promise, remains an uncertain one.

In our distant future are several possibilities for clean, limitless energy supplies—from the Sun, the wind, nuclear fusion, and others. But our problems are here and now. Energy shortages are a real and present threat to the vitality of our economy as well as to our national security.

And the outlook for the next 10 to 25 years is for the gap between domestic consumption and domestic production to grow—unless we mobilize our coal resources to fulfill our needs.

The problem surrounding increased coal production and utilization, however, are formidable. You have heard it said many times in the past couple of years, that the problem with coal is you can't mine it; if you can mine it, you can't get it to market; and if you can get it to market, you can't burn it. That is a pretty accurate statement and a sorry state of affairs.

These problems are not going to just straighten themselves out. Unless Congress passes the bill before you today, or some similar program, there are simply not going to be enough people with the skills and training necessary to solve them.

I think we can agree that the country would be in a much stronger position relative to our energy needs and the OPEC cartel, if we had a substantial synthetic fuels industry producing oil and gas from coal. Our position would be doubly strengthened if coal could be burned cleanly in coal-fired electric generating plants. Where is the technology going to come from to develop economic and environmentally acceptable synthetic fuels, to refine hazardous impurities from coal prior to burning, to improve mine safety and recovery techniques, unless we are willing to support laboratories and train scientists and engineers whose mission is to solve these problems?

And so I urge the members of the subcommittee to consider this bill favorably. Educational resources are the key to unlocking our coal resources. Our mining and energy educational resources are inadequate to meet the task of developing a secure energy supply from our domestic energy resources. This bill would go a long way to correct that imbalance.

Thank you.

Senator METCALF. Thank you, very much, Senator Moss. Coming as you do from the great committee that has jurisdiction over many of these scientific projects that you are talking about, your testimony has special weight and authority.

Yesterday we heard from administration witnesses, Dr. White and Dr. Falkie. Both of them said they already have all the power and all the authority to do the things we want to do in this legislation. They oppose this bill. Would you comment on that?

Senator Moss. I don't deny that there is considerable power now to set up laboratories and do research work but it all has to come

within the general framework in budgetary structure of the Bureau of Mines and other agencies that might be involved in this.

It seems to me that what this bill does is not only focuses on it with additional authorization of funds which can then be appropriated, but the other underlying thing are the 15,000 fellowships to get people into the field. When I sat on this committee and sat with the two Senators who are here today on the committee, we took a lot of testimony showing how school, particularly graduate training in mines, has been declining. Many mining schools that we know of have just gone out of existence because there has not been the focus on this as a need. Coal mining, above all, we need right now.

I think this gets us back into the focus, we will get some 1,500 bright, young student scientists focusing on the research we need in the field of coal.

Senator METCALF. I have one more question. I am a cosponsor of the bill, as you know. Suppose the committee finds that we cannot do both—establish a coal research laboratory financed by Federal funds and provide for fellowships. Don't you think we would still be justified to have title II of the bill that provides for fellowships?

Senator MOSS. Yes, I would strongly urge that. I recognize that the Bureau of Mines does have some authority to set up additional laboratories if they need them and they have two very fine ones now I understand. They could establish more if they wanted to and if they had the budgetary resources to do it. But the thing we need to do is to get people working in this. We have some good ones but we don't have enough of them and we need more of them.

Senator METCALF. Senator HANSEN.

Senator HANSEN. Thank you, Mr. Chairman and let me express my appreciation to you, Senator MOSS, for your continuing interest in this field that I think is vitally important to the economic well-being of the United States, as well as to its preeminence in world affairs as a Nation that carries the clout to make its voice heard.

I have often said, when people are extolling the virtues of Dr. Kissinger, which isn't perhaps as popular a subject in the last day or two as it may have been earlier, the fact is that he is a great Secretary. He is a very brilliant man and a great historian, a man of enormous physical vitality that, coupled with his other virtues, has enabled him to do many, many things.

But I always have to observe that the reason he carries the clout he does is that he speaks for a strong, great Nation and if it were not that he represented the United States of America, my guess is he would command far less influence worldwide than he does today. So I think you are addressing a vitally important subject.

I come from a State, as do you, that has enormous coal reserves. You and I are equally interested in seeing that we protect the environment and, despite the fact that I am confident that we will devise even better and even more sophisticated technology that will be applicable, in the coming years than we now have at our command, I see no reason at all because of that fact to longer delay getting on with this job.

When we stop to remember that 40 percent of the oil that we consume in this country today, and ours is an energy intensive Nation, comes from foreign countries, we cannot escape the conclusion that we

are very vulnerable. If trouble should break out in the Middle East, and I certainly hope that it will not, it is not improbable at all that we might experience the devastating effects of another embargo.

The one ready built-in quick answer we have to maximize our own energy potential in this country today has to be coal. There are other sources of energy and we want to get on with those jobs, too. You have been a leader in trying to see that we contemplate the full range, everything in the spectrum, as far as energy goes in seeing to our own self-sufficiency. But in the short term, I think coal provides the best of all answers.

So it seems tremendously important to me that we make coal more important to our total energy mix than is the present 17 percent of that energy supply now coming from coal as you spelled out in your testimony. I am groping with ways in which we can have Federal dollars make the most meaningful contribution. One thing that distresses me about the legislation that we are looking at this morning is that under section 101, subsection B2, the institution of higher education shall have experience in coal research, expertise in several areas of coal research and currently active outstanding programs in coal research.

We have had such programs at the University of Wyoming. At the present moment, we do not have but on campus or juxtaposed to the campus is the Bureau of Mines facility at Laramie, an excellent facility.

I should hope that if this bill becomes law and we do keep both sections in, the one providing for Federal help in the establishment or in the strengthening of university coal research laboratories, we could look at that and change that language there in order that the universities in Montana and in Wyoming could make the contribution that I believe they can and must make.

I say that because despite the overall national interest in coal, I think we have a special understanding and a special concern in the West in the public land States wherein coal is found. We three here know precisely how important coal is and we know something of the great concern that people in the States of Utah and Wyoming and Montana have in that. I would not want to have the language in this bill forestall participation by those people in this three State area that have such a vital interest and are committed to making certain that our contribution to the total energy mix fully conforms with the practical problems as we know them in the West.

Thank you for an excellent statement. The chairman and I will be looking forward to working closely with you in trying to make this the best possible bill that we can.

Senator Moss. Thank you, Senator, and I concur with your observations. That language, as far as I know, is in there to try to focus on areas that already are trying to do something on this rather than encourage startups elsewhere simply because some Federal money became available.

In your case, speaking of Wyoming and Senator Metcalf's case, your States both have immense resources of coal, tremendous reserves. I know that your States are making efforts to see that they are developed and utilized in an environmentally acceptable manner which is part of this.

For that reason, I would want that language certainly broad enough so that you could put into it as much State effort as you possibly

could. The only reason in my understanding that that is a little restrictive is that areas that do not have coal might just want to get part of the action because there is some money and we are in too intensive a time and a need driving us so hard that we want to keep money where it will pay off in an early time.

Senator HANSEN. I could observe that we have seven junior colleges in Wyoming on several campuses, I'm not sure exactly how many, are ongoing programs now designed to train and impart particular skills that are important in surface coal mining, in reclamation, in all facets that would be involved as we continue our effort to make this source of energy available to the Nation.

I appreciate what you say about your willingness to see if this language could be modified in a manner so as to insure that the people who are going to be where the action is will be able to participate in a program at home. I subscribe to that wholeheartedly.

Senator MOSS. Thank you very much, the bill is in good hands.

Senator METCALF. Thank you for coming this morning.

Now we have a series of witnesses from the academic community to talk to us about this question of establishment of coal research and regional research laboratories and 1,500 fellowships. I am very pleased that we have some witnesses from Montana.

We are going to set this up in four panels. The first panel are Montana and Wyoming people, Senator Hansen. We welcome you to the committee, President DeMoney of Montana College of Mineral Science, Roy Huffman, vice president for research, Montana State University, John Orth, deputy managing director, Montana Energy and MHD Research. If you will come forward and sit down. Then we are pleased to have in addition to those three Montana representatives, Mr. E. Gerald Meyer, vice president for research, University of Wyoming.

I am very interested and concerned, Senator Hansen, in having our Montana representatives which you have already pointed out come from an area in which there is a tremendous amount of coal. But when I learned that Mr. Meyer was in town, I was also interested in having him here to testify on the northern Great Plains region and I know you will be glad to welcome him.

Senator HANSEN. I recognize you at this time.

Senator HANSEN. Let me join with you, Mr. Chairman, in welcoming this distinguished panel in its appearance before the committee this morning. I know of the distinguished representatives that appear on behalf of the State of Montana by reputation. I have heard many fine things about them. I can say that Dr. Gerald Meyer is, despite his youthful appearance, and that is probably typical of all the members of the panel and some of the members of the committee, that he has a great background. He was dean of the College of Arts and Sciences at the University of Wyoming for several years when he first came on campus before assuming the post of vice president for research. Dr. Meyer is a research chemist. He has a number of degrees of which that is one. I think that we have few people on the staff of the University of Wyoming better able to speak knowledgeably in this particular area than is Dr. Meyer and I would like to welcome you along with our good friends from Montana in coming here this morning.

Senator METCALF. I certainly concur in welcoming you here. I am pleased we have an opportunity to have you here. If I may, I will just call on the witnesses on the panel in the order in which they appear on the witness list.

The first is the president of the Montana College of Mineral Science, Dr. DeMoney.

**STATEMENT OF DR. FRED DeMONEY, PRESIDENT, MONTANA  
COLLEGE OF MINERAL SCIENCE**

Dr. DeMONEY. Thank you, Senator. Good morning, Senator Hansen. I am Fred DeMoney, president of Montana Tech in Butte, Mont. I welcome the opportunity to testify on behalf of S. 62. My testimony will be from the point of view of a college president, president of a relatively small but significant and unique mining and mineral engineering college, Montana Tech, formerly known and perhaps internationally known as the Montana School of Mines.

A year ago, we had the College barely escape eventual extermination. Thanks to the combined efforts of alumni throughout the world, industrial friends, academic colleagues, the citizens of Butte, Mont., the U.S. Bureau of Mines, the help of congressional delegations, Senators Mansfield and Metcalf, we were given a new lease on our academic life.

I think I speak not just for Montana Tech but for all of the specialized schools of mining and mineral engineering when I say that something should be done and must be done to assure and insure the continuation and operation of these fine extremely important institutions.

In my opinion, these institutions should be viewed as national economic defense installations, analogous to our national military defense installations in our nation's fight for protection from overzealous foreign energy and mineral commodity cartels.

Not only should we, these institutions, barely survive but we should become vigorous and healthy once again and attain the relative importance we once had in the eyes of visionary statesmen of yesteryear.

I therefore generally favor legislation that recognizes the problem that faces these institutions and provides a plan to help solve the problem and provides opportunity to implement the plan. S. 62 recognizes the problems of these institutions and proposes to do something about it through an establishment of coal research laboratories and establishment of graduate fellowships. It focuses attention on us and on this serious energy problem. I think this is a step in the right direction, and I thank Senators Moss and Scott and their fellow Senators for introducing this important legislation.

This bill is directed at coal so I will spend a few moments on the subject. As Senator Moss mentioned, coal is a primary energy source. There is no question about that or its future role. Conversion to electrical energy is the most efficient and economically known method today. However, coal is variable in quality and its characteristics and in some instances, its quantity.

The Western States have a vast reservoir of minable coal. According to the U.S. Geological Survey, Montana has over 100 billion tons and Wyoming over 50 billion tons. The need now is to plan for the orderly

development of this coal resource, an efficient and economic method to minimize the social, economic and environmental impact on the area.

In Montana, 20 million tons of coal were produced in 1975 and it is projected to go to 40 million by 1980. Nationwide, projections are for 1 billion tons by 1985. The need is for trained manpower to develop these coal resources and solve the environmental, social and economic problems produced by the dislocating effects of mining.

In short, we need to do more with less and we need a major technological breakthrough to accomplish this.

With respect to the specific manpower needs, the data from the National Planning Association and the coal industry indicates the engineering and scientific manpower needs doubling in 1980 and tripling in 1985, the 1970 dates for both operation and research and development with significant gains for research and development in the first 10 years.

The reports of the coal industry cite the needs for all mining engineers graduated from U.S. schools in 1975. 1975's class totaled 340. Approximately the same will graduate in 1976. Estimated needs of three to five times of the national output of these engineers are not far-fetched.

For example, last June the coal industry hired 70 percent of Tech's graduating mining engineers compared to 25 percent in 1970. Obviously, there is now a large gap between the supply and demand of mining engineers in the coal industry.

I would now like to enumerate the major opportunities presented by the need and in part by S. 62. I see the following as the opportunities to higher education. The education and training of young people for the coal industry and related fields, to engage in research and development in the many varied fields of coal, from exploration to utilization on a sustained basis, at least for 6 years.

The potential for the development of faculty and facilities to handle this increase instructional and research need on a continuing basis. A challenge to contribute to the solution of the social economic problems created by the necessary acceleration of coal mining and all its ramifications.

My detailed comments are in the testimony that has been available but I would like to, in closing, enumerate my concerns with respect to the utilization. From an analysis of the manpower needs of the industry and this technological breakthrough that we mentioned earlier, there are probably too few laboratories indicated for the immense mission facing the nation concerning the orderly development of coal. The funding of these laboratories is a question in my mind since the States will need time to work out budgets, financing, and legislation to accommodate the proposed share of the States.

The effect of the graduate load and industrial competition for faculty staffing needs some help and needs development of faculty to support themselves in the increased numbers forecast by the burgeoning numbers of engineering students and graduate fellows.

Last and perhaps most important. I see that we need to look at the total picture in this area of coal development to include the social, economic, and environmental legal impacts of coal development on society. Too often, we in technology, have been criticized for not being aware of this and I want to make it clear that we are extremely aware

of it and we recognize the need and recommend that there be some way that technologists can be pecunious in this area.

I thank you for your time, Senators.

Senator METCALF. Thank you very much, President DeMoney.

[The prepared statement of Dr. DeMoney follows:]

## **Testimony on S.62**

TESTIMONY ON S.62, A BILL TO ESTABLISH UNIVERSITY COAL  
RESEARCH LABORATORIES AND TO ESTABLISH ENERGY RESOURCE  
FELLOWSHIPS AND FOR OTHER PURPOSES

COMMITTEE ON INTERIOR AND INSULAR AFFAIRS  
UNITED STATES SENATE  
NOVEMBER 5, 1975

BY

DR. FRED W. DEMONEY, PRESIDENT, MONTANA COLLEGE OF  
MINERAL SCIENCE AND TECHNOLOGY, BUTTE, MONTANA



**Montana Tech**

Butte, Montana 59701

TESTIMONY TO BE GIVEN TO COMMITTEE ON INTERIOR AND  
INSULAR AFFAIRS, UNITED STATES SENATE, NOVEMBER 5, 1975

TESTIMONY ON S.62, A BILL TO ESTABLISH UNIVERSITY COAL  
RESEARCH LABORATORIES AND TO ESTABLISH ENERGY RESOURCE  
FELLOWSHIPS AND FOR OTHER PURPOSES

By

Dr. Fred W. DeMoney, President, Montana College of  
Mineral Science and Technology, Butte, Montana

#### General Support of Concept

The legislation proposed as S.62 is admirable, and its goals are greatly to be desired. We are generally in accord with any legislation supporting those institutions currently struggling to educate the mineral engineers and scientists that the United States needs so desperately to overcome the perplexing energy and mineral shortages. These problems are threatening to overwhelm the United States. The coal industry estimates its new technical manpower needs in each of the next five years will be five times greater than the total number of mineral engineers graduated by U.S. colleges and universities (Ref. 1). , To avert social and technological collapse, we must train mineral engineers who can find the minerals we need, get them out of the ground, and process them into usable materials without damaging our environment (Exhibit A). We need technological advancements that can accomplish those goals without spurring runaway inflation and endangering our standard of living.

#### Specific Comments on S.62

Let me offer the following constructive comments on S.62.

Section 101(a): Since the legislation proposes university coal research laboratories in states having considerable coal and energy reserves, the number presently selected (five institutions of higher education) seems too limited. Many states, certainly in the western United States, could rightfully claim the need for such a laboratory.

We commend the concept of interdisciplinary academic research. This point is too often overlooked. Many problems facing the nation require interdisciplinary solutions, rather than a compartmentalized approach.

Section 101(d): Water, water tables, quality of water, etc. are increasingly important considerations in the mining and processing of coal. We suggest that hydrogeology be added to the list of research projects. The laboratory should not be limited to coal characterization per se, but should deal with all matters connected with coal: its extraction from the ground, its characterization, and its preparation for either direct energy conversion (MHD) or as a source of subsequent energy through such processes as liquefaction, gasification, etc.

Section 102(b)(2): We appreciate the generosity of federal grants, but we are concerned about the ability of various states and their universities to support what S.62 calls "the remaining costs of carrying out the program set forth." Indirect costs, overhead, and so forth, may equal 50% of the direct costs, making such a laboratory fiscally impossible under present state appropriation procedures.

Title II, Energy Resource Graduate Fellowships.

Section 201: We certainly subscribe to the principle on which these fellowships are based. The total number, 1,500, might be increased. The supply of trained energy resource engineers is far behind today's demand. The bill, however, stipulates that the fellowships shall be awarded to students in programs leading to masters degrees. This stipulation may give the program an emphasis

that is not desired. If the program is to benefit and encourage the practicing engineer, perhaps some consideration should be given to undergraduate awards or grants.

Section 202(b): Adding the words "and conservation" after "energy resources" will introduce the proper note of concern for the environment and the basic economics of future national survival.

Section 204(a): The stipend of \$4,000 and the allowance of \$500 per dependent are adequate for most public institutions. They may not be adequate for private institutions. Moreover, the amount available for the institution (that is, 100% of the amount paid to the person, less the amount for dependents) should be equal to payments currently available under the mining fellowship provisions of the current HEW policy (Ref. 2). Federal support for similar programs of graduate study should be uniform.

#### S.62 and Montana

The State of Montana has more than 100 billion tons of coal reserves that are minable under current economic and mining technology conditions (see map, Figure 1). This constitutes the largest known minable coal reserves of any state in the continental United States. Accordingly, the Montana University System--and in particular, Montana Tech--feels that it has a proprietary interest in any legislation dealing with coal (see Exhibit B). Of even more immediate concern is legislation dealing with the educational process related to production or use of coal. Montana Tech is one of the few remaining institutions granting undergraduate and graduate degrees in mining engineering and related mineral engineering subjects (Table I). It is one of the two institutions training graduate and undergraduate mineral processing engineers. Montana Tech is already deeply involved with coal resources.



TABLE I  
 ECPD\* ACCREDITED B. S. PROGRAMS IN MINING ENGINEERING AND RELATED PROGRAMS  
 (From ECPD 42nd Annual Report, Year Ending September 30, 1974)

College or University	Accredited B. S. Programs					Totals
	Geo- logical Eng.	Meta- llurgical Eng.	Mineral Proc. Eng.	Mining Eng.	Petro- leum Eng.	
Alaska, University of	X			X		2
Arizona, University of	X			X		3
Colorado School of Mines	X	X		X	X	4
Columbia University		X		X		2
Idaho, University of	X	X		X		3
Michigan Technological University	X	X	X**	X		4
Missouri at Rolla, University of	X	X		X	X	4
Montana College of Mineral Science & Technology	X	X	X	X	X	5
Nevada, Reno, University of		X		X		3
Pennsylvania State University, The				X		1
South Dakota School of Mines & Technology	X	X		X		3
Utah, University of	X	X		X		3
Virginia Polytechnic Institute & State University		X		X		2
West Virginia University				X	X	2
Wisconsin-Madison, University of				X		2
Wisconsin-Platteville, University of		X		X		1
	10	12	2	16	4	44

X Accredited Course

\* Engineers' Council for Professional Development

\*\* Option within Metallurgical Engineering Program

According to a Booz-Allen & Hamilton survey of Montana Tech in 1974 (Ref. 3), Montana Tech graduates a high percentage (16%) of the mineral engineers going into industry from the 16 colleges and universities west of the Mississippi which grant minerals engineering degrees. Montana Tech's engineering graduates are regularly hired before graduation at salaries exceeding the national average for new engineers. The coal industry is hiring about 70% of Montana Tech's mining engineers (Table II). A description of Montana Tech is appended.

The academic faculty and the Montana Bureau of Mines and Geology, a department of the College, have been conducting research on coal for years. Primarily, this research has concentrated on locating and mining coal and on the effect of this activity on ground water. This necessitated characterization of the coal. Research is under way, but much remains to be done.

For a variety of reasons, coal has been neglected as a fuel. Much of the technology related to coal production and use is antiquated. Insufficient financial resources have been directed toward research and development in this important area. From the exploration of coal to its final utilization, much needs to be done to bring coal technology to the same state as the technology in the petroleum and gas industries.

#### Coal-Related Research Under Way at Montana Tech

Montana Energy and MHD Research & Development Institute (\$407,196 funded for three projects by ERDA):

Coal characterization, (\$118,340)

Grinding and preparation of coal, (\$121,628)

Corrosion of materials in the MHD coal-burning process, (\$130,824)

MHD Project Management (\$36,404)

TABLE II  
MONTANA TECH ENGINEER PLACEMENT IN THE COAL INDUSTRY

Year	No. of Coal Cos. Recruiting	No. of Graduating Engineers		No. of Engineers Employed in Coal	
		Mining	All	Mining	All Others
1970	2	7	51	1	0
1971	3	11	54	2	1
1972	3	9	38	3	0
1973	3	17	50	5	0
1974	6	9	51	3	3
1975	8	13	48	9	2

Montana Bureau of Mines and Geology

Coal exploration and definition of coal fields (\$100,000)

Coal resource research program. Defining the quantity and quality of Montana coal (\$100,000). Since 1965, over \$1 million has been spent in these areas of research with state, EPA, Department of Interior, USGS support. Current year project is budgeted for \$100,000. Next year's project of \$200,000 supported by USGS. This study is regionally oriented for the Powder River Basin in the southeast corner of the state. Research on the quality of coal is directed at total characterization of the coal through trace element analysis. In use, trace elements in the coal can affect environment. Coal varies within the field, zone and region. The character of a coal governs its utilization processes and determines the operating parameters (sizing of plants and equipment, process flow charts, etc.) for its use. Consequently, engineers must accurately characterize the coal, not only in BTU content but in water, ash, trace elements, etc. Mistakes along these lines lead to expensive capital costs and could result in economic disaster for electrical utilities operating such plants. Hydrogeology studies are also necessary to determine the effect of coal and its mining on the water quality in the coal fields.

Needs in Coal Research

Exploration. We need to know more about core drilling methods to preserve the natural state of the coal in samples. Better techniques will give us greater accuracy in predicting the value of the coal. Hopefully, we may be able to substitute geophysical techniques for drilling to reduce the expense of the drilling operation. This could lead us to an easier and more accurate determination of the burn line (edge of combustible material deposit or boundary of the existing

coal fields) as well as the thickness of the coal beds and the overburden.

Coal characterization. The chemistry and petrography of the coal must be determined. These two characteristics combine in their effect on the way the coal is used. Coal is not uniform; it consists of many minute particles which may differ substantially. Such differences can influence the future utilization of coal. These characteristics affect not only grinding conditions but also the possible use of the coal in coking and chemical processes as a substitute for petroleum. One steel maker has made a successful blast furnace run using a mixture of eastern coking coal of metallurgical quality and the semi-bituminous western coal. As our projection for coal as a fuel is being planned, so is the production of steel. Steel production requires coking coal. This need cannot be ignored in long-range planning of coal uses. The pronounced differences between the coals in Montana, Wyoming, Utah and the eastern U.S. demand attention.

The overburden must also be analyzed to determine its chemistry and other characteristics so that we can prescribe corrective measures for the rehabilitation of the coal fields once the coal has been removed.

Hydrogeology. This deals with the ground water, the water table of the coal field. Because coal is an aquifer, its presence affects the water quality and quantity in a coal-bearing area. The ground water in Montana coal fields is largely alkaline, rather than acidic. This alkalinity must be taken into account in any consideration of rehabilitation of the ground after mining. It is also necessary to estimate the recharging rate of the water table in these fields after the coal is removed. This recharging rate will be a major factor in planning future agricultural activities in such areas.

Montana and other "coal states" need the sort of consolidated laboratory, concentrating in coal research and matters related to coal, proposed by S.62. When a laboratory of this sort is associated with a mineral engineering college such as Montana Tech, whose tradition has been in the generation of quality engineering students, it can be extremely influential in attracting new students into the mineral engineering curricula. We must attract qualified students into these programs in greatly increased numbers in order to meet the projected manpower needs (Exhibits C and D). In addition, faculty and staff can share in the operation of such a laboratory and in the research it performs. By engaging in such research, they can pass their newly gained technology to the undergraduate students, as well as to those graduate students directly involved in the program. With this added background of knowledge, students can be absorbed more effectively and efficiently into the industrial world, thus shortening the time base required to solve our energy problems.

#### Training of Faculty

Establishing the proposed coal research laboratories will affect the faculty of the associated colleges and universities in three ways:

1. Increased research by faculty will reduce the number of classroom hours they will have available for student instruction.
2. Increased numbers of undergraduate students, attracted by the emphasis on coal engineering, will require a greater number of classroom hours for student instruction, hence greater number of faculty.
3. Increased numbers of graduate students, encouraged by the proposed research fellowships, will necessitate additional graduate faculty.

The combined effect will necessitate the training and hiring of two to four times the number of mineral engineering faculty in the affected institutions. At the same time, tremendous economic forces are at work attracting faculty from the mining and mineral colleges and universities into the industrial work force. Consequently, some means must be found to hold present faculty and attract qualified faculty (or retrain faculty) to meet the demand. Lead times of three to six years are forecast before the undergraduate student "boom" can be academically accommodated. This situation and a plan for solution of faculty retraining has been outlined in Exhibit E.

List of References

1. Roger M. Haynes, "The Effects of Minerals Industry Education of Present Actions and Policies of the Federal Government," AIME Annual Meeting, February 16-20, 1975, New York, New York.
2. Domestic Mining and Mineral and Mineral Fuel Conservation Provisions of Title IX, part D of the Higher Education Act of 1965 as amended.
3. Booz-Allen & Hamilton, Inc., "Master Plan for Future Development, Montana College of Mineral Science and Technology, Butte, Montana," October 16, 1974.

## Appendix

MONTANA COLLEGE OF MINERAL SCIENCE AND TECHNOLOGY  
Butte, MontanaFounding and Government

Montana College of Mineral Science and Technology is one of six institutions which comprise the Montana University System. The other institutions are University of Montana, Missoula; Montana State University, Bozeman; Western Montana College, Dillon; Eastern Montana College, Billings; Northern Montana College, Havre.

This system of higher educational institutions began with an act of Congress approved February 18, 1881, which dedicated seventy-two sections of the public domain for university purposes in Montana. The Enabling Act providing for the organization of the State of Montana and its admission to the Union, February 22, 1889, confirmed this grant to the State and added 100,000 acres for a school of mines, 100,000 acres for normal schools, and 140,000 acres for an agricultural college. Much of the granted land grants has been sold. The proceeds have been invested in permanent funds for the maintenance of the various institutions. The source of income is supplemented by appropriations made by each succeeding Legislative Assembly.

Land for the original site of the College was donated by public spirited citizens interested in fostering a worthy institution in Butte for the training of students in mining, engineering and associated fields. Subsequently, this site was enlarged by further gifts and purchases.

It was in February, 1893, that the foundations of the school were laid by acts of the Third Legislative Assembly of Montana. In 1895 a founding commission, working under this legislation and the acts of Congress already mentioned, took steps to establish the School of Mines. Other interesting and significant dates include 1896 when the erection of Main Hall was begun; September 11, 1900, when the College opened its doors and enrolled the first students; June, 1903, when the first class was graduated; 1965 when the name was changed from Montana School of Mines to Montana College of Mineral Science and Technology.

The city of Butte was a wise and logical selection for the location of the College. It is a focal point of extensive mineral operations. Montana Tech students can gain practical experience along with theoretical training. They can do this through part-time work in mines, mills or smelters, as well as frequent visits to industrial plants to observe and study the handling of engineering problems in actual operations.

Dr. Fred W. DeMoney became the eighth president of Montana College of Mineral Science and Technology in 1972.

Location and Surroundings

Located on the southern bench of Big Butte, from which the city takes its name, Montana Tech is virtually surrounded by some of the greatest copper, zinc and manganese mines in the world. From the city's elevation of 5,767 feet, the ground rises abruptly to the east toward the 8,000-foot summit of East Ridge, snow-capped much of the year. To the south, the 10,000-foot Highlands lift rocky peaks above the forested hills. While in the west, the loftier Anaconda Mountains of the Pintlar Wilderness provide a rugged home for Rocky Mountain Goats. All three of these mountain chains are part of the Continental Divide.

Montana College of Mineral  
Science and Technology

Outdoor recreation is a major part of life in Montana. Hunting, fishing, skiing, camping, hiking and snowmobiling take place within a few miles of the campus. Forests of fir, spruce and lodgepole pine provide opportunities for solitude or group fun in summers that are mild and winters that are cold.

In the Butte area, 40,000 people earn their living in a variety of occupations, but the central theme is mining. Since the first mines were opened in the Montana gold rush of the last century, 42 miles of vertical shafts have been sunk into the Butte hill. More than 2,700 miles of other passageways honeycomb this "richest hill on earth." In 1975, underground mining was halted in Butte so that engineers might make test drillings throughout the area to determine the location of the most profitable ores and devise the most economical means of extracting them.

Meanwhile, open-pit mining continues in the largest all-truck haulage mine in the world. The Berkeley Pit, started in 1955, produces about 75,000 tons of copper annually. A large concentrator plant processes the ore before it is shipped to the nearby town of Anaconda. There, the copper is extracted by pyrometallurgical smelting and a new hydrometallurgical process.

These mines and plants provide much valuable training for Montana Tech's engineering students. No other minerals engineering college can offer such facilities for studying and observing mining, mineral processing and metallurgical operations.

Indeed, this firsthand experience and observation may very well be a major factor in the high value which industry places on Montana Tech graduates. Months before actual graduation, engineering students receive an average of more than three job offers at average salaries which surpass the national average for engineering graduates.

List of Exhibits

- A. Senator Mike Mansfield, Montana Tech Commencement Address at Butte, Montana, June 2, 1974.
- B. Governor Thomas L. Judge, Remarks to the Rocky Mountain Energy Minerals Conference in Billings, October 15, 1975.
- C. William H. Dresher, "The Importance of Mines Colleges in Educating for America's Future," Mining Congress Journal, August 1975, p. 50-55.
- D. Western Governors' Mining Advisory Council "Mining Education in the West," September 10, 1975.
- E. Ta M. Li, "Mining Education in Turmoil," Mining Engineering, March 1975, p. 32-35.

## Exhibit A

## CONGRESSIONAL RECORD—SENATE

June 5, 1974

## COMMENCEMENT ADDRESS OF SENATOR MANSFIELD AT MONTANA COLLEGE OF MINERAL SCIENCE AND TECHNOLOGY: A GREAT SCHOOL

Mr. MANSFIELD. Mr. President, on Sunday last, the distinguished Republican leader had the privilege and the opportunity to give the commencement address at Randolph Macon College, a school which he attended as an undergraduate and from which he graduated before going on to the University of Virginia and other schools.

Coincidentally, on that same day, I had the opportunity and the privilege to give the commencement address at Montana College of Mineral Science and Technology in Butte, Mont., a school which I attended and for which I have a great affection, because it gave me a start in life, which all people need at certain times.

It was a day of memories; it was a day of sadness, and a day of joy, a day of remembrance and even, perhaps, a day of forgetting.

The Montana College of Mineral Science and Technology which, until 1965, was known as the Montana School of Mines, is one of the six institutions comprising the Montana university system.

It was founded, legislation was passed, in 1893, 5 years after Montana became a State. The actual construction of the first building was begun in 1896, and the college opened its doors on September 11, 1900, and graduated its first class in June 1903.

The State bureau of mines and geology, was added to the college as a research department in 1919.

In the past decade, the college has expanded its traditional offerings in various phases of mineral engineering to include degree programs in environmental engineering, mathematics, chemistry, history, and English.

Since its founding, the Montana School of Mines, now known as the Montana College of Mineral Science and Technology, has had a worldwide reputation for the excellence of its curriculum, especially in the fields of mining, metallurgy, mineralogy, geology, petroleum engineering, and the like.

It has expanded from a school of about 130 students, when I attended it, to around 800 today. It is the best mining school in the world, without exception.

It has a reputation which can only be compared with that of Frieberg in Germany, and that was prior to the Second World War.

Its graduates are in demand, and they cover the Nation and the world. It students come from all over the globe.

It is an especially outstanding institution, in my opinion, and has meant much to the Butte-Anaconda, western Montana area, and has meant a great deal to the State and the Nation.

I wish it well. I hope it continues to grow and expand.

I want to emphasize that basically it is a mining school, and I hope that its emphasis will remain in that particular area.

Mr. President, I ask unanimous consent that the program for that day and the commencement address which I made be incorporated in the RECORD.

There being no objection, the program and the commencement address were ordered to be printed in the RECORD, as follows:

## SEVENTY-FOURTH COMMENCEMENT—MONTANA COLLEGE OF MINERAL SCIENCE AND TECHNOLOGY, BUTTE, MONT.

(Fox Theatre, June 2, 1974, 3:30 p.m.)

## PROGRAM OF COMMENCEMENT EXERCISES

Processional—Montana Tech String Ensemble, Rick Hartwig, Director.

(The audience is requested to stand for the Processional and remain standing through the Invocation and the playing of the national anthem.)

Invocation—Reverend Edward W. Newman, Immaculate Conception Church.

"Star Spangled Banner"—String Ensemble.

Introduction of Guests—President Fred W. DeMoney.

"Commentary: 1974"—Senator Michael J. Mansfield.

Conferring of Degrees—President Fred W. DeMoney.

Conferring of Degree of Doctor of Letters, Honoris Causa, on Walter Todd Scott, Professor Emeritus—Presentation of Professor Scott by Dean Kenneth McLeod.

Conferring of Degree of Doctor of Engineering, Honoris Causa, on Senator Michael J. Mansfield—Presentation of Senator Mansfield by Vice-President Donald McGlashen.

Presentation of Honor Award for High Scholarship—President Fred W. DeMoney.

Benediction—Reverend Oliver L. Jones, Gold Hill Lutheran Church.

(The audience is requested to remain standing for the Recessional)

Recessional—String Ensemble.

A reception for the graduates, their parents, and their friends will be held in the Student Union building following the Commencement Exercises.

## CANDIDATES FOR DEGREES

*Degrees in course*

## Associate of Arts

James Coryel Axelson, Butte, Montana.  
 Maskin Milovan Bigovich, Butte, Montana.  
 Michael David Boston, Butte, Montana.  
 Nicholette Ellyn Breyer, Butte, Montana.  
 John Robert Burke, Butte, Montana.  
 Rose Mary Carollo, Butte, Montana.  
 Richard Douglas Daniels, Butte, Montana.  
 Jumana A. ElSharif, Lebanon.  
 Colleen Marie Fischer, Butte, Montana.  
 Barbara Joann Hayes, Butte, Montana.  
 Thomas Kenneth Hohn, Townsend, Montana.

Carol Anne Miller, Butte, Montana.  
 Otis Nelson Mohn, Whitesburg, Kentucky.  
 Charles Henry O'Donnell, Anaconda, Montana.

Billie Jean Peterson, Gregson, Montana.  
 Dale David Rawlings, Butte, Montana.  
 Sheila Kay Rivers, Anaconda, Montana.  
 Karen Anne Seymour, Ramsay, Montana.  
 Joseph Frederick Sommers, Anaconda, Montana.

Robert James Turk, Butte, Montana.  
 Joseph Frederick Sommers, Anaconda, Associate of Science

Kimberly Adele Bawden, Butte, Montana.  
 Kathleen Ann Dillon, Butte, Montana.  
 Abdul Fattah A. ElSharif, Lebanon.  
 Shirree L. Kaighn, Butte, Montana.  
 Keith B. Jensen, Wolf Point, Montana.  
 Stanley W. D. Lawrence, Missoula, Montana.

Julie Bossard LeFever, Butte, Montana.  
 Colleen Marie McGee, Butte, Montana.  
 Rebecca Jane McGee, Butte, Montana.  
 Cindy Lou Osmanson, Butte, Montana.  
 Linda Marie Storm, Butte, Montana.  
 Roginald Lee Therault, Butte, Montana.  
 James Richard Vennes, Malta, Montana.  
 John Larry Vulcich, Anaconda, Montana.

## Associate of Science/Engineering

Andrew Morgan Chadwick, Lewistown, Montana.

Loren, George Hoekema, Laurel, Montana.  
 James Lawrence Nelson, Drummond, Montana.

Brian Charles Sayre, Great Falls, Montana.  
 Robert Joseph Smollock, Anaconda, Montana.

Momo J. Vezele, Flsebu, Liberia.

## Bachelor of Science in Chemistry

Rhonda Elaine Farrow Jacobson (with high honor), Butte, Montana.

## Bachelor of Science in Engineering Science

Robert Dean Bentley, Butte, Montana.  
 Joel Bruce Knutson, Butte, Montana.  
 Larry Alvin Olson, Butte, Montana.  
 Donald James Shea, Butte, Montana.  
 James Bennett Smitham, Jr., Butte, Montana.

Robert Joseph Smollock, Anaconda, Montana.

## Bachelor of Arts in English

John R. Beatty, Anaconda, Montana.  
 Rose Mary Carollo (with high honor), Butte, Montana.

Sylvia Frances Carollo, Butte, Montana.  
 Charlene A. Davis (with high honor), Butte, Montana.

Clara Parko Haft (with high honor), Butte, Montana.

Lillian Elizabeth McCauley (with high honor), Butte, Montana.

Grace M. Orgain (with honor), Butte, Montana.

Phyllis Adell Stout (with high honor), Butte, Montana.

William John Suydam, Butte, Montana.

Bachelor of Science in Environmental Engineering

Mark Alan Bossard, Anaconda, Montana.  
 Phillip Maurice DeDycker, Butte, Montana.  
 Harry Nick Obstar, Great Falls, Montana.  
 Darrell Robert Scharf (with high honor), Butte, Montana.

Ray Wallace Springer, Sunburst, Montana.

Bachelor of Science in Geological Engineering  
 Thomas Allen Behling (with honor), Darby, Montana.

Steve John Czehura, Butte, Montana.  
 Melvin LeRoy Granberg, Butte, Montana.  
 Wendell Eyre Johnson, Anaconda, Montana.  
 Brian Joseph Lundy, Edmonton, Alta., Canada.

Robert John Federson, Billings, Montana.

Bachelor of Science in Geophysical Engineering

John Byron Aultmann, Jr. (with high honor), Butte, Montana.  
 Carole Cecelia Collier Speake (with honor), Butte, Montana.  
 Richard Conrad West (with high honor), Charlotte, North Carolina.

## Bachelor of Arts in History

Elissa Kay Clark, Butte, Montana.  
 John Patrick Foley, Butte, Montana.  
 Keith B. Jensen, Wolf Point, Montana.  
 Stanley George Mayra (with honor), Butte, Montana.

Charles Wayne McDaniel, Butte, Montana.  
 Wayne Michael O'Brien, Butte, Montana.  
 James Robert Person, South Gate, California.

Agnes Mary Seymour (with high honor) Butte, Montana.

Doreen B. Williams, Walkerville, Montana.

Bachelor of Science in Mathematics  
 Gleen Dale Laitinen, Butte, Montana.  
 Bruce Carlyle Rowe, Butte, Montana.  
 Wendy Lee Swanson (with high honor), Butte, Montana.

John Larry Vulcich (with honor), Anaconda, Montana.

Thomas J. Walsh, Butte, Montana.

Bachelor of Science in Metallurgical Engineering  
 Joseph Frederick Sommers, Anaconda, Montana.  
 Mehrdad Nonahal Tehrani, Tehran, Iran.  
 Bachelor of Science in Mineral Dressing Engineering  
 Steven Wallis Banning, Butte, Montana.  
 Kurt Alan Forgaard (with high honor), Salmo, B.C., Canada.  
 Jon Nicholas Hoyrup, Dillon, Montana.  
 Donald Edward McCarthy, Butte, Montana.  
 Robert Dale Osmandson, Butte, Montana.  
 Joseph Frederick Sommers, Anaconda, Montana.  
 Bachelor of Science in Mining Engineering  
 Thomas Allen Behling (with honor), Darby, Montana.  
 William Robert Hansen, Glasgow, Montana.  
 Dean J. Honey, Butte, Montana.  
 John Edward Howard, Phillipsburg, Montana.  
 Curtis Allan Johnson, Glendive, Montana.  
 Scott William Lorber (with honor), Butte, Montana.  
 Donald Ernest Moe, Missoula, Montana.  
 Charles Justice Speake, Jr., Victor, Montana.  
 Jerry Lee Stacey, Butte, Montana.  
 Bachelor of Science in Petroleum Engineering  
 Gary Ernest Aho (with honor), Butte, Montana.  
 Kenneth Bernard Allen, Cochrane, Alta., Canada.  
 W. Joris Brinkerhoff, Denver, Colorado.  
 Roy L. Brown, Billings, Montana.  
 Lawrence Edward Brumit, III, Butte, Montana.  
 Albert John Ciarella, Anaconda, Montana.  
 Ali T. Dabbagh, Mecca, Saudi Arabia.  
 Stephen Alfred Davies, Butte, Montana.  
 Thomas Kenneth Hohn, Townsend, Montana.  
 David John Loran, Butte, Montana.  
 Craig Nicholas Madeen (with high honor), Butte, Montana.  
 David Margolin, Browne Station, New Jersey.  
 Otis Nelson Mohn, Whitesburg, Kentucky.  
 Eric Howard Olsen, Butte, Montana.  
 Richard Lee Paynter, Butte, Montana.  
 Ralph Dale Tronstad (with high honor), Fort Shaw, Montana.  
 Master of Science in Engineering Science  
 Gary Wayne Mannix, Butte, Montana.  
 Master of Science in Geophysical Engineering  
 Ming-Ju Jan, Taiwan, Republic of China  
 Master of Science in Metallurgical Engineering  
 John Robert Knoepke, Butte, Montana.  
 Master of Science in Mineral Dressing Engineering  
 Kent, Joseph McGrew, Sacramento, California.

Reginald Ohab, Guyana, South America.  
 David Harry Rust, Whitehall, Montana.

*Professional degrees*

Engineering Science Engineer (honoris causa)  
 Terrence Kirkland, Alexandria, Virginia.  
 Geological Engineer (honoris causa)  
 Andrew Corp, Alexandria, Virginia.  
 Mineral Dressing Engineer (honoris causa)  
 Frank Antonloli, Butte, Montana.  
 Truxton Fisher, Butte, Montana.  
 Mining Engineer (honoris causa)  
 Petrus J. Du Toit, Tucson, Arizona.  
 Rayworth F. Howe, Butte, Montana.

*Honorary degrees*

Doctor of Engineering (honoris causa)  
 Michael Joseph Mansfield, Washington, D.C.

Doctor of Letters (honoris causa)

Walter Todd Scott, Butte, Montana.  
 The Montana College of Mineral Science and Technology (until 1965 the Montana School of Mines) is one of six institutions comprising the Montana University System. Although the necessary legislation was passed in 1893, the actual construction of the first building was not begun until 1896. The college opened its doors on September 11, 1900, and graduated its first class in June 1903.

The Bureau of Mines and Geology was added to the college as a research department in 1919.

In the past decade, the college has expanded its traditional offerings in various phases of mineral engineering to include degree programs in environmental engineering mathematics, chemistry, English, and history.

Since its founding, the college has gained a world-wide reputation for its excellent graduates, who have contributed significantly to the mineral industries. Moreover, the college has offered broad educational opportunities to the people of Butte and surrounding areas.

COMMENTARY—1974

(Remarks of Senator MIKE MANSFIELD (D., Montana))

Commencement, in medieval times, meant a beginning. Today is a day of joy and relief to this class, sadness to your parents, and, to some of us, remembrances. To be with you, today, brings a flood of memories. My life and work have been closely aligned with this Institution and this part of the State. The Butte-Anaconda region has given me enormous support and encouragement over the years. I can never repay the people of this area nor the people of Montana for their trust and faith down through the decades.

Butte is the place where I worked in the mines for nine years as a mucker, a miner

and an assistant mining engineer. Butte is the place where I met the girl, a teacher at Butte High School, who became my wife, my sustenance and my support down through the years. Without her and this institution I would not be standing before you today; without her and this institution I would not be what I am today. You can understand, I'm sure, why my first two loves were my wife and this school.

Butte is the place of the old School of Mines, where at the insistence of my wife-to-be, I applied for admission. At that point, I was already approaching twenty-five and I had not gone to high school. In fact, I had not even completed eight grades. The then President of the School of Mines, Dr. George Craven, was understanding but dubious. He told me that the only way I could be admitted was as a special student. To become a regular student, he said, I would have to make up my high school entrance credits. I completed the school year, 1927-28, while working in the mines at night. At the end of that year, I had passed the required subjects, most of them just barely. The teachers were generous and took a personal interest in what to them must have been something of an educational oddity. With me, they had to conduct, not a "Head start," but a kind of "Late start" program.

Among the professors who taught me, guided me, and counseled me, was a man from Harvard by the name of Walter T. Scott, Professor of English. I cannot begin to express how honored I am to be on the same platform with Professor Scott.

He meant much to me as a student and friend as he has meant much to this school through the years. He has done a great deal for education in this State and community and he is receiving, today, the kind of recognition he richly deserves and which is long overdue.

Also, on the platform today, is another long-time friend from Butte, a man with whom I served on the faculty as the University of Montana, Ambassador Andrew Corry, who is also being honored by his old school.

I am also honored by being on the platform with Terrence Kirkland, who is receiving the Professional Degree of Engineering Science Engineer, Frank Antonoli and Truxton Fisher, who are receiving the Professional Degree of Mineral Dressing Engineer, and Petrus J. Du Toit and Rayworth F. Howe (posthumously), who are receiving the Professional Degree of Mining Engineer.

When I enrolled in Montana Tech, the entire student body was only about 130. In the same year, girls were admitted for the first time. The girls in that first class numbered somewhere between twenty-five and thirty. They came almost entirely from Butte High School, Girls Central and Anaconda High and were looked upon as either a distraction or an inspiration. In either case, this school, along with the State, was

in the vanguard in according full legal recognition to women as equal persons.

In the 1920's and 30's, the Departments of Mining, Metallurgy, Mineralogy, Petroleum Engineering and Geology were the basic components in which degrees were awarded at the School of Mines. It was considered the outstanding educational center of its kind in the world. Only Freiberg, in Germany, was considered comparable. Today, Montana Tech continues to enjoy that reputation and it is eminently deserved. The standards have been maintained even as the scope of the educational program here has been extended to take in a Liberal Arts calendar. A studies program in Liberal Arts and other changes have had the effect of increasing the size of the student body many times over. So far as I can see, however, there has not been any diluting of the quality of the educational experience. On the contrary, it has been enriched greatly since the days when I was a student. May I suggest to the Regents on this platform that they keep this in mind as the school goes on to greater heights.

I would anticipate an even larger enrollment and a greater scope of intellectual pursuits at Montana Tech in the years ahead. That can be all to the good I would only hope that in the process of growing this school will never lose what to me, as a somewhat bewildered and uncertain student, meant so much at an earlier time. That was the sense of personal concern which was communicated by the members of the faculty and administration. You mattered to them and they mattered to you.

I would hope, too, that this school will keep, as it has always had, a unique core of excellence associated with the mineral sciences because Montana is deeply involved in that aspect of the nation's well being. Montanans have exploited hard rock minerals and others have come here to exploit them throughout the history of the State. I choose the word "exploit" advisedly. The history of mining in this State is not one of unalloyed contribution to the welfare of the people of Montana. Its advantages have been interlaced with a great deal of human misery and suffering, callousness and corruption.

It is important to remember that, it seems to me, especially at this time when there is underway a dramatic shift of national attention to the vast deposits of low sulfur coal

in the Great Plains. Many people would like us to believe that this close-to-the-surface coal is the easy answer to the nation's energy problems. I do not go along with glib thinking of that kind. There are questions—many questions—to be asked and answered. Who, for example, profits by the exploitation of that coal? Do the people of this State gain if an energy shortage is exchanged for a shortage of clean air and clean water? In the long run, do the people of the nation gain thereby? Yet, that may be in store un-

less we move cautiously in exploiting these coal reserves.

Eastern Montana with its vast plains, rolling hills, and badlands, has a tradition of agriculture and livestock production. People who live there are wary of the massive disruption which is associated with crash surface mining. They have valid reason to be concerned and I share their concern. As yet, there is insufficient indication that the huge coal companies and out-of-state utilities have any deep interest in confronting the problems that their presence creates for local areas.

To be sure, there are gains to be derived from the exploitation of the coal reserves. The income and public revenues associated with mineral developments of great magnitude are very tempting. So, too, are the high prices offered for leases.

But, the other concerns I have noted are not to be ignored. They are of great significance to the people of the State and, in particular, to the generation of young people represented in this graduating class and those who will come after them.

Living Americans do not hold the land, the rivers, the sky, the air and the hills of Montana as an absolute right. The nation's natural treasures are ours to use, not to abuse. They are a trust to be maintained for future generations. In the assertion of our own rights, we cannot ignore the rights of those who will come after us.

So, insofar as I am concerned, the question of coal-stripping will be approached carefully—very carefully—and cautiously—very cautiously. In concert with the other members of the Montana Congressional delegation, it is my intention to use every avenue of the Federal government which is open to us to see that such is the case.

The development of the coal resources does not have to be ruled out if it can be done safely. In this connection, Montana Tech and other units of the Montana University System can be especially useful. They can devise, continuously, new and better ways in which coal can be extracted and utilized effectively without devastating the land and polluting the waterways. That is the only way these resources can be developed if they are to benefit Montana and the nation not only today but in all the days of the future. There is no need, in my judgment, to turn the State into a scarred and twisted wasteland in a frantic search for cheap fuel for the nation. Nor will it be.

The oil crisis last winter hich precipitated his search was a kind of hand-writing on the wall. Repeated and well-founded scientific and other expert warnings of an impending shortage were ignored for many years. Oil yields declined at home even as the nation became more and more dependent on petroleum. Alternatives were ignored. Research was neglected. Wasteful consumption continued. Then came the Arab boycott.

The great metropolitan areas of the nation were thrown into near panic when the king pin of the nation's economic and social structure was jarred. Almost overnight the Federal government went from do little to do everything. In a sudden determination to assure self-sufficiency, a massive financial and technical assault was launched in the field of energy. Dozens of agencies and offices plunged into the search. No matter that the problem was a long time in brewing and would be a long time in passing. No matter that crash Federal programs in other moments of crises have invariably proved wasteful and often misdirected. The only answer of which we were capable at that point was to pull out all the stops. It was not a very reasoned approach but it was about the only way, as a government, we were able to react at all.

That is why, it seems to me, it is high time to look beyond the immediate question of energy. We need to consider closely the way in which our entire national economic life has come to be organized and the role which government plays therein. We need to think deeply about the economic structure of the nation not just as it is today but as it is likely to be five or ten years hence.

Not only in energy but in many other facets of our economy there have also occurred haphazard and wasteful usages, unwise development and random and uncoordinated government intervention. That there is a sudden fixation of federal attention on oil, natural gas, and other fuels is understandable. But what about nickel, tin, iron, copper and bauxite? Where will we get the supplies of these and other essential resources in the years ahead? What about food? Indeed, what of the exhaustibility of clean air and pure water?

Four years ago, the Interior Department said we depended preponderantly on foreign countries to supply us with thirteen basic minerals. Today, there are at least forty minerals on the same list. They include, bauxite-aluminum, tin, lead, nickel and chromium. What happens if the countries from which we get those basic minerals should decide to cut us off? I think we can withstand a cartel such as the one which recently threatened to raise the export price of bananas from Central America—but what of other commodities? We have already seen, for example, how foreign sources can affect our economy deeply by withholding petroleum in which we ourselves have great resources. What of basic commodities in which we have little or none?

What, for example, of bauxite? Over 80 percent of the bauxite used in the production of aluminum is imported. Aluminum pervades our society. Gas-saving engines are built from it. The building trades are voracious consumers. Food packaging is dependent on it. A myriad of other industries are affected by its availability. With time, per-

haps, we could step-up domestic bauxite production in the form of aluminum clays to be found in Georgia, Idaho and Montana. But aluminum refining requires massive amounts of electricity, and we already have a shortage of power.

Chromium is another essential element which goes into a great many products. We are 100 percent dependent on imports of chromium even though we have low grade chrome in the Absarokees in southern Montana. Most of the imports presently come from the Soviet Union. Yet, there are still delays in putting trade with that nation, as well as with the Peoples Republic of China, on an equal footing with other nations. The administration has requested legislation to that end and I am frank to acknowledge that it is in the Congress where the question has become snarled in extraneous issues. Sooner or later, however, we must face up to the need to enlarge to the fullest possible extent foreign supply sources for many commodities.

The problems of a complex economy such as we have in this nation go well beyond metals and minerals. In 1973, the nation experienced the biggest boost in the cost of groceries in over twenty-five years. Any relationship between ultimate retail prices and the prices paid to the farmer is minimal at best. The price of beef on the hoof, for example, has dropped very sharply in recent months as this State knows only too well, but a similar drop in retail prices is scarcely discernible. Prices of cotton, wool and synthetic fibers have risen 93 percent. The inflation was 10½ percent from March of 1973 to March of 1974; 14½ percent for the first three months of this year. If we are going to have a chance to minimize difficulties such as these, it is going to be necessary to re-examine and readjust the government apparatus which exists in one way or another for dealing with them.

At last report, more than fifty Federal agencies and administrations were collecting and compiling data on the subject of materials-supply. The total continues to increase with the growing interest in environmental safeguards, product safety and similar questions. A great deal of information is available so that is not the critical point. Nor is it that government intervention and controls are inadequate; in some respects, they are excessive.

The root of the difficulty, as I see it, is how to employ more effectively the intellectual, technical, scientific and other resources which we have available in this nation for confronting the needs of the economy. It is, largely, how to convert what is already known into what can be done but is not being done. In the end, it is a matter of using our heads, of coordinating and applying pertinent knowledge in a rational manner.

This approach need not mean more government intervention in the private economy. The fact is that the government is

already intervening up to its ears and has been doing so for decades. That is not going to change. The question is whether the intervention is going to be coordinated for nationally acceptable ends or pursued in a way that is so disjointed and infurlating as to tax the confidence of the people in the fundamental political and governmental institutions of the nation.

What is needed, in short, and what is lacking in the role of the Federal government, to date, has been a kind of central alarm system, an early-warning system, with regard to trends in the nation's economy. May I add that an effort is now being made to design that kind of instrument. When I was asked by my Senate colleagues and the networks, last February, to speak to the nation for the Congressional majority as a supplement to the President's State of the Union message, I put the problem in these words:

"The need is to take a careful look not only at the flashing of the single danger signal (of the energy shortage) but at the whole integrated switchboard of our national existence. It is not enough, for example, for the Federal government to spend tens of millions of dollars in a rescue operation to keep the bankrupt Penn Central Railroad on the tracks. We need to know where an action of that kind fits into a national rail policy; where that policy, in turn, fits into a total transportation pattern; where that pattern, in turn, fits into the over-all requirements of the nation, today, and for the next decade or more."

In short, we need to think ahead in order to make hard political choices between what is more important to the nation and what is less, between what is enduring and what is transitory. That is the full scale by which government intervention in the nation's economy, when it must take place, should be measured. Unless we begin to use that scale, the right hand of government will tend more and more to undo or do over what the left hand has just done.

Shortly after my statement was made last February, Senator Hugh Scott, the Republican Leader, joined me in recognizing this need and, together, we sought the cooperation of the Leadership of the House of Representatives and the President. It was forthcoming. For several weeks, thereafter, the Leaders of both parties in both Houses of Congress gathered in my office, together with the Secretary of the Treasury and several other key economic officials of the Administration in a series of unprecedented meetings to consider this question.

A short time ago, this all-government group was able to reach unanimous accord on how to pursue this matter. As we see it, there is a need for tripartite cooperation on the part of the Congress, the Executive Branch and Americans drawn from outside of government to work together in a national commission which will—

First, act as the central focal and refining point for the ever-accumulating mountain of information which is available on the structure and operation of the nation's economy;

Second, to sort out this vast array of information with the aid of such wisdom and skills that the nation can muster from all relevant sources in order to perceive and forecast with reasonable accuracy what the fundamental economic needs and problems of the nation are likely to be a few years hence;

And, finally, on that basis, to make recommendations to the Congress and the President which can be translated into co-ordinated and effective government action in meeting those needs and problems. In that fashion, perhaps, crises like that of petroleum, which would otherwise burst in on us one after another, can be mitigated or prevented.

There is now under consideration in the Congress, legislation which has the unanimous support of the two party leadership in both Houses of Congress and of the Executive Branch. If passed, it will permit the taking of the next steps in fashioning a new coordinated approach to the nation's gathering economic needs and problems.

It may seem strange to you that the Executive Branch and the Legislative Branch and the two parties can cooperate at the present time in this fashion. How can there be cooperation there when there is a virtual confrontation on the question of Watergate and related matters? Is not the Congress at this very moment considering the impeachment of the President? Have there not been calls from individual members of Congress of both parties for the resignation of the President? The answer is, yes, it is a time of virtual confrontation over the Watergate affair. Yes, the Congress or, at this point, the House of Representatives, is considering impeachment. Yes, individual members of both parties have called for resignation.

But confrontation in the one instance cannot be allowed to preclude cooperation in others when cooperation is essential to the nation. Nor has it done so. The fact is that there has been cooperation with the Executive Branch not only in regard to the economic question which I have just discussed but also in other matters. Just recently, for example, I returned from discussions with the new President of France, discussions which were pursued with the full knowledge and concurrence of the President. Repeatedly, the Secretary of State, speaking and acting as he does, on behalf of the President of the United States, has had expressions and actions of support from the Senate and the House of Representatives. Not too long ago, I was with the Secretary in Mexico City at a meeting of American Foreign Ministers for precisely that reason.

So I would like to emphasize that the impeachment proceeding which is a Constitu-

tional obligation of the most solemn kind, has not and will not impair the functioning of the Congress in its regular legislative business. Least of all will it stand in the way of cooperation with the Executive Branch in the field of foreign policy. The President knows that there is a large area of agreement in foreign relations between the two Branches and the two parties. So, too, does the Congress. And so, too, may I add do foreign governments.

To be sure, the time is not a happy one either for the President or for the Congress. But the contentment of the elected and appointed incumbents is not what the Constitution is all about. What matters is not the convenience of the men and women in government—those of us who are here today and gone tomorrow—what matters is the validity and durability of the federal institutions and their continued capacity to meet the needs of the people of the nation.

It is obvious that the confidence of the people in these institutions has been badly shaken by the events and revelations of the past year and a half. We can't escape the reality, however, that Watergate and related matters was not a bad dream. It did happen. It cannot and will not be ignored. It cannot be swept out of sight. There are no short-cuts out of the situation. For Congress to drop the matter, even if it were possible, would provide no answer. For the President to resign, even if he were so inclined, would not provide an answer. A satisfactory answer, in my judgment, can be found only in the Constitution and in the processes provided therein. These are the processes which are now being pursued in a most responsible fashion in the Courts and in the Congress. They will continue to be pursued until the matter is resolved.

It is a trying time for this nation and especially for the young among us. It is not easy to face up to shortcomings in institutions which we have come to regard with a respect bordering on reverence. It is a time for patience and restraint. It is a time for understanding of your government, of the Congress and the Presidency. With that understanding, we can and will carry on during this period of difficulty. Above all, it is a time to remember that "the price of liberty is eternal vigilance."

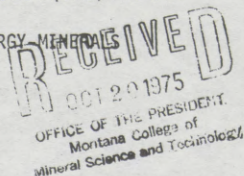
Our political processes, in the end, will be purified and strengthened by this ordeal. Watergate will pass and we will endure because there is a great deal that is right in this nation. There is a strong, decent, industrious and compassionate people. There is a bountiful land. There is intelligence, inventiveness and vitality. There must be forthcoming the leadership to put these attributes to use for the benefit of all. That is the responsibility of those who serve in government, in the Presidency, in the Congress and in the military and civilian services. This nation deserves more than a decent present. This nation deserves and it will have a decent future in freedom. And this, you may be certain, is what this nation will achieve.



## Exhibit B

Governor THOMAS L. JUDGE · STATE CAPITOL · HELENA, MONTANA 59501 · (406) 449-3111

REMARKS BY GOVERNOR THOMAS L. JUDGE TO THE ROCKY MOUNTAIN ENERGY-MINERALS  
CONFERENCE IN BILLINGS ON OCTOBER 15, 1975 at 10:30 A.M.

INTRODUCTION

I am pleased to participate in this Rocky Mountain Energy-Minerals Conference, and I wish to commend my friend, Ed Zaidlicz of the Bureau of Land Management, for the outstanding program he has arranged.

Six years ago, development of Montana's coal resources was a mildly interesting topic of discussion and concern. Three years ago, when I campaigned for Governor, it was becoming obvious that we needed to move rapidly from discussion to action. Since that time Montana has become a major focal point as one of the solutions to a nation groping for a way out of an increasingly complex energy crisis.

As the intensity of interest has grown, so have the responsibilities and problems.

But the problems and their solutions go far beyond the borders of Montana--they involve our neighboring states, the federal agencies, the Congress, the Canadian government and the Middle East Countries.

Perhaps the most overwhelming element of the energy crisis is energy demand. The Congressional Joint Committee on Atomic Energy warned in 1973 that if the growth of energy consumption continued at its present rate and even if Alaskan oil is developed, if our nation's oil shale reserves are tapped, if our coal resources are stripped from the earth, if domestic natural gas exploration is promoted, if geothermal plants are developed, if hydro-electric power sources are expanded, and if our nuclear power plants

are built as fast as technology allows; if all of these plans became reality by 1985 we<sup>would</sup> still have only two-thirds the energy supply that this nation will require.

In the face of this demand the vast storehouse of energy located within Montana's border takes on an obvious significance. Montana leads the nation with the most known coal reserves according to the U.S. Geological Survey. The survey showed that Montana has 107.7 billion tons of coal considered minable, considerably more than the second coal rich state, Illinois, with 65 billion tons and<sup>than</sup> Wyoming with 51 billion tons, which is third.

What makes Montana coal attractive is that it is close to the surface, is in relatively thick seams, has a low sulphur content, and is cheap. Accordingly, we have witnessed coal production increase from 1 million tons in 1969 to 11 million in 1973. By 1974 the figure was 14 million, and in 1975 we anticipate that over 20 million tons will be mined.

By 1980 Montana's coal production should easily exceed 40 million tons per year.

Coal fired power plant capacity in Montana has gone from zero several years ago to 1100 megawatts; applications now pending would double that figure.

With activity of this magnitude, it is obvious that energy development is now affecting the economy of our state, jobs, our tax bases, school system, environment and life style, and it will probably be the most dominating force shaping our State in the foreseeable future.

It is important to point out that as this occurs, we clearly recognize that Montana is a part of the federal system and that we have a responsibility

to share our resources with others in this country, as we have in other times of national crisis.

We also recognize that coal development can bring some benefits to our state.

Between 1950 and 1970 Montana experienced outmigration, unemployment higher than the national rate, and, less than average per capita income. Since 1970 the picture has improved. However, we have 22,000 men and women in Montana out of a job. 42% of our college graduates leave the state to find a job. Jobs are the No. 1 priority of this administration, and I am well aware that the coal industry means new jobs for Montana.

However along with the new opportunities and challenges come problems for Montana, and we do not believe that our responsibility to the nation goes so far as permitting our air and water to be polluted, our land and our way of life to be destroyed.

Nor will we tolerate the boom and bust cycles that plagued Montana's early history. The hundreds of ghost towns in Montana are picturesque but stern reminders that could be added to if we do not now concern ourselves with what happens after coal development.

Most important, we recognize the importance of Montana's agricultural industry to this state and country. We are second in the nation in barley, third in wheat, sixth in sheep, eighth in beef production. The potential for increasing this contribution is also recognized. We have enough water near agricultural areas to increase five fold the amount of land under irrigation; this could raise wheat production in the state by 42% at a time when the production of food is extremely important in reducing hunger in the world and relieving this nation's balance of payments deficits. But energy development will compete for the basic necessities of agricultural production - land and water.

Extensive coal development would make significant demands on our agricultural land base. The surface that covers 63% of the strippable coal in the West is privately owned by farmers and ranchers who make their living from it. In Montana 93% of the publicly owned strippable coal lies under privately owned surface. Strippable coal in the Montana portion of the Fort Union Basin underlies 1,131,615 acres or a land area 25 times greater than occupied by the District of Columbia. Over 1/2 million acres already have been leased for coal mining purposes.

With regard to water, we need only look at what is happening on the Yellowstone to demonstrate the point. In 1972, the Bureau of Reclamation projected that 2.6 million acre feet of the Yellowstone Basin waters might be needed annually for coal development in Montana and Wyoming by the year 2002. By early 1974, less than two years later, industrial filings, options, applications and requests in only the Montana portion of the Basin already totalled half that figure; and when Wyoming's share of the water in the Basin is taken together with other requests, the total figure could approach or exceed the critical low flows.

This could make the realization of the full potential for agriculture in the area impossible. Of course, all these requests would not be granted and steps can be taken to increase the usable supply. Nevertheless, it is obvious that not all demands for Yellowstone water can be satisfied and that by committing to one use we are precluding others.

Just as obvious, the competition for these vital resources is becoming more intense.

But what is the proper balance between energy and food, and what amount of resources should be committed to the production of each? These are complex and difficult questions. The actions that have been taken by state government are attempts to make sure that the answers will be in the best interests of Montanans.

#### Reclamation

In 1973 the Legislature, at my request, passed the strongest strip mine reclamation act in the country. The act gave the Department of State Lands authority to approve mining plans, deny mining in certain areas, and impose adequate bonds and fines. The coal conservation act was also passed. To date both of these laws have been strongly enforced and are working. The cooperation we have received from industry has been good.

#### Water

The Montana Constitution lays state claim to all water that originates in the state. In implementing this article, the 1973 Legislature passed the Montana Water Use Act, which requires anyone beginning a new use of surface water to file an application with the Department of Natural Resources. This Act has been a vast improvement in enabling the state to identify how much water is being used, for what purpose and who has rights to it.

With increasing requests for water from the Yellowstone the 1974 Montana Legislature enacted a three year moratorium on processing large water applications in that Basin. And, Montana is opposing attempts to challenge that article of the Yellowstone Compact which prohibits interbasin diversions without the consent of all signatory states.

#### Utility Siting

The 1974 Legislature also passed a Utility Siting Act. The act provides that applicants pay a fee to enable the state to conduct comprehensive studies and to make a recommendation. The Board of Health and the Board of Natural Resources then must either approve the application or deny it based on the evidence of extensive hearings.

A consortium of northwest utilities have applied for an application to construct two 750 megawatt power plants at Colstrip, Montana. After the 600 days the Department of Natural Resources recommended that the application be denied. The hearings before the Board of Health and the Board of Natural Resources have gone on since May--too long in my opinion. The Board of Health will make a decision sometime in November. Approval or denial by that Board will be based on whether or not the applicants have demonstrated that the proposed plants can meet state air and water pollution standards.

#### Taxation

The people of Montana are entitled to a fair return on the wealth that is extracted from our state. Over 8 billion dollars worth of minerals have been extracted in Montana, and we have little to show for it.

In 1973 a tax was imposed upon coal based on its B.T.U. content. This averaged about 40¢ per ton. In 1975 the Legislature changed this to tax coal at 30% of its sales price. This tax will yield \$67 million to state government during the next two years. In spite of being accused of being the Blue eyed Arabs and gouging consumers in the rest of the country, it is my opinion that the ultimate consumer should share in the environmental & economic costs of development; and it is important to note that Montana coal is still being delivered cheaper than many other forms of energy or coal from other states.

This tax has obviously not curtailed development, and a top executive of Detroit Edison recently stated that the price of Montana coal including the tax was a bargain.

The revenue generated from the tax will be divided as follows:

The Renewable Resource Development Trust Fund takes 2 1/2% of the coal tax to be used to improve the renewable resource based industry, namely agriculture and forest products. Three million dollars will be available in this biennium for long term, low-interest loans to individuals for irrigation projects and reforestation. Loans and grants will also be made to agencies and political subdivisions of the state for the same purposes. It is our intention to put as much water as possible to beneficial use for Montanans, and to build a stable and prosperous economy, one not overly dependent on coal revenues, one which will endure long after our coal reserves have been exhausted or have become less desirable through the development of renewable energy sources technology.

Ten percent of the tax will be earmarked for the reconstruction of highways in those counties most impacted by coal development.

Four percent will go directly to the counties where coal is mined to be put to whatever needs the counties determine to be greatest.

About twenty-seven percent will go into a Local Impact and Educational Trust Fund. A Coal Board will award grants to local communities to provide services and facilities needed as a direct consequence of coal development, and for which no other source of funding exists. About \$11.5 million will thus be available to mitigate the impacts on schools, roads, hospitals, fire and police protection, and local taxpayers.

Other portions of the coal tax will benefit the state as a whole, with 40% going into the state general fund, 10% to the school foundation program, 2 1/2% to acquire state parks, monuments and recreation sites, another 2 1/2% for research, development and demonstration of alternative energy sources, and 1% distributed to all counties for land planning purposes.

I think the actions Montana has taken in the last several years indicate our intention to protect our environment, to obtain an equitable return for the extraction of our finite resources, and to put the revenues realized to uses which will benefit state residents and enhance our special quality of life. We have also moved to unify those sometimes diverse actions and to answer unique problems in meeting the energy needs of Montanans.

A key organization in this effort is the Montana Energy Advisory Council, a group I formed from the directors of various state agencies and which is chaired by the Lieutenant Governor. MEAC, with cooperating state agencies, has the manpower and expertise to meet energy-related problems.

A 1975 legislative enactment, HB 453, mandates the formulation of an energy conversion policy and plan. That energy policy and plan must be both long term and comprehensive and must include alternative goals, a statewide siting inventory, and a proposed siting policy for the coordinated siting of energy conversion facilities to meet Montana's need. I have assigned this responsibility to MEAC.

Other goals of MEAC, established by executive orders, are:

- (1) To develop energy conservation policy and plans for Montana government operations, and
- (2) To provide a forum for discussion of coordinated, comprehensive and efficient state agency energy activities. The forum deals with policy formulation activities and short term interagency energy programs and problems.

One urgent, and hopefully short term energy problem revolves around Montana's reliance on both natural gas and petroleum imported from Canada.

In May of this year the Canadian Natural Energy Board curtailed natural gas exports to Montana by 10 billion cubic feet a year. 80% of the natural gas in the Montana Power Company service area, which comprises 2/3 of the state, is imported from Alberta. Our interruptible supply of gas is 29 billion cubic feet, which supports the major industries of western Montana.

The prospect of further curtailment of Canadian natural gas and crude oil which supply other refineries in Billings led me to create the gasification task force.

This task force has as its objective making Montana self sufficient in energy.

They are studying all the alternatives--

- (1) Building a coal gasification plant to supply Montana's needs,
- (2) Converting existing plants from natural gas to electricity or coal,
- (3) Increasing in-state production of gas and oil,
- (4) Obtaining Alaskan natural gas and crude, and
- (5) Conservation.

I feel that Montana has acted quickly and wisely in attempting to meet the problems revolving around energy, but I am convinced that unilateral attempts by any one state will fall short. As North Dakota Governor Arthur Link said at the Fort Union Coal Conference in Bismarck earlier this week, "If the Northern Great Plains states do not cooperate in coal development, the results could be disastrous for the individual states." Taxation, plant siting, water and air pollution, and strip mining regulation must be looked at from an interstate perspective, for the consequence of a non-regional approach could be an inappropriate level of development in any one state. Without regional cooperation, a state that lags behind in any of these areas could easily

be a plum ripe for development, with that state's interests being subordinated to those of industry. I share Governor Links' feelings.

Nor can any one state hope to assert its will against that of the federal government.

In December of 1974, realizing that each state cannot deal effectively with the federal government alone, I proposed a regional organization to my colleagues at the Democratic Governors' Conference in South Carolina. My proposal has now become the Western Governors Regional Energy Policy Office, located in Denver and funded by the two Title V Commissions, Old West and Four Corners. Former North Dakota Governor Bill Guy is staff director of the ten-state organization.

At a meeting on July 28 and 29 in Santa Fe, the ten Western Governors unanimously adopted 18 policy recommendations and passed the 19th with only two "no" votes.

Copies of this policy position are available for your information.

To obtain that kind of support from the Western Governors indicates to me that we have strong agreement on resource development in this region. I believe that WGREPO will play an important role for the states in the future, giving greater weight to our position concerning such matters as coal slurry pipelines.

For instance, the ten western Governors have opposed giving eminent domain power to the coal slurry pipeline companies, for we believe that this federal legislation is premature.

One proposed coal slurry pipeline project would extend 1036 miles from Wyoming to Arkansas. The pipeline would carry 25 million tons of coal a year requiring 6.5 million gallons of water from the Madison Formation. This formation underlies not only Wyoming, but parts of South Dakota, Utah, Montana, North Dakota, Colorado, Nebraska and Canada.

Experts on both sides disagree on the effect of withdrawing huge amounts of water, which indicates that we don't yet have enough information about the Madison Formation to make an intelligent decision.

The Old West Regional Commission, representing the States of North and South Dakota, Wyoming, Nebraska and Montana, will help us gather the kind of information which is crucial to energy development decisions. This Commission is investing about \$2 million each year on important resource development studies.

I think it is fair to say that individual states and regional groups have taken more extensive and more positive measures to answer our questions and meet our needs than has the federal government.

To date, there is no national energy policy. In spite of the fact that the energy crisis has disrupted the economy of this country, we have gone through years of confusion, inaction, successive energy czars, and compounding power struggles within the administration.

We have seen a deadlock between the executive branch and Congress in developing solutions to the energy problem.

The solutions may have been delayed, but the problems, unfortunately, cannot be postponed.

With energy development, the need for schools, housing, social services, and roads is immediate, yet the development generates tax revenue only on becoming operational. This lag presents serious financial and social problems to state and impacted local governments. We believe that the federal government has a responsibility to provide funds to offset these impacts. Should the taxpayers of state and local government pay all the impact costs of providing energy for the rest of the country? We are meeting our responsibility as a state providing millions of dollars from the state coal tax for this purpose. Industry at Colstrip has also made a significant contribution to streets, housing, schools and recreation. However, with the exception of limited funds from our regional commission, the federal government has totally ignored its responsibility.

Yet the most serious conflict is whether the states or the federal government will regulate coal and energy development and determine under what terms development will take place. We've heard of a partnership between the federal government and the states. If such a partnership exists, the states must be the junior partners.

Time after time the wishes of the states are disregarded by federal agencies and Congressmen who pursue the "Development at All Costs Philosophy".

I exclude Montana's Congressional delegation from this, as they have done an outstanding job.

In spite of strong support from the Governors for a federal strip mine reclamation act, the President vetoed it twice.

The Corps of Engineers is attempting to lay claims on all of the nation's waters, including stock ponds, although we are resisting this attempt to usurp traditional state water management authority.

The WGREPO Governors have demanded that the Department of Interior allow us to have a meaningful voice in where and under what terms federal land would be leased; to date we have had little input. Vast federal leasing will have an

enormous impact on states like Montana with large areas of federal land with coal deposits. What effect will state laws have if the federal government can lease land under entirely different standards and conditions?

In addition to opening more federal lands to coal leasing, the Administration has under consideration an aggressive program to develop synthetic fuels, a program which will have a massive impact upon the West. The federal government has been devising a national synthetic fuels program over the last 9 months, without either consulting with or informing the states that will be so significantly impacted.

One aspect of the program is the establishment of federally guaranteed loans for the private sector to encourage construction of huge plants to produce synthetic fuels from coal and oil shale.

We had a very difficult time gaining access to the federal synthetic fuels program, although all relevant documents and recommendations should be reviewed and the states to be affected should have input into the federal policy that will initiate those impacts.

Consequently, the Western Governors have asked the President's Energy Resources Council to withhold recommendations to the President on the proposed synthetic fuels program until the affected states have had an opportunity to fully review and comment on the existing planning documents.

On September 16, nine Western Governors requested the Honorable Olin Teague, Chairman of the Committee on Science and Technology, to hold hearings on the synthetic fuels program, and he agreed.

We have initially requested that the federal government synthetic fuels program be undertaken in a manner and at a pace which will not unduly impact the natural, economic and social integrity of the region and which will comply with state laws and policies.

The Western Governors have been working on a policy position which will be finalized in Denver tomorrow and presented as testimony to the Committee in Washington next week.

I find it incredible that, when legislation with a massive impact upon the western states is considered, the states are not consulted by either federal agencies or the Congress. The energy companies know more about the proposed program than do the Governors of the affected states.

Any federal government attempts to preempt state laws dealing with reclamation, land use, water rights, utility siting and water pollution will be resisted. Such confrontations of politics, however, serve neither this country nor its people. The States would prefer to cooperate with the federal government.

I suggest that the federal government celebrate the 200th anniversary of our nation by getting rid of the new federalism we heard so much about and returning some of the old federalism guaranteed by the Constitution.

Still another important factor that is missing at the federal level is an explicit conservation policy. The President in the State of the Union Address called for 250 more strip mines, 150 major coal-fired power plants and 20 major new synthetic fuel plants by 1985. He undertook no substantive discussions of many of the costs and constraints of accelerated development of our finite energy supplies, and the advantages that a commitment to conservation can provide.

Our dependence on Middle East oil has grown over the last year. Over 25 billion American dollars are now buying foreign oil--dollars that are badly needed in this country--and our purchases are increasing. At the same time, domestic production of oil and gas is declining, as are reserves.

If we matched the performance of the American-made, gas-guzzling automobile to European or Japanese performance, 40% of American oil consumption would be eliminated and the need for imports would be wiped out.

Professor Robert Stabaugh of the Harvard Business School appropriately calls U.S. gasoline consumption the "hemorrhage of the world oil system". With six percent of the world's population, we in America have been consuming one-third of the world's supply of total energy output. Other industrialized nations have managed to obtain standards of living comparable to ours with lower per capita energy consumption levels. Switzerland's per capita consumption rate is one-third and West Germany's, less than one-half, of ours.

Why do we use so much? Quite simply, we waste it.

Yet, every concrete federal proposal is aimed at increasing energy production, rather than at increasing energy efficiencies and reducing energy wastes.

#### CONCLUSION

The overriding question is: Will our entire region become, as the National Academy of Sciences predicted for certain western areas, a "national sacrifice area"? The answer is an emphatic NO--we simply will not tolerate such exploitation by the federal government and the energy producer.

I believe that the states, working together with the federal government and the private sector, can lay the basis for a balanced national policy for resource development, management and conservation. I believe that Montana and the west will make a significant contribution to our country in food, energy, minerals, timber, and recreation. But it will be done under terms spelled out by the states to protect our environment, our economy and our lifestyle.

As Chief Seattle said so many decades ago, "The earth does not belong to man, man belongs to the earth."

I am hopeful that this conference will lead us to reflect a new understanding by modern man of this timeless truth, which has been ignored for so long.

# The Importance of Mines Colleges In Educating for America's Future

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America's colleges and schools of mines are an important component of our minerals industry. It is these institutions which provide the engineers, scientists and future leaders of the industry. In the past two decades, the numbers of mining colleges have greatly diminished and several of those which currently exist continue to be threatened. Positive steps must be taken if our nation is to meet its mineral and energy requirements. Professionals must be trained and technology must be developed if the problems the minerals industry now faces are to be resolved. In considering the plight of our mining schools, let us look back on some of the reasons for their importance and the nature of their problems.

## First export from North America was bog iron

From its historical beginnings, the United States was involved in minerals. The first export from the North American Continent was bog iron, shipped as ballast from the Virginia Colony at Jamestown. One of the first factories in the New World was the integrated Hammersmith iron works at Saugus in the Massachusetts Bay Colony, built about 1644. Alexander Hamilton's Essay on Manufacturers, proposing a set of industrial goals for the United States, dealt mostly with the development of strong industries to produce materials and the skills needed for their conversion into artifacts in the United States, to *reduce reliance on sources from abroad*. Our modern day "Project Independence" is a return to this philosophy.

The commercial evolution of the United States during the 19th century relied extensively on the rapid discovery and exploitation of soil, timber and minerals. It was in this atmosphere that the Morrill Act was passed as an effort to provide "... the liberal and practical education of the industrial classes"; for, prior to this, higher education in America had been regarded as "... discipline and furniture of the mind" as advocated in an 1828 Yale University report.

It was in this atmosphere that the first colleges of mines were established in mineral-rich states. In Arizona, for example, establishment of the school of mines as the second educational unit at the university was "... to follow those lines that seem to lead to the best and immediate practical results of greatest value to the entire Territory." In the United States at this time, to about 1890, half or more of those gainfully employed worked in agriculture, and more than half of the rest were in mining and manufacturing industries. In all of these occupations prior to the turn of the century, people were in close contact with the earth, minerals and other raw materials.

By 1940, half a century later, the number of those in agriculture had greatly diminished, while the number in mining and manufacturing industries had greatly increased. But, following World War II, a new trend began to be established, so that by 1965 the numbers employed by the service sector of our economy began to exceed those in agriculture, mining and manufacturing combined.

## Minerals being used at unprecedented rates

Today, in 1975, we are predominately a service-oriented economy; this has given rise to the term "Post-Industrial Society." The term, Post-Industrial Society, however, is not meant to be descriptive of the characteristics of our society, but it merely fixes our position on the development time scale. John D. Rockefeller, III, in his book of the same name, refers to this era as "The Second American Revolution," marking the transfer of society from "materialism" to "humanism." And, in truth, for the last half century, there has been a steady trend toward reduced contact of American workers, management and the general public with raw materials in their recognizable primary forms—minerals—in spite of the fact that we are consuming these raw materials at unprecedented rates!

## Schools of mines more needed than ever

Just as the passage of society from an agrarian domination to a machine domination did not diminish man's appetite for food, the passage of our ideals from materialism to humanism has not diminished either our requirement for material goods or our requirement of skilled people to produce these goods. It has, however, greatly increased the problems associated with providing these material goods and herein is the basis of the responsibility and the challenge to the mineral engineering professions today. Herein is the reason why colleges and schools of mines, today more than ever, are necessary.

In their mineral form, raw materials are the narrow end of the pedestal on which our society is delicately balanced. The disturbance to our economy caused by the recent tripling of the price of petroleum demonstrates the precariousness of this balance. In recent years, the necessity of mineral products to American industry has escaped us because they are less visible in a service-oriented economy than they were in our earlier forms of economy. The energy crisis has reaffirmed their importance.

## Mineral production for 1974 valued at \$55 billion

Last year, the \$55-billion domestic mineral raw materials gave rise to a \$1.40-trillion U. S. economy. But, we experienced a \$24-billion deficit in our mineral commodity balance of payments largely due to the action of the Middle Eastern countries. This was one-half of the value of our domestic mineral and mineral fuel production!

The final report of the National Commission on Materials Policy, issued in June 1973, titled, "Material Needs and the Environment, Today and Tomorrow," very nicely develops the perspective necessary to understand the full implications of the task which lies ahead of us. The report said that "... it should be the policy of the United States to:

- 1) provide adequate energy and materials supplies to satisfy not only the basic needs of nutrition, shelter, and health, but a dynamic economy, without indulgence in waste;
- 2) rely on market forces as a prime determinate of the mix of imports and domestic production in the field of materials, but at the same time decrease and prevent wherever necessary a dangerous or costly dependence on imports;
- 3) accomplish the foregoing objectives while protecting or enhancing the environment in which we live;
- 4) conserve our natural resources and environment by treating waste materials as resources and returning them either to use or, in a harmless condition, to the ecosystems;
- 5) institute coordinated resource policy planning which recognizes the inter-relationships among materials, energy, and the environment."

Thus, contained in the recommendations of the NCMP are the rudiments of economic, social and technological concern linking for the first time materials, energy and the natural environment. But, of importance to the technologist, for the first time the total arena of materials concern has been very ably described and recommended for consideration as national policy. The policy, as proposed by the NCMP, contains three basic elements—*production, conservation and environmental protection*. These elements broadly encompass the areas of *supply, use and disposal*.

Raw material supply for our economy has been, and will continue to be, the mission of our mineral industries. The primary purpose of our colleges and schools of mines has been, and will continue to be, the education of mineral technologists for these industries.

#### Mineral technology increasingly complex

In raw material supply, the basic question is: How can we produce needed amounts of minerals and metals from ores of steadily decreasing grade while concurrently producing less environmental damage and consuming less energy than in the past? Encompassed in this question is the necessity for a number of very highly specialized talents: the mineral economist, who attempts to mitigate the difference between supply and demand; the geologist, who defines favorable horizons for mineral discovery; the geological engineer, who explores and delineates the mineral deposit; the mining engineer, who operates the mine in the most prudent manner possible and, the metallurgical engineer, who processes the ore to a raw material suitable for use by industry. All of these areas of technical speciality are becoming increasingly complex due to the increased requirements and regulations of society and due to the uncertainties of nature in her distribution of materials in the earth's crust.

Let us now examine some of the problems that are associated with mineral supply today and why the technological fields encompassed in the mineral engineering classification are so important.

*Discovery (geologist and geological engineer).* The problem of discovery of new mineral deposits falls to the exploration geologist and the geological engineer. As most surficial deposits are now delineated, the geologist must apply increasingly complex technologies to discover subsurface deposits. These are generally deep and covered by post-ore rocks and alluvium.

Probability of discovery is rapidly decreasing and the cost per ore deposit located is rapidly increasing. As an example, the 40-year record of Cominco's mineral exploration history between 1927 and 1967 shows the odds of finding a profitable ore deposit to be 7 in 1000 with an average expenditure of \$47 million per profitable deposit. A gambler's game, yes. But mineral exploration is a game which requires the utmost in technological sophistication in order to win.

*Extraction (mining engineer, geological engineer and petroleum engineer).* The problem of mining the ore from the ground falls to the mining engineer and to some extent to the geological engineer. Here, some of the largest earth-moving operations in the world are involved as ore grades diminish year by year. Copper ores, which averaged 2.5 percent copper in 1900, now are mined at as low a grade as 0.25 percent. As a result, the amount of earth and rock moved per pound of copper recovered is tremendous. At five lb of copper per ton of ore and a stripping ratio of 1.5:1, upwards of 1000 lb of earth and rock are moved for every pound of copper produced! A large copper mining operation will move as much as 400,000 tons of earth and rock per day!

In the mining of this ore, hazardous conditions must be rectified and abuse to the natural environment must be minimized. Capital investment in a mine may run as high as \$200 million (not including exploration costs) and as many as five years may be required before the first ore can be mined. The Carr Fork Project, recently announced by Anaconda, near Tooele, Utah will require a capital investment of \$135 million, or \$2400 per annual ton capacity. Once in operation, a modern mine may employ as many as 2500 people. Mining is energy intensive—88,000 Btu per ton of iron ore mined by open pit methods and 356,000 Btu per ton mined by underground methods. In the United States, 88 million tons of iron ore were mined last year—a feat which required approximately 18 trillion Btu of energy.

To do his job, the modern mining engineer must be skilled in the basics of engineering, management and economics. He must be knowledgeable in the properties of rock as well as an expert in materials handling systems. He must be skilled in labor relations as well as public relations. Above all, he must be continually alert for the health and safety of his employees as well as his responsibility to society in creating a minimum disturbance to the environment.

The minerals industry is seeking more engineers than ever. While our mining schools expect to graduate no more than 300 mining engineers next year, the minerals industry needs at least 500 new mining engineers. If our present enrollment were to be doubled, we would barely meet demand!

*Processing (metallurgical engineer).* The problem of processing the ore to a useful product falls to the metallurgical engineer. Here, new challenges have arisen in recent years, due to pollution abatement problems, fuel substitution requirements and energy conservation. The primary metals industry alone consumes between 8 and 10 percent of all of the energy consumed in the United States today. The traditional processes by which minerals are currently processed and metals extracted are not good enough to fulfill today's requirements of operations. For various reasons, many processes now in use are obsolete and, even worse, the trained manpower to develop new processes and to build new facilities is in extremely short supply.

We are becoming more and more dependent upon foreign sources of mineral commodities and more and more dependent upon foreign technology to process the minerals we do obtain domestically. Capital costs of plant and equipment have escalated rapidly. In the copper industry, the investment cost per ton of annual capacity has risen from \$1700 in 1961 to nearly \$5000 today. Plant depreciation and interest costs are major fractions of the selling price of all mineral-derived commodities. The need for engineers becomes all the more intense under such conditions as these; for plants must be optimally designed and built and low-capital-investment processes developed. The 1975 graduating class in metallurgical engineering was the smallest since 1956!—and only 10 percent of the total are in minerals processing or extractive metallurgy. The minerals industry can count on no more than 50 to 60 graduates in these areas. The minerals industry will require at least 260 new metallurgical engineers next year!

It should be obvious from the foregoing that the needs, challenges and the opportunities for graduates of the minerals engineering disciplines are present today and promise to be with us well into the future. Our mineral and energy supply problems and our environmental problems are not going to be solved in the near future.

#### Why have colleges, schools of mines been in trouble?

If all of these things are true, why then have our schools and colleges of mines been in trouble during the last decade? The answer is complex and has many facets. Before discussing mines colleges, let us first examine the academic scene in general.

When we examine the enrollment today in the various disciplines provided by our universities, we see reflected in the ambitions of our young people the same phenomena described by Mr. Rockefeller. Our enrollment in engineering as a percentage of the total has been steadily decreasing, while that of the humanities and social sciences has been increasing. In 1974, only 5 percent of all bachelor degrees were earned in engineering disciplines whereas 66 percent were earned in the humanities and social sciences.

The imbalance of our present system of education was adequately demonstrated in 1974's graduating class when

those in engineering, comprising 5 percent, received 56 percent of the job offers and those in humanities and social science, comprising 66 percent, received but 7 percent of the job offers. As Dr. Charles E. Reed, senior vice-president of General Electric Co. pointed out to an engineering education management conference a few years ago, "It seems we are heading towards a nation in which the number of people able to articulate problems will be far greater than the number of people capable of solving them."

#### Primary problems are four in number

Insofar as mines colleges are concerned, the primary problems seem to be: (1) that the academic disciplines which they provide have not been sufficiently popular among young people in recent years to provide an "economic" student-to-faculty ratio; (2) student enrollment and research funding opportunities have not been sufficient to permit adequate faculty development; (3) university administrations have not been sympathetic to the problems which have existed, nor have they been aware of the reasons for the existence of a specialized college and (4) the minerals industry itself has not shown direct concern with the well-being of its schools and colleges until a crisis was imminent, and then it has often been too late.

Let us now examine my four problem areas in greater detail:

1) *Lack of student popularity.* Students have not been drawn to the minerals engineering disciplines for a number of reasons. Dr. Hoskins, of the University of Idaho, did an excellent study on this a year or so ago, under the sponsorship of the U. S. Bureau of Mines. The reasons are many fold:

—*the field lacks visibility.* As discussed earlier, we have grown further and further from direct association with the primary materials which feed our economy, which create our wealth. The environmental movement of the past decade or so has been interpreted as being contrary to mining, rather than a challenge to be faced by mining professionals. Other highly visible science and engineering activities of the Space Age have detracted attention from the older, supposedly mundane fields.

Adverse publicity then becomes publicity of needs and opportunity for those who are seeking to contribute to human betterment.

—*the image of the field is tarnished.* Young people today associate mining with manual labor and picks and shovels, not with white shirted engineers with sliderules and computers. It has been pointed out that even the Kuder Preference Test, a career guidance instrument in common use today, regards all of the minerals engineering disciplines in the "trade school" category. Until the late sixties, the salary level of mining disciplines was substandard and, until recently, the "apprentice" method of early employment experience was used by mining companies.

- high school counselors, science and mathematics teachers have not been alert to the fact that the mineral engineering disciplines are worthy fields of endeavor. One reason for this has been the continual downgrading of the fields by the Department of Labor's Bureau of Labor Statistics. Even today, they publish figures indicating a need of a maximum of 100 mining engineers per year and a need for less mining engineers in 1980 than in 1970, an absolutely erroneous statistic!
- there is little publicity given to mining activities or to opportunities in the mineral industry by the news media. One analysis found that the adverse publicity associated with mine "disasters" and environmental problems has a positive effect on recruitment because at least it is publicity, whereas none existed otherwise.

2) *Lack of opportunity for faculty development.* Faculty members of institutions of higher learning are expected to continually develop themselves and their profession by extending the frontiers of knowledge. This requirement is generally interpreted as creative works or research accomplishment. Faculty promotion and tenure decisions generally hinge on such individual accomplishment. In the absence of opportunity to perform such creative work and thus develop professionally, faculty members either stagnate or move on to other fields—and both results have occurred in past years. Young faculty members who have not yet obtained tenure on the faculty are particularly vulnerable to this problem. The net result is that mining school faculties tend to consist largely of older faculty members who have not been required to keep abreast of new technology, for they obtained their tenure years ago. Opportunity for research has been limited in the mineral engineering disciplines for two major reasons:

- the mineral industry itself performs little research compared to other industries (R & D expenditures of less than 1 percent of sales in the decade, 1958-1969). It therefore contributes little to universities for research and requires few graduates who hold advanced degrees and are trained in research and development skills.
- the federal government has not assigned minerals engineering problems a sufficiently high priority to warrant extensive funding programs. Minerals engineering problems have not been interpreted to be a part of defense, space, or the Great Society—three major areas of federal concern in the recent past. In spite of warnings of insufficiencies beginning in 1952, with the Paley Commission's Report "Resources for Freedom" and continuing to this day, no substantial federal funding has been established either for general institutional support or for research in minerals engineering disciplines!

3) *Lack of administrative sympathy.* According to Dean Steitle, former Dean of the College of Mineral Industries at Pennsylvania State University, as early as 1928 . . . "it had become ritual that whenever the Dean of the School of

Mines and Mineral Industries retired or resigned, the Dean of the School of Engineering would go to the President of the College and ask that the School of Mines be dissolved and its department be placed under the aegis of the School of Engineering." This happened at Arizona just before the writer was hired and it happened at Nevada in 1972 when Dean Scheid retired. Fortunately, the respective administrations were foresighted enough to turn down this option as being a false economy.

In his defense of the Mackay School of Mines at Nevada, Dean Scheid pointed out the mortality of the minerals engineering curricula at other universities where an amalgamation had taken place. He cited Washington State University, University of Texas at El Paso, University of Pittsburgh, Ohio State University, University of Alabama, University of Kentucky, North Carolina State and the University of Minnesota. At these institutions, the previously clear mission of the minerals engineering departments became fragmented, morale and student enrollment dropped and administrators who were not attuned to the importance of mining let these disciplines quietly die. Most recently, the University of Utah's College of Mines and Mineral Industries has undergone the trauma of a merger with the College of Engineering on the initiative of the acting president. This was followed by an immediate disengagement of the two colleges by order of the state legislature, after the mineral industry of the state expressed its displeasure with the move. The result was the resignation of several university officials, the loss of the deans of both colleges and hard feelings among the members of the two faculties involved. This was an example of the minerals industry realizing the importance of the mining college, but much too late.

In 1950, Dean Steitle observed that mineral education was considered to be a nuisance by some college administrators because "enrollments in minerals industries courses were never very high and the administrators placed a greater premium on enrollment rather than on the services rendered by the graduates." Steitle also pointed out in 1944 that one of the difficulties of mining schools was that many disciplines, such as geology, mineralogy and geography, which are proper to the work of the minerals industries, were scattered throughout various colleges of the university. Besides being necessary to the curriculum, these disciplines also provide the opportunity for the service courses taught to non-mining students which enhance the number of student credit hours taught by the college.

An allied problem arises because of the criteria established for engineering curricula by the Engineers' Council for Professional Development (ECPD). These criteria tend to minimize the number of student credit hours (the figure of merit to the university administration actually taught) by the mines college. ECPD requires, for accreditation purposes, that engineering students take 1/2 of an academic year of basic sciences, 1/2 year of mathematics, 1 year of engineering sciences, 1/2 year of engineering design, synthesis and systems, 1/2 year of humanities and social sciences and 1/2 year of electives. The net result is that an engineering student spends only 1 1/2 years of his four years taking engineering subjects and, if he is a minerals engineer,

he must split these engineering subjects between the mines college and the engineering college.

At Arizona, for instance, a mining engineer can receive his BS degree with but 35 of his 140 semester units taught in the College of Mines. Compare this, for example, with our College of Architecture, a special college like the mines college, where out of 160 units for a BS degree, 135 units are obtained within the college itself. If numbers are so important, would it not be wise to cause liberal arts students to take general courses in the mines college on the influence of minerals and minerals technology on their everyday life?

I think that it is important to examine the purpose of a mines college and then decide on what basis its effectiveness is to be evaluated. It seems clear to me that, even when the state legislature decrees that a certain economic-based performance criteria be established for a university, this same criteria cannot be applied to all academic disciplines in an equal manner. Clearly, some compromise must be established in judging the need for academic curricula between value based on student popularity and value based on society's need for graduates in that discipline.

4) *Lack of concern by the mineral industry.* As will be discussed in the following section, the principal purpose of a mines school or college is to be responsive to the needs of the mineral industry. Either through the fault of industry or of education or both, adequate formal communication has never been established between the mineral industry and the administration of the universities containing colleges or schools of mines. Neither side has fully appreciated the problems of the other side, and consequently, formal communication has only been established during times of crises. In my opinion, there is much that the industry could do to foster its colleges and schools, ranging from publicity to actual financial support of activities.

#### **Purpose of mines college goes beyond training professionals**

The question is often asked, Why do we need a specialized college for minerals education? The most important answer has to be the obvious one—to provide trained professionals for employment in the minerals industry. But the reasoning is far deeper than that superficial answer.

The purpose of mines colleges, like that of agricultural colleges, is to help to assure that the United States has an adequate supply of raw materials to fulfill its needs. Our colleges have three basic functions in this mission, (1) resident instruction at both the undergraduate and the graduate level (2) research, and (3) continuing education for professionals already in the field. Through these functions, colleges of mines provide potential leaders to the mineral industry and to the governmental agencies who are concerned with the mineral industry (This latter category is becoming quite numerous in recent years). They provide applied science and technology to the problems of the industry and they make possible the continual education of mining professionals throughout their career.

The question is also raised as to why the minerals industry requires specially-trained people. Why can't they get along with an assortment of traditional engineering disciplines such as are employed by the manufacturing industry? The best way to look at this question is to examine it in view of today's technologies. Why do we have aerospace engineering, environmental engineering, industrial engineering, nuclear engineering, aeronautical engineering or any of the newly developed fields of engineering endeavor? Why can not the old reliables do the same job? These last named fields are interdisciplinary fields of engineering and represent the most efficient use of the nation's resources to compete in today's technical fields. Their curricula comprise a tailor-made assemblage of subject matter to prepare a person for employment in a specialized field of engineering activity. So it is with the mineral engineering disciplines. These were some of the very first interdisciplinary subjects. Mining and metallurgy are sometimes referred to as being the world's second and third oldest professions. They are known to date back at least to Neolithic times and the beginning of the Bronze Age. And so it is appropriate that a mines college represent an assemblage of disciplines which represent the specific needs in educating people for an industry which is basic to our society.

What, then, are some of the specific differences between the mineral engineering disciplines and the traditional engineering disciplines?

- 1) Whereas traditional engineering disciplines are based on classical sciences of physics, chemistry and mathematics, the mineral engineering disciplines also rely heavily on geology and mineralogy—courses rarely taken by the average engineer.
- 2) The traditional engineer relies on raw materials which can be purchased with specified properties and delivered where and when he wants them at an agreed upon price. Thus, the traditional engineer is dealing with a presumed certainty in raw material quality, quantity and cost. He applies his talents to these raw materials. The minerals engineer is trained to deal with uncertainty. His raw materials are infinitely variable in quality and quantity, for he must obtain his raw materials from the earth and deal with them as he finds them. No two mineral deposits are the same, no two rocks have the same physical characteristics and no two minerals have the same chemical composition. The job of the mineral engineer is to transform the uncertainty of nature into a certainty of man in order that the remainder of industry can benefit from an assured raw material supply.
- 3) Mineral deposits are irregularly distributed on the surface of the earth. They must be mined where they occur. Thus, the mineral engineer must be prepared to deal with a wide variety of technical, legal and environmental problems as he performs his job.
- 4) The mineral industry is basic to international trade. As a result, the economics of the industry are strongly influenced by factors which are beyond the scope and control of the individual company or the individual mining operation. Therefore, that individual mining

operation must be designed to operate economically under a range of economic conditions.

- 5) Mining is a high risk business. The minerals engineer is trained to make the most efficient use possible of technical, financial and human resources. While most engineers might boast of this responsibility, I submit that there are few other industrial operations which can boast a \$300-500 million capital investment and still operate under the uncertainties prevalent in the minerals industry today.
- 6) Mining is a fundamental disturbance to the environment. By its very nature, there is no way to avoid a head-on confrontation with those members of our society who would object to such operations. The environmental imperative has increased the responsibilities and the problems of the minerals engineer by many fold in recent years.

#### Mining important industry in any state

Mining is an important industry to any state, regardless of its contribution to the total economy, for it represents the contribution of new wealth to the state and national economy. As we have mined-out our known rich deposits and, as our society has become more concerned with the status of its national environment, the need for minerals technologists has become more severe. We expect this trend to continue. Each state or region of the nation should be concerned with how and to what extent its mineral resources are exploited. The existence of a strong minerals-oriented educational program in that region is of primary necessity to this concern.

#### Schools viewed as vital national resource

Our nation's schools and colleges of mines are a vital national resource. In the face of today's problems in mineral supply, they are needed more than ever. They deserve the fullest support of the nation's mineral industry and of the agencies of the federal government which are responsible for mineral supply and conservation. Without this support, they will either die or stray from the mission for which they were established. In either case, a very important educational function will be lost to the mineral effort of the nation.

*William H. Dresher has been dean of the College of Mines of the University of Arizona and director of the Arizona Bureau of Mines since 1971. For 15 years previously, Dresher was affiliated with Union Carbide Corp. as a research metallurgist, most recently as project manager of its Research Institute. He has had experience in extractive metallurgy, inorganic and colloid chemistry, research management and new business development. He holds a PhD in metallurgy from the University of Utah.*



#### RECOMMENDATIONS

- 1) Efforts should be made to establish a serious dialogue involving authoritative representatives of the mineral industry, the federal government and the mining schools for the purpose of determining:
  - a) the professional manpower needs for minerals scientists and engineers for the next decade.
  - b) the major technology needs of the mineral industry which are required to implement the national requirements for mineral products in the face of social restrictions and international restrictions to the industry.
  - c) the major needs of the schools and colleges of mines required for them to implement the needs of the mineral industry and of the federal government.
- 2) The mineral industry should attempt to improve its image in the eyes of young people with regard to employment opportunities and the challenges of work in the industry. Institutional advertising may be one approach to this image-building.
- 3) The mineral industry should establish an industry-wide technology clearinghouse whose purpose it would be to:
  - a) identify and forecast technological problems common to the members of the industry and which could be solved by university participation.
  - b) request proposals from university groups who wish to participate in the solution of these problems.
  - c) provide the funds to conduct the research necessary to seek the solution of these problems.
  - d) receive and evaluate ideas and suggestions from university groups toward the development of technology of potential use to the industry.
- 4) Companies within the mineral industry should attempt to aid in the development of academic programs within their interest areas by establishing or partially supporting faculty positions, "chairs," at schools and colleges of mines of their choice.
- 5) The federal government should establish institutional support programs for mineral science and engineering inasmuch as it supports educational programs in agriculture.
- 6) A goal-oriented mineral agency within the federal government, such as the U. S. Bureau of Mines, should develop technical programs in which university faculty and students can participate. Such programs should be related to technical work within that agency and should be monitored by technical people within the agency.
- 7) Working forums should be established for the direct interaction of industry, government and university people on matters of common technical interest whereby ideas can be exchanged and personal contacts made with people of common interests in mineral science and technology.

# MINING EDUCATION IN THE WEST

## report of the

### Western Governors' Mining Advisory Council

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#### INTRODUCTION

Shortage of trained manpower will restrict the mining and processing of minerals in the Western States. The shortage extends from skilled miners to professional engineers. The governors and their staffs are requested to recognize this problem and its implications, to direct thoughtful investigations and to take vigorous actions within their own states and all together in a regional plan.

#### Definition

Herein the term "mining" embraces exploration, development, mining and extractive metallurgy. The term "mining engineering" covers a group of related engineering disciplines such as metal mining, industrial-minerals mining, coal mining, minerals processing, smelting, refining and coal preparation.

#### Discussion

The mining and processing of minerals is a fundamental wealth-producing industry in this nation and especially in the Western States.

The value of raw fuels, metals and non-metals is only about 3% of the United States Gross National Product, but these materials have a direct impact on 40% of the economy and an indirect impact on an additional 35% of the economy<sup>1</sup>. In some Western States the value has great effect; in Arizona, for instance, mining contributes 13% of personal income. To the public the mining industry is nevertheless practically unknown; after all, it employs only about 0.9% of the U.S. working force<sup>2</sup>, it occupies less than 0.16% of the surface area of the U.S. and it operates mostly in remote non-urban places<sup>3</sup>.

The public is beginning to recognize that gasoline does not originate in service-station pumps but is derived from crude oil which, without adequate U.S. production, can be unavailable or expensive. This kind of national recognition will spread to other mineral commodities that are short in supply or expensive or adversely affect our international trade balance.

The nation and the West will need more production of minerals and mineral fuels. This means handling bigger tonnages of lower grade material, mining at greater depths and employing more complex processing, while achieving minimum damage to the environment, maximum reclamation of the land and maximum safety to employees and to the public. It also means finding new deposits, no small chore either technically or politically. It means competing successfully with richer foreign mines supported by foreign governments, and often controlled by foreign governments not necessarily friendly to the United States.

Such complex tasks require highly trained people. The industry (and its associated government agencies) are not getting enough such people. It is not getting such people because:

1. Mining is out of sight of our highly urban society.
2. Mining suffers from a "bad press," unjustified but real.

3. Mining is not discussed by most high-school counsellors as a career opportunity.

4. Mining as a trade is generally neither understood nor taught.

5. Mining engineering as a profession has been declining in the face of increasing need, and we have been closing our mining colleges due to lack of enrollment.

The present dilemma could turn into a future catastrophe. A few reasons: in 1985 we will need twice as many skilled and qualified coal miners as we have today; the demand for graduating mining engineers today exceeds the supply by at least two to one; nobody really knows the shortage of extractive metallurgists and coal preparation engineers. How can the West possibly cope with Western mining problems and new technology without trained mining people?

#### Recommendations

The Western Governors' Mining Advisory Council makes the following recommendations to the Western Governors and their staffs:

1. Improve the mining image. Provide positive support to the mining industry. Incorporate mining into each state's proud assets and publicize such assets. Exert balance in evaluating the inevitable problems involving mining and the environment, to both encourage mining and protect the environment.
2. Develop "mining consciousness" among high-school students and high-school teachers and counsellors. Reveal the opportunities for young people in mining. Such a program should be actively promoted through state departments of education and vocational guidance.
3. Encourage training centers for underground and open pit miners, and for operators of mineral-processing plants, and support the industry in establishing such centers. This is vital in states with burgeoning coal mines.
4. Encourage craftsmen training and apprenticeship programs. Mine craftsmen — mechanics, electricians, hydraulics experts — are needed in ever increasing numbers.
5. Expand two-year technician courses in community colleges. Mining technicians can play a major role in alleviating the shortage of professional people. These colleges can also inspire young people to continue with professional education in mining.
6. The greatest challenge of all is to support and improve the West's mining colleges by innovative regional action. The decline of professional education in mining and extractive metallurgy has been studied and studied, and solutions have been offered by a number of prestigious committees for the last fifteen years but no real changes take place due to total inaction by state and federal governments<sup>4,5,6,7</sup>. Sound answers depend upon top level communication among state officials, University Administrators and mining college deans.

This is a national problem, too. In 1962 the nation had 26 accredited mining engineering schools. Today there are only 17 accredited mining curricula<sup>5</sup>.

Idaho School of Mines has recently escaped a two-year probationary existence, but its situation will be reviewed again in four years. Montana Tech has just survived by a 15 to 13 vote of a special Montana Commission on post-secondary education so its future is shaky indeed. Almost every Western mining college is in trouble.

It seems inconceivable that no complete mining engineering program is offered in any public four-year college in the great states of California, Oregon and Washington, with a population of about 30,000,000 and substantial minerals industries. (Several Pacific Coast universities do offer curricula in geology, metallurgy and "materials engineering.")

Each Western mining college faces some combination of the same problems: Inadequate enrollment, lack of operating and capital funds, substandard faculty salaries and consequent shortage of faculty, insufficient graduate programs and insufficient research — sometimes leading to threats of closure or to amalgamation into other State engineering colleges, which history demonstrates is tantamount to closure. Furthermore these problems prevent out-reach into the states to stimulate mining, offer post-degree courses and assist in the lower levels of training for the industry. And this in the face of dire need for every service which can be offered by first-class mining colleges!

Recommendations on mining colleges are:

- a. Active recruitment of students based upon improved understanding in the secondary system and drawing upon a growing two-year associate-degree program.
- b. Improved funding of the mining institutions. Such funding must come from State, Federal and industry sources, as well as from tuition and fees.
- c. More scholarships for mining students.
- d. Extension of the existing "Mineral Engineering Student Exchange Program," sponsored by the Western Interstate Commission for Higher Education. "Essentially, the exchange agreement allows a student from one participating state to apply for admission at a school of mineral engineering in another participating state for 'in-state' or 'resident' tuition rates."<sup>8</sup> (The Mineral Engineering Exchange Program is presently effective among Alaska, Arizona, Idaho, Montana, Nevada, New Mexico, Utah and Wyoming.)<sup>8</sup> This exchange idea is already being expanded to include states with no mineral curricula at all; thus an Oregon high-school student who wants to go to the College of Mines in Idaho can be exchanged for an Idaho student who wants a curriculum at an Oregon state university not offered in Idaho.
- e. Finally, encourage mining and mineral processing research, and therefore graduate programs, through special industry, state and federal funding to prepare future faculty in minerals engineering, to solve the immensely complex technical problems now either unsolved or yet to be recognized, and to provide the training of technical people who are capable of solving such problems.

#### FOOTNOTES

1. *What Mining Means to the United States*, American Mining Congress, Washington, D.C., (1972)
2. *What Mining Means to the United States*, American Mining Congress, Washington, D.C., (1972)
3. *Land Utilization and Reclamation in the Mining Industry*, 1930, 71. L.C. 8642, Bureau of Mines, U.S. Department of the Interior (1974)
4. *Report of Materials Advisory Committee on Metallic Minerals*, NMAB-158-M, National Academy of Sciences, Washington (1959)

5. *Mineral Science and Technology*, National Academy of Sciences, Washington, D.C. (1969)
6. *Mineral Engineering Education in the West*, Western Interstate Commission for Higher Education, Boulder, Colorado (1969)
7. *Elements of a National Materials Policy*, NMAB-294, National Academy of Sciences, Washington (1972)
8. Western Interstate Commission for Higher Education

#### APPENDIX

##### INTRODUCTION

This appendix discusses some examples of significant actions now effective in mining education, providing inspiration for more widespread and complete programs. Some other notes are also appended.

##### 1. Image

The mining industry is striving to improve its own image. Examples:

Some sections of the Society of Mining Engineers of A.I.M.E. maintain speakers' bureaus to explain modern mining to various groups.

American Mining Congress works diligently in the field of public relations for the mining industry and makes a variety of promotional materials available.

The mining associations in a number of Western states also do public relations work for the industry. Yet environmental groups in these states are enthusiastically supported and far more vocal, thus offsetting the efforts of mining-oriented organizations.

Southern California Rock Products Association and Southern California Ready-Mixed Concrete Association sponsor "Environmental Resource Centers" for observation of actual operations, seeing a film and participating in a tour.

Kennecott Copper Corporation at Bingham Canyon, Utah maintains a tourist observation platform with multi-lingual loud-speaker explanations of operations. (Most copper-mine operators in Arizona have similar programs.)

##### 2. Mining Consciousness

The American Institute of Mining, Metallurgical and Petroleum Engineers offers career booklets and encourages its members to talk about its professions in high schools.

"A Total Concept of the Mining Industry" is a program jointly sponsored by the Colorado Mining Association and Colorado School of Mines which for six years has provided up to 40 secondary school teachers each summer with a working knowledge of the mining and metallurgical industries. Industry provides the funds and many of the lecturers and field trip leaders.

Mackay School of Mines, University of Nevada, with substantial industry help, sponsors a summer course of about the same size entitled "The Mineral Industry and Society."

The Mining and Metallurgical Society of America is underwriting a similar program at Montana School of Mines.

Earth science courses are starting to be taught in high schools, stimulated particularly by efforts of the American Geological Institute.

### 3. Training Centers

College of Eastern Utah at Price offers comprehensive curricula for coal miners.

U.S. Department of Labor conducts a mining training school at Sells, Arizona.

Arizona College of Technology, Mammoth, Arizona offers mining oriented trade skills.

Colorado and U.S. Bureau of Mines provide a miner-training entry-level program at Colorado Mountain College, Leadville.

A Colorado/Federal funded manpower training program exists at Delta-Montrose Area Vocational Technical School, primarily for coal miners.

The high school at Wallace, Idaho offers vocational training in mining to its students.

Note: The British Columbia Mining School at Rosland every year graduates 120 students from a course for open pit equipment operators and 96 from a course for underground miners. All find jobs. The school is supported by federal, provincial and industry funds.

### 4. Mine Craftsmen Training

Many mining companies are cooperating with government and unions in apprentice programs.

Arizona College of Technology, Mammoth, teaches mining oriented trade skills.

Butte Vo-Tech has similar courses.

Salt Lake City vocational schools provide trade courses oriented towards the great mining plants nearby.

### 5. Technical Training

University of Alaska, Fairbanks, offers one-year certificates and two-year associate degrees in mineral and petroleum technology.

Community College of Denver, Red Rocks Campus, offers a two-year program in Mineral Industry Technology.

Sierra College, Rocklin, California, gives an AA degree in mining after a two-year course.

College of Eastern Utah offers a growing two-year program emphasizing coal-mining technology.

In Pennsylvania, West Virginia and Ohio, the states, the universities, the federal mining agencies, the companies and the UMW are cooperating in a whole series of exciting new educational programs for coal-miner training, education and certification. The University of Pittsburgh has even reactivated its mining engineering curriculum.

To encourage mining technician training the Society of Mining Engineers of A.I.M.E. is planning to establish student associate clubs in such institutions, to offer junior associate memberships to two-year graduates and to continue offering associate memberships to mature technicians.

### 6. Mining Colleges

Eight colleges teaching mining engineering in 12 Western states are:

- o School of Mineral Industry, University of Alaska;

- o College of Mines, University of Arizona;
- o Colorado School of Mines;
- o College of Mines, University of Idaho;
- o New Mexico School of Mines and Technology;
- o Montana College of Mineral Science and Technology;
- o College of Mines and Mineral Industries, University of Utah;
- o Mackay School of Mines, University of Nevada;

To this should be added:

South Dakota School of Mines and Technology.

No complete mining programs are offered in the States of: California, Oregon, Washington, Wyoming.

A mining engineering education is more costly than a liberal arts education and should rather be compared to medicine and law in cost even though mining engineering is a highly compressed four-year program.

Mining companies have formed the Minerals Industry Education Foundation which is providing funds to students entering and remaining in mining and metallurgy curricula, with additional funds to the University for high-school recruitment.

An increasing number of mining colleges are offering cooperative education programs whereby students alternate semesters (or quarters) at work in mineral industry plants with study at college. Although the training received in such programs is valuable to the student, the main purpose is to give him a chance to earn money to stay in school — but at the expense of an extra year or more before graduation.

Mining companies and executives have generously endowed colleges of mines with scholarships and student loan funds and some chairs for professors. The problem is that industry alone cannot do the whole job and should not be expected to do so.

The Woman's Auxiliary of the American Institute of Mining, Metallurgical and Petroleum Engineers supports an active scholarship program, constantly raising money through various activities as well as helping to recruit students through their "Engineers for Tomorrow" program.

A number of private scholarships are available, such as the Browning Scholarships at the University of Utah College of Mines and Mineral Industries and the Jackling Scholarships at several Western colleges of mines.

The question is often asked: Why mining colleges? The implication is that mining engineering and its associated disciplines have no more reason to be separated than, say, mechanical engineering and its associated disciplines. The answers are several. Mining curricula, dealing as they do with an entire basic industry, require a unique combination of studies. The mining geologist cannot be satisfied simply with a good geological education; he must also understand how the minerals he finds can be mined and processed. The mining engineer must interpret the geology of the deposit he mines and know something about how the ore will be treated. The extractive metallurgist must understand the mineralogy of his ores and how they were handled in the mining operations. This linkage among the various disciplines is the reason mining schools as separate entities are essential. Furthermore, the mining "community" has an unusually strong identity of its own and consequently supports mining colleges so vigorously.

A major change in mining engineering curricula is under way. The graduate mining engineer was formerly trained as an engineering generalist who could take his handbooks with him into remote corners of the earth and establish a mine and concentrator and whatever else was needed. Today he is much more of a specialist, with training in such disciplines as rock mechanics, computer sciences, operations research, labor relations, advanced chemistry and mathematics, mine safety, land reclamation and other courses equipping him for expert application of mining knowledge under more rigorous technical and legal requirements, and no longer isolated from this world's ecological system.

## Exhibit E

The good news: student enrollment is increasing, and starting salaries are up. The bad news: there's a faculty shortage; more mining schools are plagued by financial problems; and mining curricula accreditation needs overhauling.

## Mining Education in Turmoil

Ta M. Li, Technical Editor

A record 340 senior students with majors in mining and mineral engineering from 21 schools in the US may be expected to enter a manpower-hungry mineral industry in 1975. While starting salaries may have been the deciding factor in job selection in the past, 1975 graduates will find salaries almost the same in most mining sectors.

Meanwhile, the survival prospects of various mineral engineering schools had the usual ups and downs in 1974, but tightening state budgets could still take a toll in reducing the number of schools offering mineral engineering degrees. Two such schools on the endangered list include Montana College of Mineral Science in Butte, Mont., and the College of Mines, University of Idaho, in Moscow, Idaho.

On the other hand, projected increases in US coal production seem to have resurrected mining programs at the University of Pittsburgh. Graduates with "mining concentrations" are expected by 1977.

Potential federal aid to mineral education has again been stalled: this time, aid was specified in the recently vetoed Surface Mining Bill (S.425, Title 3). Many educators expect early resurrection of the bill in the 94th Congress.

More relevant curriculum proposals have been suggested, and Engineers Council for Professional Development (ECPD) accreditation of current undergraduate programs has come under somewhat closer review.

### Demand for Coal Engineers Hikes Salaries

Based on reports by many educators, the graduating class of 1975 will find the employment field wide open. The great majority of the positions available appear to be in the coal industry. In recent years, coal has been the pacesetter in advancing starting salaries for mining engineers. As one recent graduate explains, "Salary



O'Neil: "The engineering department is a dead end at many mining operations. Once the engineer goes into production, it's unlikely that he will return to the engineering office."

incentive was necessary to bring mining engineers into the coal industry." So large is the demand for coal engineers, says one educator, that "the coal industry could use all the 1975 mining graduates, if it could get them."

The average starting salary offered by coal companies is between \$1150 and \$1250 per month, according to a variety of sources. With related summer experience, \$1400 per month is not unrealistic, says a mining professor.

With so many graduates lured into the coal business, however, there's a looming shortage of mining engineers in the hardrock industries. As a result, to remain competitive, hardrock firms have been reluctantly raising their salary scales. ME's spot check across the country reveals that although the recent glut in copper production has reduced the number of positions available in that industry, salary scales remain fairly firm. In fact, salaries in the Southwest may be only \$50 per month less, according to one recruiter. Additional calls to firms in iron-producing areas indicate salary parity with the coal companies.

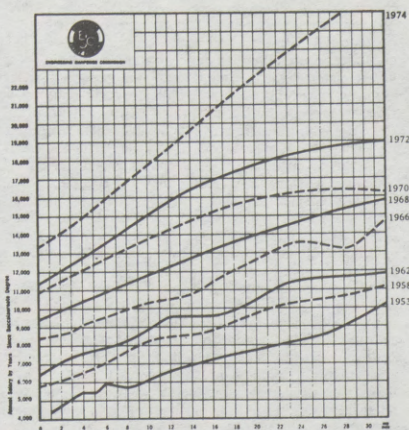
When queried about the salary situation, an industrial minerals producer bluntly stated that "... with starting salaries at this level, my company isn't going to hire these high-priced kids," and that his company's specific requirements for mineral-trained graduates would be filled by civil engineers or geologists in 1975. The fact that mining starting salaries are around \$100 per month higher than any other engineer is "ridiculous," he said.

### Technical Employment Opportunities

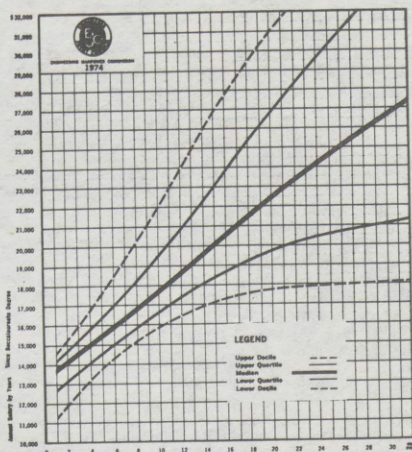
A mining engineer's first assignment has changed significantly in recent years. Very few, if any, mining firms are giving graduates the "muck stick" or surveying assignments. The days of a long formal training program may soon be a thing of the past. One firm, for instance, has reduced its program from two years to four weeks. Vernon Scheid, Dean Emeritus of Mackay School of Mines in Nevada, points out that industry cannot wait two to three years before putting a graduate to work.

For the most part, graduates are entering directly into engineering assignments. While the engineering departments are a good place for initial training, Prof. Thomas J. O'Neil of the University of Arizona notes that "... the graduate will soon see that this area is a dead end at many mining operations. Once the engineer goes into production, it's very unlikely that he will return to the engineering office." O'Neil explains that, "Returning to the engineering department may mean a re-learning of engineering, accepting reduced responsibility, and most likely receiving a lower salary. To the young man, it will appear as if he'd been demoted." Yet, ironically, the need for advanced mining engineer-

Mining Industry Medians



Salaries of Mining Engineers



## Recent Salary Trends in Mining Engineering

The recently published survey "Professional Income of Engineers—1974," by the Engineering Manpower Commission (EMC) reveals significant improvements in salaries for mining engineers. For instance, miners with five

years experience had a median salary of \$15,500 according to the 1974 survey—up about 20% from the previous study.

But John Alden, EMC executive secretary, questions the reliability of the

mining curves. For example, while the number of engineers covered increased from the 1972 study, the new survey doesn't include any coal companies. Many recruiters complained that the results were ridiculously low, but were the only available data.

work is plainly evident. The number of engineers earning a comfortable living as consultants in, say, pit-slope stability alone is impressive—to say nothing of consultants in computer applications, rock mechanics, and environmental planning. As an incentive, O'Neil suggests that firms should consider creating an engineering promotion ladder similar to the operations ladder in salary, responsibility, and authority. The technical superintendent should hold a position as financially rewarding as that of other superintendents, and he should be equally qualified for promotion. Movement between operations and engineering should be unhindered, because any two candidates for the positions of either technical or operations superintendent, might have very similar backgrounds after all. The technical staff should be encouraged to publish and contribute to professional meetings.

O'Neil also points out that it is very difficult to find experts in mining technology who can speak persuasively on public issues affecting the industry, or who are willing to participate in interdisciplinary decision groups in public affairs. "Industry sorely needs individuals of this type. A strong engineering staff would encourage a man in this type of personal development," says O'Neil.

### Mining Schools Report Jumps in Enrollment

Meanwhile, back on the campus, enrollments in mineral-related engineering curricula continue to climb. John Hoskins of the University of Idaho explains the dramatic enrollment turnaround from the '60s: "Ad-

verse publicity associated with mine 'disasters' and environmental problems have stimulated enrollment among young people who want to be problem-solvers." Also, stepped-up recruiting efforts by mining schools have succeeded in boosting enrollments.

Finally, the greater availability of financial aid programs—developed by individual mining firms, SME-AIME, and other programs such as the Mineral Industry Education Foundation (MIEF)—has assisted mining schools. Support is usually in the form of scholarships, loans, and summer jobs. For instance MIEF, initiated in 1972, has awarded 176 scholarships to 12 participating schools in the academic year 1974-75. Included in the program is an additional recruiting grant for schools to search for potential talent from regional high schools and junior colleges. A total of 18 mining, equipment manufacturing, and consulting firms contribute to the fund and offer summer jobs to scholarship recipients. J. E. Thompson of Newmont Mining Co. serves as MIEF chairman.

As an educator puts it, "... financing an undergraduate's mining education with a scholarship-loan-and-summer-job package is no longer a major problem in public mining schools."

### Enrollments Are Up—and So Are School Problems

Ironically, while student enrollments are steadily climbing, the number of schools offering degrees in mineral engineering may have yet to bottom out. Of the 21 schools in operation, 20 are "land grant" or state colleges. Traditionally, as education budgets were trimmed,

boards of regents almost always focused on mining programs as the first to go because of the traditional low enrollments in mineral-related curricula, and misunderstandings by non-mineral personnel serving the state agencies. Perhaps the growing US demand for minerals could reverse this trend; but still, two schools—Montana College of Mineral Science and Technology, and the University of Idaho's College of Mines—came under fire in 1974.

In both cases, excessive costs per student have been cited as the primary factor. In a staff report to a Blue Ribbon Commission of Higher Education, Montana Tech would have been reduced to a junior college with its engineering functions transferred to Montana State University; and the University of Idaho's College of Mines would merge with the College of Engineering.

Bunker Hill Co. and the Idaho Mining Association plan to fight the proposed merger in the Idaho Legislature. In Montana, after extensive testimony from local mining firms and leading faculty members, the commission finally recommended that the college and its programs at Butte be retained.

Meanwhile, the Department of Mining at the University of Washington will close its doors in December 1976, according to faculty member Donald Anderson. Some courses in mining will be offered by the Department of Metallurgical and Ceramic Engineering and other departments. When asked about the possibility of restoring mining curricula, Anderson told ME: "Federal legislation, such as written in the recently vetoed Surface Mining Bill, was our last hope. If and when similar legislation is adopted, we'll submit a proposal to reinstate mining at Washington University."

On the brighter side of the picture, the University of Pittsburgh's Board of Trustees approved the reactivation of a curriculum in mining engineering by the School of Engineering effective in the 1974-75 academic year. The mining program, directed by newly appointed John W. Jones and administered through the Civil Engineering Department, will train engineers for the coal industry. Both graduate and undergraduate programs are planned. Jones reports that the first graduates are expected by 1977, adding that the current energy crisis and the revitalization of the manpower demands in mining are prime factors in Pitt's return.

### The Faculty Manpower Shortage

Climbing enrollments have triggered a surge in demand for teachers. "There are at least 12 faculty vacancies in mining schools today," reports Thomas J. O'Neil, "and to fill the gap, some schools have reluctantly accepted faculty members from related disciplines such as geology, civil engineering, and mechanical engineering—or lowered the necessary teaching qualifications in terms of degree level or engineering experience normally required of faculty members."

In examining the factors behind this shortage, O'Neil points out that most universities during the past 25 years have made a doctorate degree virtually mandatory for a faculty member. A lack of industrial employment opportunities for holders of advanced degrees in mining engineering, however, has discouraged students from pursuing graduate degrees. In 1973, for instance, an estimated nine students received doctorate degrees in mining engineering. Thus, the potential pool from which a mining faculty can be drawn has been shrinking, says O'Neil.

Faculty promotion and tenure decisions generally hinge on creative work or research accomplishment. "In the absence of opportunities to perform applied research and other work, faculty members either stag-

nate or move on to other fields," says William Dresher of the University of Arizona. Both situations have certainly occurred in past years. Two specific factors are described by Dresher:

- The mineral industry itself conducts little research compared to other industries. (R&D between 1958-69 was less than 1% of sales.) It therefore contributes little to universities for research and has little need for graduates with advanced degrees and R&D skills.
- The federal government has not assigned mineral engineering problems a sufficiently high priority to warrant extensive funding programs. Apparently, solutions to mineral engineering problems are not considered to be a part of "defense," "space," or the "Great Society"—three areas of federal concern in recent years. And although warnings regarding mineral supply shortages began in earnest as early as 1952 with the Paley Commission's report "Resources for Freedom," no substantial federal funding has been established either for general institutional support or for research in mineral engineering disciplines.

A possible solution to the faculty manpower shortage has been outlined by O'Neil in his project entitled "Mining Engineering Faculty Development Consortium" (Minfac), which would be a trial program, over a seven year period to increase the number of faculty (see box). Minfac would include members from industry, government and education who would award fellowships for doctoral study in mining engineering and plan a comprehensive educational experience for the fellows. The estimated cost, if shared on a 50-50 basis, would be \$494,000 to industry. If ten firms participated, each firm's average annual contribution would be about \$7,000.

O'Neil suggests a one-year examination to review the Minfac concept with all interested parties. Assuming the resulting reaction is favorable, the details could then be worked out to convert Minfac into a viable program. He estimates the cost of the preliminary examination at about \$20,000. There is little question that the various parties would agree that urgent action is required. Although the final result might deviate considerably from the Minfac proposal discussed, this concept provides at least a good starting point and working document to insure a plan of action at an early date.

### ECPD vs Mining Educators: Who Controls Curricula?

Although all engineers must take a common base of certain scientific and engineering subjects, Vernon Scheid points out that there is a great difference in mining's technical fields. "Conventional engineers (civil, mechanical, and electrical) are concerned with force and energy, while mineral engineers deal with materials and processing," says Prof. Scheid. "The resulting curricula should be considerably different." But the Engineers' Council for Professional Development (ECPD) has different ideas, according to Scheid.

ECPD, through its Engineering Education and Accreditation Committee (EE&A), sets up basic standards for undergraduate engineering curricula. Membership in ECPD is comprised of representatives of the various professional engineering societies in the US. ECPD's purpose of accrediting, as noted in its objectives, "is to identify those institutions which offer professional curricula in engineering worthy of recognition as such." ECPD is recognized by the National Commission of Accrediting (NCA) as "the sole agency responsible for accreditation of educational programs leading to degrees in engineering." As stated in its policies, ECPD can be expected "to deny accreditation to programs which omit instruction in a significant portion of a subject in which engineers in a particular field may reasonably be ex-

## The Minfac Program

- 1) Six (6) fellowships would be awarded each year (one per year at each of six participating universities) for five years. The stipend would be \$6000 per academic year plus a \$500 allowance per dependent. Tuition and fees would also be paid. The maximum duration of each fellowship would be three years.
- 2) If the recipient does not enter mining engineering education after graduation, he must repay one-half of the total amount of his fellowship. For each year spent in mining education, his liability would drop by one-third. That is, after three years, there would be no penalty for leaving education.
- 3) The Minfac Council would consist of six members each from industry, government, and education.
- 4) Applications for the fellowships would be solicited widely. The Minfac Council would review such applications, and the top 15 would be interviewed personally by the Council.
- 5) A national seminar would be held once a year for the Council, Minfac Fellows, and other leaders from industry, government, labor, and environmental organizations. This would involve two days of intensive discussions on technical and social topics, and field trips to mining operations. The location of the seminar would be rotated to give the Fellows exposure to a variety of mining engineering problems (e.g. Pennsylvania coal, Arizona copper, Idaho lead-silver).
- 6) Participating companies will provide summer employment for the students and data for dissertation research

if possible. An ideal program for a student with no industrial experience would be a three-year program with the same company:

- 1st —rotating labor jobs.
  - 2nd —engineering employment.
  - 3rd —dissertation related work.
- 7) Universities should provide maximum flexibility for Minfac Fellows in regards to M.S. degree requirements, residency, language requirements, etc.
  - 8) Member universities should encourage reciprocity between mining engineering schools whereby a student at one institution could finish his dissertation while holding a full faculty position at another school.

### Estimated Costs of Minfac Trial Program

The table below shows the estimated costs of the five-year trial program. Expenditures would actually be spread over seven years due to the three-year commitment made to the Fellows selected in year 5.

	Yrs. 1 & 7	Yrs. 2 & 6	Yrs. 3, 4, & 5
Fellowships @ 6750 ea. avg.	\$40,500	\$81,000	\$121,500
Tuitions & Fees	12,000	24,000	36,000
Interviews & Seminars	15,000	20,000	25,000
Administrative Support, Advertising	8000	8000	8000
<b>TOTAL COST YEARS (1 to 7) =</b>	<b>\$75,500</b>	<b>\$133,000</b>	<b>\$190,500</b>

pected to have competence. This policy is intended to be a safeguard to the public. It should not entail the setting of rigid standards."

As is the case, Scheid believes, ECPD requirements governing curricula at mineral schools leave very little space to adequately develop mineral engineering programs. "Changing policy is not easy," Scheid says. For some 40 years, he explains, ECPD has been and is still controlled by the conventional engineers. They have three votes and control several other votes in the top councils of ECPD. He adds, geological, mining, and metallurgical engineers, concentrated as they are in AIME, have but one vote. Furthermore, the mineral interests are consistently outvoted on issues, many of which affect only mineral engineering. Scheid concludes that conventional engineers usually insist on the requirements for their profession at the expense of mineral education.

To resolve the issue, Scheid suggests two alternatives to the mineral industry schools:

- (1) Allow AIME to break away completely and accredit the mineral engineering schools, or
- (2) Stay within ECPD with a written agreement that AIME shall do the accrediting and have the final word. Scheid questions whether such ideas can be accepted, but in all too many instances, the value of ECPD in assisting mining programs has certainly been cloudy.

### Federal Aid to Mining Schools

For the second time, financial aid to mining schools has been vetoed. This time, aid was specified in the Surface Mining Bill (S.425, Title 3).

The provision authorized grants on a matching basis (\$200,000 for 1975, \$300,000 for 1976, and \$400,000 per annum thereafter for five years) to each participating state "to assist in carrying on the work of a competent and qualified mining and mineral resource institute at one public college or university." If a state "does not have a public college with an eligible school of mines," a private college would be designated. Additional funds (\$15 million in 1975) would be appropriated for "specific

mineral research and demonstration projects of industry-wide application" to the qualified institutes.

An appointed Advisory Committee on Mining and Mineral Resources Research would determine eligibility of various schools. That committee would have consisted of the USBM director, USGS director, president of the National Academy of Sciences, president of the National Academy of Engineering, or their respective representative, and "not more than four other persons knowledgeable in the fields of mining and mineral resources research, at least one of whom should be a representative of working coal miners."

Mining schools have reported mixed feelings with regard to the bill's re-introduction. One educator says the provision was included in S.425 to rally faculty support for the controversial Surface Mining Bill. On the other hand, a federal source notes "the recognition of a professional manpower shortage in the mineral industries prompted us to include aid in what could be considered the most likely to pass legislation. In that respect, S.425 was indeed that bill, or so we thought."

Most educators believe that the federal aid provision will be reintroduced in the 94th Congress, but are not saying what form it may finally take.

An interesting aspect of pending federal aid to mineral resource development has been the subtle revival of mining across the country in the form of "energy research centers" and other programs, says one mining professor. A recent item in the *Wall Street Journal* titled "New Energy Courses Help Colleges Attract Research Funds" lists some of the programs popping up all over the country. As one mining professor explains, "Everyone knows that any form of aid to mineral schools, to be passable, may have to provide grants to every state of the union." In light of an already existing faculty shortage in minerals engineering education, he wonders if this approach isn't further thinning the ranks. "I'm afraid that the centers-of-excellence concept (i.e., the existing 21 mining schools) won't survive in the political arena," he concludes.

Senator METCALF. Gentlemen, I think this is a relatively simple bill. Before I go ahead with Senator Hansen, I want to discuss how we are going to handle this. Mr. Sadat will address a joint session of the Congress at 12:30 p.m., so we probably have to recess this by 12:15 p.m.

A certain series of questions have already been raised and I think the reason that we have you outstanding leaders in coal research in the academic community is to have your response in various areas to these questions.

One question is the criteria involved that Senator Hansen and Senator Moss discussed. I discussed this a little bit yesterday with the panel from the administration. I wonder if we could just let all of these people go through with their testimony, Senator Hansen, and then we will ask them the questions that I will be repeating to every other panel and each of you can comment as you see fit.

We have Dr. Roy Huffman from Montana State University. Dr. Huffman, it is nice to have you before the committee again.

#### STATEMENT OF DR. ROY HUFFMAN, VICE PRESIDENT FOR RESEARCH MONTANA STATE UNIVERSITY

Dr. HUFFMAN. Thank you, Mr. Chairman and Senator Hansen.

I am Roy Huffman, vice president for research in graduate studies at Montana State University. This statement, as you know, is concerned with S. 62, a bill to establish university coal research laboratories and to establish energy resource fellowships and other purposes.

The need to develop energy resources in the United States and the obvious importance of coal in this regard indicates the timeliness of the Coal Research Laboratory and Energy Research Fellowship Act. This proposed legislation recognizes the importance of research on coal conversion technology and associated environmental problems. In addition, it provides for graduate study and research in those areas of applied science and engineering related to the production, conservation, and utilization of fuels and energy.

We have a special interest in research and education of the kind proposed in this legislation because of the tremendous coal resources in Montana and other portions of the Fort Union Basin. The complex problems associated with the production, conservation, and utilization of coal energy requires expansion of appropriate research and education resources.

S. 62 provides for the establishment and operating of coal research laboratories. The proposed legislation seems to describe a coal research laboratory as a very specific site involving specific physical facilities. I suggest that the concept of the coal research laboratory should be broadened to include situations where it is first for a laboratory involving several university campuses may be appropriate.

I refer to the arrangement in Montana with regard to the Water Resources Research Act of 1964. The Montana University Joint Water Resources Research Center involving research scientists facilities on the campus is of three universities. Integration of the resources of several university campuses into a coal research laboratory will make possible more efficient use of existing faculty expertise and a wide variety of disciplines related to coal energy problems.

Much of the need for research is interdisciplinary in scope and this is scattered over several campuses. It would seem desirable to make the broadest possible base of expertise in disciplines related to coal research and this is likely to happen on a multicampus basis.

Coal energy related research requires application of a broader array of disciplines concerned with research conservation and environmental problems. Several of the applied disciplines in agriculture are involved in land reclamation research related to strip mining of coal in the Fort Union Basin.

S. 62 lists a number of disciplines related to interdisciplinary research problems. With regard to problems of conservation and environment, the disciplinary college at the end of the list will be broad, indeed, to include the disciplines not mentioned. There are several disciplines in the biological and social sciences. There may be situations where the dispersed coal research laboratory on several campuses in one State should be expanded to consider any State or regional structure.

Again, such structure may realize the most efficient and effective use of existing resources and treat it to a more prestigious coal energy research laboratory.

Title 2 of S. 62 provides for energy resource graduate fellowships and may well be one of the most significant pieces of educational legislation in the recent history of the United States. The extreme national importance of the energy situation in the United States and the many unsolved problems suggest the need for additionally trained people in a variety of disciplines related to coal conversion and the many social problems.

In view of the many problems involving applied research, limitations of fellowships to graduate with masters degrees is also a strong point in the education imposed in title 2. Scientists who have trained at the masters degree level usually have general interest in applied research.

The preeminent position of coal in the national energy framework suggests many other forms that could be added to this statement. I do want to emphasize one major point. I urge that the wording in S. 62 allowing considerable variation on how coal research laboratories are structured. If provisions of the legislation are too restricted, an appropriate structure for a particular situation might be ineligible for approval and funding.

Thank you.

Senator METCALF. Thank you very much, Dr. Huffman.

Mr. Orth, I understand that you are the substitute this morning.

Mr. ORTH. Yes, sir; I am appearing on behalf of Dr. Jerry Plunkett, managing director of our Montana Energy Institute. Dr. Plunkett is indisposed and has asked me to appear with your permission to present his summary and deliver his complete testimony and comment which you requested.

Senator METCALF. I understand that Mr. Plunkett physically fell off a ladder. This weekend, a lot of people intellectually fell off a ladder down at the other end of Pennsylvania Avenue.

Mr. ORTH. Yes, sir; Dr. Plunkett is in full possession of all of his intellectual faculties, I can assure you of that, sir.

Senator METCALF. Thank you very much for coming, Mr. Orth, and go right ahead.

**STATEMENT OF DR. JERRY PLUNKETT, MANAGING DIRECTOR,  
MONTANA ENERGY INSTITUTE, AS PRESENTED BY JOHN ORTH,  
DEPUTY MANAGING DIRECTOR, MONTANA ENERGY AND MHD  
RESEARCH AND DEVELOPMENT**

Mr. ORTH. Thank you, Mr. Chairman, members of the committee, ladies and gentlemen. I appreciate the opportunity to be present to give testimony in support of Senate bill 62.

This legislation addresses a critically important national and regional problem at a fundamental level. The Nation's coal reserves must be used to fill the energy supply gap created by declining domestic petroleum and natural gas production. In addition, expanded coal production will be needed to reduce our unwise dependence on imported petroleum with its attendant loss of national security and its drain on our foreign exchange.

The United States has come face to face with a situation that concerns the lifeblood of an industrial society, namely the shortage of energy. Coal cannot be developed without trained professional and technical manpower and certainly it cannot be utilized in an environmentally and socially acceptable fashion unless the Nation first produces the professional people needed in large numbers and on a crash basis.

I believe this should be the principal thrust of S. 62, the inherent linking of research facilities. Research and education is the strength of this legislation. Based on my study of incomplete poorly characterized and even contradictory employment data which exists for the coal industry and for its projections for the future, it appears that a minimum of 12,000 professionally trained technical personnel will be required in 1975-85 timeframe for the acceptable expansion of coal production.

In order to provide these professionals, I recommend a minimum of 20 coal research laboratories with the attendant graduate programs be established under the provisions of this legislation. The ghost towns of the West are silent reminders of the instabilities which characterize the first 100 years of mining in the West. Even today, mining cutbacks threaten to make my present home of Butte, Mont., the largest ghost town in America unless a new economic foundation can be established quickly.

Many people earning their living from agriculture, ranching, tourism, and commerce in the mountain west and Great Plains area regard coal development as a direct threat to their well-established way of life. The boom and bust atmosphere of mining towns with their associated evils are unacceptable to these people.

Instead of a new economic day, increased coal production is generally regarded in the West as a return of an old curse. They view with alarm any activity that disrupts the land and draws off water that may be required for future agricultural production.

For the first 100 years, the Federal Government assisted the West by developing water and transportation systems. The exploiters and despoilers were absentee owners who manipulated the lives of hard-

working people in ways that seem unbelievable by today's standards.

Now the coal resource areas and their—the inhabitants of the coal resource areas are afraid that the Federal Government will side with those who would wreck, ruin, and rape the West in a wild carnage of energy production. Indisputably, energy production through coal development in the West is a national imperative. The beautiful reclamation areas of Germany, northern Illinois, and even our own Montana suggests that coal can be extracted without permanently scarring the land.

Yet, there is legitimate concern in the West that industrial spokesmen will argue that reclamation is not feasible because we lack sufficient number of trained professionals. I talked with a rancher one night in a roadside cafe near Hardin, Mont. He stated that coal development would be the ruination of the area and most of the fellows getting the high paying jobs were not residents and have no intention of making Montana their home.

I have made a brief survey of the coal research contracts let to date and my observations support his statement. Only a handful of these contracts have been granted to universities and research organizations in the States most directly affected by the coal industry. Apparently the people in the West will get the dirty work and debris of the industry while good clean laboratory jobs will go to large firms and universities in the East and Far West and existing Government laboratories.

I head what is probably the largest single coal research and development organization in all the West at the present time. I am besieged daily by representatives of Government laboratories and by representatives of private firms, none located in our area, who present strong cases why they should be assigned certain research projects in our program. Most of these groups want to shift their activities from nuclear programs to coal research areas but they want to do it in the places they are currently located.

However, I strongly believe that there is a great deal to be said for professional people living and working in the area most directly affected by their work. Absentee technology is not likely to be anymore protective of the West and its traditions than any other type of absentee influence.

I strongly urge the passage of this bill with the recommendations made in my more complete testimony which I have already submitted to meet the needs of the Nation, the coal industry and the coal resource regions.

Thank you, Mr. Chairman, for the opportunity to present my views to your committee.

[The prepared statement of Dr. Plunkett follows:]

STATEMENT OF JERRY D. PLUNKETT, PH. D., MANAGING DIRECTOR, THE MONTANA ENERGY AND MHD RESEARCH AND DEVELOPMENT INSTITUTE, INC.

1.0 INTRODUCTION AND NATIONAL OVERVIEW

Senate Bill 62 represents a positive step toward a long needed systematic approach to solving the technical and manpower problems of the coal industry. Coal must play a major role in meeting this nation's energy needs for the intermediate future. President Ford has called for the opening of 250 new coal mines by 1985 and has proposed that 150 electric power stations burn coal. The 1985 target calls for doubling the current annual coal production of 590 million tons. While we have an adequate supply of coal for the immediate future (the reserves are estimated at 1.6 trillion tons--more than eighteen times the known Arab oil reserves), most of it cannot be mined with present coal technology. The amount which can be utilized with current methods may be as little as five percent so none should be used inefficiently or wasted. Therefore, the role coal will occupy in our energy program will depend primarily on our success in developing new mining and utilization technology and in solving problems of extraction, processing, transportation, conversion, and financing.

The lack of adequate modern technology is indicated by the high accident rate of the industry, the historic lack of environmental concern, and the inability to either mine or burn much of our coal in a socially acceptable manner. This technological deficit has grown from a combination of industry inability and government inaction.

Low prices and the small scale of many coal industry firms has meant that little funding for improved technology has been available. Rogers Morton commented in 1973 that the Federal government and the coal industry

itself have not taken as aggressive a role in funding, originating and perfecting new coal technology during the last decade as they should have.

Federal R & D policy and funding has strongly favored a single new energy source--nuclear energy. This early narrowing of technical options combined with the current failure of nuclear energy to meet its promise have resulted in a lack of appropriate coal technology just when it is most needed. Despite these technological limitations, coal represents one of our largest potential resources of energy. Oil and natural gas sources continue to dwindle and prospects for finding more are not encouraging. Technologies utilizing renewable resources for certain uses are some years away from meeting our energy need. Therefore, research and development in all areas of coal technology must receive a larger area of our efforts, funds, and expertise. This intensified concern is reflected in the increased federal funding proposed for coal research and development. ERDA's director, Dr. Robert Seamans, has said that "ERDA's most significant impact during the next decade or two should be felt in the tremendous expansion and improvement in the production and utilization of coal." The Dartmouth Project on the Dynamics of Long-Term Resource Availability suggests that accelerated research programs are necessary to assure coal's place as an important transitional fuel. Manpower requirements of the coal industry are certain to grow, and the number of men and women skilled in the new coal technology must increase substantially.

In our discussions of the current energy situation it is important to keep in mind the following: "The basic energy problem facing the U. S. and other industrialized nations is not to secure independence from foreign energy suppliers. It is to negotiate an orderly transition from primary reliance on fossil oil and gas resources to energy sources not tied to

finite fuel reserves." Although ultimate energy sources such as nuclear fusion, solar, wind, ocean thermal gradient, bioconversion, and geothermal are attractive alternatives to oil and gas, they probably will not provide more than twenty to forty percent of the nation's energy demand by the year 2000.

Energy conservation is an important option which federal policy largely neglects, but it can play an important role in reducing the energy crisis to manageable proportions over the next ten to twenty years. However, energy consumption appears to be habit forming, and we cannot expect conservation to do more than reduce energy consumption to a constant level over the next ten years.

Government and industry projections indicate a larger role for coal as an intermediate or transitional fuel. Coal now accounts for slightly more than eighteen percent of U. S. energy production but represents 94.5 percent of our recoverable energy reserves. As one study suggests, the doubling of U. S. coal production by 1985 would require opening 120 new underground mines worth two million tons a year and 120 new surface mines worth five million tons a year in the next decade. Only thirteen mines with a capacity greater than two million tons a year were brought into production in the 1960's.

Direct costs for developing the 250 new mines requested by President Ford may reach \$25 billion if the cost for upgrading the coal transportation system is included. The coal industry has indicated its needs priorities in technological innovation if the 1985 production target is to be met. It includes continuous transport systems, remote-controlled mining equipment including shuttle cars and mining machines, large scale continuous boring equipment,

and collection systems for underground mines, and improved conventional surface mining equipment, new systems to integrate excavation and reclamation (including treatment of overburden soil to promote revegetation) for surface mining. There are many complex problems associated with dramatically increased coal consumption--strip mining, water flow and quality, transportation, the volume of material to be processed, low-use efficiency, environmental distress, etc. There are also long-range coal projects like gasification, liquefaction, and MHD. Meeting the technological needs of the coal industry, the energy needs of our nation, and the environmental safeguards will demand vast amounts of capital and close cooperation among industrial, federal, and research representatives.

There are two useful approaches to estimating requirements for professional technical personnel. The first is to extrapolate the historic industry employment pattern of the coal industry. The second assumes that the coal industry will need a number of trained technical personnel equal to those employed by the petroleum/gas industry in proportion to the fraction of national energy needs met. Some adjustment for the nature of the differences in fuel technology may be necessary.

In 1950 the coal and petroleum industries employed almost the same number of men and women. Coal had slightly over 400,000 total employees while petroleum employment had reached 439,000. By 1963, however, coal employment had dropped to a figure of 145,648 while petroleum figures show a slight gain at 443,000. Recent figures show that this disparity remains with 1972 coal figures at 159,600 and petroleum at slightly more than 400,000.

Even more significant than total employee growth statistics is the disparity between engineer-scientist to worker ratios in the two industries.

The petroleum industry averaged slightly less than eight percent engineers and scientists throughout the 1960's and almost nine percent in the 1970's. The coal industry, however, never approached a 2.5 percent factor for scientists and engineers in the 1960's and that figure has not changed appreciably in the 1970's.

In research and development, the picture is much the same. The number of engineers and scientists working in petroleum research and development averaged more than ten times that of the coal industry throughout the 1960's and that figure has increased. Government statistics for the mid-1960's show that the Federal government employed three to five times as many engineers and scientists in the petroleum area as they did engineers and scientist in coal. This picture is changing rapidly, however, and recent statistics suggest that coal is now getting a substantial increase in R & D funding. The 1976 ERDA budget request shows \$279 million for coal research and development with petroleum funded at \$139 million.

What This Means in Terms of R & D Needs, Engineer-Scientist Demand, and Educational Programs

The National Planning Association has estimated that 5,300 engineers and scientists will be required for coal's industrial and R & D needs by 1985. In view of new emphasis on increasing coal productivity, new methods of coal technology such as coal gasification, liquefaction, and MHD, new legislation to improve mine safety and working conditions, as well as vastly increased federal coal R & D dollars, this figure may prove far too conservative. Certainly more mining and mechanical engineers will be needed. One mining educator has stated that coal has already increased its demand for yearly graduates to the point where it could use all 300+ 1975 mining graduates if it could get them.

NPA projections are that the seven energy industries will increase their demand for engineers and scientists by as much as 100 percent. Research and development programs will need about 80,000 engineers and scientists in 1985--up from about 25,000 in 1970. This means that coal is going to face stiff competition in hiring and retaining qualified people. And as coal technology becomes more sophisticated and environmental concerns grow, the demand for graduates with a strong college background in coal will increase. Few of the current engineering graduates have had extensive training in coal. Less than 50 percent of the nation's colleges and universities offering degrees in mining engineering have strong coal research and educational programs. In addition to engineers and scientists, the coal industry is going to need upwards of 125,000 new miners to meet 1985 coal production goals. Many of these people will also require technical training.

One source indicates that there are currently 1,100 professional technical people working in the production and processing of coal and approximately 100 in R & D. If the number of professional technical personnel were doubled along with coal production, only 1,300 new people would be required. I believe that this number grossly understates real coal technology needs for the following reasons.

- 1) The need to improve safety will require a large increase in mine safety engineers. Recent new mine safety legislation already appears to have boosted the demand for coal mining engineers.
- 2) Higher efficiency of extraction requires more professional planning and control of mining operations.
- 3) Environmental safeguards will require substantial new technology and personnel to innovate, develop, and operate new control equipment.

- 4) Land reclamation efforts in the coal industry have been feeble or non-existent. Full scale efforts will require perhaps as many technical people as all other activities until the technology is well developed.

When all these factors are considered, we believe that at least ten times as many professional technical people as we have at present will be required--or perhaps 13,000 new employees.

As a second approach, we can assume that the new coal industry needs nine percent of all miners as professionals to meet its requirements. Then, given a projected employment level of 125,000 new miners, 11,250 new professionals will be needed.

I would estimate that the minimum number of new professionally trained technical personnel required by the coal industry over the next decade (75-85) will be 12,000.

## 2.0 ONE VIEW OF THE WESTERN REGIONAL SITUATION

It is essential to understand the variety of factors driving the United States to satisfy its energy consumption patterns by making the western states the energy capital (colony) of the nation. Simply stated, the reasons are as follows:

- 1) The coal is readily available in the West.
- 2) Western coal possesses a low sulphur content.
- 3) It is ideally suited for surface mining.
- 4) Coal seams are thick and lie near the surface.
- 5) Mine development requires less capital per ton of annual production.

On the other hand, a series of factors make this prospective development a mixed blessing at best and a curse to many who live in the western areas most adversely affected.

- 1) The areas most affected by coal mining are primarily areas of stable social and economic development.
- 2) The disturbance (or even despoliation) of land runs counter to the deep feelings of much of the West's population.
- 3) Social costs for roads, schools, and similar public services constitute an unacceptable burden to many states.
- 4) Coal development is viewed as another source of competition for available water supplies.
- 5) The whole melange of boom and bust characteristics offends the nature of the typically reserved, hard working, and conservative Westerner.

- 6) The presence of ghost towns is a constant reminder of the West's first 100 years of exploitation and manipulation by non-residents.
- 7) Continued decline in metals mining provides the industry with an image of unsound, unsavory, and unstable growth.
- 8) Visually, surface mines are offensive to much of the population who believe they have carefully protected and preserved their agricultural heritage.

#### The Case for Western Coal Mining

Total reserves in the Northern Great Plains region are estimated at 1,524 billion tons. Of these, 529 billion tons are inferred on the basis of mapping and field studies, 160 billion tons are minable with current technology, and the rest are hypothetical. The total figure represents about 50 percent of the nation's coal resource. Most important, the amount reachable with current technology represents 37 percent of U. S. total minable reserve by weight and 60 percent of all U. S. surface minable coal. In addition, a large percentage of this coal lies in thick near-surface beds, readily adaptable to quick and relatively inexpensive but environmentally disruptive surface methods.

Montana, with 107.7 billion short tons, leads the list of states with the most recoverable coal according to a recent news release of the United States Geological Survey. It may also possess the thickest coal seams--almost one hundred feet with a relatively low overburden. Coal fields are estimated to cover nearly 35 percent of the total land area in the state.

Almost fifty percent of U. S. coal output today is from surface mining, and this ratio has risen sharply in the last decade. Western

coal surface production has grown rapidly from nearly negligible amounts in the 1960's to 18 percent of all surface mined coal in 1972. If America's coal output is to double by 1985, then 75 percent of that increase is projected to come from additional surface mining, and western coal will provide the largest share. Estimates on total tonnage to be produced in the West by 1985 vary from a low of 350 million tons to 560 million tons a year. Estimates on the number of new miners needed in the West also differ radically, depending on the assumptions under which they are made. One authority estimates that 45,000 is a minimal figure, but the Northern Great Plains Resource Council states the figure could reach 99,000 in that region alone. Regardless, most of these estimates are too conservative because they do not include adequate numbers for reclamation and environmental restoration work. This is particularly true of industry estimates which provide only minimal manpower for this essential activity.

#### The Concerns of Western Citizens Relative to Massive Western Coal Development

It is obvious that the development of the western coal resources takes on a dramatically different character when viewed from the perspectives of Washington and the coal resource regions.

While I have lived in Montana for only four months and in Denver for the previous twelve years, I cannot speak for the West; but I will try to reflect accurately the fears of an important segment of the region's population.

Individuals here believe strongly in helping the nation, and they possess a rock hard sense of country and patriotism yet most citizens in western states with large coal reserves are greatly aroused and concerned about the impact that massive coal development will have on their

region, as well as upon their lifestyle and their stable community. They worry about the competition for land and water resources, reclamation possibilities, problems regarding shallow ground water where coal acts as an aquifer, air pollution and its impact on range vegetation and tourism, and the danger to abundant wildlife resources. The Indian population, in particular, wants clearly established priorities to protect their areas and way of life.

The social and economic impact of massive coal development may not be acceptable to large segments of the West's population. Certainly their wishes cannot be completely ignored. The states themselves will play a major role in determining the rate and extent of coal development in the West. They have expressed specific concern for mineral leasing policies, environmental quality standards, and the overall economic impact of such expansion. Most are deeply troubled by the prospects for rapid and relatively unplanned growth in coal-bearing regions which could bring an influx of out of state population. Many of these developments would be of relatively short duration, leaving potential ghost towns in their wake.

Eastern surface mines have relatively thin seams with a high ratio of overburden. Most western fields have generally thicker seams and the advantage of lower stripping ratios and huge tonnages. Further, western coal contains low sulphur impurities, is well situated to serve growing economic centers in the country, and there is an adequate immediate supply. The last characteristic makes the coal field amenable to the huge plants probably required for gasification and liquefaction. The shift to the West is likely to continue. Industry sources estimate that 100 new surface mines may be opened in the West in the next decade.

with an individual average annual production capacity of 5 million tons. Eastern deep mines require five times more labor per Btu, and three times more capital per Btu than western surface mines. Several studies indicate that reclamation will succeed only in areas with an annual rainfall of more than ten inches; however, even this standard permits access to some 80 percent of western coal reserves, primarily in the Northern Great Plains region.

The cost of an average western surface mining operation per ton of coal produced averages about one fourth that of underground mining. Although the heat value of western coal is less than most eastern and midwestern coals, this liability is offset by huge tonnages and lower reclamation costs per ton of coal mined by virtue of the thick beds and relatively flat terrain.

Newspapers carry articles, announcements, and rumors of either layoffs or possible closing of Butte's famous copper mines and pit on a near-weekly basis. The rancher in eastern Montana who reads these items cannot fail to compare his area's hundred year period of comparative social stability and moderate economic productivity with the boom and bust nature of mining camps. On a small scale, mining appears useful to a local economy, but many doubt the wisdom of building an area's economic health around an industry which appears to be its own worst enemy.

I am not sure how much technology can reduce the burdens and enhance the rewards of mining activity in the local communities and states which are so greatly affected. One thing is clear; we must marshal our best technical minds to meet this challenge, for there is simply no other recourse. All of my recommendations are designed to make this bill as responsive as possible to these needs. To do less would

be to betray the West and my professional responsibility.

Montana residents and those of neighboring states feel a definite proprietary interest in legislation designed to upgrade coal technology while preserving the nature and character of a whole region. Past exploitation of the West and the knowledge that the Federal R & D bureaucracy has not lifted a finger to give the western universities or research institutions even a slight advantage to offset the coming onslaught suggest that when it comes down to the hard facts, the West is expected to suffer and do the dirty work despite the best efforts of dedicated elected officials.

The defeat of this bill or the restricting of its impact will be viewed as further evidence of neglect and exploitation of the West by the rest of the nation. Therefore, the passage of this bill in the recommended expanded form will provide a real ray of hope that Montana and the West will not be written off as "national sacrifice areas" to satisfy a national energy habit.

## 3.0 NATURE OF THE COAL RESEARCH LABORATORY REQUIRED

In the past, research laboratories have been established to serve a variety of purposes. It is important that the laboratories established for coal research be tailored to the exact needs of present and future coal technology. The customary priority of research facilities is first, the advancement of knowledge and development of new technology, and secondly, the training of personnel. In the case of the proposed coal research centers, this traditional priority system must be inverted.

The urgent need is for trained personnel to manage and conduct coal mining operations in a manner acceptable to the communities in which they operate. This procedure is not unlike the medical training hospitals where the objective is not research but patient treatment combined with medical training. Perhaps it would be more accurate to designate these facilities as Coal Training Laboratories rather than research centers. Useful and important technology can be developed from such a training facility, but a very direct tie to the technology must be developed and encouraged. The "ivory tower syndrome" must be avoided.

While specific technical disciplines must be followed for vigor, there is an additional need for a holistic approach to prevent the training of narrow, efficient technical exploiters. It will be essential to fully impart a sense of service to society in an approach that goes far beyond the traditional mining view of ripping wealth from the earth, i.e., raping mother nature. Simple loyalty to employer or outdated and limited concepts of efficiency are no longer acceptable to the American public. Language should be included in the bill to make this mandate clear.

At present, I do not believe there are any Federal research and training programs in existence which even begin to meet the needs that are addressed by S. 62. It is my firm opinion that this act is badly--even desperately--needed to meet the nation's future energy requirements.

## 4.0 NEED FOR REGIONAL COAL RESEARCH CENTERS

Regional centers are frequently used to assemble a strong group for carrying out a specific mission when individual state or local efforts would lack adequate staff and resources. A joint effort in forming a single strong coal research laboratory among several states is a valid concept for certain regions, particularly in those areas possessing smaller coal reserves. Specific examples might include a regional center to serve Oklahoma, Arkansas, Louisiana, and Texas-- or Kansas, Nebraska, and Iowa.

However, in the Mountain West where the largest coal development impact is to be felt, the needs are simply too pressing to be adequately served by regional centers. Montana, Wyoming, Utah, Colorado, and North Dakota are certainly states requiring separate coal research facilities. In addition, the large coal reserve and production states including Illinois, West Virginia, Pennsylvania, Ohio, Kentucky, and Tennessee clearly deserve coal research centers. Regional laboratories will simply be inadequate in meeting the present and rapidly growing needs of the individual states. As I stated previously, this region will produce 75 percent of the needed 700,000,000 tons or 525 million tons of coal annually.

Based upon our estimate of 12,000 new professional technical personnel, a minimum of 9,000 skilled professionals will be needed in these five western states. If the laboratory centers turn out trained personnel for eight of the next ten years, each school must average 225 graduates per year and have a student body of between 600 and 700 in attendance at any one time. Clearly each of these states must have the largest laboratory permitted under this act.

## 5.0 RECOMMENDED CHANGES AND SPECIFIC COMMENTS: SENATE BILL S. 62

The concept of Senate Bill 62 has my unqualified support; however, in order to strengthen the bill and magnify its impact, I propose a series of recommended changes to the bill. In my judgment, the main thrust of this bill does not cut deeply enough to generate a "critical mass" to provide real federal leadership in this vital area. Thus, all the recommended changes are designed to increase the size, impact, and effectiveness of this program.

## TITLE ONE: COAL RESEARCH LABORATORIES

Section 101 (a).

## a. Subsection (1). Administrator of the Act.

I have serious reservations about the bill's designation of the Director of the National Science Foundation as chief administrator for this program. I do not believe that the Director's background, experience, or interests indicate that he is the proper individual to discharge this responsibility. NSF is an organization whose historic mission has been the support of basic research. This is an important mission but quite different than the purpose which I believe should underlie the establishment of these coal research laboratories. I submit that NSF cannot be all things to all people, and if it is given tasks for which it is not suited, its effectiveness in its primary mission will be undermined.

The record of the NSF-RANN program--with its inability to utilize small R & D firms and its poor performance in actually recognizing and supporting projects that have produced useful and workable technological solutions to social and economic problems--provides persuasive testimony

that the laboratories should be placed under another agency's control.

I strongly recommend that the chief administrator of the Energy Research and Development Administration be given the role of "Director" in S. 62. The coordination of ERDA Fossil Energy Division R & D programs with the activities of these new coal research laboratories is extremely desirable. Further, I maintain that this would encourage closer ties between the laboratories and the national coal industry's plans and programs.

a. Subsection (2).

It is recommended that the number of laboratories be increased from five (5) to twenty (20).

The rationale for this change is as follows: Coal is the major fuel resource of the United States, and its extraction and utilization depend upon developing a competent professional staff capable of supporting the industry and protecting the public. It is my estimate that at least 12,000 professional technical people will be required to support the doubling of coal output and to cure the safety and environmental problems that have cursed the public image of this vital industry. The development of the coal industry as a competitive fuel source is dependent upon an adequate supply of trained technical and scientific personnel.

If these twenty laboratories are established in 1976 and commence operation immediately, it will be two years before the first trained professional is produced. Thus, over the remaining eight years, each of these twenty schools must produce an average of seventy-five (75) professionals per year. This many graduates require a student body of between three hundred fifty and four hundred students in coal and related programs.

While the actual research performed in these research facilities is important (and hopefully useful), the major objective of these research laboratories should be the training of personnel, not research per se. Therefore, it is essential that these laboratories are designed not as remote ivory towers, but as programs able to generate strong ties to the area, the industry, and the environmental needs they aspire to serve.

b. Subsection (1).

The ten states possessing the largest currently recoverable coal reserves shall be given a strong priority and automatic designation as sites for coal research laboratories. It is in precisely these areas that the coal development required to meet national energy needs will have the maximum local, state, and regional impact. Furthermore, the greatest need for advanced coal technology and manpower will be in these states. If citizens of this region are to develop any trust in professional people to look after their environmental, social, and economic interests, then it will come in the knowledge that the professional people making the day-to-day decisions have a real commitment to the heritage of their state and region.

A brief review of past and current coal research programs funded by the National Science Foundation and the Fossil Energy Division of the Energy Research and Development Administration leads one sadly to the conclusion that the interests of the West are not likely to be seriously considered. Coal research has been consistently given to established laboratories in the East, West Coast, and Midwest, while the West has been almost completely neglected. Given an honest extrapolation of past policies, it is clear that the West has been selected as a "national sacrifice area," and the people in the Mountain West are being asked to

perform the dirty job of slaughtering their landscapes while the good jobs involving research and development go to Boston, San Francisco, and Los Angeles.

I can assure this hearing that the federal bureaucracy in Washington has taken very little affirmative action to promote R & D coal activities in the Mountain West to this date. The only bright spot is the MHD (magneto-hydrodynamics) project in Butte, Montana, of which I am the Managing Director. I would hasten to point out that this project came from the vision, wisdom, and leadership of Senator Mansfield, Senator Metcalf, and Congressman <sup>Metcalf</sup> Baucus, not from the R & D establishment in Washington.

Subsection (2).

As written, this section of the bill will likely be used as an excuse to support established "centers of excellence." This is simply another way of saying that the rich get richer, and the poor get poorer. The Mountain States are small in population; yet they have, by and large, made greater efforts to support education proportionately than most other states. Despite their effort, they have lacked sufficient funds for maintaining their institutions at a level they deserve and require. Therefore, instead of attempting to build excellence where it is needed, this section of the bill may well be used to feed the already fat schools.

It is my recommendation that the clear purpose and intent of this bill be to establish schools from the ground up where they are needed, mostly in the coal resource areas, as well as to expand existing schools. I am not saying this simply for the benefit of Montana since I am convinced that the Montana College of Mineral Science and Technology, combined with the support of other elements of the Montana system of

higher education, can make a strong case in its own right. Rather, I want to underscore the principle that the prime criteria for site selection shall be the assurance that regional coal development problems are fully met.

Section 103 (a).

It is a virtual certainty that \$4,000,000 will be inadequate for the construction of new laboratory buildings and the installation of fixed equipment. Ten million dollars seems a more reasonable figure. Other figures must accordingly be adjusted upward; the \$1,500,000 allocated for initially installed movable equipment should be funded at \$5,000,000, and startup expenses of \$2,000,000 should be provided, rather than the \$500,000 current figure. In addition, federal funding for operating expenses should be changed upward from \$1,500,000 to \$3,000,000.

Section 104 (b).

The Federal government must assume full responsibility in funding the coal research laboratories during a minimal ten year period for the following reasons:

1) The scope of the bill is indisputably federal; the coal research centers are designed to meet an urgent national need. The fact that these laboratories are required primarily to offset local coal development impacts in no way justifies local, state, or other non-federal funds. Please keep in mind that the alternative is for the coal rich states to do simply nothing.

2) The Federal government has generously supported the development of the atomic power industry for twenty (20) years. Unfortunately, this program has been a great disappointment. Now, after years of federal neglect, this bill asks that the coal research centers be supported

by fifty percent non-federal funds. In simple words, this is a grossly unfair proposition.

3) State governments are increasingly resentful of funding programs in which the Federal government provides initial funding then withdraws support when activities are established and people are hired. The states must either assume severe economic burdens at that point or scrap ongoing programs.

4) Several western states have enacted taxes on coal production or sales taxes to serve two purposes. First, they are designed to offset the enormous expenses required to provide the necessary social infrastructure (schools, roads, etc.) in coal areas. Secondly, they are designed to anticipate the decline of the coal industry in some areas by developing alternate energy sources to replace the coal industry as it phases out of production. I'm pleased to say that Montana has enacted a law with this important long term purpose. However, I doubt that Montana could provide adequate matching revenue of this act at present taxation levels.

Is anyone seriously prepared to argue that the United States can pay \$20 billion per year to the Arabs for oil and neglect to pay about 1 1/2 percent of this amount to make a measure step in ridding the country of such a foreign exchange burden?

Section 105 (a).

The coal industry and even the Federal government itself have never been fully responsive to the environmental sensitivities of regions containing large coal reserves. Therefore, the Advisory Council should reflect greater concern for environmental protection by including strong representation from the various environmental agencies within the

Federal government. I strongly urge that the Chairman of the Council of Environmental Quality and the Head of the Environmental Protection Agency be appointed to the Advisory Council.

I further recommend that the Director of the National Science Foundation be retained as a member since basic research should not be overlooked. The Council's chairperson should be the Administrator of the Energy Research and Development Administration. In addition, the non-governmental members should be carefully chosen to provide a balanced representation from all concerned elements of society. I recommend two industry representatives (one each from the coal producing and coal using industries), two environmentalists, one labor representative, and a member from one institution of higher learning. Care should be exercised to assure a reasonable geographic balance within the Council as a whole.

Section 106.

Again, I feel the costs of the program must be adjusted upward with the total authorization for the fiscal year ending June 30, 1976 changed from \$30,000,000 to \$340,000,000 and the \$7,500,000 annual appropriation changed to \$60,000,000.

TITLE TWO: ENERGY RESOURCE GRADUATE FELLOWSHIPS

Section 201 (a).

The number of 1,500 fellowships awarded annually is simply inadequate and should be expanded to 3,000 to meet the demand for qualified people. While it is clear that the major thrust of the program is to provide Master's degree training, particularly re-training current engineers, it appears unwise to exclude all Ph.D. candidates. The inclusion of 20 percent to 25 percent Ph.D. degree or equivalent candidates

in the program would serve to strengthen and improve the quality of the whole program.

Areas set aside for research and study should also include environmental, social and economic impact studies (as opposed to conservation per se) since expertise in these areas will almost certainly be required by the states with large coal reserves.

Section 201 (b).

With the inclusion of Ph.D degrees, as recommended above, it will be necessary to extend the period of the awards from two to four years in appropriate cases.

Section 202 (b).

Recipients of fellowships should be expanded to include conservation and environmental social and economic impact studies related to coal production and use, as well as those planning careers in energy resources, production, and utilization.

Section 203.

Special consideration to be accorded institutions of higher learning should also include those with a demonstrated capacity in the area of relevant environmental social and economic impact studies.

Section 204 (a).

A stipend figure of \$4000 is inadequate for attracting qualified graduate level students and unreasonable in light of Section 206 (a) which prohibits a student earning outside income. A \$8000 stipend with no provision for dependents seems a more adequate incentive.

Section 204 (b).

The figure for institutional matching grants can be frozen at \$4000--less stated reductions.

Section 207.

The fellowship appropriation authorization would have to be expanded upward under the conditions outlined above, from \$11,000,000 to \$36,000,000.

Senator METCALF. Dr. Meyer, I am very pleased that you did accept my rather abrupt invitation. You did not have very much notice but Senator Hansen told me you were in town and yesterday, during the course of our discussion with the administration, mention was made of the research laboratory at Laramie and how it was representative of the Great Plains. I join Senator Hansen in being delighted to have you here this morning.

**STATEMENT OF E. GERALD MEYER, VICE PRESIDENT FOR  
RESEARCH, UNIVERSITY OF WYOMING**

Dr. MEYER. Senator, it is a pleasure to be here and I thank you for the opportunity to say some words concerning S. 62 before this committee.

Senator Hansen indicated the University of Wyoming is an unusual institution in that first of all, it is the only university in the State, college in the State. I think Wyoming is unique among the 50 States in having a single institution, 4-year institution within its boundaries.

Second, we have a number of distinguished alumni, one of whom is Senator Hansen. We have a prevailing interest in all kinds of energy research. We have work going on in oil shale and coal, environmental impact, in human services. All of the aspects that have to do with the development of energy resources for the State and region.

I don't think it is necessary for me to go over again the information that has been given this committee in connection with the need for the development of the energy resources of the West. The energy plan, which was prepared by ERDA and submitted to the Congress on June 30 of this year, Energy Choices for the Future, I believe was the title, indicated that coal, indeed uranium, had to be the intermediate term energy sources for the United States.

So the background, the need, I think is well demonstrated. The real question in my mind, gentlemen, is how one can best bring about the development of university expertise and the desired production of trained manpower in order to develop our coal industry and indeed, our uranium industry in order that the Nation may be supplied with the energy that it vitally must have.

To my mind, S. 62 has in it the provision for fellowships, which is excellent. One might ask, however, whether or not it is necessary to authorize a fellowship program of this kind or whether possibly an alternative would be to fund the existing fellowship program that the National Science Foundation has. NSF has an energy research trainee-ship program and just submitted to the universities sets of guidelines by means of which applications and proposals will be made.

Perhaps an alternative then would be to fund at a higher level the existing energy traineeship program which I believe has the same objective as the one in S. 62. The gentlemen on my right have indicated the vast need for trained personnel in order to develop the Nation's coal industry and I second that.

We have made in Wyoming, and I am sorry I do not have this with me, Senator, but I can send a copy to your office, we have made in conjunction with the industries a study of the manpower needs. The industries themselves were asked by us to give us some information on what they felt their needs would be for doing a coal job

in Wyoming. This is not simply an extractive coal program but it includes the synthetic fuel program, the minemouth electrification effort and so on.

Senator METCALF. Would you send it to Senator Hansen and he will make it available to the members of the committee?

Dr. MEYER. Certainly. One of the interesting things that developed, and I am going from memory here, but one of the interesting things that develops in looking over this requirement is that there is a large requirement number-wise for people at the technician level, people at the associate or 2-year level. There is also a large requirement for people at the baccalaureate level and the requirement one could say decreases—the number of people needed seems to decrease as the level of education increases.

Therefore, as one of my colleagues stated, the notion of having 2-year fellowships that would prepare people at the masters level seems to make pretty good sense. In addition, I would submit that it might be advisable for the committee to look into the possible production of people at the baccalaureate and associate or 2-year levels because these seem to be required.

Let me briefly address the other component of this bill, namely the establishment of these five coal energy research centers. My thought here is simply this. I am interested, as a taxpayer, you gentlemen likewise are interested in getting the most bang for the buck in funding R. & D. programs. I would wonder if the establishment of five coal energy research stations which involve literally a lot of concrete is the best way to attack this problem.

I think you may have a concentration here of programs which would literally be set in concrete. There are existing mechanisms, ERDA—I understand Dr. White has testified before the committee. There is authority within ERDA to fund at a higher level coal energy R. & D. One of the concerns that I have as a member of the academic community, and perhaps this is the reason why this bill might be considered, but one of the concerns I have is that the Congress needs to know and probably does, that R. & D. funding that goes to ERDA and many of these government agencies, ends up in a large amount in the so-called Federal laboratories, both the contract laboratories and the captive, if you will, laboratories, particularly the contract laboratories. A large amount goes to industry. I don't think that that is bad per se but I think if one wishes to develop the universities' expertise and capability in these fields, and all of us heavily subscribe to that concept, some mechanism must be devised whereby funding does end up in the universities and not in the contract laboratories or some of the other captive laboratories.

ERDA inherited the large AEC laboratories. Los Alamos, Livermore, Oreg., Brookhaven and the like. These laboratories, as you all know, were developed in the World War II period to provide us with a nuclear capability. All of a sudden they are now becoming great experts in the fossil fuel area and those provides serious competition.

What I am saying here in sum is perhaps mechanisms exist where funding additional R. & D. and teaching efforts in coal energy at the universities but the appropriations and the manner in which money is funneled into these existing agencies, I think needs to be looked at fairly carefully so that the universities can, indeed, participate.



going to come. We want to make certain that any deleterious effects are minimized to as great an extent as is possible.

So we share a parallel concern in Wyoming that you have expressed on behalf of the State of Montana. I think you two gentlemen from the academic community in Montana point out in a very logical and understandable fashion some of the problems we are going to face and I compliment you for your testimony.

I was impressed, Dr. Huffman, with your statement that I suggest the concept of a coal research laboratory should be broadened to include situations where a dispersed laboratory involving several university campuses may be appropriate. That seems to me to fit our situation in Wyoming, too.

Following that thought, I would like to ask you, Dr. Meyer, how may we—do you have any suggestions as to ways by which we might hope to get the most bang for the buck as you put it? How can we bring the expertise that has been developed both in the academic communities and in industry? I suspect I would underscore industry because many times I think their scientists and their professionals can be ahead because they are working daily with the problem. How can we bring that sort of knowledge, how can we assure that it will be available to make its contribution in training the scientist and professionals in the West in order that we can better solve the problem? Do you have any suggestions on that?

Dr. MEYER. Senator, I have one thought that is perhaps pretty far out. Nevertheless, I will mention it. It seems to me that of the various Federal programs, and I have lived with these for many years and profited from them, that we have had programmatic R. & D. support, we have had fellowship R. & D. support, we have structural, building R. & D. support, all of which is very useful.

The one area that I think the Federal Government has not looked at which perhaps would be worth looking at, is the matter of supporting faculty chairs, professorships. It is well known in academia that an endowed professorship is very useful and desirable thing for an institution to have. It provides an opportunity to bring distinguished people to the campus. It provides an opportunity for the institution to focus on a problem. It provides the institution with an opportunity to go to its constituents and ask for support.

I would suggest, therefore, that as an alternative to building in concrete, as an alternative, it might be possible to look at Federal energy professorships to be endowed on a matching basis by the Federal Government. This would mean for each fellowship we are talking between a half and three-quarters of a million dollars. This is about what it takes to endow a professorship. On a matching basis, this would mean a quarter to three-eighths, \$350,000 to \$370,000 of Federal money that would be given to the institution on a competitive basis and would provide the institution with an incentive, if you will, to raise matching funds. The money then would endow the Federal energy professorship at that institution.

It could be used to bring to the campus on a permanent basis, on a visiting basis, distinguished individuals who could address problems of hard technology as we call it, or problems of environmental impact or problems of human services as the needs would change.

I think that it would provide an attractive focus so that particular types of research would be done on the campus. As you say, Senator

Hansen, the possibility of bringing a person from industry would provide a linkage between academia and industry that I think would be very valuable. This, sir, is a possibility that I have considered for some time. Perhaps in the energy field, this would be a way to go.

Senator HANSEN. Just let me say, Mr. Chairman, that that is an intriguing proposal you have just made, Dr. Meyer. I think that I am captivated by the prospect that we could bring, if this were to be made part of this legislation, we could bring in the best expertise literally, from around the world possibly. We might get people from Germany and other countries where they have had great experience in technology where we could, I should think in the East with coal mining, having continued as long as it has, we could get some input from sociologists who would help us understand better how to address the problems of the social and economic impacts that a tremendous upsurge in people has on a community and how to respond to that kind of problem. This, I know, is very much on your mind, Mr. Chairman, as it is on mine.

It should think that that sort of concept might bring immediately onto campuses, not only one campus but several campuses over a multi-state area, a distillation of the empirical knowledge that has been gained through long-time grappling with the problem and I am intrigued with it.

I would hope that maybe Senator Metcalf might have some expression on that point, too.

Dr. MEYER. Senator, just very briefly, the University of Wyoming, South Dakota School of Mines and Technology at Rapid City have combined this academic year to bring a very distinguished coalologist from Germany. This is just a 1 year thing. The gentleman is spending the fall semester in South Dakota and in the spring semester in Wyoming. We will have the benefit of this person's help and expertise for a whole year. On a continuing permanent basis, I think this would be an extremely valuable thing.

Senator HANSEN. Thank you very much, Mr. Chairman.

Senator METCALF. Thank you, Senator Hansen.

Now, gentlemen, let me get back away from the intriguing proposal that was set forth by Dr. Meyer to talk about fellowships and the establishment of laboratories.

The establishment of buildings, brick and mortar, is not necessarily the answer. It seems to me we have institutions that we need. What we need is skilled personnel and manpower. Yesterday, I discussed some of this with Dr. White. He had a breakdown of some of the research activity at ERDA. In my opinion and the opinion of many of the Congress, it still is overweighed toward nuclear fission.

It seems that for a while, we went all out in this country with appropriations of large sums of money for the development of nuclear technology. Even now, when you break down the research categories that he talked about yesterday, and he will give us some detailed information, it was overweighed, in spite of your comment, Dr. Meyer, on nuclear research.

It seems to me that somewhere along the line, we have to take some of that away from these people who are totally imbued with the idea that the future of the country is involved in development of nuclear technology and, as Senator Moss has said in his opening statement

this morning, look at the realities of the next three or four decades and find out something about coal.

So I have a rather dim view that we can change some of these people that are so involved in nuclear research and development back to coal research. Maybe we should start with training new people and new personnel.

Now, to get back to the bill. I have the same concern that Senator Hansen and Senator Moss expressed in asking this question. Mr. Orth has perhaps already answered it by suggesting that we have many more laboratories that we already provide for. Do you see in this criterion some dangers to activities of universities located in such new coal areas the northern Great Plains, southwestern Four Corners Region, Alaska, perhaps even in the Central United States against the old and traditional coal producing areas such as Pennsylvania, Kentucky, Tennessee?

MR. ORTH. I see none, Senator. I think the magnitude of the transition from petroleum to coal, the magnitude of that problem is so great that it is staggering. The amount of money this bill calls for is insignificant compared to just single line items in the nuclear RDS. The universities in the affected areas will be expected by the population in those coal resource areas to actively participate. Certainly this problem is going to be of great and large magnitude, and programs going into any university or school will cause problems. They are not the problems that our universities and colleges have been accustomed to handling. Ordinarily, they have been fighting legislatures that have been cutting their appropriations.

Here is an opportunity for the Federal Government to build these schools which are self-sufficient and have managed to build to their present state of greatness on their own. It is a chance to utilize the capability and management at those schools to further expand and address in a comprehensive way a real national problem.

Senator METCALF. For instance, in subsection 101(b)(2) of the bill on page 2, it provides that the institution of higher education shall have experience in coal research, expertise in several areas of coal research, and be currently active outstanding program in coal research. In the State of Montana, for example, during a long period we did not use coal, we abandoned our mines. I can recall when the Northern Pacific and the Great Northern transferred to diesel fuel. Of course, we had our homes which were heated for many years by coal, transferred to natural gas. We even put such a valuable fuel as natural gas under the distillers of the Anaconda Co. We did not do much about coal, we were interested in other mining techniques.

We might not be able to compete with West Virginia universities or Pennsylvania universities which have had a 100 year tradition of coal.

MR. ORTH. I am sure that the gentlemen from the universities will have more to say about that but first of all, I think you would be surprised at the rapid expansion and competent expansion of coal research within our State, within our total university system in every aspect, from mining to reclamation to the socioeconomic impact. I believe our institutions can stand on their own two feet in competing for the five laboratories which this legislation calls for which, incidentally, I recommend as being too few in number to meet the total problem.

At any rate, the important point is that our schools can stand on their own and can compete with the universities in those areas that have had coal research ongoing for many, many years.

On the other hand, there will be other university systems that will not be as well able to meet the restrictions of this legislation and I do recommend that they be modified to take full accord of the need of the State and of the recognition of the amount of coal resources in that particular State.

Dr. DEMONEY. Mr. Chairman, I would like to respond to your question with regard to section 101(b)2, the institutions of higher education shall have experience in coal research, expertise in several areas of coal research and currently active outstanding programs in coal research. I think this is a point and at the same time, there might be drawbacks. It is good to build on existing strengths and existing personnel and know-how. At the same time, I think it clearly indicates that new looks have to be made in coal, new approaches which oftentimes are not available or possible if an institution has been so hidebound that it cannot think in new directions and tackle new horizons.

If I can speak for our segment of the institution, higher education in Montana, the Montana Bureau of Mines and Geology in the last 10 years have had extensive research activity, not only with coal exploration and definition and delineation but also in hydrology, the effect of the water table and so on, once the coal is removed. Coal is an aquifer and a great deal of work has to be done in that area.

Of course, the current MHD research project which is a joint effort between Montana State University, Montana Tech, ERDA sponsored, does deal with the conversion of coal to energy source, energy utilization. This deals with coal characterization, coal preparation, handling of the coal to the combuster, effect of coal burning on materials contained in the combuster and the channel and so on. Dr. Huffman might speak more on what Montana State is doing in that area. Together these amount to about \$1.7 million of contract money.

The range of projects currently underway through Montana Tech and through the Bureau of Mines and Geology, there are approximately 12 projects dealing with coal research. I will read a few to give you the sense of what we are doing. Mining related hydrologic evaluations near the Big Sky Mines. Premine hydrological evaluations on the southern part of the Crow Indian Reservation. Hydrological characteristics of mine spoils, a cooperative program to evaluate surface and groundwater problems associated with potential strip mining sites, a three-State proposal, Montana, North Dakota, and Wyoming. The last is hydrologic study of the coal strip area.

In connection with Dr. Huffman's good presentation on the definition of a laboratory, I would subscribe in part to the concept of having available through a number of different agencies. About a year ago, I proposed that we look at regional colleges and regional institutes dealing with mineral and mining research and education, a five-State region of Wyoming, Montana, Idaho, Oregon, and Washington, because it was clear to me that unless something was done, there would be no mineral engineering education serving this important area.

This, of course, has run into problems of a variety of ways and ideas, political and otherwise. Nobody wants to give up anything in this area. I am sure we would be right up there in the front saying we

don't want to give up our fine institution in favor of something else.

However, I think it does point out, and I am glad to hear the doctor from Wyoming discuss the cooperative programing of shared faculties and that is a great idea. We are looking toward that ourselves.

While I have the floor for a moment, I would also support the proposal of the endowed chairs on a shared basis. Those are the ways we are trying to lift ourselves up by our boot straps in that operation, too. I hope I have not taken too long to answer your question, Senator, and I would be glad to amplify any section you would like.

Senator METCALF. Thank you very much, Dr. Huffman.

Dr. HUFFMAN. I want to comment on two things. One, I think we can show a surprisingly good history of participation already in coal related research problems. Interestingly enough, Senator Metcalf, in relation to what you were saying about having abandoned the use of coal, our first major participation in coal research had to do with trying to find things to do with coal when everybody quite burning it. We were trying to find new uses.

Senator METCALF. As I recall, Congressman Edmundson was the chairman of a special ad hoc committee I was on when I was a Member of the House of Representatives. As a result of that, we created the Office of Coal Research to try to find a way to burn some of the coal.

Dr. HUFFMAN. The other thing I would comment on, I recognize that there are problems of universities adjusting to the kinds of problems that need to be addressed. I think we have a reasonably good record in that regard, too. We are all familiar with the major research effort now underway at Montana Tech and MSU with regard to MHD but getting less publicity is the fact that our institution, we have three contracts with the Environmental Protection Agency which totals \$1¼ million, about the same as we have with MHD which are all concerned with the environmental impacts of strip mining, surface water problems, groundwater problems, and so on.

I think we have a good history of being able to address those kinds of problems and try to find the answers that will facilitate, in this case, and make more acceptable the mining of coal and its use. I think when it comes down to structuring of a research laboratory and justifying it, that we would present a reasonably good background and a reasonably good case for the ability of the university system in Montana to respond to this.

Senator METCALF. Dr. Meyer.

Dr. MEYER. Senator, very quickly, I think that section 101(b)2 is too restrictive.

Senator METCALF. I just picked that for an example.

Dr. MEYER. I think it is too restrictive, I really do. I think there should be some opportunities, as the president of Montana Tech said, to indicate that universities that have new technologies in developing programs, there should be opportunities for these kinds of institutions to participate.

Second, I believe I commented in a letter that I wrote to you a month ago on what seems to me to be an important possibility and that is to provide for small consortiums or groups of institutions to jointly manage one of these laboratories.

Senator METCALF. Dr. Huffman, in his initial testimony, talked about a consortium and you have all talked about it a little bit. Yesterday I asked the administration people and they said that even within a

university, it was difficult to have various disciplines work together. They did not think they would get unity and cooperation inside of several universities.

I would like to have some discussion on that, whether or not we could set up a regional group, for instance in the Northern Great Plains—Wyoming, Montana, and North and South Dakota. Could we have a group of people that would have the university professors or the skilled visitors that you talked about from Germany.

Dr. Huffman, you started this—

Dr. HUFFMAN. Yes; it is not easy. I grant you that, but it can be done. I think more and more of our faculty people are recognizing that they will have to find ways to do it for two reasons. One is that it is the way to get the most effective use of available money. Second, it is the way that a great many of the problems have to be addressed because they are interdisciplinary problems. It is no longer a situation where a person in one scientific specialty can really come up with the answers to the problems, it is just too complex.

We found in some of our interdisciplinary research, particularly the research project we did on the big sky recreational development that it took quite a bit of give and take and learning about what the other discipline does before we put a team together that could do that job. After a year or so, they began to work together pretty well.

I think internally, in the State of Montana, I just mentioned in passing in my statement the arrangement that we have under the Water Resources Research Act of 1964. This is joint among three institutions. Our principal problem there is the limited amount of funding that is available and when you divide it among three institutions, it becomes even a more restrictive problem.

But the willingness of people to work together on common problems has grown over the 10-year period. Dr. DeMoney mentioned the three-State research project now underway among Montana, Wyoming, and North Dakota and the fact that people can sit down and work out something like that speaks well for their willingness to work together. There will be problems on how you carry it out, how effective it is and this sort of thing.

But research people are increasingly willing to sit down and discuss common problems.

Dr. MEYER. I would second everything that Roy Huffman says. He said it just exactly right and I would like to add one other thought. I believe that in our part of the country, the opportunity to bring about these kinds of interinstitutional programs, the possibility of getting faculty members to work together interinstitutionally, in our part of the country, there is a better chance of getting this done, mostly because we have a feeling that we really need one another.

I feel optimistic about the chances of interinstitutional cooperation in these problems. I think we are recognizing a number of different disciplines that have to be brought to bear and the fact that State boundaries, the Fort Union coal deposit did not know where the lines between Montana, Wyoming and North Dakota would be laid down. All of these things mitigate towards having a consortia and good relationships.

Senator METCALF. Would a small institution such as Montana Tech that has some specialized activities such as you are doing in MHD,

be overwhelmed if you had to go in with some of the larger institutions in other States?

Dr. DEMONEY. I think we would kind of be like the mouse and the lion, I hope, where the mouse finally won out. I am only joking of course, but I subscribe to the philosophy of collaboration and cooperation. On a faculty level, I think it is great. Where we run into difficulty is with administrators like me. They have to worry about budgets and worry about equal time for equal pay and recognition and all the rest. This goes through the State legislature. Somehow we have to find a way to get around those problems.

We also have different kinds of commissions of higher education with different method of operation and different goals. I think they have to be brought in, too, at the same time we are developing this. I am not saying it cannot be done. I'm just saying in theory it is great and the mechanics are the things that bog us down.

One of the major drawbacks to mechanics is the budgeting item. When we budget our institutions, Roy and I are representatives of institutions in the Montana system. We have gone through budget formulas and let the Montana State University get along with what it does but it affords us a little cushion because the budget does not work out that way.

MSU says how come that's happening, why don't we get the same amount? These are the kinds of internal problems you run into. I am just saying that theoretically and ideally, it should not be any problem when you work on the level of the research order, that generally is not a problem. Our people get along well and understand and cooperate with each other. When you start moving into a higher echelon, then we have to knock heads together for the common good, but I think it can be done.

Senator METCALF. You are telling me that you recognize the problems are considerable and some of the obstacles are difficult but you agree with your other two colleagues that they are not insurmountable.

Dr. DEMONEY. They are not insurmountable if we all recognize our roles. I am not subscribing to a merger or swallow up or anything of that nature. I think if everyone understands that there is a rightful role for everyone of these institutions to play independently and collectively, I would subscribe to that; yes, sir.

Senator METCALF. Mr. Orth, you are not part of the academic community here.

Mr. ORTH. No; I am not, Senator, but I do have some observations on them and I think they could be made from a government and industrial R. & D. capacity looking into the institutions from outside. I suspect that your witness yesterday stating a belief that even departments within schools could not work together, I think he was misreading something. I firmly believe that competition both between departments within a school and between schools is an essential lifeblood item for building excellence in our schools and is not to be lightly dismissed. You should not confuse competition with cooperation or a lack thereof.

I wholeheartedly believe that administrators in our universities promote to some extent this competition in order to build excellence. On the other hand, it is my feeling that it is very possible to bring together these departments and work cooperatively. One reason that we have seen bitter arguments and struggles between schools in the same States

and between neighboring States and between departments has been the very limited amount of research money available. The less the supply of research money, the more intense and acrimonious the competition for that money.

I believe in the establishment of this legislation, of these research laboratories, and if this legislation adequately recognizes the magnitude of the problem and adequately funds these institutions, I believe that to a great extent internecine competition for those funds will be reduced but will still maintain the competition for excellence between departments and between institutions.

Senator HANSEN. Mr. Chairman, I want to compliment the panel for having made several significant points. One is, I gather it is the consensus that section 101, subsection (b)2 is unnecessarily restrictive.

Senator METCALF. I don't want to just leave it at that section. I have some problems with, for instance, line 11 on page 3 where a facility would have to have all of those people involved.

Senator HANSEN. That bothers me, too.

Senator METCALF. Some of the other criteria also bother me.

Senator HANSEN. I was thinking about this. When we look at problems of energy development today and see where the focus of attention is, it is in the West for a number of reasons. Black lung was a problem; people were leaving underground mines. The low sulfur content of western coals, its relative ease insofar as strippability is concerned is another. But along with that, we open up a whole new set of problems that is practically unknown to the East.

Water is one. We are concerned about underground water sources because the water is in short supply. It is not a problem in the East and that is very important. Second, we have to think in terms of energy source versus use and that brings up the problems of transportation. Are we going to do it by rail or slurry line or by wire? Coal gasification and liquifaction are two other areas. How do you find out what is the best way to take that kinetic source of energy and transmit it into something usable where the people are?

It seems to me that these questions have been useful. I think the panel has made a very fine contribution in focusing on the basic problem that disturbs me, as I know it does you, and that is, how do we construct and fashion a bill that will make it possible to get the attention that the Government proposes to give by virtue of appropriations to those areas of the country where the problems are?

That is all I have to say, Mr. Chairman. Thank you very much.

Senator METCALF. I regret very much, gentlemen, that I have some time restrictions this morning. I think you have been most helpful in analyzing some of the problems with which we are confronted in this legislation, which has two titles, one would establish the federal coal laboratories and the other would establish this fellowship system.

I think we are all in accord that we badly need additional trained and skilled professionals in all the coal areas we discussed. We need to know more about the hydrology of the Great Plains, the mining techniques, transportation techniques, MHD, and more efficient ways of turning coal into energy. One of the ways in which we are trying to solve that shortage of manpower and trained personnel is this bill.

You had an interesting suggestion of special chairs for coal technology and that is certainly an area we will explore. I have a lot of

problems and I may circulate some questions after these hearings are over to the people who wrote us and whose letters are in the hearing record already.

However, I would like to accommodate the next panel this morning. Time is running out on me so I will thank you gentlemen for your appearance here and for your suggestions. We will be in touch with you again.

The next panel is Dean Charles L. Hosler of Pennsylvania State University and Mr. William Spackman, director of Coal Research Section of the Pennsylvania State University. We are delighted to have you both here from a great university that has a long history of coal research and coal development.

I can remember back to the time when I was on the Edmundson committee that established the Office of Coal Research. We were in the anthracite region of Pennsylvania and visited your university that long ago. You had an ongoing problem at that time.

Dean HOSLER. We have a long history.

Senator METCALF. Dean Hosler, are you going to start?

Dean HOSLER. Yes.

Senator METCALF. Go ahead.

#### STATEMENT OF CHARLES L. HOSLER, DEAN, COLLEGE OF EARTH AND MINERAL SCIENCES, PENNSYLVANIA STATE UNIVERSITY

Dean HOSLER. Mr. Chairman, I have brought a prepared statement but in the interest of brevity, I will not read the prepared statement but I would like to address some particular points I made in there that are relevant to questions you have asked this morning.

Senator METCALF. Yes. I would like to have both of you just give us your observations.

Dean HOSLER. I would like to say the establishment of these coal research laboratories is very important from the standpoint of the continuity they would give university programs. While at the present time there are a lot of dollars available for specific research objectives from Federal agencies, the fact is that for the past 25 years, coal research has gone from zero up to some significant figures, down to zero, it just is not possible to build a viable university research group with that type of erratic funding. Plus the personal problems that people have, they can't move from one institution to the next every year and you cannot build a team based on this discontinuous funding.

One very important feature of the bill would be there would be this continued funding where you could build a cadre of expertise which could then absorb the fluctuation in year to year contracts that are constantly occurring.

The other thing that we have encountered in university research of all types, and coal research is no different, that we are a minority group that is saying last hired, first fired. This is true when you compete with Government laboratories in any field. Once the Government laboratory is established and the program builds, then they go out and give contracts to universities and industry. But when things begin to get tough again and things contract, usually these contracts are the first ones terminated in order to sustain the Government laboratories.

It is only human and that should be so but I think it is important that funds be segregated out and line items appear in the budget for continued funding of coal research. If such continued funding had existed, many of the problems we have today in coal characterization, sulfur removal, liquefaction and gasification could have been solved 20, 25 years ago and there were many people who advocated this at that time.

Unfortunately, we did not heed their voices or they were inarticulate and we did not recognize what they were saying. But in the fear that this Government program might run its cycle of 4 or 5 years and the excitement may die down, although in this case it looks like circumstances will sustain it, I think there is need for some guarantee in the education institutions of continued funding.

The other thing that I think is important to point out is while Government laboratories and industry can do a lot of this work, the source of the manpower, the source of the new people we must attract in this field is going to have to be the universities. The new blood that will feed the Government laboratories and industrial laboratories will have to be acquired in the universities.

Unless there is a large and viable and visible program within a university, you just don't attract the graduate students. We have found over many years of hard experience that some of the exotic fields like fuel science and fuel technology and mineral processing, these fields have not attracted large numbers of graduate students simply because they have been very small programs within large universities and did not have the visibility of the traditional fields such as chemical engineering, civil engineering or what have you.

So it is important that the universities—I might say regionally it is important that these universities be well distributed all over the United States because the types of problems that we must deal with, whether it is in the extraction of coal, in the reclamation or the processing of the coal, are highly variable. Your coal varies from anthracite to bituminous to lignite where water table problems are quite different. In the east you have problems of getting rid of the water and in the west, you have problems getting the water.

These problems are so variable it is absolutely essential that these be regionally established.

SENATOR METCALF. And the overburden problem.

DEAN HOSLER. The overburden problem is quite different. In some cases, there are acid mine drainage problems and in some cases, none. Since these are large and complex problems, it is essential there be people in the regions where the problems exist and where industry must face these problems where there will be university laboratories that can feed personnel trained and working on these problems into the industries that have the problem and where the university in turn—I must say that our experience has been the interaction between the university and Government laboratories and industrial laboratories is rather good.

We have a number of joint programs at our university with industry and with Government. I am not worried about the interaction but I am worried about the strength of the third leg on the tripod, the university in the overall program of research that will be necessary to make maximum utilization of our coal resources in the United States.

I must say one other thing and that is what we are faced in our university with great expansion in this area. The number of students has almost quadrupled in just a few years in the mining and mineral engineering fields, for example. We are faced, as are most other universities at this time, with decreasing public support for universities in general and with shrinking funds for the university at a time when we should be rapidly expanding a segment of the university.

It is very difficult for a small minority group within a university to complete with the larger segments of the university, tenure being what it is in university and university politics being what it is. So we really need some outside help in order to meet the needs of the society and providing the manpower.

I am very pleased to report that the public is responding, students from high schools and universities are coming into these programs at a very great rate. We have people even switching from being French majors into mining engineers believe it or not, because they recognize the need for people in this area.

But I think this bill, S. 62, while I would not worry about the detail in it, the general principle of providing continuing Federal funding to support a number of educational institutions in this country to have strong research and educational programs is a very good concept.

I don't want to dwell on this further but I would like to have Dr. Spackman who directs our Coal Research Laboratory at Penn State run through some of the complexities of coal and some of the problems we need to approach in this field.

[The prepared statement of Dean Hosler follows:]

STATEMENT OF C. L. HOSLER, DEAN, COLLEGE OF EARTH AND MINERAL SCIENCES,  
THE PENNSYLVANIA STATE UNIVERSITY, UNIVERSITY PARK, PENNSYLVANIA

I should like to thank the Chairman and the Committee for the opportunity to discuss the importance of the provisions of S. 62 to the future of U.S. energy supplies. My only regret is that we cannot turn back the clock 25 years and are not able to have a second chance to heed the advice of those who at that time were warning of increased dependence upon foreign oil and calling attention to our vast coal reserves and the need to better understand how to turn them into clean and useful energy. One of my predecessors as Dean of the College of Earth and Mineral Sciences at Penn State wrote a book at that time called "Mineral Forecast 2000 A.D." The accuracy of the chronology of events predicted therein is uncanny. For example, 1975 was highlighted as the year natural gas shortages would become acute. In traditional human fashion we ignored the portents of problems to come and felt that things would somehow work out. We now find ourselves faced with the need to do in a few years what might have been done in 25 years had we more foresight.

Suffice it to say that for the past 25 years support for coal research has been small and erratic. For example, there were some years in the 60's when no contract funds were available for coal research. Research groups had to be disbanded and dispersed.

Suddenly there are large sums of money on a year to year basis available for specific goals of Federal agencies, but there still does not exist a reliable base upon which to build a cadre of professionals and a facility which can be dedicated to continued work in this area. A University faculty capable of high level research and teaching cannot be built upon year to year grants and the whims of the agencies who dispense them. Particularly at a time when competition for qualified potential staff are in great demand by all segments of the energy community. Reasonable assurance of continuity in order to follow through on difficult and long range research objectives and stability in the personal life of staff dictate that some base of continuous support be available.

The flow of talented graduate students to a field also is difficult to start without the visibility of an established base of activity in the University. Around a

nucleus such as the proposed coal research laboratories, one can expand or contract as year to year funding is available to pursue short-term objectives. The core of knowledgeable and experienced researchers is on hand.

Unfortunately, the great emphasis upon expanding energy research and instruction comes at a time when University funding has leveled off and real purchasing power has decreased. The ability of universities to allocate funds of their own to back such programs as coal research is minimal or nonexistent. In fact, existing programs are still being threatened in favor of cheaper more popular university programs. Even if S. 62 should pass in its present form, many institutions will have difficulty finding matching funds.

One might ask why university research laboratories are needed when industry and government laboratories exist. The simple answer is that the American society needs every input it can get toward solution to our problems. Universities can be the source of new ideas and a place to introduce new people to the old problems. The probability of rapid progress in research is in direct proportion to the number of heads concerned with that problem. We cannot afford to ignore such an important segment of the problem-solving community as the universities represent. For the solution of our long-range problems, new people will be needed. These people must come from universities and must be recruited into the field of coal research through the existence of viable and visible programs in the universities. A strong activity within the university which involves teaching faculty inevitably leads to the attraction of students to the field of activity.

The problems of coal extraction and utilization are so different from region to region in the United States as to demand a number of laboratories with experience and emphasis on the diverse problems. The coals range from anthracite through lignite and peat. The extraction problems range from thin seams of depths of inches to seams 50 to 100 feet thick and from level horizontal seams of bituminous to the deeply pitching and contorted seams of anthracite. Environmental problems range from water drainage problems of the east to preserving desert areas of the west. Some seams contain acid-producing sulfur and others do not. The physical and chemical nature of coal is extremely complex as Dr. Spackman will show you. Some coals are so different that entirely different approaches to treatment are required. The knowledge of coal necessary to design economical gasification and liquifaction processes is a whole new story from what was required ten years ago to fire a boiler with coal. It is essential that the laboratories be located to permit involvement in regional problems and interaction with government and industrial interests who are faced with the problems. I urge that S. 62 be favorably considered by your Committee.

Senator METCALF. Dr. Spackman, we are delighted to have you before the committee.

**STATEMENT OF DR. WILLIAM SPACKMAN, DIRECTOR, COAL  
RESEARCH SECTION, PENNSYLVANIA STATE UNIVERSITY**

Dr. SPACKMAN. Thank you very much, Mr. Chairman. We all know of our vast coal reserves and have seen estimates of these. I always think it is useful to look at these depletion curves which tell us something about the extent to which we are going to have the availability of these materials in the United States on the West. Even if we turn to the world figures where the Middle East can supply us with vast amounts of oil, we see that the picture is not significantly changed.

[Slide presentation.]

The message contained in these two slides is that even though we might wish to make some adjustment and suggest that the amount of coal that we are estimating is exaggerated or perhaps we want to double the amount of energy that may be supplied from nuclear sources, still the picture remains the same, coal has a major role to play in satisfying the Nation's and the world's energy requirements.

The map that you see on the left there as you recognize depicts the coalfields of the United States. We are used to seeing that sort of map.

The orange areas represent areas that contain sufficient coal to handle the large coal conversion complexes that we are likely to be involved with in the future. This says to me that we have to be concerned with all of the major coalfields of the country and this immediately brings us into the problem of dealing with many different coal types formed in different ages and having different properties.

With that in the way of introduction, let me say that this is, I suppose, the conventional image that one has of this material called coal. Unfortunately, it is a very misleading picture and in fact, it would be much better for us to cut that piece of coal down through the middle, take a slice of it and look at it through the microscope.

We see immediately that coal is an extremely complex material. I think I can say categorically that it is the most complex rock within the Earth's crust. To further illustrate the point, the material that you see there on the left is one kind of coal. On the right, you see another kind of coal from the same seam at the same location and still a third kind of material is shown again from the same seam at the same site.

So, indeed, coal is indeed not coal, and will differ significantly in different parts of the country. You will never find the material illustrated on the right in the State of Utah simply because of the difference in ages of those materials. So we deal with a complex material and our knowledge of the characteristics of the coals in the eastern part of the country is meager.

Our ignorance of the characteristics of the coal in the western part of the country is abysmal. What I am saying, therefore, is that on the right, coal is not only a mixture of the common minerals that form the rocks of the Earth's crust, but it also contains a myriad of other organic substances that of course is, in fact, responsible for making the material coal.

While I can tell you the composition of the grains you see on the right-hand side, I can tell you the chemical composition of the mineral grains, the hardness if specific gravity and all the other properties as far as handling is concerned, there is no man on the face of the Earth that can tell you the composition of the yellow object in the center of the field below the word macerals.

I am saying we have had too easy a time in our utilization of coal. It has been too easy to burn it and consequently, we have not needed to understand the material as we are going to have to now. I suppose one might say that this is all well and good but is it really of importance to us to have some knowledge of the nature of these pretty materials or is this just an academic matter?

Let me comment on this and try to convince you of the importance of understanding these materials. At the same time emphasize the role that universities can and should play in cooperating with industry. One of the important ways that we use coal at the moment is in the manufacture of metallurgical coke. The coke oven you see on the left is a long slot like oven. You charge 18 tons of coal into that and in that particular situation, each of these organic materials has an opportunity to respond in its own particular way to the coking process.

Some 20 years ago, one of the major steel corporations in the country came to Penn State because they had acquired properties that proved to be very poor in quality as far as coking is concerned. They

encountered this kind of a situation, coking the coal on the left, they produced a very poor product, one you couldn't possibly use in the blast furnace. They blended, for example, that very poor coal on the left with the one in the middle and discovered to their surprise that by adding a poor coal to a mediocre coal, you could produce a good coke.

It became evident it would be useful to understand what was behind this in the interest of making operations more effective and efficient in the coke plants. As a result of our cooperative work with the steel industry, we came to know that all we had to do really was to look through a microscope and generate some information on the relative concentrations of these different materials, some of which are reactive and some of which are not reactive in the coke oven.

If we convert those numbers to a set of sample indexes like this, we have the ability to predict in advance the quality of the coke that will be generated. At the Pittsburgh seam in the case of this particular sample, it is going to produce a coke with a strength that is said to be 38. In other words, it is an arbitrary index of strength.

But the interesting thing about all of this is that now armed with this technique, I can, with the information available on the composition of coal "x", I can predict the quality of the coke that will be derived from mixing those two materials together in any proportion.

Senator METCALF. Mr. Spackman, I'm very sorry to have to interrupt but there is a vote on the Senate floor on the final passage of the foreign aid bill. I would refrain from voting on some of these things but I think it is necessary to get over there and vote on that bill. Would it be convenient for you to come back at 2 p.m.?

Dr. SPACKMAN. Certainly.

Senator METCALF. As I understand it, the next panel has already been informed that we will hold until 2 p.m. and they would come back shortly after Dr. Hosler and Dr. Spackman finish their testimony. Then we will be in recess until 2 p.m.

[Whereupon, the hearing was recessed at 11:50 a.m.]

#### AFTERNOON SESSION

Senator METCALF. The subcommittee will be in order. I am very grateful to my friends from Pennsylvania State University for their patience in waiting for a renewal of this hearing, and without any more discussion, I call on Dr. Spackman to continue his slide presentation and then discuss it.

#### STATEMENT OF DR. WILLIAM SPACKMAN, DIRECTOR, COAL RESEARCH SECTION, PENNSYLVANIA STATE UNIVERSITY—Resumed

Dr. SPACKMAN. If I may be permitted just a few words to recap which I attempted to say—first, I was trying to depict the magnitude of our job as I see it, and the first point that I attempted to make was that we are dealing from exceptionally complex raw material, and our knowledge of this material is minimal.

I would urge that coal should not be equated in our thinking with iron or oil or uranium because of its much greater complexity.

Second, I was trying to say we should face up to the job and demonstrate the ability to produce practical research results within an acceptable time frame.

And third, I commented that alliance between Penn State and industry has been mutually beneficial and improved the rate at which new technology transfer was effected. I did this by describing our successes in establishing important relationships between coal characteristics and the behavior of coal in the making of metallurgical coke which, as you know, is the second largest market for our coal resources.

What it amounts to is that we have learned to optimize feedstock composition in the case of making this kind of a product. I indicated that the complex nature of coal was such that each of these materials reacted somewhat differently in the coke oven, and commented that we have developed techniques whereby we can generate quantitative data relating to the characteristics of coal, reduce the data down to industries shown on the right, and then with the aid of a standardized set of curves predict with accuracy the kind of coke that is going to be produced.

As you see from the slide on the left, what that amounts to is demonstrating to ourselves how we can take a coal such as the Pittsburgh coal that was illustrated there on the right of the diagram and blend it with a coal that is of the same quality and as a result of that blending operation and because we understand the mechanism that's involved, we end up with a much better product than you might otherwise anticipate—or if you look at the numbers, a strength of 38 plus 38 equals 52, or you can take a poor coal and add it to a poor coal and make a good coke.

The impact of this is, of course, to expand the variety of coals that can be used in this important process. In other words, we are optimizing the composition of the material we are putting into the oven, thereby not only maintaining better quality control, but also extending our natural resources which I think it, of course, an important matter.

Now having said these things, I would like to comment that we are now moving into a new era. We are talking about converting coal to gases. You may be familiar with the fact that there are upward of 75 different processes that have been explored in the past to do this kind of job.

We are also talking about converting our coal to liquid products, and both of these things are well along in the research and even demonstration phase. We are talking about converting coal to clean solids, and the point I wish to make here is that, gentlemen, we are dealing now with an infinitely more sophisticated technique that is involved in the combustion of coal in boilers or even the carbonization of coal in coke ovens.

So we have a vast amount of process research that is required in addition to the research that is essential to understanding our coal resources. I guess what I am trying to say is that in my judgment a much more massive research effort must be mounted immediately if we are to in fact have the information that we need available at the time which it is required.

And I think what I am saying is that this is, of course, not only the job of the universities; it involves the Federal agencies concerned with coal research; it involves ERDA and all of the effort that ERDA

can put into it. It involves the universities and other agencies competent to carry on the research.

I think perhaps an interesting point should be made of the fact that universities have a unique role to play in connection with this whole future of coal utilization in that they bear the primary responsibility for not only producing research results, but also for training manpower. I would comment that at least three different classes of manpower are required.

To my judgment, we should be about the business of developing additional coal science faculties so that they in turn can, in fact, produce the kinds of coal research scientists needed to produce the research results, and they, of course, are also required to generate the coal technologists and engineers necessary to construct and operate the plant.

So we have to not only train the workers, as it were, but we have to educate the educators in order to have sufficient competence to get the total job done.

This having been said, let me turn to the Penn State situation. We have been very fortunate at Penn State in obtaining funding, but let me call to your attention that that alone does not mean that we are without problems, and in fact, S. 62 directs itself to some of these problems.

At Penn State we have a coal research organization that has been functioning for a number of years. We probably have an expertise both in depth and in scope that is difficult to equal in other parts of the country. We in addition have, I think, a good track record in that we have produced results and we have produced trained people.

We have a sizable program that is underway at the moment with a reasonable amount of funding for that. We, of course, are called upon almost daily to expand our research efforts in the interest of getting the job done, because there are so few universities that are involved in the coal research area.

These things, among other matters, have resulted in the development at Penn State of a very massive program sponsored in part by ERDA and in part by EPRI, all of these programs being complementary and integrated, and designed to generate information now on the relationships between coal characteristics and gasification and liquefaction behavior.

The requests that have been made to expand the program suggest to us that we ought to be in the business if we are going to fulfill our responsibilities of materially expanding our operations and building upon the expertise that exists there.

On the surface, it would appear that Penn State is in good shape, but in fact our problems are no different than the other universities around the country, and the first problem centers upon the fact that most coal research has been conducted on the university scene with nonuniversity funds on a contract basis with outside agencies.

This is simply to depict the manner in which the number of dollars varied over a period of time in our history, and we could do the same thing for other units of time and see similar things. I am sure just from the diagram you can immediately perceive that that is a heck of a way to run a ship. It is difficult from a number of standpoints.

The other problem that we are confronted with, when we are faced with the need of increasing significantly our efforts, is the problem of

space and facilities, and the way that we see this thing resolved is contained at least in part in S. 62, and we envision the need for a reasonable number of laboratories scattered certainly all around the country developing areas of expertise as well as capitalizing on them.

In summary, although the universities are structured to meet the challenge, universities cannot in my judgment produce the required results under the present circumstances. Two essential ingredients are, in my opinion, lacking: first, a base funding that insures continuity of research effort and graduate student support does not exist. For the most part, university coal research operates on non-university funding and on an indefinite, insecure, year-to-year basis.

Second, the massive effort that must be undertaken cannot be conducted in the existing facilities where (1) the space is already occupied. There are not large volumes of space sitting empty, of course; (2) the equipment in hand is fully committed, inadequate or nonexistent; and (3) the talents one needs to assemble are dispersed in various departments and various colleges around the university and this does not contribute to the kind of rate at which we would like to see and I think must see research proceed.

So in my judgment S. 62 addresses itself to these two important problems and in large measure provides the lacking ingredients; and again in my judgment it would be extremely valuable to have this bill enacted in the interests of the successful attainment of the Nation's goal of minimizing our dependence on foreign energy sources.

Thank you, sir.

Senator METCALF. Thank you very much. Thank you both for your appearance here. I am reminded of a visit I made to TVA with Red Wagner.

He said that he had a group of people going through the TVA and he showed them the coal-fired furnaces and the hydro facilities and how they matched the facilities and the tremendous interrelated dams and coal-burning areas and so forth, and at the end of it; one of the people that was in the party that was viewing it said: "Well, you men are very ingenious and this is a tremendously impressive sort of thing, but up where we live all we do is flick a switch and turn the lights on." [Laughter.]

And I am impressed by the activities that you have had over the years, the traditional work you have done at Penn State, but what I am really concerned about right now is the last statement that you made.

Will the passage of S. 62 help you in implementing the activities that have been so important and so significant in the research laboratories at your university?

Dr. SPACKMAN. Yes, in my judgment it will very materially assist us. We, for example, in connection with the ERDA program that we have underway now among other things are required to obtain from roundabout the country some 100 to 1,400 samples of coal, each of which might amount to as much as a ton. And because we at Penn State again, as part of our obligation under the ERDA contract maintain a sample bank which is a source of research materials for anyone in the coal research community, this material that will be collected requires something on the order of 10,000 square feet of storage space.

I have people that are working on the program that have no place to sit to do any of their work. Much of it is done at home; so

that there is a need for additional facilities. As I say, our need is no different than the need at Montana State or the University of Utah. I think you will find the situations are identical.

It is also my understanding that there is a base funding provided in this bill which will help again in securing and maintaining a nucleus that you need at a university to insure the effectiveness of the program.

Senator METCALF. You had 10 on your chart.

Dr. SPACKMAN. Yes, sir. The number is not meaningful. I did that simply to illustrate the fact that in my judgment they should be dispersed over the country because as I tried to indicate, the coals of Montana and Utah are quite dissimilar from the coals of West Virginia.

Senator METCALF. Now in the very unlikely event that Penn State with its history and tradition of coal research and coal development was not selected for one of these laboratories provided for by title I of S. 62, what effect would that have on your university or your opportunities for continuation of research?

Dr. SPACKMAN. Well, I guess I am concerned about the impact that it will have upon our Nation and the energy problem that we are confronted with, and if that happened to be the manner in which things evolved, in my judgment there would be an overall good that justified the passage of the bill and the action that followed it, even though Penn State might not be able to profit from it.

Senator METCALF. I can't imagine a situation, either politically with Senator Scott as the minority leader and the Republican President around, or intellectually and historically with that tremendous background of research that Penn State wouldn't benefit; but suppose you were thrown in with your great good friend West Virginia and West Virginia were chosen as the laboratory?

Dr. HOSLER. If the funds were prorated on the basis of the score between West Virginia and Penn State in football—

Senator METCALF. I was hoping we would get away from those interdisciplinary rivalries. See on your chart you don't have anything for Montana in these laboratories or these 10, but right now in Montana ERDA puts a million-and-a-quarter—something like that—and Laramie, which was on your chart doesn't get any money from ERDA—so just from a parochial standpoint I would say Montana is better off under the present situation than with the passage of this legislation.

Dr. SPACKMAN. I was merely trying to emphasize the fact that in my judgment it would be a tragedy if all the laboratories were confined to the East. As a matter of fact, if Penn State were the only laboratory that benefitted from this, it would be an even greater tragedy. I think it is going to require the combined efforts of every laboratory we can establish to do the job.

Senator METCALF. Dr. White said yesterday that—there wouldn't be a laboratory in his own home State of Illinois where there are different problems of overburden, flat country, and different kinds of seams than you have in Pennsylvania or we have up in Montana or in the Northern Great Plains; so I am trying to make a record for that legislation. We do have to have laboratories in various geographical localities; don't you agree?

Dr. SPACKMAN. I certainly do, sir.

Dr. HOSLER. I think the chart Mr. Spackman showed was just illustrative of the spread you need across the country.

Senator METCALF. What if we set up a regional system?

Dr. HOSLER. I think it would be excellent based on the problems of processing the coals in those regions. Certainly there should be laboratories based on the coal utilization.

But I think the important thing is, as a number of people have said, that some of this research must be done in a university setting so that the students we process through the university have contact with this discipline and go out with some expertise. A Government laboratory does not generate any new blood—does not train people.

Senator METCALF. Now that is what title II of this bill does.

Dr. HOSLER. That alone will not do it, because fellowships really rely on the existence of a cadre of faculty and physical facilities to train those people, and the fellowships don't contribute anything to maintaining that package.

Senator METCALF. In ERDA there is not the skilled teaching personnel nor the laboratory facilities to train these additional 1,500 fellows that we anticipate?

Dr. HOSLER. That I can state with certainty. I think every person who has been in this room today is connected with trying to acquire faculty to handle existing loads of students and would tell you it is practically impossible. No new ones are being generated. We must attract graduate students in and train them and train new faculty. We can't make it on the existing faculty, and to do that we need facilities.

Senator METCALF. Now, as I understand it, the training of graduate students requires a great deal more faculty and laboratory facilities than the training of ordinary students?

Dr. HOSLER. It costs about 10 times as much per unit of instruction to train these people in mining—

Senator METCALF. A unit of instruction is a person?

Dr. HOSLER. That's right—as it does one in sociology, let's say, because—

Senator METCALF. Or political science?

Dr. HOSLER. Or political science, right. Not quite as much as it costs in medical school, however.

Senator METCALF. Thank you very much. Thank you for your patience. I know that most of my colleagues share my feeling that this is a very important and significant area. I congratulate you on the work you have done at Penn State over the years, and thank you for coming down and helping us. We may call on you for some more help, and I know it will be available.

As I understand it, Mr. Osborn and Mr. Bagge have submitted their material for the record. It will be incorporated in the appendix.

[The prepared statement of Dr. Spackman follows:]

STATEMENT OF DR. WILLIAM SPACKMAN, DIRECTOR, COAL RESEARCH SECTION,  
THE PENNSYLVANIA STATE UNIVERSITY

Coal is the most complex rock encountered within the Earth's crust. It is more heterogeneous than any other rock type and its composition varies as a function of: 1) the original environment of deposition, 2) the time of formation,

3) the temperature to which it was subjected during burial and 4) the geographic area in which it occurs. In addition to the common rock-forming minerals, it contains a myriad of organic constituents whose compositions are virtually unknown. These complicated mixtures of materials occur in seams which are, themselves, complex rock bodies composed of several to many superposed coal types. Our lack of knowledge of coal and coal seam composition severely impairs our ability to utilize this important resource in an effective and efficient manner.

To date, most coal has been used for direct combustion or for coke-making. This has required a comparatively simple technology and minimal knowledge of coal composition. We are about to embark on an era that will require the beneficiating and refining of coal and its conversion to clean liquids, gases and solids. The technology involved is infinitely more sophisticated than that associated with combustion and carbonization. Because of this, and because of our lack of knowledge of coal composition, a research effort more massive than that underway must be undertaken without further delay. All available expertise must be brought to bear, including research talent in state and federal agencies, in industry and in our universities. It must be recognized that the nature of the required coal research and the ramifications of the essential process research make it necessary to bring talents from diverse disciplines to bear on the problems.

Teams of competent scientists and engineers must be assembled and given the facilities required to get the job done. At present, personnel from the requisite disciplines seldom interact effectively because of spatial and organizational barriers. These would be removed by creation of laboratories such as those proposed by Senate Bill S. 62.

Conduction of the aforementioned research, plus designing and construction of the numerous coal refining and conversion facilities, plus operation of these facilities is going to require trained manpower in quantities far in excess of current production rates. The Nation's universities now face a major challenge, in that it is primarily their responsibility to produce this manpower in the quantity required over the critical period of the next quarter century. Three classes of personnel must be educated: 1) educators to increase the number of coal science faculties, 2) coal scientists to perform the research and 3) coal technologists and engineers to construct and operate the conversion and refining facilities. In the graduate schools of our universities, the conduct of research is an integral part of the instructional program. Accordingly, the creation of trained coal manpower and production of essential coal research results are uniquely wedded in these institutions. Our universities, therefore, are structured to meet the challenge confronting them.

Although structured to meet the challenge, universities cannot, under the present circumstances, produce the required results. Two essential ingredients are lacking. First, a base funding that insures continuity of research effort and graduate student support does not exist. For the most part, university coal research operates on non-university funding and on an indefinite, insecure, year-to-year basis. Second, the massive interdisciplinary research and training effort that must be undertaken cannot be conducted in existing facilities where: 1) the space is already occupied, 2) equipment is fully committed, inadequate and often non-existent, and 3) talents are diffusely dispersed in various departmental and college facilities within the University. Senate Bill S. 62 provides these lacking ingredients and must be enacted to insure the successful attainment of the Nation's goal of minimizing our dependency on foreign energy sources.

Senator METCALF. So the next group will be panel 3, Dr. Jay Hilary Kelley, dean of the School of Mines of West Virginia; Dean Lattman, College of Mines, University of Utah; Dean Lear, College of Engineering, University of Alabama; Dean Planje, School of Mines and Metallurgy, University of Missouri; and Dean Beistline, University of Alaska. Let's get the order of you gentlemen.

Dr. LEAR. Just the way they appear.

Senator METCALF. Now who is going to start. Are we going to start with Dean Kelley?

Dr. KELLEY. Yes.

STATEMENT OF DR. JAY HILARY KELLEY, DEAN, COLLEGE OF  
MINERAL AND ENERGY RESOURCES, WEST VIRGINIA UNIVER-  
SITY

Dr. KELLEY. Mr. Chairman and members of the subcommittee, I am Jay Hilary Kelley, dean, College of Mineral and Energy Resources of West Virginia University. I present this statement as a member of the Committee on Mineral Resources of the National Association of State Universities and Land Grant Colleges.

I am submitting this statement in behalf of the over 100 institutions represented by this committee to support S. 62, a bill to establish university coal research laboratories and to establish energy resource fellowships. The subcommittee can perhaps obtain a better insight to the need for this legislation if I use the vantage point of my own institution and a professional mining engineer and researcher.

The committee staff is to be commended for their diligence in preparing this very worthwhile piece of legislation. We concur with the general provisions of the bill, but we do have some suggestions to make regarding the administration of the program and other factors.

As background material for the benefit of the subcommittee, I would like to provide you with a brief history of one minerals institution which is deeply involved in the flurry of activities at the heart of the fossil fuels industry.

For many years, our college, known previously as the School of Mines at West Virginia University, produced petroleum and mining engineers with very low enrollments relative to other units of the university.

Prior to 1971, the number of graduates rarely exceeded 10 graduates per year. In the last 5 years, with great emphasis on recruiting activities, the updating of our curriculum, and the hiring of new faculty members, our enrollment has skyrocketed such that our present enrollment is 360 students. The attached chart shows this trend.

Moreover, our enrollments are increasing faster than the average increases in mineral programs nationwide. Judging from the rate of growth, it appears as though our enrollments in the 2 programs will peak at about 700 students in 2 or 3 years.

I am confident that these enrollments are not transitory; that students are anxious to follow an enlightened profession that mineral engineering has become. Indeed, it may be necessary to restrict the enrollment because of facilities and faculty constraints.

With some difficulty we have had accepted by the university new programs in mineral processing and mineral resource economics which are now awaiting approval by the West Virginia Board of Regents. Given these programs, our total college enrollment should reach 1,000 where it should remain for a long time to come.

It might also be questioned why, if undergraduate enrollments are increasing in the minerals colleges, support cannot be rendered through the ordinary university budgetary process. Ordinarily this is what would be done if universities were in a growth situation and enjoyed increasing total enrollments.

However, in recent years universities are experiencing declining total enrollments or nonincreasing enrollments such that university

administrations would be hard pressed to shift support to the growing minerals areas. Faculty pressures from other parts of the university make such shifting of support unpopular.

Clearly there are critical problems facing the minerals engineers programs at many universities. For example, at our institution while undergraduate enrollment is increasing, the graduate enrollment is not responding in the same numbers. For one thing, the high starting salaries of bachelors' graduates make it difficult to lure the bright students into graduate work.

It is our belief that the establishment of a few selected centers of coal research would help alleviate this problem, especially if certain changes in the legislation were made.

In the area of coal research the West Virginia Legislature in its great wisdom established the coal research bureau in our college in the early 1960's. We are proud to say that this unit has made its mark in the development of new knowledge, new processes, and new techniques.

Under partial support from ERDA, then the Office of Coal Research, and the State appropriated funds, our coal research bureau developed a process for making structural brick and other ceramic products from coal flyash. Using our information, two brick plants have been established and are now in operation. It may be one of the few examples where governmentally sponsored coal research resulted in a commercial product.

Additionally, our coal research bureau has developed data and information on various coal constituents and has correlated this information with geographic locations and energy reserves. Our scientists have developed processes for the combustion of high sulfur coal by the absorption of the sulfur during combustion.

Our college has a commanding position with regard to research in new methods, new systems, and new equipment for the mining of coal. Just 3 days ago we presented a paper to the West Virginia Coal Mining Institute and Appalachian Section of the A.I.M.E. on the significant recent developments in coal equipment design.

But the key to progress in the coal industry and energy utilization is the merging of manpower development and education with research activities. It has been established through many studies of the President's Science Advisory Committee in other Government and non-Government organizations that the most efficient and fastest way to communicate new knowledge from the laboratory to field applications is by direct exposure of the people involved. This is why we need to tie any proposed research laboratories closer together with the production of graduates.

I cannot stress too strongly how important it is that research be performed where the problems exist. With the reminder that "necessity is the mother of invention," one is more likely to have results when the people involved in research are exposed to the problems themselves.

This is why we endorse the provision in S. 62 calling for the location of coal research laboratories where coal is being mined. Then, too, experimentation on ideas that do not obtain the results desired has the saving benefit that the persons gaining experience conducting the experimentation are located near the problem areas where they can apply that experience to other problems.

Also, the establishment of coal research centers where research ideas are generated locally has the advantage of utilizing the serendipity and imagination of large numbers of researchers as opposed to research planning in Washington. In this connection we are pleased to see that the U.S. Bureau of Mines is beginning to fund more unsolicited projects at the universities. It indicates that the management of this Bureau and the Department of the Interior are capable of administering this program.

We do note that S. 62 would have the coal research centers administered by the National Science Foundation assisted by the National Academy of Engineering. Although these are fine organizations, neither has demonstrated previous concern for the mineral industry. It is, therefore, recommended that the choice of five to ten coal research centers be chosen by the Secretary of the Interior in consultation with the U.S. Office of Education, which latter organization has shown a great responsiveness to the mineral educators in administering the minerals fellowships under the Higher Education Act of 1975.

We would like to see the National Academy of Engineering and the National Science Foundation be parties to the selection of the 5 to 10 centers; but we would make strong bid to have the involvement of advisory committees composed of mineral educators, coal industry officials, and the natural resource committee of the National Association of State Universities and Land Grant Colleges.

Senator METCALF. Why do we just have coal industry officials? Why not somebody from the United Mine Workers?

Dr. KELLEY. I would endorse that, sir.

Senator METCALF. Or somebody from Consumers' Council as well?

Dr. KELLEY. We need a broadly based spectrum, yes, sir.

We would like also to see changes made in the energy fellowship provision of S. 62 so that an individual receiving a fellowship could receive up to \$10,000 either entirely from the fellowship itself or by a combined stipend from the fellowship and a graduate assistantship funded from other sources.

The experience with the fellowships under the domestic mining and mineral fuel conservation provisions of title IX, part D, of the Higher Education Act of 1965 has shown clearly that an upgrading is necessary to attract the quality and quantity of graduate students into the program. Also we would like to see the fellowships made available to graduate students working for the Ph. D. degree as well as the masters' degree.

In conclusion, we are hopeful that the subcommittee and the Congress will accept S. 62 with the modifications suggested. Such well conceived legislation is a necessity for our country and will reap many rewards for the prudent use of our mineral resources and the conservation of our resources for later generations.

I now, with your permission, Mr. Chairman, would like to comment on the statement made this morning, or the implications made this morning, that there is a rift or a competition.

Senator METCALF. Now Mr. Kelley, I am delighted that you are going to do that. You know some of the questions I have asked this morning—you were here—and I hope all of you will amplify your statements. Thank you very much for volunteering and giving us the opportunity to make that suggestion. Go right ahead.

Dr. KELLEY. There really is no competition between the eastern universities and the western universities. We all feel ourselves part of the profession. I was one of the persons who put a plea in to the authorities in the State of Montana to preserve that school of mines, and I think it would be an unconscionable error for the State of Montana to eliminate that institution at this time in history, and I am very happy to see that it is preserved.

We need, I think, a similar institution in Wyoming, and we will go out of our way to help those western institutions gain strength. It really disturbed me to hear or to get that feeling that there was any sense of competition. I think there is a sense of regionalism which we all share.

I think those States that have minerals that are exported to other States and to other countries do have a concern that they receive the amount of Federal support for research and also enough price for their product so that their countryside is not disturbed.

I just wanted to make this comment, sir. Then I will pass on to the next speaker.

Senator METCALF. Mr. Kelley, during the course of our hearings on the Surface Mining Act, Dr. Curry of the University of Montana came in and testified about how long it took in that arid western region to accumulate the fragile soil that is the overburden in the strip mining areas. He suggested that (1) you couldn't stockpile it and save it, and (2) it would take another 10,000 years or so to accumulate it.

On the other hand, it was suggested that out in the Midwest where we had a rain forest once and dozens of feet of fertile overburden, you had a different situation. The point is that, no matter who is right, we have such differing situations involved—kind of a very flimsy and fragile topsoil in one area, sand almost that will grow cactus only in the four corners area of the Southwest, fragile tundra in Alaska. I would hope that we would be able to work out some sort of a reasonable program that would do what you suggest.

I want all of you to answer this question—if we only passed title II of this bill and provided for 1,500 fellowships, do we have the facilities to properly and adequately train those young men and women?

Dr. KELLEY. I think I would have to agree with Dean Hosler of Penn State that we probably would have a hard time doing it. It would make a difference, however, if we would increase the annual stipend. I think if we would as he had suggested increase the annual stipend to \$10,000 or more, then we might have a prayer of doing it.

Mr. HARVEY. Dean Kelley, in your testimony you refer to the fact that the experience of fellowships under the Higher Education Act has shown upgrading is necessary. It wasn't clear what you meant. Do you think that the Higher Education Act provisions are adequate?

Dr. KELLEY. What is the difficulty with the administration of that is the low stipend. There is no way we can attract graduate students with that low a stipend.

Mr. HARVEY. Thank you very much.

Senator METCALF. As I understand it, that means that not only do we need the stipend that goes to the students. There have to be facilities that will encourage that bright student to stay around and participate in research that is involved?

Dr. KELLEY. Yes.

Senator METCALF. I used to be on the Education Committee in the House of Representatives. I was the sponsor of one of the first aid to education bills, the so-called Metcalf bill. They used to tell me that the best education was Mark Hopkins and one student on a log. But these days we have to have a laboratory in between?

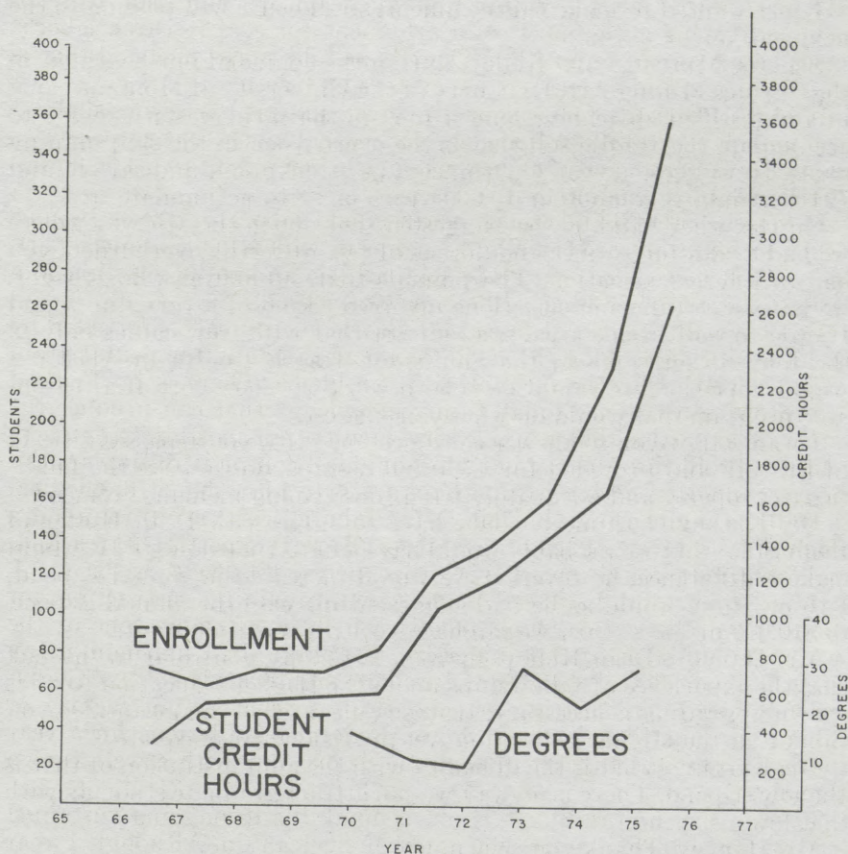
Dr. KELLEY. That is correct. All of the mineral colleges are hurting for facilities. I don't think title VI of this bill refers to or affects the facilities. I don't think that is included. We have to fight that battle on the State level or obtain help from industry.

Senator METCALF. Or some grants in aid from industry.

Dr. KELLEY. That's right. We are now seeking a new building from the State of West Virginia, and we will have our difficulties, but I hope we succeed.

Senator METCALF. Thank you, Dr. Kelley.

[The chart referred to by Dr. Kelley follows:]



Senator METCALF. And now we will hear from Dr. Lattman of the University of Utah. As you know, Senator Moss has been a stalwart advocate of this legislation.

STATEMENT OF DR. LAURENCE H. LATTMAN, DEAN, COLLEGE OF  
MINES AND MINERAL SCIENCES, UNIVERSITY OF UTAH

Dr. LATTMAN. Thank you, Mr. Chairman. I am Laurence H. Lattman, dean, College of Mines and Mineral Sciences of the University of Utah. Much of what I was going to say, as I suspected, was preempted by those who went before, because we all have similar conclusions, Mr. Chairman.

Senator METCALF. That happens to us in politics all the time. If you are the last speaker, it has already been said. But let me tell you we want to hear you say it, too.

Dr. LATTMAN. All right. I am here to support S. 62, and I included in my written testimony five points I wanted to bring out which I will amplify slightly in verbal presentation.

In the necessity for regional laboratories which was emphasized by Dr. Spackman caused by the fact that coal varies very greatly regionally, or for that matter within a single seam or from seam to seam technically, this is the most solid argument for coal research laboratories being spread regionally. There is an additional one, and that is accessibility to and by local coal operators.

It is very difficult for someone involved in coal operation, coal extraction, or processing to journey to a Federal laboratory three States away, for example, and present the problem and expect to get a sympathetic and quick reaction to it.

If, on the other hand, there is a regional laboratory close by, one either in his State or servicing a region in which his State is a part, he is much more likely to get a sympathetic and rapid reaction to a problem because, in addition, it seems to me logical.

Point No. 2 is that coal research today is, of course, complicated by the necessity of sociological, legal, economic, and environmental problems, as well as by the technological problems. There is no Federal laboratory in existence today to my knowledge that can produce the range of expertise that a university faculty can in addressing these complex problems. Most universities or small consortia of universities have sociologists, economists, perhaps access to a law school, biomedical as well as engineering, and hence the laboratories can draw upon a much greater range of scientific and sociological expertise than a Federal laboratory could sustain on a permanent civil service basis.

Third, the point has been made about providing instruction for young researchers and young faculty which is, of course, one of the two major missions of the university. Frankly, Mr. Chairman, many Federal agencies feel that they contribute significantly to this by giving fellowships or shifting associateships so that young faculty or advance graduate students can go on Federal installations for a year and work perhaps on part of their thesis or work with a well-known investigator.

This is very useful, but it is not comparable to ongoing sustained instruction that a laboratory at a university can do. Although 1 year of visiting a Federal laboratory is available, it can hardly be compared with 3 years or more of graduate work in constant connection both with the Federal laboratory and the instructional facilities of the university. They are just an order of magnitude apart.

Two other points I would mention. Coal research as we look at it today is continually tied in with energy and the energy problem, and we look upon coal as the energy source we must develop between now and the year 2,000. Frequently it is compared with such possible energy sources as solar cells or hydroelectric power or fission—nuclear processes. Oil and gas is not only a very significant source of energy, it is the basis for the whole petrochemical industry of the United States, a multibillion-dollar industry of heavy chemicals, plastics, synthetic rubber, and the like. We would be in bad shape without a healthy petrochemical industry.

The importance of national coal laboratories is they will carry on research in the immediate products as well as in just the combustion of coal. Solar cells, nuclear fission, and the like will produce energy absolutely, but they will not produce the immediate hydrocarbons which are the basis of the petrochemical industry.

As we use up the oil and gas reserves, we must substitute petrochemicals from another source, and the only source is coal. Therefore, I wish to emphasize the importance of national coal research laboratories as against national solar research laboratories, nuclear fission laboratories, and the like.

Finally, in my fifth point here, and again much has been repeated before, is universities are particularly geared to the rapid dissemination of knowledge, including research results. Not only do they publish, and indeed, of course, Federal laboratories publish, but by direct instruction it is possible for the results of the coal research laboratory's work, the regional one located at a university campus, to get this information to the students and the user, the consuming public by seminars, short courses, and publication.

It is very difficult for a Federal laboratory to maintain ongoing programs of such continuing education type of instruction which the universities are particularly geared to do, and hence transmit to the user community the results of the coal laboratory's research.

For all of these reasons plus those outlined in the written testimony, I would recommend that S. 62, with a modification for an increase to 10 or 12 laboratories rather than 5, be favorably looked upon by your subcommittee, sir.

In response to the question would the 1,500 fellowships alone be a major advance in mining engineering or materials engineering or mineral engineering, certainly it would help, but I must agree with both Dean Kelley and Dean Hosler that the lack of facilities today would markedly reduce the significance of this 1,500 fellowships. I don't think we would realize their full potential. We are short of faculty. We are short of space. We are short of sustaining funds for the equipment, the expensive equipment, necessary for teaching as well as research, and although certainly the fellowships would help, their value would be many times amplified by the package of title I also.

Thank you very much for this opportunity.

Senator METCALF. Thank you very much for an appearance here. Dr. Kelley, I think you raised a good question that certainly should be considered, and that is whether this should be administered under the National Science Foundation or some others. I think it is a serious question. We should consider it. Dr. Lattman has raised similar questions.

I am delighted that we have had at this late hour some new and innovative material.

[The prepared statement of Dr. Lattman follows:]

STATEMENT OF DR. LAURENCE H. LATTMAN, DEAN, COLLEGE OF MINES AND MINERAL INDUSTRIES, THE UNIVERSITY OF UTAH

I support the establishment of several National Coal Laboratories as embodied in S. 62. Such laboratories established on selected university campuses would, I believe have a significant and beneficial effect on the use of our nation's vital coal reserves. The laboratories would fill a role not now covered by any federal, state, or private organization. Five major points are listed below in support of the establishment of these laboratories:

1. The properties of coal vary widely—both regionally and from seam to seam locally. There do not now exist complete national or regional data bases of coal properties or characterization. The characterization of coal has advanced rapidly in the past several decades and new and continually up-dated bases must be maintained to allow the most effective planning for coal use. Such data bases are most logically maintained regionally because of the large effort involved, but each such data base must be coordinated into a national inventory. Efficient use of coal as a fuel and a source of petrochemicals will be effectively served by modern data bases maintained by the regional laboratories.

2. The complexity of research and development on coal use requires a very wide range of expertise—scientific, technical, sociological and legal. Faculties of universities provide such a range in expertise. It is difficult to assemble several large similar groups outside of universities.

3. Location of the laboratories at universities also has the important result of providing instruction for young researchers and for users. Graduate students would, of course, be directly involved in all phases of research and young faculty would develop the needed experience. Additionally, seminars and short courses for the user community would be a natural spinoff from such laboratories. Cooperative programs between universities and industry have been a significant part of several university instructional programs and could be easily developed around the laboratories. Today there is a severe shortage of trained technical people.

4. Coal research is expensive, involving sophisticated equipment and skilled personnel. Most, if not all, such large programs at universities today involve continuously obtaining large federal grants. This type of funding is tenuous and as a result a permanent and experienced faculty is difficult to retain. A National Coal Laboratory would be a permanent fixture on a campus and allow the development of a permanent and experienced staff. The importance of such a permanent facility can hardly be over-emphasized; it is the most efficient means of research.

5. Universities are geared to rapid dissemination of information in the form of publication, seminars and in regular instructional courses. Thus the work of a National Coal Laboratory would be made available to a large audience very rapidly. Hopefully, such information dissemination would minimize duplication of effort among the laboratories.

For all of the reasons given above, I believe S. 62 would provide a major step forward in solving our energy problems.

Senator METCALF. Now, Dean Lear, of the University of Alabama.

STATEMENT OF W. EDWARD LEAR, DEAN, COLLEGE OF ENGINEERING, UNIVERSITY OF ALABAMA

Dr. LEAR. Thank you, Senator Metcalf. I have in my written testimony done a fair amount of the same sort of thing which others have done and have made particular reference and emphasized three points which I will summarize, one having to do with regional need for research centers as outlined in S. 62 because of the regional character of the problems.

I have suggested there also that five centers might not take advantage of the expertise which lies in the schools which would be involved in these programs, and also would probably not allow us to tackle the regional problems.

And finally I have given some data which we feel is conservative based on production figures and on rates of expansion of coal capacity, on health and safety requirements, on environmental requirements for manpower needs for the next several years in the southern Appalachian region, and it would be expected there is a tremendous shortfall on that score.

Rather than read that testimony, I am now prompted by some points which have come up with regard to the availability from ERDA and from the Bureau of Mines and others of contract type of support as opposed to sustaining support.

With your permission, I would like to give an illustration taken from our own institution of how we have found that sustaining support is a much more effective and efficient means of mounting the research effort than the contract support which has been available.

Senator METCALF. Please go ahead. This is just exactly what we are asking for here. We want to hear your comments as much as we want to see your testimony.

Dr. LEAR. We have been in the business turning out mining engineers at the University of Alabama since about 1880 and have had a State mining experimenting station since 1920, 1921. This experimenting station has not had a line item appropriation from the State. It has been a bringing together of people in mining and assorted disciplines to do research of a character which depends on the particular need at the time of industry or the individual profession and so on, and many cases it looked like the charts you saw.

Never has it produced a unified research team which could tackle problems on a broad scale. Two years go, in light of uncertainty which was present at that time on the Federal legislation on mineral resources, research institutes were sitting in this same room talking about that. At that time the Legislature of the State of Alabama decided to create the Mineral Resources Institute in the State, and this was established at the University of Alabama.

It was created with a conditional appropriation of \$300,000 a year. Now, additional appropriation, of course, is harder. It is harder than some of the soft money, but still not a permanent budget. But the university administration, recognizing the great need for this effort, decided to provide a permanent budget of a good fraction of that \$300,000 on an annual basis to keep the Mineral Resources Institute in being as a regular part of the university effort.

As a result of this permanent budget, we have been able to acquire staff, a very competent core of people who can do jobs in a variety of areas. This is an interdisciplinary effort of mining engineers, metallurgists, chemical engineers, civil engineers, geologists, lawyers—which is involved in a variety of efforts now in the research front where you have an extremely large program in underground coal, gasification, for example, under way. We have work in environmental problems of underground mining; we have health and safety efforts going on. This is not just coal, incidentally, but the main thrust is in coal—management problems, a variety of things which not all are funded by the sustaining money from the mineral resources budget, but has produced

the staff and facilities which allow us to really put together an effort and to attract the project type support, of course, to do many jobs which would not be possible otherwise.

All I am saying is that this effort has given us a cadre of competent people which we would not have been able to put together on the project-type basis. It has simply taken a sustaining effort which allows you to hire permanent staff, which you can't do with the project-type support.

One other point I would like to make has to do with manpower. We have heard many things about the dearth of mining engineers and other professionals in the mineral industries. I think we simply have to get away from the musical chairs game which is going on these days, and I will cite one example.

We have acquired in the last year at the University of Alabama two very, very competent faculty members in mining engineering. Our gain in one case was the loss of the University of Wisconsin. In the other case, and perhaps I should have deleted that, we acquired the person from Montana Tech. One of the large Kraft Paper companies in Alabama has acquired a very fine minerals land management director. In the process the University of Alabama has lost the director of its Mineral Resources Institute.

A national and international coal company has acquired a first-class vice president. We have lost one of the most competent of our faculty members. And finally, just recently the University of Alabama has acquired a very competent director for its Mineral Resources Institute at the same time the Bureau of Mines has lost one of its most valued and most experienced assistant directors.

This is the type thing going on day after day among all of us in the mining education business and in the mining industries, and it is imperative in my mind that we do something to alleviate this situation.

I think that title II of the act certainly will address that. It will bring people into mining who would not otherwise have gone in the business, and in answer to the specific question you raised about whether title II—I'm not sure what the import to the question was—do the job—I think that I would have to say that the research and the graduate study, the research and the fellowships must be hand-in-hand, and in order to have the graduates get their training, we have this core of people and facilities to make it possible for them to do so.

So I don't see how we can separate the need for those two.

Senator METCALF. Thank you very much, Dr. Lear. I want you to know that when I first came to Congress in the House of Representatives I sat next to Congressman Carl Elliott. As I remember he came from Jasper, Ala. and was familiar with coal mining regions, and so I was concerned and interested through my entire congressional career with some of the problems my friend from Alabama had.

Is Carl Elliott still there?

Dr. LEAR. Yes, sir. My brother-in-law ran on the statewide election a few years ago and happened to meet Mr. Elliott at that time, but he lost to the Republicans in the general election that year, so—

Senator METCALF. Anyway, I had an introduction to some of the problems of Alabama and coal early in my congressional career.

[The prepared statement of Dr. Lear follows:]

STATEMENT OF  
DR. W. EDWARD LEAR  
DEAN, COLLEGE OF ENGINEERING  
THE UNIVERSITY OF ALABAMA  
PRESENTED TO THE  
SENATE SUBCOMMITTEE ON  
MINERALS, MATERIALS AND FUELS  
ON  
S. 62  
NOVEMBER 5, 1975

Mr. Chairman and Members of the Subcommittee,

I appreciate very much having the opportunity to present my views on the very important legislation which is being considered here today.

First, let me give you some background data which is germane to the problems addressed in S. 62 on the University, the state and the region which I represent. As you have heard in other testimony, there remain 17 degree-granting programs in mining engineering in the United States, and of these, due to location, several have no faculty expertise or interest in coal. If we draw a line on the map of the United States from Blacksburg, Virginia to Socorro, New Mexico the only mining engineering program south of that line is at The University of Alabama. The State of Alabama is currently producing bituminous coal at the rate of approximately 22,000,000 tons per year which ranks it 8th in the coal producing states of the nation. The combined output of Alabama and Tennessee, a state in which there is no mining engineering program, is approximately 35,000,000 tons annually. The coal in our region has the distinguishing characteristic of being of exceptional quality and is much sought after by industry. This factor coupled with the very abundant

supply of navigable waterways and of ground water makes our state and region a prime candidate for the expansion of industry which will rely increasingly on the enormous untapped reserves of coal for future energy supply. The mining industry of the state of Alabama has actively under development some 16,000,000 tons of new capacity and is planning an additional 19,000,000 tons of capacity. As one example of the level of activity aimed at increasing production, a 2100 foot mine, which will be the deepest vertical shaft coal mine in the United States, is being developed in Tuscaloosa County, the home county of The University of Alabama.

With this brief backdrop of regional information, let me address specifically some points contained in S. 62. First, the sponsors of this legislation are to be congratulated for taking this action to bring coal, our number one energy resource, rapidly into the arsenal in our battle for energy independence. The tragic failure of the Mineral Resources Research Institutes legislation during the past two sessions of Congress, due in neither case to lack of merit of the concept itself, makes it even more urgent that we marshal immediately the expertise for coal research and manpower development which is present in the mining engineering departments of the nation. Incidentally, the legislature of the State of Alabama took the initiative two years ago to move ahead without federal support and created a Mineral Resources Institute at The University of Alabama. This is an interdisciplinary group of mining, civil, chemical and metallurgical engineers and geologists who are involved in a variety of research projects (with heavy emphasis on coal), in continuing education programs at all

levels for the mineral industries, and in public and legislative information programs.

S. 62 provides for the establishment of five coal research centers which by the very nature of the dispersion of mining engineering programs in the coal producing states will result in a fair amount of regional distribution of the centers. Of the 17 mineral engineering degree-granting programs left in the nation 7 are in states which have minimal or no coal production. (Five of the states which are among the top ten coal producers in the nation have no degree program in mining engineering.) This leaves then 10 universities fairly well distributed throughout the coal-bearing regions of the nation which would be eligible for a coal research center under the provisions of S. 62.

The concept of a regional attack on the problems of the mining and utilization of coal and of manpower production for the industry is of course a sound one. While there are obvious things common to all coal producing sectors, a large number of the problems of the southeast are not those of the western or central or the northern Appalachian states, and this comparison is true for any of the coal producing regions. For example, the approach to optimum methods of mining, preparation and utilization of coal from the relatively deep and thin seams of high quality coal in Alabama is totally different from that of a region with thick seams of low quality coal located near the surface. As another example, in situ gasification in thin, deep seams of coal, a research project currently being pursued on a very large scale at the University of Alabama has some features which would

apply to any underground gasification effort but also has a large component of dependence on local geology, grade of coal and seam configuration. So the approach of having centers which can tackle problems of uniquely regional character in addition to more general ones is in my opinion a logical one. The only question I would raise is whether the five centers specified in S. 62 are sufficient to cover these regional needs and at the same time take advantage of all the strong background of coal research which exists in a relatively small number of universities. I believe that the cost involved in authorizing three to five additional centers would be recovered many times over in the long term to the benefit of the nation.

On the manpower score, Title II of S. 62, which provides for graduate fellowships, is a vital component of the creation of the research centers. Applied research in a university of the nature which would be performed in a coal research center is a two-edged sword providing valuable training and knowledge for undergraduate and graduate students who will be going into the mining industries and at the same time providing a manpower pool, under the direction of faculty members, to tackle the critical problems which must be solved. Additionally however, although Title II does not restrict students to the area of coal research and graduate study, the attraction of fellowship support will bring into mining as a career many students who otherwise would not have been there. And I also see no conflict between the fellowships authorized in S. 62 and those currently available in NSF and Office of Education programs. The present supply of fellowships is very small, and the need is very great.

I'm sure you have read in the literature and heard from other witnesses about the critical need which exists for mining engineering graduates. I can only illustrate that need by citing a comment by a representative of one of the major coal producers during the past year who stated that his company alone could absorb all the graduates of the mining curricula in the nation. An accurate projection of the need for mining engineers over the next few years is difficult because of the variables involved, but an educated estimate can at least provide us with an order-of-magnitude answer. For the Alabama mining industry we are assuming (conservatively, we believe) that to provide replacements for normal attrition we will need each year one engineer per one million tons of capacity. To effect expansion of capacity we assume that three engineers will be required for each million tons of new capacity. This means that for the current year in Alabama alone current production will require 22 new engineers and expansion will require another 9 for a total of 31. By 1980 capacity is expected to be approximately 37 million tons and expansion rate continued at 3 million tons/year, so 46 new graduates would be required. These estimates are based entirely on technical operations and management needs, and do not take into account what will surely be a growing need for engineering expertise in the fields of health and safety and in environmental protection. Assuming these factors will increase engineering manpower requirements by 50%, the Alabama need for 1980 is 69 mining engineering graduates.

The University of Alabama currently has 73 students in its mining engineering program, graduated 13 in 1974, and will graduate 15-20 per year over the next five years at the present rate of production. Not all

of these will go into the coal industry of course. So it is obvious that we are going to be unable to take care of our own state needs, much less those of the region we serve, unless some drastic change such as the infusion of scholarship money attracts more students to a career in mining. This deficit of qualified mining engineering manpower exists in every sector of the nation, and although mining engineering enrollments have shown a steady increase percentage-wise during the past few years the absolute numbers are still quite small--210 mining engineering graduates in 1974.

In summary let me repeat that in my opinion (1) the enactment of S. 62 will do much to avert the national disaster of our not being able to recover in sufficient quantity and to use effectively the one energy source which we have in abundant supply, (2) that a number of research centers in various regions of the country is appropriate to solving not only general problems but the variety of problems unique to mining, preparation, transportation, utilization and environmental protection in the various coal producing regions of the nation, (3) that the number of centers called for in S. 62 does not take advantage of all the expertise of the relatively small number of university faculties with solid experience in coal mining research, and that therefore a few additional centers would be appropriate, and (4) that Title II of S. 62 will do much to provide the manpower which will be required by attrition, expanding capacity, the introduction of new technology and by health, safety and environmental requirements.

Again, Mr. Chairman, many thanks to you and to the members of the Subcommittee for allowing me this opportunity to present my views on this legislation.

Senator METCALF. So now we will have Mr. Planje of the University of Missouri, and delighted to have you.

**STATEMENT OF THEODORE J. PLANJE, DEAN, SCHOOL OF MINES AND METALLURGY, UNIVERSITY OF MISSOURI AT ROLLA**

Dr. PLANJE. Thank you, Mr. Chairman. It is indeed a pleasure to be here.

Senator METCALF. You know the questions I have been asking. I would appreciate all the extra comments you can make on those questions.

Dr. PLANJE. I am Theodore J. Planje, dean of the School of Mines and Metallurgy of the University of Missouri-Rolla, which is one of the Missouri Schools of Mines established in 1872. It was established by the Morrill Act of 1862, and is a school primarily of energy and mineral education.

I would like to point out that in the 18-State midcontinent region we have a proportion of our total estimated reserve approaching some 43 percent of the Nation's reserves, as estimated by the U.S. Geological Survey in its latest report, and in that 18-State region there are only five universities continuing to offer mining engineering education, namely Michigan Tech, Missouri School of Mines, South Dakota, Wisconsin at Madison and Wisconsin at Plattsville, and of these five, only one has a vital and moving program in coal research at this time.

I think it is absolutely imperative that because of the character of the coals in that region that there should be a midcontinent region research center.

With regard to our total reserves, I think the testimony up to this point has brought out one very important factor which I think this Congress can take due pride in recognizing the need for these centers as it may well be documented by future generations in our history.

As the latest report of the U.S. Geological Survey indicates, our estimated resource of coal is some 3,968 billion tons, and of that only 45 percent have been identified by geological exploration. That very report also notes that of this reserve, only some 5 percent may be considered recoverable under the current restraints of regulatory agencies and also State agencies, and with present mining technology, only 5 percent.

Of that 5 percent I don't think any agency can give us an estimate. As Dr. Spackman has pointed out, it must be characterized if coal is going to be used efficiently for all of the subsequent needs. Also as Dean Lattman has pointed out, it needs to be characterized as a source of hydrocarbons. If that isn't done, our coal reserves are not going to be utilized efficiently.

If that happens, I am sure history will say that—you know—we blew it again, but I hope—certainly, Mr. Chairman, we recognize the work of your committee in this session—I feel strongly that there is a minimum need of 10 centers as proposed.

The task of characterizing coal, getting the best and most utilization and energy in that resource, demands that we give that attention at this time, primarily again as I pointed out, to generate the manpower

in the several disciplines that impact upon coal research that we absolutely do not have at this time.

As Dr. Lear has pointed out, we are all swapping personnel and this thing is intolerable. We cannot maintain stable programs if people are constantly moving. We can maintain schools, but not a coherent program.

I would say with regard to the proposed 1,500 fellowships in title II it certainly is commendable. It is badly needed. I would concur in Dean Kelley's observation that the stipends proposed for these—we have experienced this year with the USOE domestic mining fellowship program—have seen that these stipends of \$3,200 a year are inadequate for us to compete with industry and with government to retain graduate programs.

Senator METCALF. Do you think we have to go to \$10,000 a year?

Dr. PLANJE. I don't think it is critical, the dollars. It has to be more competitive. I wouldn't essentially guess necessarily \$10,000 a year. I would say you have to be more than competitive with the stipends offered on the average in engineering education today, and those stipends are running generally around \$5,000 in our own institution, so you can see the problem we have had even trying to find five good candidates. We have had to supplement those from other university resources.

I think that it would behoove the committee to consider either if it is not possible to increase the stipend, let us suggest maybe reducing the number of stipends with the same dollar authorization. I think there would be a merit in having all the available fellowships filled with the best quality of students, even though the number would have to be reduced, if the \$10,000 stipend is in the order of magnitude necessary to attract and maintain the best students in graduate programs.

With regard to our total manpower need in this country, mention has been made in previous testimony that the number of energy and mineral engineering and science disciplines have decreased since World War II, and I think as an example, mining engineering is mentioned.

Specifically I would like to get into the record the fact that right after World War II we had 28 accredited mining engineering programs in this country. Today we are down to 18. Our productivity has dropped more than 50 percent. There isn't a single coal mining company of any consequence in this country that wouldn't hire all graduates.

The shortage is three to five times what it should be. The other disciplines related to coal research in addition to mining engineering have the same problems prevailing. Our universities found opportunities to reallocate resources during the period following World War II in the programmatic areas that were more attractive to student interest and more adaptable to competition for Federal funds. Mineral engineering and education were not these programs. So we are in facilities totally inadequate today and almost every institution—my programs are housed in facilities built prior to or shortly after the turn of the century.

So I think that the need to provide adequate facilities to initiate an ongoing modern coal research effort is important as the need for moneys to support the research and the fellowships. So I think the

sustaining grant suggestion that was made by Dean Lear is absolutely essential if we are going to encourage universities to turn around and reallocate resources for capital facilities. They have to see some evidence there is going to be continuity programs.

I would hope some sustaining arrangement could evolve, if not in S. 62 in subsequent legislation, to support the coal research program.

Thank you.

Senator METCALF As you know, Mr. Planje, we can't in the Congress guarantee some of the continuity that might arise from some of the other programs. I think perhaps our aid to education programs have been witness to the fact that we are almost like that M. & M. draft that you showed of the yoyo bouncing up and down. However, if we make a good record at the inception of authorization and get some appropriations, I think that we can assume that there will be some continuity. It might not have the high rate of appropriations every year, but there will be something that I feel that the universities can work with.

Dr. PLANJE. I fully concur, sir.

[The prepared statement of Dr. Planje follows:]

STATEMENT PREPARED BY  
DR. T.J. PLANJE  
DEAN, SCHOOL OF MINES & METALLURGY, THE UNIVERSITY OF MISSOURI - ROLLA  
FOR  
THE MINERALS, MATERIALS AND FUELS SUBCOMMITTEE  
OF  
THE INTERIOR & INSULAR AFFAIRS COMMITTEE OF THE UNITED STATES SENATE  
ON  
THE SENATE BILL S.62

MR. CHAIRMAN AND MEMBERS OF THE SUBCOMMITTEE:

I am Theodore J. Planje, and I reside at 2 McFarland Drive, Rolla, Missouri 65401. I am a ceramic engineer by profession and serve as Dean of the School of Mines and Metallurgy of the University of Missouri-Rolla, formerly Missouri School of Mines & Metallurgy.

I sincerely appreciate this opportunity to present my interests in and views on the legislation under consideration which are in essential agreement with those of the administration of the University of Missouri, a four campus state land-grant institution.

As the engineering campus of the University, the Rolla campus, which was established in 1870 through the State's participation in the provisions of the Morrill Act of 1862, is in its second one hundred years of service to mineral engineering education and the mineral industries of the state, nation, and the some sixty foreign countries in which its alumni are employed. The mineral engineering faculty of the University has requested that I prevail upon you gentlemen to report briefly their collective concern for the many problems confronting this nation in fulfilling the demands for energy and mineral resources in the years ahead, particularly those for fossil fuels resources of which coal is the Nation's most abundant, and in evolving in these years a total resource management program for essentially complete recovery and efficient utilization of our coal resources to insure their best possible use in meeting the short and long term energy needs of the Nation with a minimum consequence to the environment.

In the mid-continent region of eighteen states, there is an estimated reserve of 321 billion tons of bituminous coal and 362 billion tons of lignite occurring in the states of North and South Dakota, Kansas, Oklahoma, Texas, Iowa, Missouri, Arkansas, Illinois, Kentucky, Tennessee, Indiana, and Alabama; approximately 43% of the Nation's reserves, as estimated by the U.S. Geological Survey in its Geological Survey Professional Paper 820, which was based on data available as of 1 January 1972. In the mid-continent region there are only five universities which offer accredited degree programs in mining engineering, namely: Michigan, Missouri, South Dakota, and Wisconsin-Madison and Plattsville. Of these institutions only the University of Missouri-Rolla School

Department of Mines & Metallurgy has maintained a viable coal research program. However, because of attrition of faculty and the unavailability of qualified replacements, even this program is presently limited to research directly related to new coal mining technology and methods. Research in the areas of coal preparation, analysis, and utilization has essentially been abandoned pending the acquisition of competent faculty additions to revitalize both instruction and research in these fields.

The depressed state of the coal industry in this country over the last two decades had discouraged students from pursuing degree programs to prepare for careers in coal research. The National goal for doubling coal production by 1985 has created a demand for individuals with training and experience in coal research which exceeds the most optimistic estimates of the numbers to be graduated through this time period. If the coal research needs of the country are to be fulfilled, and in turn the personnel needs of education, government and industry for coal researchers are to be met in time to permit the coal industry to attain the 1985 production goal, it is imperative that funds be authorized as proposed in S.62 for the establishment of coal research laboratories and energy research fellowships. Failure to enact this or similar legislation in the very near future will increase the Nation's dependence upon foreign petroleum supplies and its declining natural gas reserves.

The latest report of the United States Geological Survey indicates that the Nation's coal resources in the ground as of 1 January 1974 is approximately 3,968 billion tons. This is approximately 23% higher than the agency's 1 January 1972 estimate of 3,224 billion tons. However, as pointed out in this latter report only 1,731 billion tons of this estimated resource are known and identified from detailed geologic mapping and exploration. The remaining 2,237 billion tons are believed to be present in unmapped and unexplored areas and in deeper parts of known coal basins. The author of this report estimates that only about 5% of this resource can be considered recoverable under present regulatory and other restraints and with present mining technologies. It is reasonable to suggest that less than half of this reserve, or no more than 100 billion tons, has been adequately characterized to establish what portions of this reserve may be gasified or liquified with the best efficiency and what portions may be beneficiated adequately with present coal preparation technologies to permit their direct use in electric power generation and other industrial processes within the prescribed limits for sulphur dioxide and other detrimental gaseous effluents or to permit their upgrading for use in coal gasification or liquification. With this limited knowledge of our presently known reserves it is evident that a significant increase in coal research is necessary, if these reserves are to be used in the best interest of the Nation's short and long term energy needs. In addition to characterizing

the known reserves for efficient utilization coal research must be accelerated in the following areas:

- To study our estimated total resources with the objective of increasing the percentage of reliable reserves
- To develop new technologies for exploration which may increase the reliability of the estimates of the total coal resources of the Nation
- To develop new mining methods for more efficient, safe, and complete extraction of coal deposits, including in-situ gasification and liquification, particularly where the latter may be applicable to the economic extraction of thin coal seams, generally under thirty inches in thickness, at shallow depths and thicker seams at greater depths
- To study new alternate technologies for more efficient and economical preparation of coals for direct fire and conversion fuel uses
- To investigate alternate technologies for the removal of organic and pyritic sulphur
- To explore alternated gasification and liquification technologies than those currently under investigation with the objective of providing for more efficient conversion of these energy forms
- To inventory the known coal reserves with the goal of establishing a National data bank for the effective management of the reserves in relation with other fossil fuels and alternate energy sources
- To develop from the inventory of our known reserves programming models for the assessment of coal utilization on a real time basis as a primary tool for management of our coal reserves.

The latter technology is critically needed on an intermediate-term basis, next five to ten years. Even though our present estimated recoverable reserve of coal is only some five percent of the approximated resource, it constitutes some seventy percent of the Nation's estimated reserve of all fossil fuel: petroleum, natural gas and oil shale, which is only a potential energy resource at present, make up the remaining thirty percent of our fossil fuels. If coal is to fulfill the Nation's energy needs, while conserving our domestic reserves of petroleum and natural gas for uses where alternate fuels are not adaptable or as feed stocks for the petro chemical and other material industries, the known reserves must be managed to optimize coal production and utilization on a regional and National basis. Short falls of coal or the availability of coal of the proper quality will have an increasing impact on the Nation's energy balance and in turn its economy, as coal's contribution to the total annual energy utilization advances from its present seventeen percent level to one

approaching its relative abundance in the Nation's fossil fuel resources, representing approximately 70%.

In addition to developing badly needed technology to produce and manage the Nation's most abundant energy resources the Coal Research Centers to be established by this legislation will have a secondary benefit in serving to educate and provide research experience for the critically needed manpower to expand production, processing, and efficient utilization of this resource. Of the several disciplines in which educated personnel are presently needed mining engineering is probably one of the most critical.

The future supply of mining engineering graduates, which has been significantly below the demand for the past several years, is likely to be the limiting factor in attaining the National goal for energy self-sufficiency by 1985, particularly if the coal industry is to make its projected contribution by doubling its current production in the middle of the next decade. Earlier this year the officers of the National Coal Association and the United Mine Workers estimated that to fulfill its assigned role the coal industry would have to add between 180,000 to 200,000 people to its work force in the next ten years.

Assuming that the proportion of mining engineers in this new work force will remain the same as today, which is a conservative assumption in that experience in the recent past has shown that the size of the engineering staff have increased as the industry has adopted new mining methods and technology, the industry will need upward to 12,000 mining engineers in this ten year period (or some 1200 graduates per year). As evident from the following data the eighteen accredited mining engineering departments in the country have produced (in the past 19 years) only some 3400 graduates or less than 30% of the coal industries next ten year need:

ACADEMIC YEAR	MINING ENGINEERING GRADUATES		
	B.S.	M.S.	Ph.D.
1956-57	231		
1957-58	240		
1958-59	239		
1959-60	242		
1960-61	220	DATA NOT AVAILABLE	
1961-62	193		
1962-63	180		
1963-64	144	21	4
1964-65	146	29	6
1965-66	138		
1966-67	112	24	7
1967-68	95	35	7
1968-69	137		
1969-70	124	19	10
1970-71	136	20	15
1971-72	139	25	17
1972-73	159		
1973-74	210	32	7
1974-75	318	46	6
TOTALS:	3403	248	79

This estimate does not include the requirements of the rest of the mining industry, which produces the Nation's metallic and non-metallic minerals. Because of the growing World demand for these resources and the escalating prices of metallic and non-metallic minerals in the international market, there is a growing consensus that this country will be confronted in the very near future with mineral shortages, which could be as critical or even more critical than those encountered to date with energy resources. To develop a domestic supply of the mineral commodities to sustain the Nation's productivity would require this segment of the mining industry to expand its production, which in many instances would involve the development of poorer reserves, as well as alternate reserves, for some of the more critical mineral needs.

With this uncertainty it is difficult to estimate the total mining engineering needs of the industry; however, there is a growing consensus, it will approach 1800 graduates a year for the next ten years and beyond. This will represent about 5% of the total engineers graduated annually, which is about the same percent which prevailed prior to the early 1950's. The prospects for fulfilling this demand are not good and will not improve unless more college bound young men and women can be made aware of the need and the resulting career opportunities in the mining engineering profession. Furthermore, it will require that mining engineering education be made more readily available to those who do not have the good fortune to reside in a state in which universities offer mining engineering degree programs. Since only eighteen states offer degree programs in mining engineering, residents of the other 32 states encounter a costly out-of-state tuition to earn a mining engineering degree. To afford all college bound young men and women an equal opportunity to prepare for a career in the profession there is a real need for a National effort to encourage states to enter into agreements for the exchange of students on a tuition free basis for education in mining engineering, as well as the other energy and mineral engineering fields.

Gentlemen, I wish to thank you for extending me this opportunity to present the views of my faculty with regard to this legislation.

Senator METCALF. Now we have a representative of the great undeveloped coal areas of America, Dean Beistline, who is representing the University of Alaska. I spent quite a bit of time in Alaska on the Alaska Native claims question. Of course we have had both Alaska Senators as former members of this committee, and very respected members. We in Montana feel a sort of a fraternity to Alaska because there are lots of Montanans up there and during World War II the Alcan Highway originated down in Montana. Also they are hauling a lot of air freight to build the pipeline, and you, Montana and a couple of others are the last of the frontier States. Delighted to have you here.

**STATEMENT OF EARL H. BEISTLINE, DEAN, SCHOOL OF MINERAL INDUSTRY, UNIVERSITY OF ALASKA**

Dr. BEISTLINE. Thank you, Senator Metcalf. It is my pleasure to be here, and I thank you and members of your committee for the opportunity to discuss S. 62.

Also I might say that we certainly welcome you to Alaska, you and your colleagues, whenever you so desire.

Senator METCALF. We're going to have to postpone that for a few months. The last time I went to Alaska was in February in Fairbanks, and I could just barely see over the snowdrifts, so I would rather see a little more of Alaska than I did that time.

Dr. BEISTLINE. Washington has taken the extreme to what we have had in Alaska. The temperature yesterday in Fairbanks was 30° below, and we have had a foot of snow and can anticipate this now until April.

Senator METCALF. I am not going to get into a contest bragging about how much snow Montana or Alaska has.

Dr. BEISTLINE. We better get along with the subject here. Much of what I would have to say has been said before by my colleagues.

Senator METCALF. Your statement will be filed, and again I want to say that we may be confronted here with a recommendation for a veto. We want to make as strong a record as possible from as many people in various areas as possible who may say the same thing; but you say it over again. It will certainly help us in supporting this legislation.

Dr. BEISTLINE. I will just briefly comment on some of the conditions that exist in Alaska that are a little unusual compared to what you find with reference to coal mining in other States.

In addition to the usual problems that we encounter in all coal mining exploration research and this type of thing, we have a situation there, first of all, where a very large area with a very small population, perhaps 365,000 people to an area one-fifth the size of the United States with concentrations in two areas, gives us problems of supply, of transportation, this type of thing, and then when this is compounded with the weather we have, the Arctic, the subarctic weather and the temperate weather through the parts of the State, plus the permafrost conditions which exist in many parts of the State, we really have many problems, and there is a great deal of work that needs to be done.

Certainly the crash program in building the pipeline has indicated this, but yet there is much more to do. I would be happy to go into this in any more detail you might want if a question were to come.

But now on Senate bill S. 62, the concept is excellent and I support and encourage the passage of this bill with accompanying funds to implement the objectives of laboratories and scholarships as soon as possible.

Conceivably the concept of this bill could well be expanded to include other minerals. But specifically on S. 62, I recommend consideration for a change to increase the number of laboratories by at least an additional 5—that is, 5 to 10. Perhaps some of these might be in the nature of regional centers.

This recommendation to increase the number of laboratories is based on several things. First of all, by reviewing the coal resources reserves as outlined by the USGS and a copy of this is included with the paper, there are 10 States that are listed with reserves of more than 50 billion tons. Also, the areas of coal research are many and varied.

Support should be for the full utilization of talents currently available for research at the various universities. There are at least five universities that are doing considerable coal research, and I am sure that a number of others are doing coal research on a more restricted basis.

Limiting the number of coal laboratories to five will not stimulate research at a number of schools where need, talent, and interest exist.

With reference to regional centers, coal deposits were formed without reference to State boundaries, and hence a particular deposit may cover portions of several States. This justifies the idea of having regional centers.

However, full consideration should be given to assure that all universities now conducting coal research will have the opportunity to enhance their respective programs. The regional concept if developed will allow such research to be simulated and at the same time provide for overall financial economy, efficiency of management, and so forth, and then it would seem that such a concept is justified.

On a broad regional basis university coal research laboratories should be widely located geographically rather than being concentrated in a particular area within the Nation. Such wide distribution will allow more meaningful research to be done at or near the particular environment.

Alaska's reserves of coal are tremendous, and yet at the present time the annual coal production in the State approximates 750,000 tons a year, and this is from only one mine. This particular mine is described in attachments to the report. I think it is rather noteworthy here to say that the reclamation that has been done by the mine and one particular benefit that has occurred is that each year now a herd of between 100 and 150 Dall sheep come into the area and winter and eat the grains that have been planted during the year, certainly helping wildlife.

Utilization of Alaska's coal, whether it be for generation of power, export shipment, production of coal products or other uses requires research first, followed by planning and manpower needs, the man-

power to give management and engineering capabilities as well as the manpower for these mining and utilization needs.

Alaska has need for such industry and for the training of manpower to provide work opportunities for her people. With reference to relation of the programs to existing Federal research and training programs, certainly maximum coordination and cooperation is a necessity between university research programs financed by the Federal Government and Government research and training organizations.

Such coordination will tend to reduce duplication of projects and therefore allow for research to be accomplished for a given amount of funding, thus providing the greatest benefit for the people of the Nation.

This bill with its sustaining grants will allow a critical mass to be built and assembled in professional personnel, equipment and facilities at various universities and hence will give them more capability for contract coal research with private industry and Government agencies such as ERDA.

With reference to scholarships and facilities, it seems to me that both should go hand in hand, and therefore I do support that concept.

By way of conclusion I would certainly support and encourage the passage of S. 62, again with the hope that funding would be implemented as soon as possible.

I would be happy to answer any specific questions.

[The prepared statement of Dr. Beistline follows:]

STATEMENT OF EARL H. BEISTLINE, DEAN, SCHOOL OF MINERAL INDUSTRY,  
UNIVERSITY OF ALASKA, FAIRBANKS, ALASKA

Senator Metcalf and members of the Subcommittee on Minerals, Materials and Fuels, my name is Earl H. Beistline, Dean of the School of Mineral Industry, University of Alaska, Fairbanks, and I speak to you today as a life-long Alaskan interested in the utilization of Alaska's and the Nation's coal resources for the benefit of the American people and in an energy resource fellowship program that will encourage men and women to enter this important field.

First, I express my sincere appreciation to you and members of your Subcommittee on Minerals, Materials and Fuels for the opportunity to testify before you on S. 62, which has for its objectives the establishment of university coal research laboratories and energy resource fellowships.

Before commenting specifically on S. 62, the following brief background is given. Last June, William T. Simon stated to the National Coal Association, "America is literally sitting on top of the biggest coal mine in the world and yet, we can neither mine it nor burn it in anything approaching the degree that we should." These words penetrate to the heart of the situation—a better way for utilization of coal through research by professionally trained persons.

It is generally agreed that of all the promising sources of energy, coal is the only resource that can tide us over into the next century when nuclear energy and perhaps other types promise to take over as a primary source. In addition to increased demands, coal has to replace the crude oil that is currently being imported in order to curtail our dependence on foreign sources.

The increased use of coal needs further research into improved methods of exploration, mining, preparation, purification and utilization. The proposed bill would pave the way in achieving these objectives.

The School of Mineral Industry, University of Alaska, is most interested in further developing Alaska's coal resources, along with development of all energy sources.

With reference to my home state, the United States Geological Survey has made a conservative estimate that coal reserves amount to 130 billion tons.<sup>1</sup>

<sup>1</sup> P. Everitt, "Coal Resources of the United States," *U.S. Geological Survey Bulletin No. 1275*, 1969.

Recent evaluation of drill logs in the Cook Inlet area<sup>2</sup> and additional data from the North Slope<sup>3</sup> show that coal resources exceed several-fold of the original estimates. When considering resource development in Alaska, one can not overlook factors such as:

- (a) Large area ( $\frac{1}{5}$  of continental United States) with small population (365,000).
- (b) Long transportation routes.
- (c) Permafrost conditions.
- (d) Arctic and sub-arctic weather.

Thus, within the state, conditions and resulting problems are diverse, i.e., in contrast to Nenana and Northern Alaska fields, the weather in Cook Inlet region, comprised of Matanuska, Susitna, Beluga, and Kenai fields, is less severe and may be comparable to Montana or North Dakota. In addition, the problems common to a specific resource, such as coal, in other states also exist in Alaska.

At the University of Alaska, through its Mineral Industry Research Laboratory, the surface has only been scratched in on-going research which began in 1965 when a grant of \$25,000 was made available to the University from the Usibelli Coal Mines to further coal research. Important as research is to our Nation and State, our efforts have been minimal due to the lack of funding for major programs. An appreciation of the type of work being done by the Mineral Industry Research Laboratory may be gleaned by referring to Appendix I.

Equally important is the need for scholarship support to encourage men and women to enter professional careers in the coal energy field. Such well-trained people will, in the final analysis, contribute to the more complete utilization of coal for the benefit of the Nation.

The interest in Alaskan coal was enthusiastically demonstrated during October 1975 by the excellent attendance of interested people from Alaska and other states, as well as Canada, at a Coal Conference held on the University of Alaska, Fairbanks campus. The conference was arranged on relatively short notice, but we feel it was most successful in presenting current information pertaining to Alaska's coals to interested persons. Copies of the program are included with this presentation, see Appendix II.

With the foregoing as background, I compliment and commend the authors of S. 62 for their realistic, forward look about the needs to further enhance the utilization of coal resources for the American people. The concept of the bill is excellent and I support and encourage the passage of S. 62 with accompanying funds to implement the objectives of laboratories and scholarships as soon as possible. Conceivably the concept of this bill could well be expanded to include other minerals.

On the bill, S. 62, I respectfully recommend consideration for a change to increase the number of research laboratories by at least an additional five, that is, from 5 to 10. Perhaps, some might be in the nature of regional centers. This recommendation is based on the following facts:

(a) Table 27, Total Estimated Remaining Coal Resources of the United States, Jan. 1, 1972,<sup>4</sup> shows there are 10 states listed with total reserves of more than 50 billion tons.

(b) The areas of coal research are many and varied, as shown in Appendix III. Thus, support should be for full utilization of talents currently available for coal research at various universities, either as a coal research laboratory as proposed in this bill or by possible regional units.

(c) At present there are at least five universities that are doing considerable coal research and I am sure that a number of others are doing coal research on a more restricted basis. Limiting the number of coal laboratories to five will not stimulate research at a number of schools where needed talent and interest exist.

#### NEED FOR REGIONAL CENTERS

Coal deposits were formed without reference to state boundaries and hence, a particular deposit may cover portions of several states.

<sup>2</sup> D. L. McGee and K. M. O'Connor, "Cook Inlet Basin Subsurface Coal Reserve Study," *Alaska State Division of Geological and Geophysical Surveys Open File Report No. 74*, also presented at Focus on Alaska's Coal Conference, October 1975.

<sup>3</sup> I. L. Tailleu and W. P. Brosgé, "Coal Resources of Northern Alaska May Be Nation's Largest," presented at Focus on Alaska's Coal Conference, October 1975.

<sup>4</sup> P. Everitt, "Coal, Part of United States Mineral Resources," *U.S. Geological Survey Professional Paper 820*, edited by Donald A. Brobst and Walden P. Pratt, 1973, p. 137.

A regional research laboratory concept might be justified in such a situation; however, full consideration should be given to assure that all universities now conducting coal research will have the opportunity to enhance their respective programs. If a regional concept is developed that will allow such research to be stimulated and, at the same time, provide for overall financial economy and efficiency of management, then it would seem that such a concept is justified.

Overall, an advisory group with representation from appropriate units would be essential.

On a broad regional basis university coal research laboratories should be widely located geographically rather than being concentrated in a particular area within the Nation. Such wide distribution will allow more meaningful research to be done in or near the particular environment.

#### PRESENT AND PROSPECTIVE MANPOWER NEEDS IN ALASKA

Alaska's reserves of coal are tremendous and yet, at the present time, the annual coal production in the state approximates 750,000 tons, from only one mine, see Appendix IV.

Utilization of Alaska's coal, whether it be for generation of power, export shipment, production of coal products, or other uses, requires research first, followed by training of manpower needs—the manpower to give management and engineering capabilities, as well as the manpower for the necessary mining and utilization of the coal. Alaska has need for such industry and for the training of manpower to provide work opportunities for her people.

#### RELATION OF THE PROGRAM TO EXISTING FEDERAL RESEARCH AND TRAINING PROGRAMS

Maximum coordination and cooperation is a necessity between university research programs financed by the Federal government and government research and training organizations.

Such coordination will tend to reduce duplication of projects and therefore, allow more research to be accomplished for a given amount of funding, thus, providing the greatest benefits for the people of the Nation.

This bill with its sustaining grants will allow a critical mass to be built and assembled in professional personnel, equipment and facilities at various universities and hence will give them more capability for contract coal research with private industry and government agencies such as ERDA.

By way of conclusion, I support and encourage the passage of S. 62 with the hope that funding will be provided for implementation as soon as possible.

#### APPENDIX I

1. Hankinson, Fred C., *Petrographic Evaluation of Coking Potential of Selected Alaskan Coals and Blends*, Mineral Industry Research Laboratory Report No. 3, February 1965, 35 pp.
2. Rao, P. Dharma, *Distribution of Certain Minor Elements in Alaskan Coals*, Mineral Industry Research Laboratory Report No. 15, June 1968, 57 pp.
3. Rao, P. Dharma, *Washability Characteristics of Low-volatile Bituminous Coal from Bering River Fields, Alaska*, Mineral Industry Research Laboratory Report No. 21, February 1969, 40 pp.
4. Lu, F. D. J. and Rao, P. Dharma, *Characteristics and Utilization of Fly Ash Produced by Fairbanks Area Power Plants*, Mineral Industry Research Laboratory Open File Report, January 1971, 21 pp.
5. Wolff, Ernest N., Lambert, Chris A., Johansen, Nils I., Rhoads, Edwin M., and Solie, Richard J., *Optimum Transportation Systems to Serve the Mineral Industry North of the Yukon Basin in Alaska*, Mineral Industry Research Laboratory Report No. 29, September 1972, 70 pp.
6. Rao, P. Dharma, *Distribution and Significance of Major, Minor, and Trace Elements in Arctic Alaskan Coals*, (in press), 31 pp.
7. Rao, J. Dharma, "Determination of Mercury in Arctic Alaskan Coals by Flameless Atomic Absorption," presented at Fourth International Conference on Atomic Spectroscopy, Montreal, Canada, October 1973.
8. Johansen, Nils I., *Mining in Alaska—Environmental Impact and Pollution Control*, (in press), 60 pp.
9. Wolff, Ernest N., Lambert, Chris A., Lynch, Donald F., and Johansen, Nils I., *Constraints on the Development of Coal Mining in Arctic Alaska Based on Review of Eurasian Practice*, (report in preparation).

10. Rao, P. Dharma, "Characterization of Alaskan Coal," presented at Focus on Alaska's Coal Conference, October 1975, 17 pp.
11. Wolff, Ernest N., and Rao, P. Dharma, "Current State of Art in Drying Low-rank Coals," presented at Focus on Alaska's Coal Conference October 1975, 8 pp.
12. Rao, P. Dharma, "Reflectance Rank and Petrology of Alaskan Coals," (continuing investigations).

APPENDIX II

Program

Focus on Alaska's Coal  
A Conference

Fairbanks, Alaska  
October 15-17, 1975



Sponsored by

School of Mineral Industry  
University of Alaska, Fairbanks

in cooperation with

The Federal Energy Administration  
Anchorage

## ORGANIZING COMMITTEE

Earl H. Beistline - General Chairman  
 Ernest N. Wolff - Vice Chairman  
 Don Jean - Vice Chairman  
 P. D. Rao - Program Chairman

## GENERAL INFORMATION

### REGISTRATION:

In order to participate everyone must register for the Conference. Registration will begin on Oct. 14 from 6:00 p.m. to 10:00 p.m., Fairbanks Inn and will continue 8:00 a.m. to 5:00 p.m. daily in the Main Lounge in Wood Center.

Registration fee is \$15.00. Students are exempted from payment of registration fee.

### HOUSING AND TRANSPORTATION:

Housing is available at the Fairbanks Inn at 1521 Cushman. Participants should identify themselves as being with the Coal Conference to qualify for the special rates. Transportation will be provided to and from the Fairbanks Inn to the University of Alaska.

### MEALS:

Luncheons will be served at 12:00 p.m. in the Wood Center Ballroom on Oct. 15 and 16. On Oct. 16, a Buffet Banquet will be held in the Wood Center Ballroom with Cocktails being served from 6:00 p.m. immediately followed by dinner at 7:00 p.m. Participants are urged to purchase tickets to the luncheons and banquet in advance. Participants may also elect to eat individually and food service is available at the Fairbanks Inn and on the University Campus.

## FIELD TRIP:

A field trip to the Usibelli Coal mine at Healy is scheduled for 0900 on Oct. 17. The Usibelli mine is the only operating coal mine in the State. Transportation will be provided and food will be available at Healy. Cost of the Healy trip is \$10.00

## TECHNICAL PROGRAM - WOOD CENTER

WEDNESDAY, OCTOBER 15, 1975

0800 REGISTRATION

0845 OPENING CEREMONIES, Rms. 127/128

Chairman - *Earl H. Beistline,*  
*Dean, School of Mineral Industry,*  
*University of Alaska.*

Welcoming Address  
*Robert W. Hiatt, President,*  
*University of Alaska*

Importance of Coal at National  
Level,  
*Arthur Hughes, Special Asst. for*  
*Economic Affairs, Office of Coal,*  
*Federal Energy Administration.*

Comments from State Energy Office,  
*William McConkey, Director*

U. S. Bureau of Mines Research  
Programs,  
*Robert L. Marovelli, U.S. Bureau*  
*of Mines, Washington, D.C.*

## TECHNICAL SESSIONS, Rms. 127/128

Chairman - Cleland Conwell

- 0930 Coal Resources of Alaska,  
*Robert Sanders, U.S. Geological Survey, Anchorage.*
- 0950 Characterization of Alaskan Coals,  
*P. D. Rao, Mineral Industry Research Laboratory, U. of A.*
- 1010 Geology of Arctic Alaskan Coal Fields,  
*James E. Callahan, U.S. Geological Survey, Anchorage.*
- 1030 INTERMISSION  
Chairman - Don Triplehorn
- 1045 Land Problems, Rights of Way, and Rights of Eminent Domain,  
*Pedro Denton, State Division of Lands.*
- 1105 Mine Entries: Vertical Shafts and Slopes,  
*Richard Stewart, DRAVO Corporation*
- 1125 Exploration and Development of Beluga Coal Field,  
*Benno Patsch, Placer - AMEX*
- 1140 Coal Exploration and Development on Native Lands,  
*Sam Kito, Alaska Federation of Natives.*
- 1200 LUNCHEON - Ballroom, Wood Center  
Chairman - Earl H. Beistline  
Role of the State Division of Geological and Geophysical Surveys in Mineral Exploration and

Development in Alaska,  
*Ross Schaff, State Geologist,  
 Alaska Division of Geological  
 and Geophysical Surveys.*

TECHNICAL SESSIONS, Rms. 127/128

Chairman - Donald J. Cook

- 1400 Mining Constraints and Operations  
 at Usibelli Coal Mine,  
*Joseph Usibelli, Usibelli Coal Co.*
- 1420 Transport of Coal as a Slurry,  
*Harry Eaton and Robert Jacques,  
 Gulf Interstate Engineering.*
- 1440 Present Facilities and Future  
 Needs of Railroad and Port  
 Terminal Facilities,  
*Walker Johnston, Alaska Railroad  
 Company.*
- 1500 Coal as a Fuel Source for Arctic  
 Villages,  
*Donald Slone, North Slope Borough*
- 1520 INTERMISSION  
 Chairman - Don Jean
- 1535 Economic Impact of Developing  
 Alaskan Coals,  
*Irene Ryan, Former Commissioner  
 of Economic Development, State  
 of Alaska.*
- 1555 Offshore Coal Fired Power Plants  
 and Alaskan Coals,  
*G. W. Johnson, TRW, Inc.*

- 1615 Changing Economics of Alaskan Coals,  
*Bob Bottge, U.S. Bureau of Mines.*
- 1630 Current State of the Art in Drying Low Rank Coals,  
*Ernest N. Wolff and P. D. Rao, Mineral Industry Research Laboratory, U. of A.*

## THURSDAY, OCTOBER 16, 1975

## TECHNICAL SESSIONS, Rms. 127/128

Chairman - Ernest N. Wolff

- 0830 Federal Surface Mining Regulations,  
*Leo Saarella, U.S. Geological Survey, Menlo Park, Calif.*
- 0850 Alaska Laws and Regulations Applicable to Mining of Alaskan Coals,  
*Cleland Conwell, Alaska Division of Geological and Geophysical Surveys.*
- 0900 Slope Stability of Open Pit Mines,  
*Brian Stimpson and Dermot Ross-Brown, Dames and Moore.*
- 0920 Economic Development of Alaskan Coal,  
*Richard Eakins, Director, Department of Economic Development.*
- 0940 State of Environmental Conservation Program in Alaska,  
*Lance Elphic, Dept. of Environmental Conservation.*
- 1000 Potential Water Quality Impact of Alaskan Coal Mining,  
*Timothy Tilsworth, Donald Cook and Gill Zemansky, U. of A.*
- 1020 INTERMISSION

Chairman - John Mulligan

- 1040 El Paso's Burnham Gasification Project,  
*Mike Holland, El Paso Natural Gas Corporation.*
- 1100 In situ Gasification of Coal,  
*Douglas Stevens, Lawrence Livermore Laboratory.*
- 1120 Geology and the Coal Reserves of the Bering River Coal Field,  
*Robert Sanders, U.S. Geological Survey, Anchorage.*
- 1140 Coal Conversion, Synthane and Synthol Process,  
*Sam Friedman, Pittsburgh Energy Research Center, Energy Research and Development Administration.*
- 1200 LUNCHEON - Ballroom, Wood Center  
Chairman - Joseph Usibelli  
Reevaluation of North Slope Coal Potential,  
*Irvin Tailleir, Geologist, U.S. Geological Survey, Menlo Park, Calif.*

TECHNICAL SESSIONS, Rms. 127/128

Chairman, Alfred Service

- 1400 Coal Conversion Processes,  
*Paul Etter, Fluor - Utah Corp.*
- 1420 Gasification Prospects and Application in Cook Inlet, Alaska,  
*Donald McGee, Alaska Division of Geological & Geophysical Surveys.*
- 1440 Coal Utilization as a Means of Meeting the U.S. Energy Demand,

- Including Portions from Energy Supply and Environmental Coordination Act,  
*Arthur Hughes, Spec. Asst. for Econ. Affairs, Office of Coal, F.E.A.*
- 1500 Changing of Fossil Fuel Base,  
*Van McDonald, Lounsberry and Assoc.*
- 1520 INTERMISSION
- Panel Discussion
- Moderator - Ernest N. Wolff
- Future of Coal Development in Alaska,  
*George Sall, Assistant Associate Administrator for Coal, Federal Energy Administration.*
- William Waugaman, Usibelli Coal Mines, Inc.*
- A. W. Baker, Jr., Golden Valley Electric Association.*
- Arthur Hughes, Spec. Asst. for Econ. Affairs, Office of Coal, F.E.A.*
- 1800 BANQUET - Ballroom, Wood Center
- Chairman - Earl H. Beistline
- Development of Alaskan Coals - A Challenge,  
*Hugh Matheson, Vice Pres. Exploration, Placer - AMEX.*
- 2100 Adjournment

## FRIDAY, OCTOBER 17, 1975

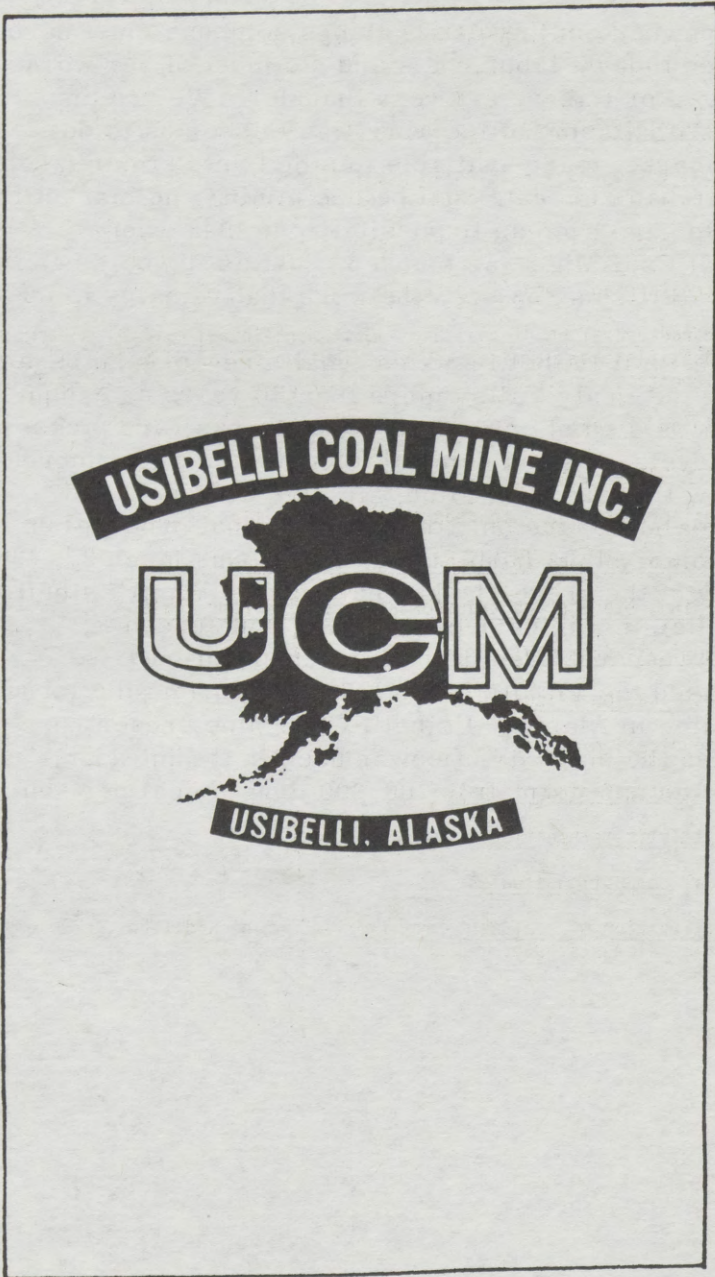
- 0900 Field Trip to Usibelli Coal Mine,  
Healy, Alaska.

## Appendix III

## Some Areas of Coal Research

- 1) Palynology - study of spores in coals for seam correlation and dating.
- 2) Coal petrography - helps in predicting the behavior of coal in use, such as coking, gasification, solvent refining, etc.
- 3) Chemistry coal - organic chemistry.
- 4) Structure and porosity of coal.
- 5) Characterization of coal ash - Determination of mineral matter, identification of minerals, distribution of major, minor and trace elements in coal ash.
- 6) Mining of coal.
- 7) Mine safety.
- 8) Coal preparation - to reduce ash and pyritic sulfur.
- 9) Behavior of coal in low and high temperature coking.
- 10) Drying, storage and transportation of low-rank coals.
- 11) Chemicals from coal.
- 12) Gasification of coal.
- 13) Liquefaction of coal.
- 14) Solvent refining of coal.
- 15) Catalytic methanation.
- 16) Coal combustion studies.
- 17) Utilization of coal ash - for bricks, cement additives, recovery of trace elements, etc.

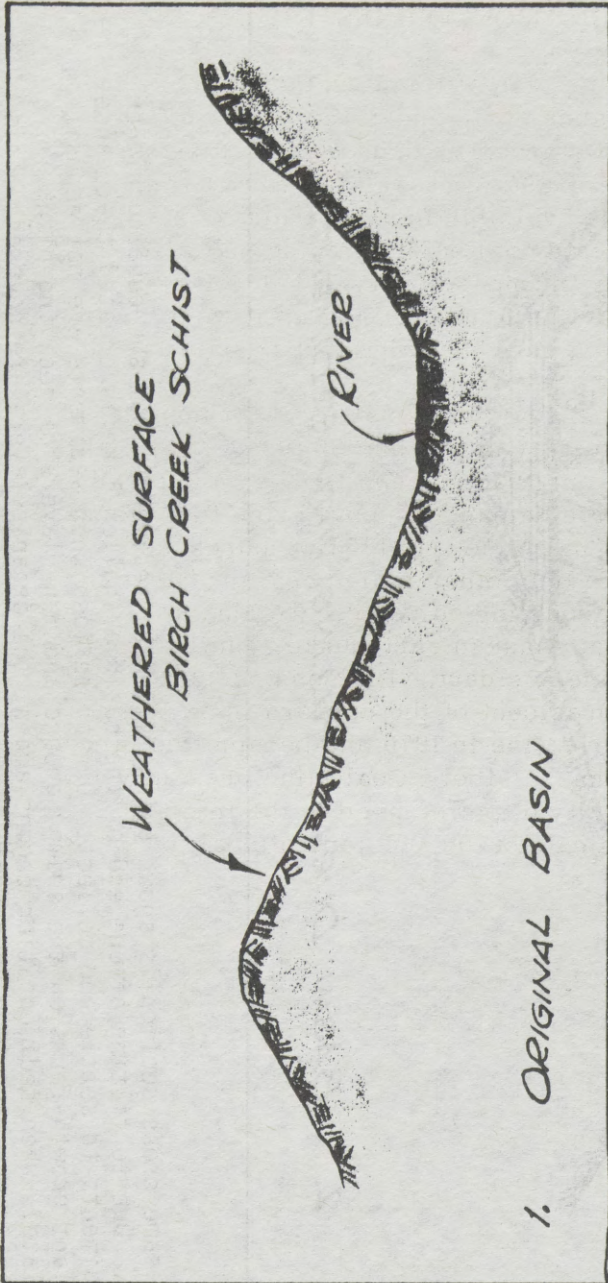
APPENDIX IV



## INTRODUCTION AND HISTORY

Somewhere in the plan of things someone must have realized today's labor costs and did most of our work for us. For this we are very thankful. We are also thankful that some of the work was left for us to do and a market made available for the fruits of our labor. To have had to create coal before mining and marketing it would have been an impossibility in 1943 when Usibelli Coal Mine was founded, just as it would be today. Still, as you see, the work that remains is no small task.

When Emil Usibelli and his small crew of men began mining the Healy Valley more than 30 years ago, equipment consisted of one tractor, two trucks, and picks and shovels. As the demand for power and fuel increased, so grew Usibelli Coal Mine. In 1952 we purchased Suntrana Mine, the only other major coal producer in the interior, thus doubling our size. On March 27, 1964, the day of the great Alaskan earthquake, Emil Usibelli was killed in a mine accident. His son Joseph E. Usibelli became president of the corporation. We purchased the Vitro Mine in 1970 and became the largest coal mine in Alaska. Usibelli Coal Mine presently supplies the majority of power used in the interior, producing approximately 700,000 tons of coal per year.



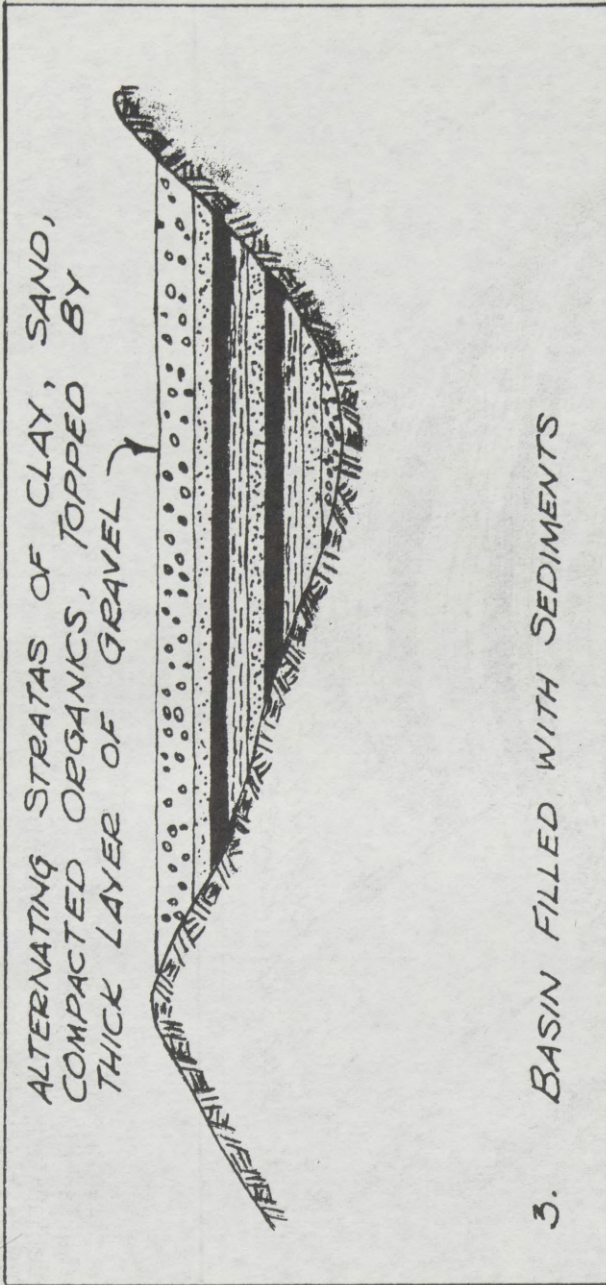
This cross section shows a typical coal basin somewhere along the north slope of what will someday be the Alaska Range. The time is many million years ago before the coal has started to form.

LUSH SWAMP GROWTH  
DURING QUIET PERIOD  
IN SEDIMENT DEPOSITION

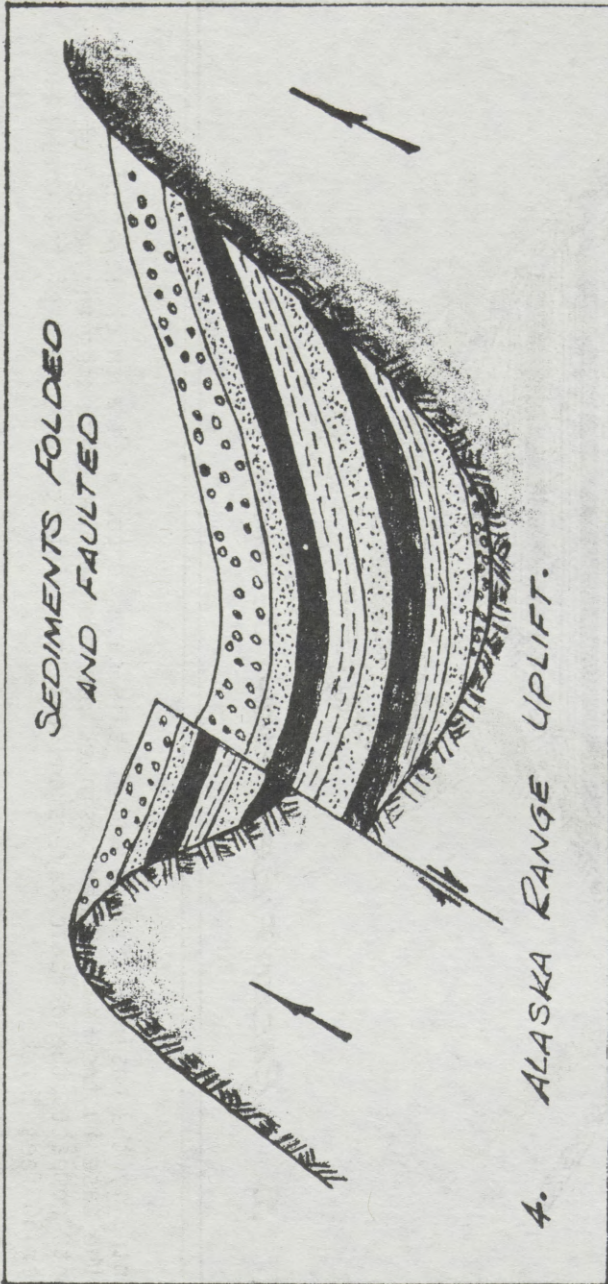


## 2. BASIN DURING FILLING WITH SEDIMENTS

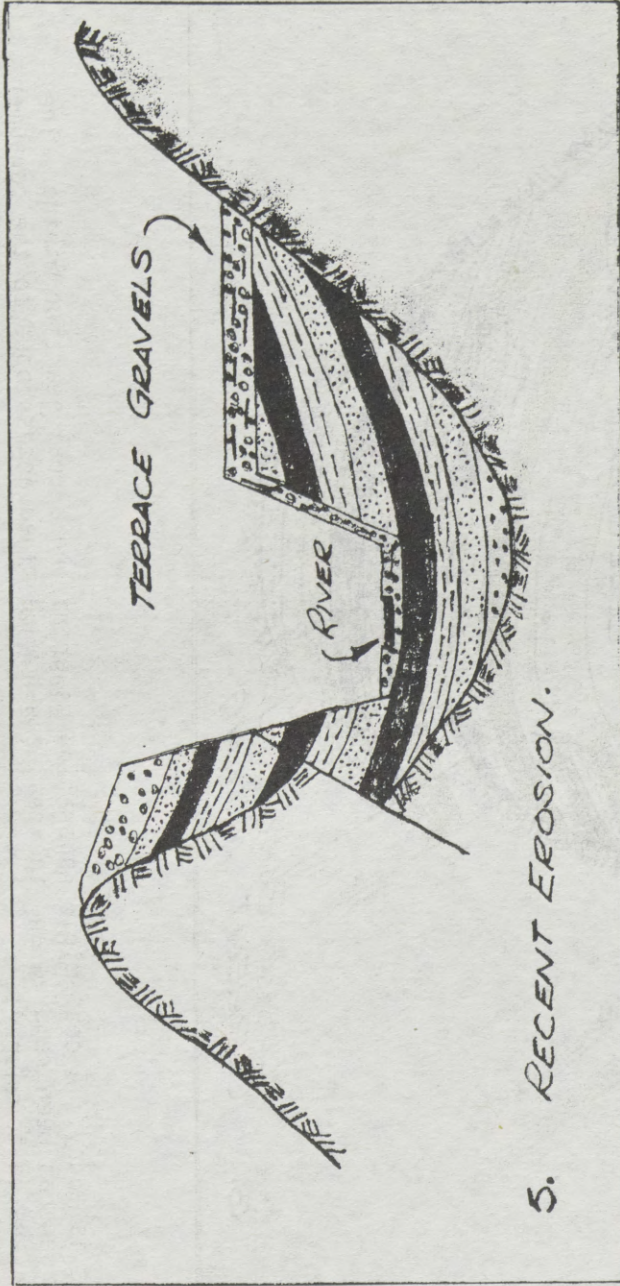
The same cross section is shown being filled by sediments from surrounding higher ground. Due to tilting of one end of the basin a shallow lake is created that causes the sediments to settle and collect. During periods when sediments are not deposited, lush plant growth forms on the swampy ground and many layers of decaying plant life accumulate. When sedimentation begins again, the organic layers are covered. This sequence occurs many times over the years.



Eventually the basin is filled and in this case topped with a thick layer of gravel as is the case in the Healy Creek basin. Over the passing centuries the weight of the sediments compacts the organic layers and they turn into coal. (Some of the coal seams are over 50 feet thick.)

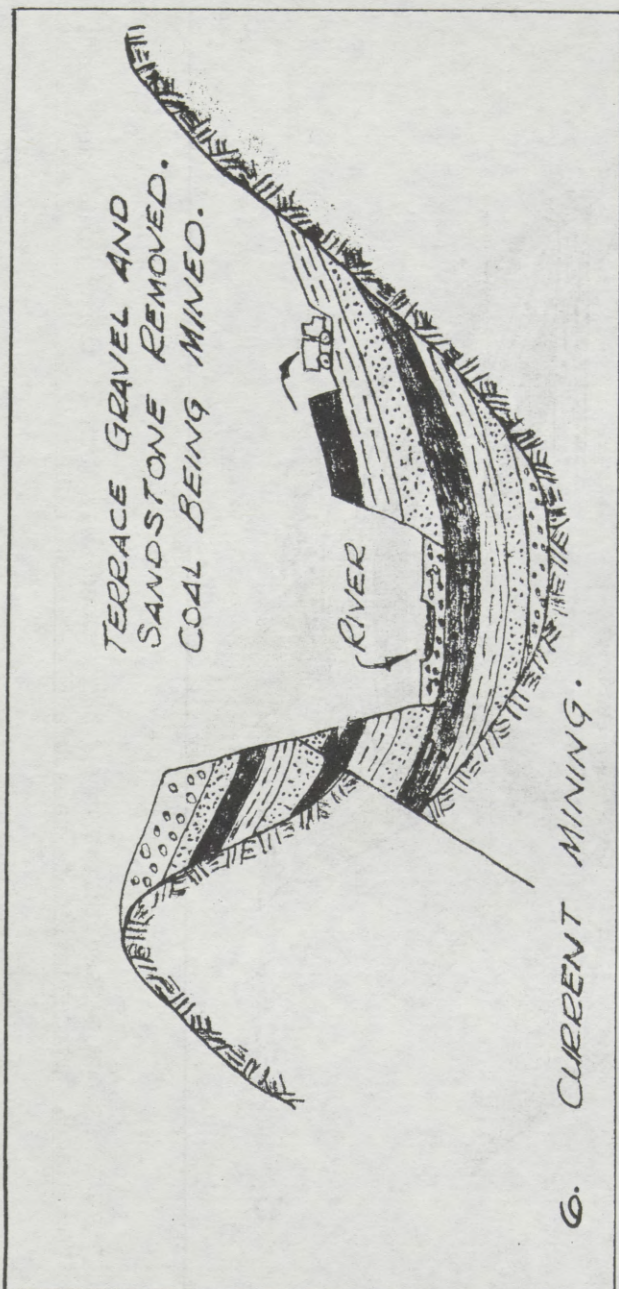


For a time in geologic history great tectonic forces created the uplift that became the Alaska Range. The sediments being very elastic by comparison with the underlying rock were faulted, folded and contorted between these moving masses of rock. In some cases the coal is tilted as much as 85 degrees.



5. RECENT EROSION.

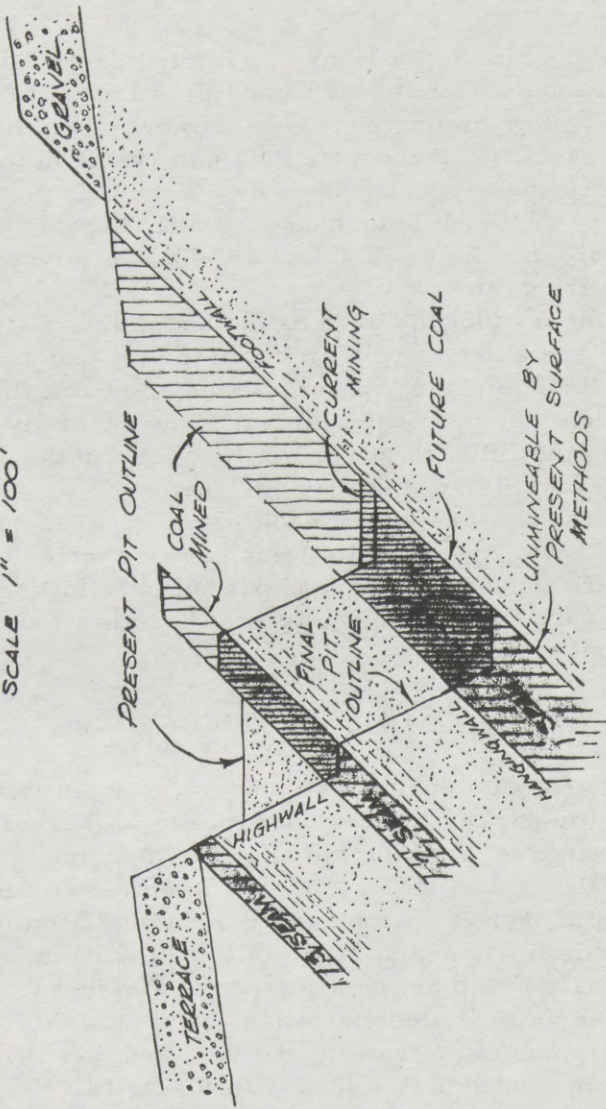
Enough time has now passed that a river has eroded away much of the original sediments and in some places has deposited terrace gravels.



This is today. A coal mining operation is preparing a coal seam for mining. The overburden has been removed and the coal can now be mined and shipped to the consumer for conversion to energy.

TYPICAL SECTION AT HYDRAULIC PIT

SCALE 1" = 100'



This is a typical section of one of several pits in the Healy Valley. It is presented to give a more precise picture of the mining operation.

## ENGINEERING

Coal bearing formations are fairly orderly so the locations of the coal seams can be predicted with some accuracy. For mining purposes, however, the location must be precise. Inaccurate data can result in the moving of excess overburden with a resulting increase in expense and land disturbance. Drills capable of drilling six inch holes to a depth of 400 feet are used to locate the coal.

Engineers plot the drill data, design the coal pits on paper and stake the pit limits on the ground as a guide to the equipment operators who are removing the overburden. Slopes of the pit walls are carefully controlled so the finished pit will in fact contain the amount of coal for which it is designed.

Several pits are mined each year. Coal is normally produced from one pit while stripping is carried on in others. Frequently pits are expanded in following years until the ratio of overburden to coal becomes too large to be economical.

## MINING OPERATIONS

Following the engineers' plan overburden is removed until the top edge of the coal is exposed. Overburden is then removed from the sloping side (hanging wall) of the coal seam. The overburden is either ripped or blasted to loosen it. Ripping is done with 72 ton HD 41 Allis-Chalmers tractors or 35 ton TD 25C International tractors. For blasting a pattern of six-inch holes 20 feet deep are drilled and filled with 50 to 100 lbs. each of ammonium nitrate (fertilizer) and diesel. The loosened overburden is mined with 10-yard H400 Hough loaders and loaded into 45-ton PH 180 International trucks. The trucks haul the rock to spoil piles near the pit. Stripping is conducted two 10-hour shifts five days per week.

After the coal is exposed and the surface cleaned, an H400 loader loads it into PH180 trucks equipped with special large coal beds capable of holding 50 tons. The trucks haul it to the tippie at Suntrana for processing. All traffic on mine roads drives on the left

as in England. The trucks are over 14 feet wide with the cab on the extreme left. Left hand traffic enables the driver to accurately judge his distance from the shoulder. Left traffic is also a safety measure as it insures that any spillage from oncoming trucks will not hit the driver's compartment.

The trucks dump their loads in the processing plant which is called a tipple. The coal is crushed twice to reduce it to its final size as determined by the customers' specifications. The crushed coal travels up a 300-foot long 36-inch wide conveyor belt to a seven by sixteen foot vibrating screen. The screen separates the coal into three sizes-- $3/4$  inch minus,  $3/4$  inch to  $13/4$  inches, and  $13/4$  inch plus. Each size is sorted in a 250-ton surge bin. Coal is fed from the bins and blended according to specifications on another conveyor belt which transports it to 75-ton railroad cars. A bill of lading is prepared for each car. The railroad pulls the loaded cars and replaces them with empty ones twice each day. Coal mined one day normally arrives at its destination the following morning. The record mine production is 57 cars totalling 4275 tons in one shift. Coal is normally produced one 8 to 10 hour shift per day 5 days per week for 12 months of the year.

#### PERSONNEL AND EQUIPMENT

The crew at the mine varies from about 70 in winter months to over 90 during the summer when stripping is in progress. The annual payroll is nearly \$2,000,000. The summer crew is comprised of approximately 40 equipment operators, 30 shop personnel, 4 tipple operators, 4 camp maintenance men, and 10 supervisors. A full-time safety officer is responsible for an active accident prevention program.

The equipment fleet is one of the most modern in Alaska. Three 10-yard H400 Hough Loaders, eleven 45 to 50-ton PH180 International trucks, three HD41 Allis-Chalmers crawler tractors, one TD25C Inter-

national crawler tractor, one D500 Hough rubber-tired tractor, one Caterpillar D-6, two S24 scrapers, one 6-yard 560 Hough loader, one D-605-T Champion motor grader, one No. 16 Caterpillar grader, one TH60 cyclone drill and one T550 Chicago Pneumatic drill are used in coal production. The equipment is equipped with roll-over protection, back-up alarms, and other safety devices for the protection of the operators. The production fleet is supported by a large number of pickups, service trucks, cranes, etc.

### RECLAMATION

Usibelli Coal Mine started an active reclamation program in 1971. Test plots were planted on spoil piles to test the feasibility of reseeding mined areas. In 1972 800 acres of previously mined land were planted and fertilized by aerial application and in 1973 an additional 800 acres were reclaimed. Future plans call for annual seeding and fertilization as well as back-filling of old pits with current overburden where possible. Where terrain permits the grass will be harvested and sold as hay or mulch.

### THE FUTURE

Coal has been the primary energy source of Interior Alaska for nearly fifty years. Energy requirements have grown continually during that time and will grow at ever-increasing rates in the future. While the sub-bituminous coal of the Healy Creek area is not of coking quality, it does provide an excellent fuel for electrical generation. Because of its extremely low sulphur content the coal produces little pollution when burned in a modern plant. While oil and gas do pose a threat to our business, the low cost of coal keeps it in a very competitive position. As our national energy crisis continues to grow and we are no longer able to depend on foreign sources of oil, oil and gas will probably be too precious to waste as a fuel for steam generators. Our confidence in the future of coal in Alaska has led us to acquire additional coal leases in the Lignite Creek basin.

The new property is north of our present location. The new leases have expanded our known coal reserves to over 180 years at the present consumption. Considerable research is being conducted in the world to upgrade coal or to convert it to gas or liquid. When the research is completed and economically feasible processes are available, the coal from the Alaska Interior will be able to compete in the world energy market. Our intention is to continue to grow with and help expand the economy of Interior Alaska.

Senator METCALF. You know, all day we have had people suggesting that the number of five research laboratories, which is an arbitrary number, is inadequate. We had 12 dots on the map of the Penn State people, Montana said 10, and you suggested a similar amount.

It would seem to me that it is the consensus of all the people from these various areas, the deans of these schools, is that five laboratories are inadequate. Let the record show that our distinguished panel all nodded.

You know, there isn't any magic in five or ten or twelve. There is a little magic in getting appropriations for such laboratories. I think it is very interesting that we have had a consensus of people from all over America suggesting that we, in order to take care of the regional differences in the geographic location of the coal seams and so forth, need more than five laboratories.

You go out to Montana and Wyoming. There are some coal seams that are 150 feet thick. It is awesome when you see those huge mining machines go down and dig up a 100 and 150 foot seam of coal. And at the same time in some areas there may be higher quality coal in very, very narrow seams. The overburden is sometimes infinitesimal in some areas. In other areas you have permafrost.

So I think a strong suggestion has been made today by all the members voting for more than five. I will certainly take that up with my committee.

Do any of you have any further comments? I know you do have, but I think today we have made a good record on this bill. I certainly shall make suggestions as a result of the hearing yesterday and today, and as soon as a revised draft bill is prepared we will be in touch with you again. I appreciate your comments, your discussion, and your suggestions of where we go from there.

Thank you all for coming. Thank you for your participation. I have learned a great deal about the coal industry and I have been working with it almost as long as some of you people. You have been most helpful to me.

I thank you all for your patience and consideration. We will be in recess subject to the call of the Chair.

[Whereupon, at 3:30 p.m. the hearing was recessed, subject to the call of the Chair.]

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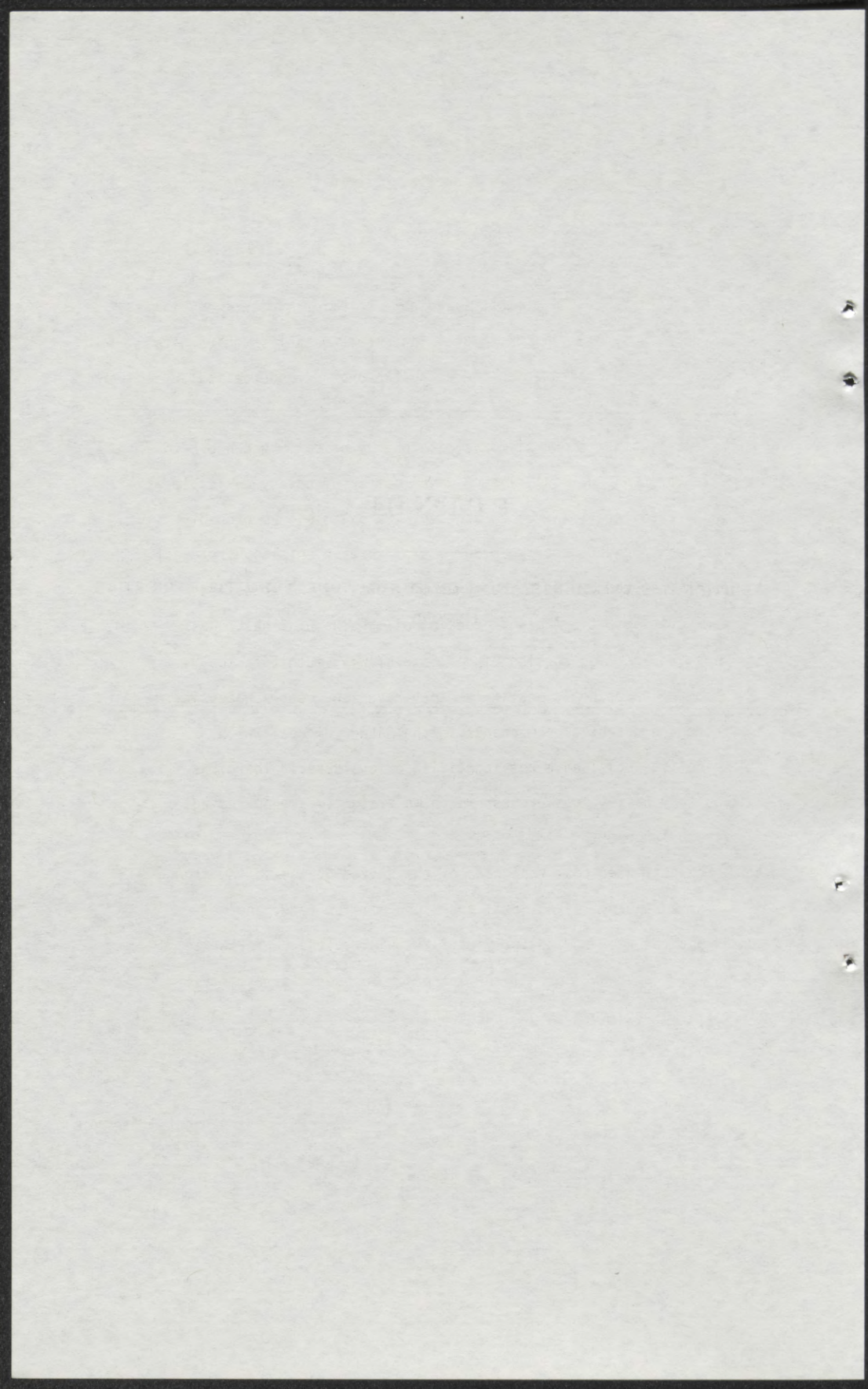
APPENDIX

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ADDITIONAL STATEMENTS AND COMMUNICATIONS SUBMITTED FOR THE  
RECORD

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STATEMENT BY SENATOR HUGH SCOTT

## Subcommittee on Minerals, Materials and Fuels

November 4, 1975

Mr. Chairman, I am pleased to be able to offer my testimony in support of my bill, S. 62, a bill that would establish university coal research laboratories and establish energy resource fellowships.

At this time in our history, with energy of so much concern to all Americans, we must develop every source of energy available to us. So far, we have not done so. We have ignored probably the most abundant energy resource available in this country; coal.

Man has used coal for thousands of years, yet he knows less about its potential than he does of oil and natural gas. Gasification and liquefaction of coal are slowly, much too slowly, becoming an economic reality -- they have long been a necessity. There are essential components in the makeup of coal which scientists still have not identified or evaluated. Therefore, coal may have valuable uses, which we presently are not using, for our economy.

The estimated coal resources of the United States in the ground as of 1 January, 1974, total over 3000 billion tons, and we do not yet know how to fully utilize this wealth. Unfortunately, we will not know, nor will we learn how to use this resource, until we educate more engineers and researchers in this field and help them by adequate funding to search out the required knowledge.

Lead time is critical for the production of that knowledge, and the source of basic knowledge is our university system. In the Sixties when our mineral science and engineering departments, for example, should have been receiving the support necessary to provide the base of fundamental knowledge so that today we could be actually liquifying or gasifying coal instead of just talking about it, what was happening? Eleven out of the 27 mining engineering departments throughout the nation were allowed to go out of business. The Universities are now scrambling to get them back at a time when sustaining funds to rebuild faculties and facilities are non-existent, and university operating budgets are being cut back.

If we are to meet the information needs required for energy policy and action in the remainder of the Seventies, Eighties, and Nineties, we must provide initial and continuing support for reconstruction of the base of knowledge that will generate that information.

Having that vital knowledge is not enough to expand coal production...we must initiate a program for increasing coal mining and research manpower by State and federally financed programs in vocation schools and colleges.

Last June the 16 universities in the United States that still had mining engineering departments produced a total of 336 mining engineers with B.S. degrees. With about half of these going into

the coal business, this means only one new engineer for every 30 operating coal mines; and this at a time when we are talking about increasing coal production by 50% in the next ten years. At Penn State University every prospective June graduate was interviewed by at least ten companies, and starting salaries ranged from \$1300 to \$2000 per month. Under such conditions there is obviously little incentive for even a few of the best undergraduates to continue graduate school in order to acquire further education and thereby add to the numbers of professors and researchers in our universities. The significant increase in educated manpower needed to face and alleviate our energy problems will result only by strengthening the support of those university departments responsible for producing such increases. With an improved environment of equipment and facilities to provide the incentive, and more graduate fellowships to provide attractive financial help, increased numbers of undergraduates will be persuaded to continue in graduate school training to fill depleted faculty ranks. Only in this way will our mineral science and engineering departments acquire the strength and critical mass of faculty sufficient to produce the required manpower.

If our mineral science and engineering colleges are to provide the necessary knowledge and manpower they must have funds that are sufficiently flexible to be used effectively to rebuild faculty strength, provide equipment, convert outmoded space into modern research and demonstration laboratories, and make fellow-

ships available at the graduate level. We are not preparing here for a ten year get-to-the-moon space age; but for at least 30 years of major trials and tribulations in the energy field. From our experience of these last few years we can now fully appreciate that our knowledge of coal, coal conversion processes, scrubbing and other <sup>essential</sup> ~~beneficiation~~ techniques, and a host of other technical problems, is woefully inadequate relative to the burgeoning energy requirements of the immediate and long range future.

The situation in coal research in our American universities today is not dissimilar to that in Agriculture 100 years ago: a few self-made centers of excellence do exist but on the whole there is an abysmal lack of expertise in light of the problems confronting the nation. The pattern of the agricultural experiment stations is a viable one to follow in setting up an appropriate number of coal research laboratories. American agriculture leads the world today, in large part, because continuous, flexible funding over the years has permitted the development of strong cadres of research and teaching personnel working at the cutting edge of their disciplines for the most benefit of the American farmer and national agricultural production. Strong organizational and regional relations inhibit research duplication yet encourage beneficial competition. Shared responsibility with government, the university, and the

industry assures a productive partnership in research and the problem solving application of results. Appropriate federal funding in the minerals and fuels area could achieve similar results by following a pattern that has already demonstrated cost benefits exceeding those of most federal programs. Indeed, with estimated available coal resources in the United States accounting for more than one-tenth of those of the entire world, there might even come a day when - as in the case of agricultural products - we will be shipping liquified coal to the Arabs.

Time is of the essence; the longer we delay in developing our coal research, the longer we will be captives of the OPEC nations. I therefore urge my colleagues to move forward with this bill in order to help Americans gain their energy independence.

NATIONAL COAL ASSOCIATION

Statement by

CARL E. BAGGE  
President

NATIONAL COAL ASSOCIATION

before the

SENATE INTERIOR COMMITTEE  
SUBCOMMITTEE ON MINERALS, MATERIALS AND FUELS

In conjunction with

S. 62

Coal Research Laboratory and Energy Research  
Fellowship Act

November 5, 1975

My name is Carl E. Bagge. I am president of the National Coal Association, a national trade association whose members include the major coal producing and coal sales companies of the nation. I appreciate this opportunity to express the coal industry's views on S. 62, which would establish coal research laboratories and energy resource fellowships.

#### I. Background

The coal industry is in a dilemma as it tries to cope with the huge called-for expansion in coal production. Coal is needed in increasing quantities for power plants, steel mills and other industrial plants and this in turn requires a highly-skilled labor force to carry out the energy needs of our nation. The problem is that the supply of competent research scientists, trained engineers and technicians needed to improve production techniques and other coal-related problems is simply not adequate to meet the coal industry's needs. The present supply of mining engineers and technicians entering the labor force is not even sufficient to take care of our present mining activities.

The coal industry estimates its manpower requirements to be an additional 152,000 people from 1975 through 1985. As of June 1975, there were 192,000 people employed in the coal industry. The numbers point out the tremendous burden which is being placed on the coal industry, since it is today's experienced people who will have to train tomorrow's new people. This presents another

problem, because our universities are not capable of turning out the quantities of highly-trained engineers and technicians who are necessary to properly supervise the new coal miners.

We estimate that the 1975 requirement for mining engineers will be in the neighborhood of 1,000 people. The number of mining engineers projected to graduate during the year is only 365, leaving the industry responsible for attracting roughly two-thirds of this essential talent from other curricula to make up the gap. During the past recruiting year, the coal industry has been able to hire the needed engineering graduates by attracting people from other related engineering fields. For the most part, this has been possible because of the weak job market in other disciplines due to the recession. When the economy does pick up in these other areas, the competition for engineering graduates in these related fields will intensify, and the coal industry will not be able to continue to count on these people as potential employees. Therefore, an increased number of mining engineers will be essential.

Upwards of 22,000 engineers and technicians are projected to be required by the coal industry during the next decade. Because the majority of these people will be inexperienced in mining, the burden of training the engineers and technicians in the areas of safety, environmental and productivity requirements will fall upon the present coal management. Many of the new engineers and

technicians hired between now and 1985 will go on to be section foremen and mine supervisors. Therefore, it is essential that positive programs be developed in the school curricula as soon as possible so that the people who are placed in these responsible positions are trained according to the latest safety, environmental and productivity doctrines and techniques.

The coal industry will continue to do its part in training miners, engineers and technicians. With the huge influx of new workers, however, it cannot be expected to shoulder the entire burden. Therefore, the educational process must be expanded and revitalized to undertake the task of training many of these people -- especially the mining engineers and technicians.

The educational system must not only re-tool its curricula and revamp some programs, it must also seek new and innovative ways of serving the educational needs of the coal community. Vocational and technical schools could play a key role in filling this education gap. Likewise, two-year programs in junior colleges could provide another alternative for handling the critical problem of providing a quality technical education to a vast number of new students.

In order for the needed coal to be mined during the next ten years, the coal industry needs more technically-oriented people with the expertise it takes to mine coal more efficiently and safely, with a respect for environmental considerations. Production-

oriented people are needed with the technical background to take new mining systems, such as continuous haulage, and be able to solve the problems associated with productivity increases. Highly-trained people are needed to work in areas such as automatic roof bolting and hydraulic transportation. New people are needed to continue the work related in solving the maintenance problems in a systematic manner.

The coal industry is presently engaged in active scholarship programs which support the areas of mining technology and science in general. In some instances, the scholarships are awarded to students by the companies while other programs appropriate the money to the college or university with the institution performing the screening process. Most of the scholarships are for undergraduates at four-year schools with very few scholarships directed for graduate studies.

In addition, the coal industry also gives grants directly to schools in support of the school's efforts in mining engineering, environmental sciences, mining technology, coal research and other coal-related disciplines. Usually the schools determine how the money is used. Grants go to two-year technical schools, four-year colleges and graduate schools.

The fact that very few coal industry scholarships are used for graduate level studies is directly related to the current shortage of mining engineers, which has been in existence throughout the seventies. The coal industry presently needs all the graduating

mining engineers and more just to maintain existing production levels, to say nothing of the projected increases in production which the coal industry is being called upon to mine in the future. Therefore, there is little hope that there will be any significant increase in graduate level scholarships under the present system since the undergraduates will be employed by mining companies upon their graduation because of the coal industry's present critical need for well-trained personnel.

In some instances, mining schools have suffered from an image of being weak in research due to a lack of funds and a lack of interest. As a result, their ability to attract top quality research scientists and professors has suffered. Certainly the area of coal mining no longer suffers from lack of interest in today's increased awareness of energy and energy-related activities. I am gratified to note that a solution to the ongoing problem of lack of funds is contained in S. 62.

## II. S. 62

### A. Title I

The National Coal Association has in the past endorsed various proposals to expand coal research in such areas as production, transportation and utilization of coal. The mining research presently carried on, as we all know, is done through the Bureau of Mines. On the other hand, coal utilization research which was originally centered in the Office of Coal Research

has been incorporated into the Energy Research and Development Administration.

The coal research laboratories set up under Title I of S. 62 are a sensible means of centering research activities in the best qualified universities or colleges. In addition to carrying on much-needed coal research, the coal research laboratory is something concrete that prospective students can identify with as they decide upon their careers.

The coal research laboratories would be the focal point for academic coal research and would serve as bridges of communication between universities and coal or coal-related industries. It is centers such as these which provide the environment for the seeds of discovery to develop into improved production and use of our most abundant domestic fuel -- coal.

There are several provisions in Title I which we believe must be changed. For instance, Section 101 establishes an arbitrary limit of five institutions which will have coal research laboratories while only one school in any given state can be funded. This could severely limit the research in those states which have more than one institution of higher education having expertise in coal research. We urge that these limits be eliminated from the legislation.

In order that the coal research laboratory be used for what it is intended, and to eliminate confusion, we believe that

Section 101(d) (3) should be amended so that it focuses more on coal R & D rather than "...any discipline which is related to the development of adequate energy supplies..." to insure that the students' activities be directed at development of adequate coal or coal-related energy supplies in the United States.

Our final and most critical concern about Title I is the placing of the coal research activity under the Director of the National Science Foundation. As stated in our opening remarks, research activities are presently centered within the Bureau of Mines and ERDA. We believe that an adequate apparatus for the direction of the coal research laboratory already exists within the framework of the coal-related government agencies. Therefore, we urge that Title I be amended to provide that the university coal research laboratories will be established and under the direction of the Director of the Bureau of Mines with consultation provided by ERDA. This would allow coal research to continue to be centered within those government agencies which are already structured to handle coal research and its associated funding.

At a time when there is a public concern for needless duplication within the government, especially in the energy area, we think that the public's money would be better spent through the existing framework. It also makes more sense to use the existing expertise of the government officials presently engaged

in coal research rather than spread the authority to those engaged in other areas.

B. Title II

Title II, entitled "Energy Resource Graduate Fellowships", is a section for which we compliment the sponsors of the proposal, particularly for their insight into the nation's present and future needs to develop qualified persons in the areas of applied science and engineering that are related to the production, conservation, and utilization of fuels and energy. We believe, however, that Title II should be amended to be entitled "Coal Research Graduate Fellowships" and that the area of study and research be limited to those areas of applied science and engineering that are related to the production, conservation, and utilization of coal and coal-related fuels and energy.

It is our fear that of the 1,500 graduate fellowships handed out in the six years specified, only a miniscule portion of the fellowships would be in the coal or coal-related research area. If this committee is truly concerned with the development of coal research facilities and directing students toward coal and coal-related research, this suggested change is absolutely essential.

The coal industry urges that the granting of fellowships, like the coal research laboratory, be put under the direction of the Bureau of Mines. Since the coal research laboratories and the graduate fellowships are so interrelated, it is essential they be

placed under the same agency.

### III. Conclusion

The coal industry is attracting talented young people with engineering and technical backgrounds. The need for more coal in the next decade will mean even more highly-trained people will be required. At the present time, the universities are unable to turn out the number of well-trained people needed by the coal industry.

The nation would certainly benefit through the creation of coal research laboratories and coal or coal-related resource fellowships. The people who would enter into these programs would generate the new ideas needed to enhance coal's position in the energy arena which is synonymous with enhancing the nation's position in terms of energy dependence.

The time is long overdue for creation of such a program, for the longer we delay, the further away we are from doing what is needed in attaining energy self-sufficiency. Use of the existing government agencies involved in coal research would be a plus for the proposed program since both the Bureau of Mines and ERDA are already heavily involved in coal or coal-related research programs. Also, granting the fellowships in coal or coal-related work would appear to guarantee continuous use of the coal research laboratories.

The coal industry supports S. 62 with the amendments and suggestions I have outlined here today. It is now time to act

if we are to avert a potential manpower and research crisis in the coal industry.

S. 62 has many good concepts, and so do our young people attending universities involved in research. Let's give them a chance to put the ideas to work in helping the nation to achieve its energy goals.

## Testimony on S.62

before the Subcommittee on Minerals, Materials and Fuels

Senator Lee Metcalf, Chairman

by

Elburt F. Osborn, Carnegie Institution of Washington

Mr. Chairman and Members of the Subcommittee:

The Senate Bill No. S.62 has been wisely introduced in the belief that its provisions, if carried out, would help meet an important need in this country in connection with our very serious energy problem. I wish to testify in support of this legislation, and do appreciate the invitation to appear as a witness.

As a former member of a mineral science and engineering faculty, and successively a department head, dean, and vice president for research at one of our fine land grant universities, I have for many years been very much concerned about the small, and to me very inadequate, mineral science and engineering programs in our universities. I also served as chairman of the Mineral Science and Technology Committee of The National Academy of Sciences, which issued a report in 1969\* detailing the deplorably low state of these fields in our universities. I now serve as chairman of the Academy's Board on Mineral Resources, a group who also are very much concerned about the low level of university activity on mineral resources.

From 1970 to 1973 I was Director of the U. S. Bureau of Mines. As our program expanded with enforcement of the new Coal Mine Health and Safety Act and the Metal and Non-Metallic Mine Safety Act, both of which became effective in 1970, there was absolutely no chance of obtaining the mining

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\*"Mineral Science and Technology--Needs, Challenges and Opportunities"  
Report of Committee on Mineral Science and Technology, National Academy  
Sciences, Washington, D. C. 1969

engineers needed for the most effective enforcement of these laws. In addition, work on problems in connection with surface mine reclamation and surface subsidence over abandoned coal mines was undertaken without our being able to obtain the mining engineers needed to do the job most effectively. Only about 125 to 150 mining engineers a year were being graduated. With its expanded program, the Bureau of Mines could have used all of these graduates each year for several years, and their services would have upgraded the quality of the whole Bureau of Mines effort. Compare this number of graduates with over 500 mining engineers produced per year in Poland. The Bureau also needed mineral economists, but with only one school in the country producing these specialists, the Bureau had to settle for people without such training to do the highly important mineral information work on which the government and industry so critically depend. Even worse than this manpower situation was the lack of competent faculty groups in universities where research on coal and other mineral problems could be undertaken.

In all fields we depend on universities for the more basic types of research. But for research on coal and other mineral resources, universities simply have not had the support to develop these programs. Serious mineral problems, such as surface subsidence where communities have been undermined by coal extraction or the critical problem of dust in coal mines causing "black lung," were not being studied at universities in 1970. As a step toward improving this situation, we established in the Bureau of Mines in 1971 an Office of University Relations. This office, I know, was very helpful to universities trying to upgrade their mineral resource programs, but the universities have been able to make only small progress because of

lack of sustained funding.

The basic resources on which we must depend are agricultural, mineral, and human. A former Congress wisely recognized the need for university programs in agriculture, passing the Hatch Act of 1887 that provided an annual appropriation, matched by the states, to establish and maintain an agricultural experiment station at a land grant college in each state. Earlier, human resources were considered in the famous Land Grant Act. The great benefits to this country of these university research programs in agriculture, complemented by the associated resident education and extension programs, are well known. Despite the great success of these agricultural resource programs, and despite the parallel need for research and educational programs on mineral resources, no similar provision for mineral research has been enacted into law, except for the water resources research program.

We need continuing support of broad mineral resource programs in universities, similar to the agricultural programs--not just coal, but the whole spectrum of minerals including petroleum, natural gas, uranium, copper, aluminum ore, iron ore, etc. However, the most critical resource by far at the present time, from the standpoints of research and technology and our environment, is coal. Therefore, in the absence of a broad based mineral resource program, the bill strikes at the most important and critical aspect, and if enacted into law should stimulate research and education of great importance to the nation.

The general idea of the bill is undoubtedly just what is needed. I refer to continuing annual support, on the one hand, and support primarily of research and graduate work, on the other. Regular, annual support, comparable to that of the Agricultural Experiment Stations at land grant colleges, is essential to building up a competent faculty of adequate size

and scope to tackle the difficult mineral science and engineering problems. Emphasis on research is important to make it possible for universities to do the type of long-range, basic research that can only be done in the universities with our traditional and highly successful tripartite research and development system combining the efforts of government, industry, and universities. With first-class graduate and research programs underway and recognized, these universities will attract good students to this field, and the student body should build up.

I should like to comment, however, on two aspects of this bill that I believe should be modified or at least clarified. First, with regard to the number of university programs, I would hope that the small number of five be considered as simply the start of the program. Problems concerning coal vary greatly from one section of the country to another. For this reason alone we should have ten or fifteen university centers. There are vast quantities of coal, and the properties of this coal and the mining conditions vary widely. Coal ought to be studied bed by bed so that it can be burned or converted to gas or oil with greatest efficiency, or so that we may know the quantities of minor elements in the coal—such as cadmium, uranium, and arsenic - that will be put into the air or streams or underground systems during production and use. Some of these elements, and their possible capture during processing of the coal, must be studied to determine the feasibility of recovering them as an important mineral resource. The quantities will be large when we are consuming over 1 billion tons of coal a year, possibly by 1985.

Much of this coal research should be done in universities, and five coal research centers is too small a number. Coal problems in Alaska (permafrost), Pennsylvania (surface subsidence), West Virginia (methane in coal),

Wyoming (underground gasification), Texas (lignite utilization), North Dakota (high alkali), Montana (reclamation), Kentucky (roof control), Utah (very deep coal mining) and others will be studied more eagerly and knowledgeably by the local universities.

My second comment concerns Sec. 104(b), where 50% federal matching is to be provided for cost of operation of the "coal research laboratory." It should be made clear that by "coal research laboratory" is meant the whole program of research and graduate work on coal-i.e., coal petrography, coal geology, coal conversion, coal mining, coal preparation, coal economics, etc. - including salaries, wages, supplies, and indirect costs, so that the universities can meet the 50% nonfederal matching requirement. I suggest that "coal research laboratory" in this section be interpreted to mean, for matching purposes, the university's "total coal research and education program."

Mr. Chairman, this is an important bill. Inevitably, as we run short of energy and other resources, the public will realize that we have not used enough foresight and done the necessary planning in the energy and mineral resource field. If we are to have strong university programs ten years from now, when resource problems will be even greater, we must get started now. This bill can be a good start.

Carnegie Institution of Washington  
2801 Upton Street, N. W.  
Washington, D. C. 20008

5 November, 1975

STATEMENT OF  
HARRY PATRICK  
SECRETARY TREASURER  
UNITED MINE WORKERS OF AMERICA  
BEFORE THE  
SENATE INTERIOR SUBCOMMITTEE ON MINERALS  
MATERIALS AND FUELS  
ON S.62  
COAL RESEARCH LABORATORY AND ENERGY  
RESEARCH FELLOWSHIP ACT  
NOVEMBER 5, 1975

Mr. Chairman, I would like to thank you and the other members of the Committee for this opportunity to voice the UMWA's strong support for S.62. The UMWA has long advocated a federally mandated and supported program of comprehensive coal research which would include all aspects and phases of coal production and utilization.

It is not necessary to repeat again the important role that coal could and should play in America's overall energy plan. There are abundantly known and recoverable coal reserves in the United States; however, there are obstacles which prevent their full and safe utilization. S.62 represents a strong and sensible beginning toward removing many of these obstacles. It provides an uncomplicated and relatively inexpensive solution to some of the problems presently inhibiting the use of coal as our primary energy source.

In order to fully utilize our vast coal reserves in a manner which will relieve our energy shortages, there must be substitution of coal for oil and gas. Mr. Chairman and members of the Committee, I am sure that you are all very familiar with the problems associated with this substitution. Before coal can begin to assume the role as a substitute for oil and gas, the two major problems of flexibility and environmental soundness must be solved. They can only be solved through research.

As it stands now, oil and gas can be accomodated to a greater variety of uses than can coal and, in most cases, oil and gas can more easily meet the standards set by the Clean Air Act. I believe

that is has been adequately demonstrated that both these problems of flexibility and environmental pollution can be eliminated in the near future through advanced coal research. S.62 serves to foster and encourage this much needed research.

Coal liquefaction and gasification are just two of the technologies being pursued which will increase the flexibility of coal. Chemical and mechanical cleaning, and in-place or on-line desulphurization processes, such as scrubbers, are only a few of the areas being explored which will make coal a more environmentally acceptable fuel. All of these technologies may have been a commercial reality today if the proper approach had been taken. We must not continue to make the same mistakes concerning coal research that we have made in the past.

Today, as in the past, much of our coal research is being conducted by oil companies or their subsidiaries. For instance, Consolidated Coal is a leader in the field of synthetic fuels development. Consolidated Coal is a wholly-owned subsidiary of Continental Oil. This illustrates the inherent conflict-of-interest present in much of our coal research. Any technology that would increase the competitiveness of coal in the oil and gas markets is counter to the best interests of the oil and gas companies. By developing inexpensive fuels from coal, the oil companies would be lowering the value of their oil and gas reserves. It is in their best interest to produce a semblance of progress in coal technology while allowing oil and gas to remain the more attractive fuels.

There is an urgent need to place coal research in an independent environment free from economic and political pressure. Coal research is now centered in private industry and the federal government. In the former, it is subject to profit generated pressure and it naturally succumbs to the more profitable oil and gas. In the latter, it is subject to political pressure and loses time and again to nuclear power. Nuclear power has a stronger lobby, both inside and outside of the government. This lobby's effectiveness can be clearly seen by studying past and present ERDA budgets.

The ideal independent environment for coal research is the nation's universities. They have the personnel and in many cases the facilities. With a government program such as the one outlined in S.62, these potential coal laboratories could be put to very effective use. S.62 would encourage the creation of coal research programs in selected universities in various coal states across the nation. The advancement of coal research would be greatly enhanced if the existing wealth of knowledge, expertise and research facilities of our universities is tapped.

Title 11 of S.62 would provide fellowships for students interested in pursuing graduate degrees in a coal-related field. This is a long term solution to a long term problem. Many of our present programs dealing with the "energy crisis" are of a short-term nature. By attracting young careerists into the energy field, S. 62 will be providing the nation with a permanent means to solve our present and future energy problems.

The distribution of 9,000 fellowships over the next six years is the perfect complement to the creation of coal research programs as provided for in Title 1 of this bill. Together the two provisions would form a strong base for a structure of energy research in the years ahead. They constitute a continuing solution to what surely will be a continuing problem.

At the end of this testimony there is attached a list of recommended amendments to S. 62. These amendments intend only to broaden the scope of S.62. They are simple, almost technical, changes and it is our hope, Mr. Chairman, that the Committee will seriously consider their merit.

The first suggested amendment would add labor and industrial economists, sociologists and regional planners to the fields covered by the bill. Economic and social dislocation, and other adverse effects upon a community and the services it provides, is a major problem associated with a significant expansion in coal production. This is especially true today in the west. Certain communities and certain people are expected to share a disproportionate burden in the solution of our energy problems. Minimizing these adverse effects is an integral part of any program which seeks to exploit the nation's coal reserves to their fullest potential.

Other suggested amendments would provide for the study of manpower, health and safety and community development problems, along with environmental problems already provided for in the original bill. The solution to these kinds of problems is just as important as finding an inexpensive process for producing gas from coal.

Finally the UMWA recommends that the fellowships be expanded to include doctorate degrees rather than just master degrees. This would simply make this a more complete bill.

The UMWA recommends these changes to the Committee, Mr. Chairman, in the belief that they will make S. 62 a more comprehensive piece of legislation. Yet, with or without these changes, I believe that this bill should have the support of anyone who sincerely desires to find an answer to our energy problem. S.62 has the complete support of the United Mine Workers and I hope that the members of this Committee will act favorably regarding this bill.

## S.62--SUGGESTED AMENDMENTS

Change Section 101 (d) (1), line 19:

To Read, "civil engineers, mechanical engineers, labor economists, industrial economists, sociologists, regional planners, and ecologists;"

Insert as Section 101 (d) (2);

"(2) set forth a program for the establishment of a laboratory for coal characterization and for coal labor market, manpower training, health and safety and community research which, in addition, may be used as a vehicle for exchange of research with representatives of labor, private industry, and state government"

Insert as Section 101 (d), line 13;

"on related manpower, health and safety, community development, and environmental problems including facilities for"

Insert as Section 101 (d) (3), line 7:

"tion and utilization of coal and its related manpower, health and safety, community development, and environmental problems"

Insert as Section 201 (a) line 16:

"shall be awarded to students in programs leading to a master's or doctorate"

Change Section 201 (a) line 23:

change "two years" to "three years"



JAMES A. RHODES  
GOVERNOR

STATE OF OHIO  
OFFICE OF THE GOVERNOR  
COLUMBUS 43215

*MW*

November 21, 1975

Honorable Lee Metcalf, Chairman  
Subcommittee on Minerals, Materials and Fuels  
1121 Dirksen Senate Office Building  
Washington, D. C. 20510

Dear Senator Metcalf:

U. S. Senate Bill No. 62, to establish coal research laboratories and provide fellowships for the training of manpower to develop our coal resources, is vital if the United States is to achieve energy independence. I urge your support of this bill and the location of a research center in Ohio. We have identified coal resource development as an essential feature of Ohio's energy program.

The location of a coal research center in Ohio is essential to the development of Ohio's native coal resources. Currently, Ohio does not have a central coal R&D laboratory to carry out basic studies related to coal processing, mining technology, reclamation or coal conversion. Moreover, a need exists to develop manpower training programs to provide a strong labor base to parallel the development of additional coal mines.

The State of Ohio is firmly committed to develop the technology and institute the requisite programs to develop our coal resources.

Although Ohio does not currently have a research laboratory dedicated specifically to coal research, the state is fortunate in having such nationally recognized research institutions as Battelle Memorial Institute, Ohio State University, University of Cincinnati, Wright-Patterson Air Force Base, NASA-Lewis, and the Monsanto Mound Laboratory. Battelle and Ohio State

Hon. Lee Metcalf


-2-

November 21, 1975

University, which are located adjacent to each other, could serve as a strong central R&D core which can provide supporting R&D in all disciplines which impact on coal R&D, in addition to housing the primary coal research laboratory. Ohio's proximity to the coal fields, Battelle's past history of coal R&D, and the excellent technical manpower base which exists at our educational institutions are compelling reasons why a major coal R&D laboratory should be located here.

The Ohio Energy and Resource Development Agency, under the direction of Robert Ryan, is prepared to work with you in any way necessary to establish these vital coal research laboratories, including one in our state.

Sincerely,



JAMES A. RHODES  
Governor

JAR:pmj

cc: ✓ U.S. Senator Jackson  
U. S. Senator Glenn  
U. S. Senator Taft

# Colorado School of Mines

golden, colorado 80401 • (303) 279-0300



Guy T. McBride, Jr.  
President

October 28, 1975

The Honorable Lee Metcalf  
Committee on Interior and Insular Affairs  
United States Senate  
Washington, D.C. 20510

Dear Senator Metcalf:

The purpose of this letter is to respond to your request for written comments on S.62.

After reviewing S.62 with my staff, I feel that the proposed legislation is both timely and needed. The establishment of energy resource fellowships and five university coal research laboratories will greatly aid the development of coal resources and will to some extent, assist the university coal community through a particularly difficult financial period.

We note with some concern that the location of the research laboratories could be quite political and recommend that upon passage of the legislation every effort be made to insure that the most qualified and deserving institutions receive proper consideration. Since the development of western coal will play such an important role in the solution of the nation's energy needs, we suggest that a majority of the centers be located in the western United States.

In terms of manpower, we are very concerned that the university community will not be able to supply the mineral engineers necessary for the development of our nation's coal reserves and mineral resources. Accordingly, the proposed legislation will, through the establishment of energy resource fellowships, assist the Colorado School of Mines and similar academic institutions to fulfill this mission. Although several federal agencies (ERDA, NSF, and the Bureau of Mines) have programs that will impact manpower and coal research training, it is our impression that these programs will not be sufficient, particularly in the critical mineral resource area. With the increased development of the nation's coal reserves and alternate energy sources, the United States will face serious manpower shortages in the following engineering disciplines: mining engineering, geophysical engineering, geological engineering, petroleum engineering, chemical and metallurgical engineering. The shortfall of available mining engineers will be particularly acute

the university of mineral resources



NATIONAL SCIENCE FOUNDATION  
WASHINGTON, D.C. 20550



OFFICE OF THE  
DIRECTOR

November 13, 1975

Honorable Henry M. Jackson  
Chairman, Committee on Interior  
and Insular Affairs  
United States Senate  
Washington, D. C. 20510

Dear Mr. Chairman:

The National Science Foundation would like to take this opportunity to set forth its views on S. 62, the "Coal Research Laboratory and Energy Research Fellowship Act."

The proposed legislation would: (1) authorize NSF to provide grants to five selected universities to establish coal research laboratories, (2) establish an Advisory Committee on Coal Research chaired by the Director of NSF, and (3) authorize NSF to award up to 1500 fellowships annually for graduate study in energy research.

The Foundation recommends that S. 62 not be enacted. Existing authorities and programs of the Energy Research and Development Administration (ERDA), the Department of Interior, and the National Science Foundation are sufficient to achieve the objectives of the bill, and no new statutory authority is necessary. Moreover, by placing such significant responsibilities for coal research and education in NSF, the bill would appear to be contrary to the intent of Congress as expressed in the Federal Nonnuclear Energy R&D Act of 1974 (P.L. 93-577) and the Energy Reorganization Act of 1974 (P.L. 93-438) which established ERDA and directed that it assume principal responsibility for fossil energy research and development.

It should also be noted that the number of Federal contracts and grants for coal research and the overall level of funding have increased substantially in the last two years, and the present emphasis on solving energy-related problems indicates that they will continue

to increase in the future. We believe that the more flexible and efficient means of dealing with the problem is to continue to make awards to a number of universities on the basis of the scientific merits of individual proposals, rather than making large awards to a very small and limited number of institutions.

With regard to the awarding of fellowships for graduate studies in energy resource fields, the Foundation currently has a program for energy-related postdoctoral studies and has budgeted \$1.4 million for this purpose in fiscal 1976. In addition, as the level of energy-related research increases, the number of graduate students participating in research will also increase, and the training they receive in this manner should add substantially to the number of available personnel.

For the above reasons, the Foundation is unable to support enactment of S. 62.

The Office of Management and Budget has advised us that there is no objection to the submission of this report from the viewpoint of the Administration's program.

Sincerely yours,



H. Guyford Stever  
Director



**coal** extraction and  
utilization research center

Southern Illinois University at Carbondale  
Carbondale, Illinois 62901

October 27, 1975

The Honorable Lee Metcalf  
Senate Office Building  
Washington, D.C. 20510

Dear Senator Metcalf:

In answer to your letter I am pleased to comment on bill S.62. I have read the bill carefully and am in complete agreement with its provisions. The objectives are very worthy and hopefully this bill will become law.

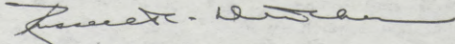
The United States of America has a great need for such legislation - our coal resources are certainly one of our most important mineral assets. A thorough understanding of the nature of our varied coal resources is essential for their most economical, safe and environmentally sound utilization. This bill, S.62, is a much needed step in the direction of providing a significant level of continuous funding which is so important in any research endeavor. Coal studies have suffered in the past because of erratic funding efforts by both governmental and private bodies.

The provisions which allow for the construction of physical facilities are excellent. The opportunity for investigators from various disciplines to be housed together in a research environment will provide for more significant results than would be obtained if personnel were scattered about on any campus or in any state. The chances for interaction will greatly enhance the research products. Most areas of coal research today require interdisciplinary approaches - the field is too large and too complex for a single line of pursuit.

Present day science and technology is extremely sophisticated. They promise to become more so as we move to advanced conversion systems, new mining methods, new underground transportation systems and as we are forced to utilize coals which were previously considered undesirable. We are facing new problems in the coal area every day and the need for legislation such as S.62 is urgent.

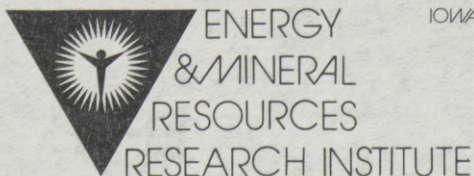
Thank you for inviting me to comment. I would be most pleased to help in any way that I may.

Yours sincerely,

A handwritten signature in dark ink, appearing to read "Russell R. Dutcher". The signature is fluid and cursive, with a long horizontal stroke at the end.

Russell R. Dutcher

RRD:dpd



IOWA STATE UNIVERSITY Ames, Iowa 50010

October 29, 1975

Senator Lee Metcalf, Chairman  
Subcommittee on Minerals,  
Materials and Fuels  
United States Senate  
Washington, D.C. 20510

Dear Senator Metcalf:

This replies to your request dated September 30, 1975 for comments on S. 62, a bill to establish university coal research laboratories and to establish energy resource fellowships. I have studied this bill myself, and a number of my colleagues have studied it independently and given me their comments; many of them are reflected in the comments which follow.

So far as I can judge, the Energy Research and Development Administration has been charged with research, development, and demonstration responsibilities incident to the development of processes for the conversion of coal to liquid fuels, to high BTU gas, and to low BTU gas as well as for the development of advanced combustion technologies (e.g., fluidized bed) and heat conversion technologies (e.g., magnetohydrodynamics). It therefore appears to me that ERDA has essentially pre-empted these particular areas of coal technology; as ERDA appears also to be moving toward funding university programs and fellowships in these areas, the pre-emption seems also to extend to the university relations and involvement functions in these areas of coal technology as well. This remark pertains to relationship between S. 62 and existing federal research and training programs. The ERDA program is the only large program with substantial coal technology component which S. 62 must carefully consider if there is concern about duplication. This is not to say that I am impressed with what ERDA is doing in the research components of the areas of coal technology for which it has been assigned responsibility, for I am so far singularly unimpressed. ERDA seems wholly preoccupied with demonstration plants and industrial interfacing in the coal technology area, and seems to be so far doing nothing significant in coal research or university interfacing in the coal area. But it has been given the R and D responsibility in the coal

## ELECTRIC POWER RESEARCH INSTITUTE

October 17, 1975

**EPRI**

United States Senate  
Committee on Interior and Insular Affairs  
Washington, D.C. 20510

Gentlemen:

My name is George R. Hill. I am Director of the Fossil Fuel Department for the Electric Power Research Institute located in Palo Alto, California.

Prior to joining the Institute staff, I served fifteen months as Director, Office of Coal Research, Department of the Interior. The six years preceding that, I was Dean of the College of Mines and Metal Industries at the University of Utah, Salt Lake City, Utah.

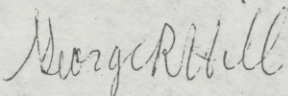
An action program as described in Senate Bill 62 to establish university coal research laboratories and to establish energy research fellowships has been needed for many years.

As the critical nature of the real shortage in natural gas and petroleum has become evident, the nation's need for technically competent engineers and scientists trained in coal science and technology has become serious. From the history of mining engineering departments, and of scientific and engineering research areas, it is abundantly apparent that a stabilizing budgetary mechanism must be introduced to insure a continuing supply of these technically-trained individuals.

The principal of co-funding by the states in which the institutions are located is essential. The limitation of the federal money available for each year's operation of the research laboratories and fellowship support is also very worthwhile.

To limit the number of schools supported to an arbitrary five is short-sighted, I believe. It would appear to me that putting the requirement of matching support on a continuing basis on states with major coal reserves will sufficiently restrict the total number of responsive universities to the order of 10-15. If each of the 25 states with major coal reserves elected to support one center, there still would not be too much effort expended in coal research, nor too many technically-trained individuals coming into the market in coal mining, coal conversion, and coal combustion for the electric utility and other industrial operations using coal and other fossil fuels.

I am pleased to support SB62 and hope that it will be modified to meet more adequately the needs of the United States.



George R. Hill

technology areas I cited, and the ERDA posture (as contrasted with actions to date) indicates an acceptance of responsibility both for research and university interfacing in these areas.

On the other hand, ERDA has assumed no responsibility at all for coal mining, beneficiation of coal (e.g., by heavy medium or froth flotation techniques), land reclamation, ecological effects of coal mining, etc. (The only caveat is in situ gasification of coal, if one wishes to call this a form of mining--ERDA is supporting development projects in in situ gasification.) Further, the areas of coal mining, beneficiation, and reclamation remain the responsibility of the Bureau of Mines, which, so far as I can see, has not received substantial increases in funding to increase research efforts in these areas, and, so far as I can see, no significant acceleration in research in these areas is visible. Such acceleration, in my opinion, is badly needed if anything like the increased coal production planned is to be achieved without wrecking the land and seriously disrupting water systems. S. 62 hence speaks to an aspect of the energy problem which seriously needs address. However, by specifically mentioning "coal energy resources" and "conversion", lines 11-12, page 3, while not mentioning "mining" and "beneficiation", the bill gives some sense of moving into the areas pre-empted by ERDA and away from those areas where the gap is. The words "test laboratory", line 21, page 3, connotes a routine test laboratory (e.g., one furnishing analyses for BTU/lb, % ash, % sulfur, etc.). Such laboratories abound, and the bill should not give the impression that its main aim is to create five more.

The form of S. 62 suggests to me that it was written with five specific beneficiaries very much in mind. Limitations such as "no more than five", "not more than one per state", "state must have abundant coal reserves" ("abundant" of course leaves room for flexibility, but it would very likely be taken on a relative basis to exclude Iowa, although Iowa's proven coal reserves would suffice to provide its total energy needs, assuming fuel interconvertibility, for about 200 years), "up to \$1,500,000/year, providing that at least an equal part is provided by non-federal funds" (which implies that only those with \$1,500,000/year non-federal coal research funding in hand need apply) point very much in this direction. Quite apart from feeling piqued by language seemingly aimed at excluding institutes such as ours and institutions such as Iowa State University, the apparent focus on five institutions has tended to "freeze in" existing research practices and focuses.

In June 1975 the State of Iowa appropriated \$3,000,000 for a three-year study of the feasibility of mining and beneficiation of Iowa coal, including the feasibility both of resuscitating

the Iowa coal industry and satisfying a substantial part of Iowa's energy needs for Iowa's own resources. This study was assigned to our Institute for execution. In the past year and a half, I and many of my colleagues have learned more about the "coal business" than we had learned during our previous lives. Some of our experiences, I believe, bear on S. 62. Here are a few:

- (1) Our first demonstration strip mine is in operation, and we expect to remove 135,000 tons of coal from it within the next year, and to rehabilitate the land. Agronomists and agricultural engineers have been heavily involved in development of the mining plan and will be heavily involved in the reclamation portion (we intend to leave the land suitable for row cropping, not simply picnics). Neither of these specialties is listed on page 3 of S. 62. Quite generally, the bill does not recognize the benefit of a substantial participation of agricultural experts in surface mining research.
- (2) Simply because the Iowa coal mining industry declined sharply after 1920, mineral rights became of little interest, and in property transfers associated with farm foreclosures and repossessions during the depression, often became separated from surface rights. We have a legal team working on this problem, and its findings to date already indicate the need for clarifying legislation if a substantial coal mining industry is to develop in Iowa. I suspect that many other states with substantial reserves but limited exploitation to date may encounter similar problems. So at least in our case, our interdisciplinary research needed lawyers--S. 62 does not recognize this as a possibility on page 3.
- (3) The characterization of coal deposits needed for effective mine management (particularly to avoid acid soil generation and acid water runoff) and beneficiation following mining requires chemists--page 3 of S. 62 does not mention them either. In fact the chemical characterization of coal is in poor shape as a scientific area, and needs substantial research encouragement. Particular areas where ignorance is going to lead to future technological and environmental problems include the molecular structure of coal, distribution of toxic trace metals among coal components, and chemical form of sulfur in coal.
- (4) We have made a total economic analysis of the Iowa "coal business" an integral part of our study. This is not just "mineral economics" as page 3 of S. 62 suggests,

but includes an extensive analyses of the transportation sector--the connection of supply points with demand points by rail in Iowa is one tremendous problem (and is going to be a national problem, too). The problem also involves balancing transportation between, e.g., coal shipments and grain shipments. The analysis also reveals the possibility that cyclic industries such as road building industries with equipment adaptable to mining may balance out their cycles by using coal mining as a balancing venture.

I have a few additional general comments about S. 62.

- (1) The total program funding is quite small for the magnitude of problem addressed. For example, the \$11,000,000 per year planned is very small compared to the funding planned by ERDA for coal liquefaction alone. It amounts really to a moderate encouragement of a few existing programs, rather than a substantial stimulation of new research effort. I would suggest doubling the number of laboratories contemplated, and broadening the scope of types of work to be supported (still leaving the liquefaction and gasification areas to ERDA) in hopes of stimulating some new kinds of programs (as contrasted to simply accelerating old programs, although the latter function is needed too).
- (2) Coal reserves are characterized geologically by regions, not by states. I think it would be a good idea to see that the distribution of laboratories achieves some kind of representation of the various different major coal fields of the United States.
- (3) Title II emphasizes fellowships for Master's degree candidates. It is unclear on the matter of Ph.D. candidates; I do not think such candidates should be excluded. Title II does not address the encouragement of undergraduate and technician education in coal mining and technology. Encouragement of such training is surely needed--candidates for the graduate fellowships mentioned presumably will come from baccalaureates in corresponding fields and programs in mining engineering, in particular, have been dropping out all over the country. I do not see myself what kind of help would be most useful, but suspect that you could get helpful advice on this point from deans of engineering colleges and chairmen of existing departments of mining engineering.

Very truly yours,

*Robert S. Hansen*  
Robert S. Hansen  
Director

## NATIONAL ACADEMY OF SCIENCES

OFFICE OF THE PRESIDENT  
2101 CONSTITUTION AVENUE  
WASHINGTON, D. C. 20418

November 11, 1975

The Honorable Lee Metcalf  
Chairman, Subcommittee on Minerals and Fuels  
Committee on Interior and Insular Affairs  
United States Senate  
Washington, D. C. 20510

Dear Senator Metcalf:

Your Subcommittee has recently held hearings on S. 62, a bill "to establish university coal research laboratories and to establish energy resource fellowships, and for other purposes." This proposed measure was introduced by Senator Scott for himself and for other Senators and represents a matter of great concern for those who are making efforts to further the use of coal as a natural resource. In sponsoring this proposed measure, Senator Scott last year asked for views of the National Academy of Sciences, and in that regard I submitted to him by letter of October 7, 1974 a number of suggestions concerning the proposed measure.

S. 62 addresses a critically important issue and I should add that the objectives sought are generally consistent with recommendations set forth in an earlier report by the National Academy of Sciences, entitled "Mineral Science and Technology, Needs, Challenges and Opportunities." This 1969 study was undertaken by our Committee on Mineral Science and Technology in response to a request from the Bureau of Mines for assistance in determining the state of mineral science and technology in the United States. At the time the report was made, mineral technology was, as it continues to be, in a declining state.

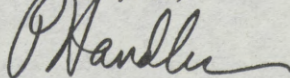
However, the purpose of this letter is not to comment upon the program proposals of S. 62, but to address my concerns to a specific provision of Section 105(a) which relates to the creation of an Advisory Council on Coal Research. Sec. 105(a) would provide for the establishment of an Advisory Council for Coal Research and includes among its membership the Presidents of the National Academy of Sciences and the National Academy of Engineering. In your deliberation you may wish to consider a potential difficulty of conflict of interest that could arise with the inclusion of these two officials

among the membership of such a Council. In the event that, at some future time, the Director of the National Science Foundation may wish to seek the advice of the Academies concerning aspects of the management and administration of the programs proposed in S. 62, their prior involvement as members of such a Council could compromise the independence of the advice given.

If the Subcommittee considers it desirable to include the two Presidents as members of the proposed Advisory Council for Coal Research, may I suggest that following enumeration of the names of each President under Sec. 105(a) (3) and (4) that the additional words be added "or their designee." In this way, the heads of these two institutions could designate alternative representatives and preserve their independence as Presidents of NAS and NAE to provide advice, if such is ever required, to the Director of the National Science Foundation.

I appreciate this opportunity to provide for the record this proposed modification in S. 62, and would appreciate your further consideration of the proposed change.

Sincerely yours,



Philip Handler  
President

Enclosure

New Mexico Bureau of Mines & Mineral Resources  
Socorro, NM 87801

A DIVISION OF  
NEW MEXICO INSTITUTE OF MINING & TECHNOLOGY

October 8, 1975



Information: 505/835-5420  
Publications: 505/835-5410  
After hours: 505/835-5011

The Honorable Lee Metcalf  
Chairman, Subcommittee on Minerals,  
Materials and Fuels  
U. S. Senate  
Washington, D. C. 20510

Dear Senator Metcalf:

You have asked me to comment on Senate Bill 62, a bill to establish university coal research laboratories and to establish energy resource fellowships.

The Title II part to establish graduate fellowships is reasonable and would be of great help to the nation in its energy and mineral crisis.

The Title I part to set up university coal research laboratories contains considerable duplication with existing federal and state laboratories. Universities should concentrate on preparing the engineers and geologists needed to find, develop, and produce our energy resources. Both basic and applied research should be part of their program, particularly in the training of graduate students. However, the setting up of these laboratories would concentrate much faculty time on research rather than teaching, and would duplicate much present research work.

For example, Penn State University is presently conducting a poll to see what need there is for a coal analytic laboratory whose main purpose would be to do the proximate and ultimate analysis of coal as well as trace element analysis. This is a duplication of work so well being performed by the U. S. Bureau of Mines laboratory in Pittsburgh. If we need to increase the national program for this type of work, the Pittsburgh laboratory should be expanded, using professional chemists, rather than setting up 5 other regional laboratories who would utilize mainly student chemists.

With the large amounts of money being thrown around by Congress to such energy oriented federal agencies as ERDA, I do not see the necessity for these coal research laboratories at universities.

In its place I would suggest a similar sum of money to be overseen by NSF and utilized in granting coal research funds to individual university investigators. Let's fund ideas, not equipment.

Sincerely yours,



Frank E. Kottowski  
Director

FEK:jd

COLLEGE OF ENGINEERING  
Department of Chemical Engineering



THE UNIVERSITY OF KENTUCKY  
LEXINGTON 40506

October 16, 1975

Mr. Lee Metcalf, Chairman  
Subcommittee on Minerals, Materials  
and Fuels  
United States Senate  
Committee on Interior and Insular Affairs  
Washington, D.C. 20510

Dear Mr. Metcalf:

In response to your letter concerning bill S. 62, the need for university affiliated coal research centers and supporting training fellowships has been recognized by the Congress of the United States on at least one previous occasion. A bill establishing a similar program was passed by both Houses of Congress and subsequently pocket vetoed by President Nixon. That bill, I believe, was somewhat more specific in that it related directly to the mining aspects of coal. The present bill is broader in that it emphasizes the energy resource nature of coal. Thus, coal utilization and conversion, health and safety, as well as mining would appear to be appropriate areas of research supported by the funds provided under this title.

Two features of this bill which I find particularly attractive are the requirement that the research facility be built in a state which is a major coal producer, and that the program be administered by the National Science Foundation. The first insures that the research will be conducted in a state where coal provides employment to a substantial number of people, and therefore is very important economically. The second, that of NSF control, means that the research programs will be guided and administered by the agency with the most direct experience with virtually all types of university research. The foundation presently is administering coal oriented energy research projects at several colleges and universities.

Mr. Lee Metcalf

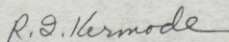
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October 16, 1975

The need for this type of research facility has existed for many years. It is my hope that the potential severity of the impending energy crisis is recognized and as a result S. 62 will become law.

If I can be of further assistance in any matters related to the area of energy research, please do not hesitate to contact me.

Sincerely,



R. I. Kermode  
Professor

pjb



THE UNIVERSITY OF TEXAS AT AUSTIN  
BUREAU OF ECONOMIC GEOLOGY  
AUSTIN, TEXAS 78712

November 12, 1975

University Station, Box X  
Phone 512-471-1534

The Honorable Lee Metcalf  
Committee on Interior and  
Insular Affairs  
United States Senate  
Washington, D. C. 20510

Dear Senator Metcalf:

I am pleased to respond to your request for comments on Senate Bill 62 which would establish university coal research laboratories and energy research fellowships.

Coal is our most abundant fossil fuel yet development of this resource to its fullest potential will require innovative technology in the areas of conversion and environmental aspects of coal mining and utilization. To date, the financial support for coal research and the spectrum of talent doing coal research have been far too limited in proportion to coal's potential significance to the nation. Senate Bill 62 takes an important step in bringing the universities into the picture in a major way and I support this action.

It is of critical importance that the programs of the coal research laboratories and their use of funds be closely monitored to insure that federal priorities are spoken to in an efficient manner. The Advisory Council, as described in the bill, should be given sufficient funding to allow it to have the staff necessary for careful project monitoring.

My main concern with the bill as it now reads is that certain very important geographic and topical areas of coal research will be excluded. By designating only 5 institutions, the bill restricts serious consideration to those universities in major coal producing states. This is not inappropriate, but it does create the need for a mechanism to allow universities with proven coal research expertise located in areas of significant coal occurrence geographically separated from the better-known reserves.

My concern over exclusion of these areas is based on my experience with Gulf Coastal Plain lignites. Federal interest in this resource has been minimal; in fact, disregard has characterized the government's attitude. Work by the states has shown that the reserves are large, the quality good and the location of the deposits is ideal with respect to the energy-intensive industrial complex in Texas and Louisiana. The efficient mining, transportation and utilization of

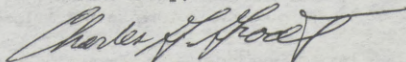
these deposits will require the kinds of innovative techniques that result from an active research program. A dedication of funds to this effort through a university or two would insure that the research would take place and not be set aside in favor of better publicized and more politically influential coal areas.

Insuring necessary university research into coal resources geographically separated from the better-known areas could be accomplished by establishing a second level of coal research laboratories handling their own budgets, but working as affiliates of one of the five major centers. Other approaches to the structure and administration of these facilities may be more efficient, but the basic concept and rationale for having them is clear.

With regard to the fellowship program, I support the emphasis on masters' degrees; however, the complete exclusion of support to Ph.D. candidates is not in the best interest of a balanced research effort. Restricting the grants to two years will keep the proportion of master's to Ph.D. students at a suitable level.

Adoption of Senate Bill 62 would lend proper emphasis to research in- to our most abundant fossil fuel; the nation would benefit greatly from the results of the programs it would foster.

Sincerely,



Charles G. Groat  
Acting Director

CGG:lh



*Record*

**THE UNIVERSITY OF WYOMING**

UNIVERSITY STATION, BOX 3335

**LARAMIE, WYOMING 82071**

October 16, 1975

Senator Lee Metcalf  
 Chairman, Subcommittee on  
 Minerals, Materials and Fuels  
 Committee on Interior and Insular Affairs  
 United States Senate  
 Washington, D. C. 20510

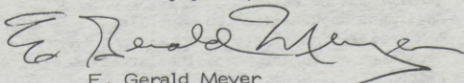
Dear Senator Metcalf:

In response to your 30 September letter asking for comment on S. 62, I am pleased to furnish the following specific statements:

1. Under Section 101(b), provision should be made for a group of universities to form a consortium with one serving as the "lead" and fiscal agent for the project. This would enable several Rocky Mountain universities to combine their strengths and submit a proposal.
2. Under Section 101(a)2, is it really wise to require that each of the University Coal Research Laboratories establish a "test laboratory for coal characterization..."? I fully concur in the importance of characterization as it relates to research, but I don't believe that a coal characterization test laboratory as a stand-alone feature of the University Coal Research Laboratories is justified. I do believe that the second half of 101(d) (2) calling for exchange between the university and industry is extremely valuable, but should not be buried as a tag-end of a test laboratory requirement.
3. Since the Bureau of Mines is now concerned principally with safety it seems to me that the Advisory Council should have the Administrator (or Assistant Administrator for Fossil Fuels) of ERDA instead of the Director of the Bureau of Mines. (ref: 105(a)(2))
4. In section 201(c), why the shift from the Director to the Commissioner?
5. Page 11, line 17 - "to such person" seems superfluous.

In general I support the concept of S.62. The main question involves the trade-off of 5 very large (up to \$7½ million first-year, plus \$1½ million thereafter) grants versus a larger number of smaller grants. Thus one might distribute the \$37½ million (first year) and \$7½ million (thereafter) among 7 or 10 institutions. Of course, the question is how to maximize the impact on coal R & D. The present formula may well exclude the medium-sized universities such as those in the Rocky Mountains, and that is where the coal is!

Sincerely yours,



E. Gerald Meyer  
Vice President for Research

cc: Senator Clifford Hansen



COLLEGE OF ENGINEERING

## VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Blacksburg, Virginia 24061

DIVISION OF MINERALS ENGINEERING (703) 951-6671

November 5, 1975

Senator Lee Metcalf  
Chairman, Subcommittee on Minerals,  
Materials, and Fuels  
Committee on Interior and Insular Affairs  
United States Senate  
Washington, D. C. 20510

Dear Senator Metcalf:

This is in response to your letter of September 30 regarding S.62, "Coal Research Laboratory and Energy Research Fellowship Act."

It is a pleasure to be given the opportunity to comment on this important legislation, which is being considered by your subcommittee. In accordance with your request, I will comment on the areas that you listed in your letter and they are as follows:

1. Merits of the legislation.
2. Assessment of the need for regional centers.
3. Present and prospective manpower needs in your area of the nation.
4. Relationship of the programs of S.62 to existing Federal research and training programs.

S.62 possesses many legislative merits to fill substantial needs that exist in the nation today. However, I would like to offer suggestions that may improve this legislation substantially in meeting the needs of the nation. Because we have 17 to 20 mining engineering schools, depending on the criteria for selection, it would be most difficult to select the five most worthy institutions to receive grants for the proposed coal research laboratories. Certainly there would be many more worthy schools that could effectively invest resources from the grant than five as the Act proposes. While the coal industry has great needs in the nation for research and trained manpower, the broader question of mineral industry support requires some attention and hopefully could be addressed in this legislation. Because the matter of research and trained manpower in the mineral industries, as well as the coal industry, is a continuing problem that will not be solved in a few years, it is strongly recommended that continuing support be considered rather than terminating in the year 1981.

The need for coal research laboratories and energy research cannot be disputed in this critical period of our nation, and we are suffering from a lack of energy and very shortly from a lack of important mineral commodities. This need is not

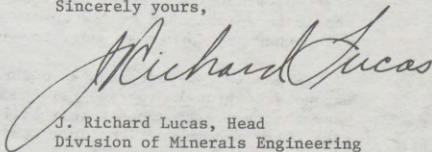
regional but includes the entire nation and could well be based on the nucleus of strength that the nation has in the 17 to 20 established mining and mineral engineering institutions.

The present and prospective manpower needs in our area of the nation, namely the Appalachian coalfields, has been well studied and well defined. Recognizing that the coal industry of this nation will be doubling its production from 600 to 1200 million tons by 1985, it will require a substantial increase in technically-trained manpower to achieve this admirable and necessary objective. Because the manpower needs to support increased growth of coal production will be substantial as well as the replacement needs for retiring professionals active in existing mines, I am certain that this institution will be forced to produce 200%, 300% or 400% the number of graduates that we have been and are currently producing. Whereas the nation has been producing somewhat in excess of 200 mining engineers per year, it is estimated that the coal industry may easily absorb five times this number or more if we are to achieve the coal production objectives of this nation. The number of research personnel trained to enter the research laboratories and other research activities of the nation begin from an even smaller base since little emphasis has been placed on this training in the past. Today industry, state and Federal government, and the industrial laboratory are actively seeking trained mining engineers on the master and the doctoral level. To fill this need and to adequately support the commitment to an expanded research program will require a substantial investment of resources to accelerate graduate education in our mining schools.

The programs that would be authorized by S.62 would have little conflict or in common with existing Federal research and training programs in this area which have been minimal or non-existent within the last few years. Federal assistance for coal and mineral research and training programs is mandatory if this nation is to develop the technology that will be necessary for it to meet its needs in the production of mineral raw materials to support its industrial base adequately. Because our national interest is at stake, it is most important that implementation of this concept be given a deservingly high priority.

It is hoped that these comments will be helpful to you and the Subcommittee and I assure you that I stand ready to cooperate with the Subcommittee in this strategically important matter. If I can be of further assistance, please do not hesitate to call upon me for my prompt cooperation.

Sincerely yours,

A handwritten signature in cursive script that reads "Richard Lucas". The signature is written in dark ink and is positioned above the typed name and title.

J. Richard Lucas, Head  
Division of Minerals Engineering

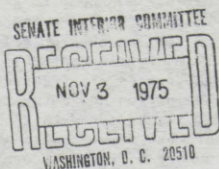


KANSAS STATE UNIVERSITY Manhattan, Kansas 66502

DEPARTMENT OF NUCLEAR ENGINEERING  
Ward Hall

SEATON-HALL

October 21, 1975



SS

The Honorable Robert Dole  
The United States Senate  
Senate Office Building  
Washington, D.C. 20510

Dear Sir:

This letter is to express my concern over Senate Bill 62: "Coal Research Laboratory and Energy Research Fellowship Act." I am particularly concerned with Title 2: "Energy Research Graduate Fellowships."

In Title 2 of the act, 1,500 fellowships are called for, to be administered by the Director of the National Science Foundation. More logically, the fellowship program would fall within the mission of the Energy Research and Development Administration and in particular the Division of University and Manpower Development Programs of that Administration. Secondly, I would like to suggest that participation in this program would be distributed over a much broader geographical area if, instead of a fellowship program, a traineeship program were established. In a fellowship program the awardee selects the institution at which he will pursue graduate education. However, in a traineeship program, as I understand it, selected institutions of higher education are each awarded a certain number of traineeships and are each responsible for the recruitment and selection of students. Thirdly, Title 2 calls for stipends of \$4,000 for each academic year of study and an additional annual allowance of \$500 for each dependent of the student. It would seem to me that the level of financial support provided by either fellowships or traineeships should be established by the agency administering the program in accordance with other such programs under the administration of that agency.

Financial support such as described in this bill is badly needed to expand educational programs related to energy resource development. I hope that you will support this bill or a similar bill and that you will take these recommendations into consideration.

Very sincerely yours,

*Richard E. Faw*

Richard E. Faw  
Professor and Head

REF/csa

# The University of Vermont



ENVIRONMENTAL PROGRAM

THE BITTERSWEET

153 SOUTH PROSPECT STREET

BURLINGTON, VERMONT 05401

(802) 656-4055

November 10, 1975

Michael D. Harvey  
 Department General Counsel  
 Senate Interior Committee  
 Room 3106  
 New Senate Office Building  
 Washington, D. C. 20013

Dear Mr. Harvey:

I have recently had the occasion to speak with several persons in and out of the Federal Government concerning legislation regarding mining in National Parks. It was suggested that I present myself and some of my thoughts to you in writing.

My present position is that of a professor at the University of Vermont with a split appointment in Environmental Studies and Botany. I also do contract consulting work for the National Park Service here in the east, and more particularly, at Glacier Bay National Monument in Alaska.

Botanically my especial skills are in natural area evaluation, community structure, and the geography of mosses. Environmentally I am primarily concerned with general theories and philosophies, and am particularly hired here to present courses in environmental theories and their practical applications.

For the National Park Service as a contracted consultant I have participated in three years (mostly in the summer) of biological investigations at Glacier Bay National Monument in the vicinity of the Newmont claims and proposed development. My role has been as: a) a field botanist, b) an ecosystem synthesist, c) an editor of reports, and d) a planner for future environmental investigations. In conjunction with this activity I have prepared an environmental report on the Granduc Mine at Stewart, British Columbia. This report views an existing mine in an environment similar to the proposed Newmont development highlighting parallels between the two situations.

My "Granduc Report", my field ecological researches, and my academic inquiries have provided the following general conclusion: In the National Park setting the most devastating environmental disruptions caused by mining are not the acts of construction and operation of the mine (for the negative effects of these, for the most part, are technologically solvable and can be enforced by appropriate cooperation, management, and/or legislation) but the combined daily effects of the people and communities which comprise the work force and supporting facilities.

It is my opinion, then, since a National Park is, in fact, a social

institution, and since the greatest impact of mining upon the National Park results from the individual people directly and indirectly involved with the mining operations, that mining in National Parks is a deeply serious sociological problem affecting far more than a piece of landscape and its plants and animals. I would further suggest that as now envisioned by the majority (though by no means unanimously) of United States citizens, mining in National Parks is contrary to most of the reasons for the existence of the National Parks -- but not necessarily contrary to a frontier philosophy often inherent in the concept of the National Parks. This is a difficult contradiction to resolve.

As an aside may I mention that the presence of the Newmont development at Glacier Bay will undoubtedly increase mining activity throughout that National Monument.

Thank you for your attention. I am here offering my expertise and experience to you in any way it would be serviceable. As I currently understand the proposed legislation I would be for its passage.

Please feel free to contact me at any time. My office phone is 802 656 2930.

Best wishes,

*Ian A. Worley*

Ian A. Worley, Ph. D.  
Assistant Professor of Botany  
Assistant Professor of Environmental Studies  
Assistant Ecologist  
Research Associate, University of Alaska

IAW:jb

P.S.

Similar letters have been sent to:

Rep. Roy A. Taylor  
Rep. John F. Seiberling  
Sen. Lee Metcalf  
Sen. Henry Jackson

○