# EDUCATIONAL GRANTS FOR MINERAL RESEARCH



## HEARING

BEFORE THE

## SUBCOMMITTEE ON MINERALS, MATERIALS, AND FUELS

OF THE

## COMMITTEE ON INTERIOR AND INSULAR AFFAIRS UNITED STATES SENATE

EIGHTY-EIGHTH CONGRESS

FIRST SESSION

ON

## S. 1166

A BILL TO AUTHORIZE THE SECRETARY OF THE INTERIOR TO ENTER INTO CONTRACTS AND MAKE GRANTS FOR RESEARCH AND DEVELOPMENT IN FURTHERANCE OF THE PURPOSE OF THE ACT OF MAY 16, 1910 (36 STAT. 369; 30 U.S.C. 1, 3, 5, AND 7), AS AMENDED AND SUPPLEMENTED

AUGUST 29, 1963

Printed for the use of the
Committee on Interior and Insular Affairs



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# EDUCATIONAL GRANTS FOR MINERAL RESEARCH

THURSDAY, AUGUST 29, 1963

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 call, at 10 a.m., in room 3110, New Senate Office Building, Senator Ernest Gruening (chairman of the subcommittee) presiding.

Present: Senators Ernest Gruening, Alaska; Alan Bible, Nevada; and Peter H. Dominick, Colorado.

Also present: Stewart French, chief counsel; and Jerry T. Verkler, staff director.

Senator GRUENING. The meeting will please come to order.

This is an open, public hearing by the Minerals, Materials, and Fuels Subcommittee of the Senate Interior Committee.

The bill before us, S. 1166, sponsored by the distinguished Senator from Michigan, the Honorable Philip Hart, is another step forward in the increasing trend toward utilization, for what might be called practical purposes, of the vast reservoir of knowledge and ability to be found in our college and university faculties, as well as the often excellent technical facilities for research in academic laboratories.

Senator Hart's bill would authorize the Department of the Interior to enter into contracts with colleges and universities, or make outright grants to them, to do research and experimentation for the better carrying out of the purposes and responsibilities of the Bureau of Mines. Such academic research would include mining methods and ore beneficiation processes, and also mine health and safety.

I am certain no one who knows of my great interest in furthering the restoration and further development of gold mining and production in our country will be surprised when I recommend and urge, as a priority matter, a crash program under the authorization provided by Senator Hart's bill for means of increasing domestic gold production.

I would like to insert in the record of this hearing two letters from President William R. Wood of the University of Alaska in support of S. 1166 and a proposal to the president of the University of Alaska for the establishment of a minerals research laboratory which expresses the importance of minerals research to the development of the State of Alaska.

(The documents referred to are as follows:)

UNIVERSITY OF ALASKA,
OFFICE OF THE PRESIDENT,
*College, Alaska, July 26, 1963.*

Hon. ERNEST GRUENING,
*U.S. Senate, Senate Office Building,*
*Washington, D.C.*

DEAR SENATOR GRUENING: This will acknowledge receipt of materials from the office of Senator Bartlett concerning S. 1166 which would authorize the Secretary of the Interior to enter into contracts and make grants for research and development in mineral industry. The University of Alaska is certainly interested in participating as extensively as possible under the provisions of the proposal and urges all possible support toward its successful passage.

I am pleased to note the content of Secretary Udall's statement on mineral industry research contained in his letter of June 10, 1963, to Senator Jackson, copy of which was attached to the copies of S. 1166 that have just reached my desk from Senator Bartlett's office.

Sincerely yours,

WILLIAM R. WOOD, *President.*

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UNIVERSITY OF ALASKA,
OFFICE OF THE PRESIDENT,
*College, Alaska, August 9, 1963.*

Hon. ERNEST GRUENING,
*U.S. Senate, Senate Office Building,*
*Washington, D.C.*

DEAR SENATOR GRUENING: In response to your letter of August 4, I asked Dean Beistline to prepare materials which might be of some value to you in connection with the hearings of your Committee on Minerals, Materials, and Fuels.

While I am sure much more could be said concerning the importance to the Nation of Alaska's latent mineral resource, I know that you are familiar with the details on this, and often have presented eloquently the case for speeding up the acquisition of basic information about that resource and how to develop it for the common good. I sincerely hope that your committee will be able to push through an appropriation adequate to stimulate at once wise use of the nonrenewable resources of Alaska.

Sincerely yours,

WILLIAM R. WOOD, *President.*

A PROPOSAL TO THE PRESIDENT OF THE UNIVERSITY OF ALASKA FOR THE ESTABLISHMENT OF A MINERALS RESEARCH LABORATORY

The wealth and strength of nations depend to a great extent upon the mineral resources controlled or located within their borders. The political, military, and economic strength and the high standard of living of the United States may be ascribed, in large measure, to mineral resources within the States themselves or to the availability of minerals from free world allies. Mines in foreign countries can be nationalized and our supply line of mineral resources cut off immediately. Because of the rapidity with which the United States is sapping its mineral resources, it is imperative that all known deposits be mapped and evaluated and that new sources be found. A nation ignorant of its mineral resource reserve cannot prosper or survive. Thus, it is essential that the United States know precisely the extent of mineral resources available for normal civilian use and for economic and military emergencies. Realistic National and State planning for economic and national security and foreign policy is evolved from knowledge rather than from smatterings of information.

Alaska is popularly believed to be a treasure house of mineral resources which can be tapped during national emergencies. Even considering the past and present excellent programs of the U.S. Geological Survey, U.S. Bureau of Mines, and the State Division of Mines and Minerals, present mineral resource information is insufficient to allow immediate minerals production to counter emergencies and to draw much needed private capital and basic industry into this northernmost State. As the Nation's needs for more minerals, metals, and fuels increase due to exploding populations and developments in technology, Alaska's resources and industry will become increasingly important to the United States and to the basic economy of this State. Alaska, although the largest State in the Union, is

the least explored from the viewpoint of known mineral resources. A substantial percentage of it is located in arctic and subarctic climates.

Of equal importance to the growing State is the pressing need to acquire more knowledge and understanding about those factors that affect land utilization. Soils, rocks, minerals, natural structures, permafrost, glaciers, ice and snow all greatly affect agricultural and forestry programs, water resouce planning, tansportation facilities, industrial power generation, and urban living. Geologic mapping would provide basic understanding of these conditions.

### RESEARCH IS ESSENTIAL

It is apparent that more basic mineral resource and land utilization information is needed, and these research data must be obtained much more rapidly than they have been in the past. This fact, in turn, points to the need of immediately initiating intensified major research effort.

The simplified concept of such a research program is threefold:

1. Resource investigation, including detailed geologic mapping, subsurface exploration, and valuation.
2. Feasibility studies, including mining and beneficiation and related studies.
3. Economic studies, including marketing studies of the commodities: fuels, metals, and minerals.

The problems to be solved in all categories are numerous and varied, and many are affected by arctic and subarctic weather conditions.

(1) As an example, the U.S. Geological Survey announced on April 27, 1962, the possible economic occurrence of beryllium on the Seward Peninsula in areas where tin and gold have been known to exist and have been mined for many years. Beryllium is much in demand for the Nation's space program. The prospect was not previously known and as such was of no apparent value to the immediate needs of the Nation. As part of phase 1, research should continue on the beryllium prospect to determine the probable extent of mineralization. Following surface mapping, subsurface exploration should be initiated to obtain data that would allow probable tonnage and average ore grade to be calculated. This information is essential for planning the future program of obtaining the minerals from nature's storehouse. Similarly, intensified geologic mapping programs very likely would locate many other valuable mineral deposits that then would be known and evaluated for either current or future uses.

All of the modern techniques of exploration—aerial photography, geochemical, and geophysical techniques—should be used. Research should be carried out on basic properties of minerals to allow development of better exploration techniques. This could be interpreted to include basic studies of ore deposits and the relationship of these to rocks. With reference to land utilization, geologic mapping would give information that would aid engineers in the selection of better sites for water supply, sewage control, flood control, dams, highways, railroads, bridges, airports, and similar structures. In addition, the forestry department could obtain information concerning soil, water, and minerals that would enhance planning for reforestation and conservation. In similar ways, geologic information for planning would aid agriculture.

(2) The second stage is basic research that would provide knowledge that could be used to solve more satisfactorily the problems of extracting ores from various types of deposits under arctic conditions. Included are such problems as cold weather operation, ventilation, and ground support (which necessitates basic research in geomechanics and ground water drainage).

Beneficiation studies are most important to facilitate the design of processes that would give maximum efficient recovery of the desired materials.

This research should begin with basic studies of the physical properties of earth materials which include seismic, magnetic, electrical, and electromagnetic properties and mechanical properties, among them strength, breaking strength, density, elasticity, plasticity, viscosity, and compressibility under various conditions of pressure and temperature.

Another urgent need is for applied research that would promise maximum recovery of all minerals of commercial value in ore. Such studies begin with determination of the type of mineral association in the ore and carry through the realease and separation of minerals and, finally, the recovery of each valuable constituent through processes such as gravity, flotation, amalgamation,

cyanidation, magnetic and electrostatic methods, all of which depend upon basic properties of minerals.

After mineral products have been obtained, the material must be marketed—to local outlets as well as to State, national, and possibly foreign markets. Here problems arise—among them, transportation, costs, taxation, import-export laws, suitability of product, competition, market location and demands, and price. Economic studies are essential in order to successfully market products. These studies should be conducted on a specific commodity basis and undertaken in cooperation with beneficiation studies. The outcome, by signaling ways in which mineral resources can be utilized more completely, should foster growth in the economy of the State and nation.

As a further example, intensified geologic mapping would locate industrial minerals that will become increasingly in demand as Alaska's population grows. The extent and content of such deposits should be determined, the mining and beneficiation problems solved, and economic marketing studies completed.

### DESIGN FOR ACTION

Each day vast quantities of nonrenewable resources are being consumed. No matter how large the reserves, with increasing demands the mineral resources of mines are being depleted. Research, as indicated above, is essential to provide our State and Nation with continuing ample supplies of minerals and metals. Because of the comprehensive volume of new research essential in the mineral industries, all Federal, State, and private agencies must increase the scope of their activities. Coordinating the activities of all such agencies, accompanied by making available published and unpublished data, is absolutely essential to prevent duplication and omission. To best do this, a mineral research institute should be established in Alaska.

The overall objective of the institute would be to coordinate mineral research activities of teams of scientists working under the plan of "operation research." These coordinated activities of physical scientists and engineers would allow maximum effort to be exerted in basic and applied studies.

An appropriate administrative organization with a director and advisory board may be designed readily.

### FACILITIES

The institute should have laboratories for basic geologic research and services, geochemical studies, geophysical studies, permafrost research, mining research with special emphasis on conditions created by low temperatures in the northern latitudes, and beneficiation studies including fuel and ceramic technology. Also necessary are: library; depository for maps and aerial photographs; mineral, rock and paleontological collections; office space and conventional facilities, such as shops, work rooms and storage rooms. In addition to the equiment for the main facility, field equipment, and transportation equipment would be necessary.

The facility would have a year-round capability and, in addition, would be used as a summer headquarters for research teams who work throughout Alaska during summer seasons. Cold weather research would be conducted during the winter season in addition to year-round projects. Both "in-shop" and "out-of-shop" contracts could be signed with various institutions to make possible increased activities during the summer season as well as bringing in "specialists" for cold weather research. Out-of-shop contracts would allow the Nation to utilize more completely the excellent and qualified staffs of educational institutions which may well bring in new creative thinking—an essential to progress. In addition, such out-of-shop research could be of financial assistance to academic personnel and universities.

### FINANCING

Because of the growing trend for the Federal Government to support higher education and research, it is recommended that funds for the construction of the facility come from the National Government, probably through an agency such as the National Science Foundation. Operating funds and out-of-shop grants could be derived in part from agencies which would utilize the facility and in part from the National Science Foundation. It is anticipated that cooperative programs between the State and Federal Governments would develop, such as the excellent mapping project conducted by the U.S. Geological Survey and the State of Kentucky.

LOCATION

To accomplish the objectives, it is recommended that a central facility be constructed on the campus of the University of Alaska at College, Alaska. Such a location would assure access to existing academic and research facilities at the university.

Additional reasons are:

(*a*) Geographically, the campus is centrally located.

(*b*) Arctic and subarctic areas are nearby.

(*c*) Qualified university personnel are familiar with such unique conditions of ice, permafrost, low temperatures, and great transportation distances.

(*d*) Existing academic and research facilities would give the advantages of interdiscipline participation so essential in present and future programs.

(*e*) Central library facilities now exist at the University of Alaska.

(*f*) An overall contribution would be made to higher education as well as to the State and Nation by having graduate students participate in research programs, thus orienting young scholars to important problems which beckon for solution.

A recent tentative draft of a statement entitled, "Desirable National Action Affecting Higher Education" by the Association of State Universities and Land-Grant Colleges states in part: "We believe that basic research flourishes best in the atmosphere of a university, that graduate education of a high quality is inseparable from basic research, and that any national policy of encouraging the establishment of new basic research institutes, which are not university related, would be seriously detrimental to both basic research and graduate education."

Senator GRUENING. At this point in the record we will insert the committee print of S. 1166 which shows the amendments recommended by the Department of the Interior and those recommended by the Comptroller General of the United States. Also at this point we will insert departmental reports on the bill.

(The committee print and reports referred to are as follows:)

[COMMITTEE PRINT, AUGUST 29, 1963]

**Amendments Recommended by Interior Are Shown in Italic; Those Proposed by the Comptroller General Are Shown in Boldface**

[S. 1166, 88th Cong., 1st sess.]

A BILL To authorize the Secretary of the Interior to enter into contracts and make grants for research and development in furtherance of the purposes of the Act of May 16, 1910 (36 Stat. 369; 30 U.S.C. 1, 3, 5, and 7), as amended and supplemented

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That the Secretary of the Interior is authorized to enter into contracts and to make grants for the performance of research and development in furtherance of the purposes of the Act of May 16, 1910 (36 Stat. 369; 30 U.S.C. 1, 3, 5, and 7), as amended and supplemented, relating among other things to mining, and the preparation, treatment, and utilization of mineral substances; and health conditions and safety; and efficiency, economic development, and conservation of resources of the mineral and fuel industries. Such contracts or grants shall be restricted to colleges or universities or organizations under the administrative control of colleges or universities.

SEC. 2. *No part of any appropriated funds may be expended pursuant to authorization given by this Act for any scientific or technological research or development activity unless such expenditure is conditioned upon provisions determined by the Secretary of the Interior, with the approval of the Attorney General, to be effective to insure that all information, uses, intellectual products, processes, United State patents, and other developments resulting from that activity will (with such exceptions and limitations as the Secretary may determine after consultation with the Secretary of Defense to be necessary in the interest of the national defense) be made freely and fully available to the general public in the United States. Nothing contained in this subsection shall deprive the owner of any background patent relating to any such activity of any right which that owner may have under that patent.*

SEC. 3. There is authorized to be appropriated such sums as are necessary to carry out the purposes of this Act.

(a) Each contractor or grantee under this Act shall keep such records as the Secretary of the Interior shall prescribe, including records which fully disclose the amount and the disposition by such contractor or grantee of all funds received pursuant to the terms of such contract or grant.

(b) The Secretary of the Interior, the Comptroller General of the United States, or any of their duly authorized representatives, shall have access for the purpose of audit and examination to any books, documents, papers and records of the contractor or grantee pertinent to work performed or funds expended pursuant to any contract or grant awarded pursuant to the terms of this Act.

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U.S. DEPARTMENT OF THE INTERIOR,
OFFICE OF THE SECRETARY,
*Washington, D.C., June 10, 1963.*

Hon. HENRY M. JACKSON,
*Chairman, Committee on Interior and Insular Affairs, U.S. Senate,*
*Washington, D.C.*

DEAR SENATOR JACKSON: Your committee has requested the views of this Department on S. 1166, a bill to authorize the Secretary of the Interior to enter into contracts and make grants for research and development in furtherance of the purposes of the act of May 16, 1910 (36 Stat. 369; 30 U.S.C. 1, 3, 5, and 7), as amended and supplemented.

We recommend enactment of the bill, but suggest that it be amended as set forth below.

S. 1166 would provide authority for the Secretary of the Interior to enter into contracts with and make grants to colleges and universities or to organizations under the administrative control of colleges and universities for the conduct of research and development in programs of the Bureau of Mines relating to minerals, and health and safety in the minerals industry.

The bill would enable the Bureau of Mines to draw on the scientific talents and technological resources of colleges and universities to supplement and complement the Bureau's own scientific establishment. Thus augmented the Bureau could better provide for the Nation's expanding needs for gases, oil, coal, minerals, and metals, and for the safety of the people engaged in exploration for and production of these mineral commodities.

The authority to contract for research as provided in the bill would impart depth and flexibility to the Bureau of Mines' capability for scientific inquiries and investigations. Means would become available for coordinated and intensive effort to achieve the timely solution of urgent technological problems.

The granting of contracting authority is of particular importance because it would permit the Bureau of Mines to promptly emphasize and accelerate studies of the basic properties of organic and inorganic mineral substances, and of the fundamental science principles that underlie the exploration for and extraction, processing, and utilization of mineral commodities.

In a recent statement to your committee, on another matter, the Secretary of the Interior said:

"The key importance of utilizing institutions of higher education for both enlarging our knowledge through research and training scientists and engineers is attested by a distinguished series of authorities. Notable among them is the President's Science Advisory Committee's 1960 Report of the Panel on Basic Research and Graduate Education under the chairmanship of Dr. Glenn T. Seaborg, then chancellor of the University of California at Berkeley and now Chairman of the Atomic Energy Commission.

"The Panel stated:

" 'The central proposition of this report is that science and the making of scientists go best together. This means that when it can be managed, basic research should be done in, or at least in association with, universities. Exceptions to this rule are numerous, of course. Some problems, by their nature, require attack in ways that are not suited to university life; and the work of the geological survey, for example, can hardly be divided among the universities, yet it requires science of high quality, and basic research is essential to the whole undertaking; the same thing is true of many other enterprises of government and industry. Yet we hold to the view that in the absence of special considerations

the university is the best place for basic research, and we note that separate installations which do the best work are, as a rule, those which have a close and effective connection with academic centers; the geological survey, in its intimate relation to academic geology, is an excellent case in point.'

"The Committee on Natural Resources of the National Academy of Sciences-National Research Council came to the conclusion that:

" 'In adapting their research programs and activities to the requirements of the problems outlined in this report, governmental and nongovernmental agencies and institutions should take full advantage of the resources of the universities, contracting out especially those studies for which the universities are uniquely equipped. It should be remembered that an important byproduct of the university research is the training that accompanies it, and the Committee reemphasizes the need for training research workers to deal effectively with the problems relating to natural resources. These problems require closer cooperation between natural and social scientists.' "

An indirect, but no less essential, national benefit from research grants to universities would stem from the new incentive and vitality that such grants would engender in the university minerals science departments that now are languishing and deteriorating. In the absence of support and incentive that for some years past have been channeled almost exclusively into other areas, the academic staffs and student enrollment, both graduate and undergraduate, in minerals science and engineering fields have been seriously eroded. This deterioration of academic stature in the minerals field and dwindling supply of minerals oriented scientists and engineers have caused concern as to the Nation's ability to maintain its eminent position in minerals productivity. As the only Government agency with a comprehensive research program in minerals sciences and technologies, and with broad responsibility for the Nation's posture in these areas, it appears incumbent upon the Bureau of Mines to take positive action toward sustaining and revitalizing the appropriate university departments.

Failure to accomplish this purpose will deprive the Bureau of Mines in subsequent years of a supply of properly trained and oriented scientists and engineers.

In summary, this legislation would reinforce the Bureau of Mines capability for vigorous, perceptive, and timely research in support of the Nation's minerals needs and revitalize the academic structure essential for the education and preparation of minerals oriented scientists and engineers. A stronger research capability in men and facilities is requisite to meet growing demands for gas, oil, coal, minerals, and metals which must be met by wider and more precise explanations, deeper drilling and mining, and processing and utilizing leaner source materials.

We suggest that the bill be amended as follows:

After section 1 add two new sections as set forth below.

"SEC. 2. No part of any appropriated funds may be expended pursuant to authorization given by this Act for any scientific or technological research or development activity unless such expenditure is conditioned upon provisions determined by the Secretary of the Interior, with the approval of the Attorney General, to be effective to insure that all information, uses, intellectual products, processes, United States patents, and other developments resulting from that activity will (with such exceptions and limitations as the Secretary may determine after consultation with the Secretary of Defense to be necessary in the interest of the national defense) be made freely and fully available to the general public in the United States. Nothing contained in this subsection shall deprive the owner of any background patent relating to any such activity of any right which that owner may have under that patent.

"SEC. 3. There is authorized to be appropriated such sums as are necessary to carry out the purposes of this Act."

The bill would not in any way increase the scope of the Bureau of Mines' programs or otherwise interfere with the divisions of responsibility established in the Department of the Interior. In this regard, and in connection with coal research, the Bureau of Mines would continue to have a program stressing the conservation aspects of the Department's responsibilities while the Office of Coal Research would continue to give emphasis to projects involving shortrun research and development that have tonnage potential for improving the coal market. We believe that the initial contracts of the Bureau of Mines would be mainly or entirely in the field of extractive metallurgy.

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

Sincerely yours,

JOHN M. KELLY,
*Assistant Secretary of the Interior.*

EXECUTIVE OFFICE OF THE PRESIDENT,
BUREAU OF THE BUDGET,
*Washington, D.C., June 7, 1963.*

Hon. HENRY M. JACKSON,
*Chairman, Committee on Interior and Insular Affairs, U.S. Senate, New Senate Office Building, Washington, D.C.*

DEAR MR. CHAIRMAN: This is in response to your request for the views of the Bureau of the Budget on S. 1166, a bill to authorize the Secretary of the Interior to enter into contracts and make grants for research and development in furtherance of the purposes of the act of May 16, 1910 (36 Stat 369; 30 U.S.C. 1, 3, 5, and 7), as amended and supplemented.

The report which the Secretary of the Interior is submitting suggests certain amendments to the bill.

The Bureau of the Budget would have no objection to the enactment of S. 1166 subject to the committee's consideration of those amendments.

Sincerely yours,

PHILLIP S. HUGHES,
*Assistant Director for Legislative Reference.*

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COMPTROLLER GENERAL OF THE UNITED STATES,
*Washington, April 29, 1963.*

Hon. HENRY M. JACKSON,
*Chairman, Committee on Interior and Insular Affairs,*
*U.S. Senate.*

DEAR MR. CHAIRMAN: We refer again to your letter of March 25, 1963, acknowledged March 26, 1963, requesting our comments on S. 1166, 88th Congress.

The proposed legislation would authorize the Secretary of the Interior to enter into contracts with and make grants to colleges, universities, or organizations under their administrative control for the performance of research and development in furtherance of the purposes of the act of May 16, 1910 (36 Stat. 369, as amended, 30 U.S.C. secs. 1, 3, 5, and 7), relating among other things to mining and the preparation, treatment and utilization of mineral substances; health conditions and safety; and economic development and conservation of resources of the mineral and fuel industries. The desirability of the purposes to be effected by the bill is a matter of policy primarily for the consideration of the Congress and we therefore make no recommendation with respect to its enactment. We believe, however, that certain aspects of the bill warrant comment.

The act of May 16, 1910, established the Bureau of Mines and generally prescribed its duties and functions. The Bureau is not authorized by existing law to make grants of funds or enter into contracts for research and development work in the several broad categories proposed. However, under Public Law 86-599, July 7, 1960, 74 Stat. 336, the Office of Coal Research in the Department of the Interior is authorized to contract for, sponsor, cosponsor, and promote the coordination of research to develop new and more efficient methods of mining, preparing, and utilizing coal. To avoid possible duplication of effort, your committee may wish to consider amending the proposed legislation either to place the contract and grant authority in the Office of Coal Research or, alternatively, to specifically restrict the authority to be provided by the legislation to those areas not included in the authority granted in Public Law 86-599.

In order to provide protection against waste or improper use of Federal funds, we suggest that a section be added to the bill requiring contractors and grantees pursuant thereto to keep appropriate records and to authorize the Department and our Office to audit such records. The following language to accomplish this is suggested for your consideration:

"(*a*) Each contractor or grantee under this act shall keep such records as the Secretary of the Interior shall prescribe, including records which fully disclose the amount and the disposition by such contractor or grantee of all funds received pursuant to the terms of such contract or grant.

"(*b*) The Secretary of the Interior, the Comptroller General of the United States, or any of their duly authorized representatives, shall have access for the purpose of audit and examination to any books, documents, papers, and records of the contractor or grantee pertinent to work performed or funds expended pursuant to any contract or grant awarded pursuant to the terms of this act."

Sincerely yours,

JOSEPH CAMPBELL,
*Comptroller General of the United States*

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE,
*Washington, D.C., July 8, 1963.*

Hon. HENRY M. JACKSON,
*Chairman,*
*Committee on Interior and Insular Affairs,*
*U.S. Senate, Washington, D.C.*

Dear Mr. CHAIRMAN: This letter is in response to your request of March 25, 1963, for a report on S. 1166, a bill to authorize the Secretary of the Interior to enter into contracts and make grants for research and development in furtherance of the purposes of the act of May 16, 1910 (36 Stat. 369; 30 U.S.C. 1, 3, 5, and 7), as amended and supplemented.

The bill would authorize contracts and grants for the performance of research and development relating to mining and the preparation, treatment, and utilization of mineral substances; and health conditions and safety; and efficiency, economic develpoment, and conservation of resources of the mineral and fuel industries. The bill would, however, restrict such contracts or grants to colleges or universities or organizations under the administrative control of colleges or universities.

In furtherance of health and safety in the mineral industries, the Public Health Service and the Bureau of Mines cooperate under the terms of a memorandum of understanding signed in January 1962, a copy of which is attached. Nothing in the proposed legislation is incompatible with this agreement and we do not oppose its passage.

We are advised by the Bureau of the Budget that there is no objection to the presentation of this report from the standpoint of the administration's program.

Sincerely,

ANTHONY J. CELEBREZZE, *Secretary.*

MEMORANDUM OF UNDERSTANDING FOR COOPERATIVE ACTIVITY IN THE FIELD OF INDUSTRIAL HYGIENE IN THE MINERAL INDUSTRIES

The Public Health Service and the Bureau of Mines hereby agree to this memorandum of understanding as a basis for cooperative activity to achieve increased protection of health and safety through the investigation, control, and prevention of industrial health hazards in the mineral industries and in connection with the mining, preparation, treatment, and utilization of minerals and through furnishing assistance in industrial hygiene, health, and safety to those State and local organizations engaged in protecting workers against health and safety hazards in the mineral industries.

*1. Outline of existing activities of the Public Health Service and the Bureau of Mines*

(*a*) The Public Health Service conducts investigations in industry for the purpose of measuring existing health hazards and determining methods of controlling and, where possible, eliminating these hazards. Information thus obtained is available to State agencies for their use in administering laws, and enforcing rules and regulations, designed to prevent and control industrial health hazards. The Public Health Service, through consultative services, also assists the several States in formulating programs for health protection in industry, and through grants-in-aid, extends financial assistance for the creation and maintenance of industrial hygiene programs.

(*b*) The Bureau of Mines, among other things, conducts investigation with a view of improving health and safety in the mineral industries. The information thus obtained is published and widely disseminated among workers and operators and is available to Federal, State, and local governments for use in administering and enforcing laws and regulations relating to health and safety in the industries thus investigated. The Bureau of Mines also maintains safety stations and equipment in the various mineral regions of the United States for the purpose of giving instruction and training on safety and health and making inspections and investigations in mines and for giving aid in mine disasters. Engineering studies, research, and tests pertaining to health and safety of workers in the mineral industries are conducted by the Bureau of Mines in the field, and at several of the many research installations of the Bureau located at appropriate centers in the mineral industries. These investigations relate to the determination and abatement of harmful gases and dusts, and the reduc-

tion of hazards from inadequate ventilation, the use of explosives, electricity, and mechanical appliances in mining and related industries.

2. *Outline of cooperative functions under this memorandum of understanding*

It is agreed, therefore, that subject to applicable statutes and available appropriations, the following shall be the basis for the cooperative efforts of the Public Health Service and the Bureau of Mines under this memorandum of Understanding to achieve their objectives of increasing the protection of the health of workers in the mineral industries:

(*a*) Cooperative functions of the Public Health Service under this agreement:

(1) To conduct in cooperation with the Bureau of Mines broad field studies embracing the various epidemiological phases necessary for an evaluation of conditions suspected of causing occupational diseases in the mineral industries. Such studies will include medical examination of workers, statistical surveys, and studies of working environment.

(2) To conduct laboratory studies on the toxicity or physiological effects of minerals, mineral products, or substances encountered in the mineral industries, for the purpose of supplementing field investigations on the health of workers in the mineral industries.. The Public Health Service will, on the request of the Bureau of Mines, furnish to the Bureau information on the result of such studies. The Public Health Service, at the request of the Bureau of Mines, also will make studies of the physiological effects of specific substances submitted by the Bureau and/or assign qualified personnel for special studies in the Bureau of Mines facilities.

(*b*) Cooperative functions of the Bureau of Mines under this agreement:

(1) To conduct in cooperation with the Public Health Service broad studies of the health problems in the mineral industries; such studies embracing the chemical, physical, and engineering phases of health problems which the Bureau of Mines and the Public Health Service have agreed should be investigated.

(2) To conduct laboratory studies in the chemical, engineering, and physical phases of field investigations pertaining to the health of workers in the mineral industries.

(3) To cooperate with the proper State agencies in promoting the applications of the results of the studies of the health of workers in the mineral industries made by the Public Health Service and the Bureau of Mines for the purpose of controlling and preventing health hazards in these industries.

(4) To test equipment for permissibility and develop methods for control of health hazards in the mineral industries.

(*c*) The Bureau of Mines and the Public Health Service shall work in close cooperation according to the foregoing statement of existing and developing relationships in a united effort to stimulate interest and action on the part of State agencies and others concerned with the protection of the workers in the mineral industries.

(*d*) Manuscripts reporting the results of cooperative activities under this memorandum of understanding will be published by consent of both parties.

3. As used in this memorandum of understanding, the term "mineral industries" covers all operations relating to the mining, preparation, treatment, and utilization of minerals.

4. This memorandum of understanding supersedes the "memorandum of understanding for cooperative activity in the field of industrial hygiene in the mineral industries between the Department of Health, Education, and Welfare (Public Health Service) and the Department of the Interior (Bureau of Mines)," approved in 1956. This memorandum of understanding shall terminate at the end of 5 years from the date of final approval thereof, but may be terminated by either party, at any time prior thereto upon 30 days' written notice to the other party.

LUTHER L. TERRY,
*Surgeon General, Public Health Service.*
MARLING J. ANKENY,
*Director, Bureau of Mines.*
ABRAHAM A. RIBICOFF,
*Secretary of Health, Education, and Welfare.*
STEWART L. UDALL,
*Secretary of the Interior.*

Approved: January 1962.

Senator GRUENING. Senator Hart will be the first witness. Will you come forward please?

## STATEMENT OF HON. PHILIP A. HART, A U.S. SENATOR FROM THE STATE OF MICHIGAN

Senator HART. Mr. Chairman and members of the committee, you are very gracious to permit us to go ahead and I will be very brief. I would like permission to file in full a short statement for the record to be included at the conclusion of my oral testimony.

In 1961, Mr. Chairman, the subcommittee of which you are now chairman held a 1-day hearing on the problems of the iron ore industry in the upper Great Lakes region. That hearing brought to the attention of the committee the need for basic research to develop the knowledge required to use the vast deposits of low-grade nonmagnetic ores on the Lake Superior ranges.

It is estimated that there are as many as 35 billion tons of this crude ore with a content range of between 25- and 45-percent iron. Over the last 10 years, there has been a trend, as all of us know, away from domestic ores and toward reliance on foreign imports.

To get the sense of this, one must realize that iron ore imports ranged about 7 million tons in 1950 and by 1960 they had gone up to about 35 million tons, and in the same period the investments by American steel firms in iron ore resource development in countries other than this country increased measurably. This is a trend all of us want to reverse, not just to prevent further economic deterioration in the areas affected directly, but because of national security reasons.

There have been proposals from time to time that the way to solve this problem is through increased tariffs or import quotas. In my book, this is not the answer—either short or long term—that is most responsive to the question of adequate use of our own resources.

Senator BIBLE. Not wanting to get into a tariff argument with you at this point, even with all of this research and development, do you think that the iron ore beds of northern Michigan—and we have considerable iron deposits in my State, and it is a great natural resource—would be competitive with some of the great iron ranges of the Far East or the other iron ranges around the world?

Senator HART. Senator, I have a hunch that until we have the maximum of research none of us will really know the answer to that. We can hope, as all of us do, that it will be. I, too, want to avoid the debate on the quota or tariff question (and it is a highly debatable subject all around), beyond making the point that whatever we may do, if anything, in terms of quotas or tariffs, we do have the obligation to insure that we know as much as we can about the means of making economically competitive our own resource.

Senator BIBLE. I don't disagree with that premise in any way and I am rather surprised to find that it takes specific legislation for the Secretary of the Interior to enter into these contracts for research and development.

Senator HART. Sir, I think all of us are surprised.

Senator BIBLE. This can't be done under the existing laws, I assume, or you wouldn't have this bill in here.

Senator HART. This brings me to the end of my prepared statement.

Senator BIBLE. I am sorry.

Senator HART. No, no. This is exactly the point. I think it came as a great surprise to the Bureau and those of us concerned that this kind of legislation is required, but in fact, apparently it is, and it is to insure the opportunity that we offer it. I have in support a number of very explicit recommendations supporting the passage of the bill from a number of schools of mines across the country.

Senator BIBLE. Our school is the Mackay School of Mines in Nevada.

Senator HART. Yes, sir.

Senator GRUENING. You would like to have those introduced in the record?

Senator HART. Yes.

Senator GRUENING. They will be included at the end of the oral testimony and I have already put in a statement from the University of Alaska on the same subject.

There seems to be a very widespread interest and I think it is a very desirable objective and they will all be included at the conclusion of the testimony in behalf of this bill.

Senator HART. It is my understanding, Mr. Chairman, that my statement in full will be included in the record.

Senator GRUENING. Yes, the statement will be included in full at this point.

(The statement referred to follows:)

PREPARED STATEMENT OF HON. PHILIP A. HART, A U.S. SENATOR FROM THE STATE OF MICHIGAN

Mr. Chairman, thank you for this opportunity to appear before this committee in support of S. 1166.

In 1961, at my request, the Minerals Subcommittee held a 1-day hearing on the problems of the iron ore industry in the Upper Great Lakes region. The expert testimony at that hearing brought to the attention of this committee the need for basic research to develop the knowledge required to utilize the vast deposits of low-grade nonmagnetic taconite and semitaconite ores on the Lake Superior ranges.

It has been estimated that there are as many as 35 billion tons of this crude ore in this area with a content of 25–45 percent iron.

Over the past decade there has been a trend away from the use of domestic ores and toward reliance on foreign imports. This trend is reflected in the increase in iron ore imports from around 7.1 million tons in 1950 to 34.3 million tons in 1960. The trend has been abetted by investments by American steel companies in iron resource development in other countries.

It is imperative that we reverse this trend, not only to prevent the further economic deterioration of this area, but also for very vital national security reasons.

From time to time, proposals have been made for the solution of the problem through tariffs or import quotas. As I see it, this would not be the best short- or long-range answer in terms of adequate usage of our own resources.

In my opinion, and in the opinion of those who know the iron ore industry, the way to reverse this trend is to develop methods by which the great medium- and low-grad iron ore resources we possess can be made economically competitive.

And this requires, first of all, the basic research which can best be carried on in the laboratories of our colleges and universities.

When I explored with the Bureau of Mines the possibility of their underwriting this kind of basic research, I found to my surprise that in their opinion they did not have the authority to enter into this kind of research contract.

Explorations with other Federal agencies were no more encouraging. The National Science Foundation believes this type of iron ore research falls more nearly into the category of applied research than the basic research they are authorized to sponsor.

The Technical Assistance Division of the Area Redevelopment Administration admits the long-range benefits of such research, but has been reluctant to approve projects such as this which do not promise to generate employment in more immediate terms.

Finally, I went back to the Bureau of Mines and asked them for the specific language which would permit them to enter into contracts with nonprofit institutions to carry on research into the utilization of medium- and low-grade iron ores. S. 1166, which I introduced on March 21, 1963, is the result.

The committee may want to consider the possibility of expanding the authorization so that contracts could be entered into with profit as well as nonprofit organizations. For my own part, I am not clear as to whether the Bureau already has this authority.

As you know, the Department of the Interior has filed a report in support of this bill with the proviso that there be a section spelling out the right of the public to any patentable knowledge resulting from the authorized research.

The Comptroller General in his report suggested that since, under Public Law 86–599, the Office of Coal Research is authorized to sponsor research into coal mining methods, this committee might wish to consider either placing the administration of the proposal program in the Coal Research Office or restricting the authority of this legislation to areas not now within the jurisdiction of that office.

The committee, of course, will want to consider these suggestions. But I would make clear my strong feeling that this legislation should not be amended in any way which would jeopardize bringing to bear the full resources of this new research authorization on the problems of the iron ore industry.

Senator HART. As your able staff has indicated to you, there are several witnesses here in support of the bill. I should add for the record one name which has inadvertently been omitted.

Senator GRUENING. Mr. Volin?

Senator HART. Dr. Volin from the Michigan College of Mining and Technology at Houghton who is appearing also with me.

Mr. Chairman, the experts you referred to are much better equipped than I to respond to any specifics, but this happily is one of these relatively easy pieces of legislation. It authorizes certain activities which we are told we cannot undertake without this explicit authorization.

The activities, I think, make good sense and I would hope that the committee may favorably consider it.

Senator GRUENING. Thank you very much.

Senator BIBLE. Mr. Chairman, I just want to commend and compliment the Senator from Michigan for bringing this legislation before us. I think this is most important legislation. I think if we are to move forward competitively in any of these mineral fields, we do have to continue research and development even beyond the Bureau of Mines, which is specifically set up for that type of research and development. This is something akin, as I view it, to some of the contracts and grants and research done under the auspices of the National Institutes of Health with colleges, universities, and medical schools, and hospitals around the United States, and I want to commend you

most highly, Senator Hart, for your alertness, and awareness, and wisdom in bringing this bill before us.

Senator GRUENING. I share the views of my colleague from Nevada.

Senator HART. Thank you.

Senator GRUENING. Thank you very much.

Senator HART. I would be glad to introduce the distinguished experts if the committee wishes, but I will bow to your judgment.

Senator BIBLE. It has been called to my attention you have not commented, and you might wish to comment, on one of the problems we constantly run into in this legislation and that is the open-end authorization, and this is a troublesome problem, as to the amount that you should put in there as a guideline to the Appropriations Committee that you can't expend over $x$ dollars in this field, but maybe you would prefer that we develop that through the Bureau of Mines witnesses. I have no idea what type of a figure you would write in there that would be realistic and I imagine this might take some study.

Senator HART. I think, Senator, that my opinion would be no more than a hunch and I am sure the committee can establish a responsible figure.

Senator BIBLE. I am advised that the House has always had some questions on this so-called open-end authorization. I think those questions are correct. If we can write a realistic ceiling on the cost to the Federal Government we will help the bill. Then, of course, as you are very well aware, the authorization doesn't mean that the Appropriations Committee is going to give the full amount of the authorization. They are the final word on the money that is appropriated, but we can develop that through Mr. Ankeny of the Bureau of Mines.

Senator GRUENING. I would like to ask you, Senator Hart, whether you are prepared to accept the amendments proposed by the Department of the Interior, whether you have had some time to study them or not.

Senator HART. Mr. Chairman, I should be in position to respond to that because the Department was prompt in its response to your committee's inquiry, but frankly, I would prefer that the committee in its good judgment decide.

Senator GRUENING. We would like to have your views. It will probably be a few days before we go into executive session. During that time, if you have any views that you would like to transmit to the committee, we would be very happy to have them.

Senator HART. Thank you very much.

Senator GRUENING. On S. 1166, Senator Hart's bill, we have several witnesses: Mr. Marling J. Ankeny, Director of the Bureau of Mines, accompanied by Mr. J. B. Rosenbaum, Director of the Minerals and Research Branch of the Bureau of Mines; Dr. M. E. Volin, Michigan College of Mining and Technology, Houghton, Mich.; Dr. Philip L. Walker, chairman of the division of mineral technology, College of Mineral Industries, Pennsylvania State University; Dr. J. Russell Bright, director of the office of research administration, Wayne State University, Detroit.

Will you gentlemen all come forward so that we can have the benefit of your collective wisdom. Which of you gentlemen would like to testify first?

## STATEMENTS OF MARLING J. ANKENY, DIRECTOR, BUREAU OF MINES; ACCOMPANIED BY J. B. ROSENBAUM, DIRECTOR, MINERALS AND RESEARCH BRANCH, BUREAU OF MINES; DR. M. E. VOLIN, MICHIGAN COLLEGE OF MINING AND TECHNOLOGY, HOUGHTON, MICH.; DR. PHILIP L. WALKER, JR., CHAIRMAN, DIVISION OF MINERAL TECHNOLOGY, COLLEGE OF MINERAL INDUSTRIES, UNIVERSITY OF PENNSYLVANIA; DR. J. RUSSELL BRIGHT, DIRECTOR, OFFICE OF RESEARCH ADMINISTRATION, WAYNE STATE UNIVERSITY, DETROIT, MICH.; AND JOHN C. CALHOUN, JR., SPECIAL ASSISTANT AND SCIENCE ADVISER TO SECRETARY OF THE INTERIOR

Mr. ANKENY. I am prepared to make my statement.

Senator GRUENING. Mr. Ankeny, we are very happy to have you here and proceed in your own way.

Mr. ANKENY. Gentlemen, I am Marling J. Ankeny, Director, Bureau of Mines, Department of the Interior. I am accompanied this morning by Mr. J. B. Rosenbaum, the Bureau's Assistant Director of Minerals Research. We appreciate the chance to appear and discuss with you Senate bill 1166. This proposed legislation would allow the Secretary of the Interior to enter into contracts and to make grants to colleges and universities for research that would complement the research programs of the Bureau of Mines.

Such research would include that relating to the mining, processing, and utilization of mineral substances, and that pertaining to the efficiency, economic development, and conservation of mineral and fuel resources, and to health and safety in the mineral industries.

The Bureau of Mines recommends passage of this legislation for two reasons. First, we feel that it would reinforce the Bureau's capability for rigorous, perceptive, and timely research in support of the Nation's mineral needs.

Second, it is believed that this action would help revitalize the academic structure essential for the education and preparation of minerals-oriented scientists and engineers.

As you know, the Bureau of Mines is engaged in a program of wide scope of basic and applied research and development designed to provide for the Nation's expanding needs for fuels, minerals and metals, and for the safety of people engaged in exploration for and production of these mineral commodities.

The Bureau of Mines is the only Government agency with a comprehensive research program in mineral sciences and technologies, and as such, it has an exacting responsibility for the Nation's position in these areas.

In certain phases of the work, especially those involving basic and fundamental research, the Bureau is experiencing increasing difficulty in obtaining scientists and engineers with the desired disciplinary backgrounds and professional skills necessary to carry out a dynamic program. The proposed bill would enable the Bureau to complement and supplement its own research capabilities by drawing on the scientific and technological resources of colleges and universities, and it would impart depth and flexibility to the Bureau's scientific inquiries and investigations.

The Bureau of Mines has long sponsored cooperative fellowships at certain colleges and universities. These fellowships are actually research assistantships and require that the student be employed 20 hours per week in a Bureau laboratory and hence can be sponsored only at those schools near a Bureau establishment.

In the past, this program has been highly successful. Many of the present leaders in industry and in the Bureau of Mines completed their college training under this type of fellowship agreement. In recent years, however, the arrangement is no longer attractive to students because of the competition with more lucrative conventional fellowships and with research assistantships on more liberal terms sponsored by other Government agencies.

Authority to contract for research, as provided in the proposed bill, would not restrict location and would make the Bureau sponsored fellowships and research grants more attractive to students.

Availability of research facilities at a large number of selected colleges and universities with unique capabilities, would permit the Bureau to emphasize promptly and accelerate studies of the basic properties of organic and inorganic mineral materials, and of the fundamental scientific principles that underlie exploration, extraction, processing, and utilization of mineral commodities. In short, the proposed legislation would augment the Bureau's current research programs and allow it to better fulfill its mission.

During recent years there has been a series of surveys and analyses conducted by the National Science Foundation, Bureau of Labor Statistics, professional societies, and others concerning the prospects for education of scientific and technical personnel. All of these studies have resulted in startling and depressing conclusions.

The percentage of college freshmen entering engineering professions started to decline in 1957 and has been dropping steadily ever since. This fact has been partially obscured by the rapidly increasing total enrollment in colleges and universities. The surveys all agree, however, that the Nation lacks the necessary number of scientists and engineers to keep up research and production, let alone increase the ranks of personnel needed to search for new theories, new applications, and new uses for old ideas. Specifically, a recent statement by the National Science Foundation claims that the demand for engineers and scientists will double within the next 10 years.

In 1961, the engineering schools of the United States produced 36,000 bachelor-level graduates. Yet these same schools—most of them experiencing enrollment decreases at the freshman level—are expected to graduate an average of 72,000 engineers each year to keep pace with demand.

Our colleges and universities graduated about 60,000 science majors in 1961. But, for the next 10 years, the same schools must turn out at least 83,000 annually. One point in favor of the scientific disciplines is that enrollments are increasing, spurred by the glamour of space-age activities. The sobering thought is that science enrollments, though increasing, are not increasing fast enough—and the increase is largely at the expense of the engineering enrollments.

The picture of minerals-oriented colleges and universities is even more disturbing. For example, of the 36,000 engineers graduated in 1961, only 800 of them were metallurgical engineers. Most of these

were prepared to enter either the physical metallurgy or the process metallurgy fields. The number that choose process metallurgy is woefully small. This is not because of lack of interest in processing but simply because industrial, defense and space interest has created an opportunity for higher salaries and faster advancement working with metals and alloys than in the minerals processing field.

The Bureau of Mines examination revealed that extremely little significant academic research is being conducted in the field of process metallurgy even at the schools that 15 years ago were strongest in the field. Invariably, the school staffs, when questioned, replied that obtaining Federal and industrial support for physical metallurgy on scientific programs is relatively easy, but support for process metallurgy is practically nonexistent.

Senator BIBLE. Right at that point, Mr. Chairman, might I ask one question?

Senator GRUENING. Yes, indeed.

Senator BIBLE. I am wondering if part of that isn't due to the fact that we have no gold mining and we have no silver mining. Lead-zinc mining is out of business. Tungsten is out of business. If I had a son I certainly don't think I would recommend that he become a mining engineer. How would he get a job after he came through these schools?

Where could he go with any degree of confidence in the future of holding his profession? The mines are closed in the length and breadth of this land by and large.

Mr. ANKENY. I think from that standpoint you are correct, that these industries have declined, but other phases of metallurgy, not mining, but metallurgy, have grown. I would like Mr. Rosenbaum to expand on that.

Mr. ROSENBAUM. I believe I can and while it is true that very many areas in the extraction processing of minerals are in a sadly depressed state, the total volume of minerals being processed is still much larger than it was 15 or 20 years ago.

Senator BIBLE. I don't know what you put into your statistics. Maybe you throw sand and gravel in there to get this. What do you throw into your statistics?

Mr. ROSENBAUM. As an illustration, we are producing more copper today.

Senator BIBLE. I think this is right. I think copper is in a fairly healthy state. With the exception of copper where else are we doing so well?

Mr. ROSENBAUM. As an illustration, where perhaps 15 years ago we had no uranium, right now we certainly have people engaged in it and the byproducts.

Senator DOMINICK. But you are phasing that out.

Senator GRUENING. That is diminishing.

Senator DOMINICK. You are phasing that out as rapidly as possible.

Mr. ROSENBAUM. It certainly doesn't have any stability, but the situation is that graduates are not available in the field of extractive metallurgy. This is the situation.

Senator BIBLE. Is that a fact?

Mr. ROSENBAUM. Yes, this is true. We have not been able to employ extractive metallurgists on the Bureau of Mines staff to meet our requirements.

Senator BIBLE. That is Government employment. How about metallurgists in private industry?

Mr. ROSENBAUM. Private industry has the same problems in obtaining graduate metallurgists.

Mr. BRIGHT. I am Dr. J. Russell Bright, Wayne State University. It has been true in recent years that the metallurgy department in our college of engineering has been one of the fastest growing ones, but when we have four or five private companies come in to interview prospective chemical engineers, there may be five come in on one day and have one student interviewed. For some reason or other, even though we have a lot of students starting in that, we haven't graduated very many. There aren't enough. I think he is right.

Mr. ROSENBAUM. That is correct. There is an acute shortage.

Senator GRUENING. Isn't that a problem to which we should direct our attention? What is needed to stimulate the interest of more students?

Mr. ROSENBAUM. This is one of the things this bill will help focus attention on, and we feel strongly that, since the Bureau of Mines has a responsibility to see that the country has a strong mineral industry, we have to have the people who are capable of carrying on in this area.

Senator BIBLE. We have to have some Government policies in order to face up to the fact that there is nothing wrong with giving American industry a fair share of the market too.

Senator GRUENING. Yes. That is a point we hope to bring up later. Would you say that this shortage exists in other countries too?

Mr. ROSENBAUM. Not to the extent as here. From experience in talking to foreign nationals they themselves do not appear to have the same shortage.

Senator GRUENING. Is any attempt being made by industry to recruit foreign nationals who may be expert in that field? Do they encounter any difficulties with the immigration laws?

Mr. ROSENBAUM. I am not familiar with that.

Senator GRUENING. Mr. Ankeny, do you happen to know?

Mr. ANKENY. No, sir.

Senator GRUENING. There is legislation in the works now to modify immigration laws with special emphasis on facilitating people skilled in the professions, technicians and so forth, and I think this might be pertinent to this situation.

Mr. ANKENY. I recall several instances where we have been helped by the State Department by getting limited permission for employing foreigners to serve private industry in this sense.

Senator GRUENING. I think it would be very helpful to this legislation if the Department would do a little research because this might be very important in connection with this immigration legislation. The emphasis is to try to bring in trained skills which we do not have in this country and get away from the difficulty of giving just temporary visas.

If there is a shortage here which would be supplied by foreign talent we would certainly try to make it easy for that talent to be available.

Senator BIBLE. May I ask one more question, Mr. Chairman? Do you have any idea of how many graduate mining engineers industry could use this year, or next year or 1965?

Mr. ROSENBAUM. We don't have the figures.

Senator BIBLE. By way of statistics which the industries might want. Maybe Dr. Bright might have some observation.

Mr. BRIGHT. I am not an engineer, but I am active in several engineering societies and I believe the answer to your question could best come from the American Society for Engineering Colleges. This would be a question I believe they could answer with ease.

I haven't the statistics, but I believe they are available.

Senator BIBLE. Part of the burden of your presentation is that we are in short supply of mining engineers. How short is that supply? That could be supplied for the record, Mr. Ankeny.

Mr. ANKENY. We will be happy to make inquiries and supply some information on that.

(The material to be furnished follows:)

SUPPLEMENTARY STATEMENT BY MARLING J. ANKENY, DIRECTOR, BUREAU OF MINES

The Bureau of Mines urges passage and enactment of Senate bill 1166, which will authorize the Secretary of the Interior to enter into contracts and to make grants to colleges and universities to augment the research programs of the Bureau of Mines.

Each appropriation act for the Department of Interior has authorized the Secretary to "accept lands, buildings, equipment, and other contributions from public and private sources and prosecute projects in cooperation with other agencies, Federal, State, or private," but does not specifically grant permission to let contracts for research. Public Law 86-777 of the 86th Congress (Helium Act of 1960), however, authorizes the Secretary to "conduct or contract with public or private parties for the experimentation and research to discover helium supplies and to improve processes and methods of helium production, purification, transportation, liquifaction, storage, and utilization." Senate bill 1166 will extend to the minerals and fuels segments of the Bureau of Mines research program the access to additional scientific talents and facilities that is obtained through making research grants and contracts and that is now enjoyed by Helium Activity and by other Federal research organizations.

We believe that enactment of this legislation would result in a significant strengthening of the Bureau of Mines research program. The Bureau has experienced difficulty in obtaining qualified personnel to conduct research in certain areas of endeavor, especially in the fields of process (extractive) metallurgy and mining research. Not only would contract authority make available to the Bureau the services and professional skills of trained mineral scientists, but it would help stimulate education of science-oriented young persons familiar with minerals problems.

The advantages and benefits to the Bureau of Mines research program to be derived from close association and cooperation with academic institutions is the prime motivation for the Bureau's support of Senate bill 1166. Of secondary interest, yet of long-range importance, is the belief that this action will help sustain and revitalize the university and college structure and programs essential for the education and preparation of scientists and engineers that are desperately needed by this Nation's minerals industry.

As requested, to supplement our previous statement that there is a general shortage of graduates in the minerals industry area, data concerning recent metallurgical and mining graduates are shown in tables 1 and 2.

TABLE 1.—*Degrees granted in metallurgy*

| Year | Bachelors, not differentiated | Masters | | | Doctors | | |
|---|---|---|---|---|---|---|---|
| | | Not differentiated | Physical metallurgy | Process metallurgy | Not differentiated | Physical metallurgy | Process metallurgy |
| 1958–59 | 797 | 55 | 136 | 21 | 17 | 49 | 8 |
| 1959–60 | 713 | 30 | 171 | 39 | 10 | 58 | 7 |
| 1960–61 | 755 | 39 | 165 | 43 | 9 | 58 | 13 |

TABLE 2.—*Degrees granted in mining engineering*

| Year | Bachelors | Masters | Doctors |
|---|---|---|---|
| 1961 | 220 | 33 | 2 |
| 1962 | 179 | 49 | 6 |

Table 1, prepared from statistics of the American Society for Metals Foundation for Education and Research, shows metallurgical graduates from U.S. schools at the bachelor's, master's, and doctor's levels over a 3-year period.

Graduates at the bachelor's level cannot be classified into the branches of physical and process metallurgy because the training is generally applicable to either specialty. However, based on the proportion in each branch among the masters, it is widely conceded that only 15 to 20 percent of the total metallurgy graduates actually enter the field of process metallurgy. These figures are of grave concern to the Bureau of Mines and to others concerned with the problem of assuring the United States a continuing and adequate supply of essential minerals and fuels. Without a sufficient number of process metallurgy graduates, not only is the Bureau's own research program endangered, but also the efficiency of the Nation's minerals industries.

Scarcity of graduates is not limited to metallurgy. Statistics supplied by the Department of Health, Education, and Welfare (table 2) show that the number of mining engineers graduating each year is approximately one-fourth that of total metallurgists, and therefore only slightly higher than the number of process metallurgists. It is a well-established fact that many of the colleges and universities have had to close their mining and engineering departments for lack of students.

When it is considered that over 70,000 engineers and scientists are graduated each year, and that the combined metallurgists and mining engineers comprise only 1,000 of the total, it can be realized that the matter is one of serious concern. Accurate figures are not available on the number of foreign nationals included among the graduating engineers and extractive metallurgists. Estimates from several schools range from 10 to 40 percent. Nevertheless, it is apparent that the number is appreciable, and that the number of young minerals-oriented graduates available to the U.S. industry and research organizations is even less than the figures shown in the tables.

It has been suggested that paucity of graduates in minerals fields is due to a lack of job opportunities. This, however, does not appear to be true. Two of our largest mineral engineering schools, Colorado School of Mines and Missouri School of Mines and Metallurgy, report that the number of positions available far exceeds the number of graduates to fill them.

The question was raised as to what extent research in the areas of mining and extractive metallurgy is financed by other Federal agencies. The Bureau of Mines has investigated this subject as instructed and determined that such

financing is negligible. Typical of the statements in response to our inquiries was that from the Director of Defense Research and Engineering, as follows:

SEPTEMBER 16, 1963.

Mr. MARLING J. ANKENY,
*Director, Bureau of Mines,*
*U.S. Department of the Interior,*
*Washington, D.C.*

DEAR MR. ANKENY: Pursuant to your request of last week I have examined the metallurgy and materials programs of the Department of Defense in regard to basic or applied research in the areas of extractive metallurgy and mining. To the best of my knowledge the DOD has no work going on in either of these areas at this time. It has been my understanding that through the years the Bureau of Mines was the sole Government agency engaged in research in these two areas. The DOD, while it may have an interest in such programs and coordinates with the Bureau of Mines, is primarily interested in supporting physical metallurgy programs on the application of metals.

Sincerely yours,

EARL T. HAYES,
*Assistant Director (Materials).*

Also received in answer to this inquiry was a letter from the chairman, Coordinating Committee on Materials Research and Development, Federal Council for Science and Technology, pertaining to Federal agency support of minerals research. It is as follows:

FEDERAL COUNCIL FOR SCIENCE AND TECHNOLOGY,
*Washington, D.C., October 8, 1963.*

Mr. MARLING J. ANKENY,
*Director, U.S. Bureau of Mines,*
*U.S. Department of the Interior,*
*Washington, D.C.*

DEAR MR. ANKENY: At a recent meeting of the Coordinating Committee on Materials Research and Development of the Federal Council for Science and Technology it came to our attention that the Bureau of Mines has been requested to determine the degree of other Federal agency support of research through contracts and grants at universities in the field of extractive metallurgy to see whether there would be a duplication of effort as a result of Bureau of Mines plans to start a program in this field.

The membership of CCMRD is composed of representatives and observers from the Atomic Energy Commission, Department of Defense, National Bureau of Standards, Advanced Research Projects Agency, National Aeronautics and Space Administration, Bureau of Mines, National Science Foundation, Bureau of the Budget, Office of Emergency Planning, and the Office of Science and Technology. These agencies would be conducting, or would have knowledge of, technical programs of the type proposed by the Bureau of Mines if such a program were to be undertaken. Since these representatives and observers on the CCMRD are in a position to have direct knowledge of any Government work, inhouse or contract, being done by their respective agencies in this area, the group was asked to identify any work in this field currently being supported by their agency. The result of this poll was that except for the very specialized support of the Ames Atomic Laboratory of the Iowa State University by the AEC for research on the separation of rare earths, none of the agencies has a significant amount of work in this area. Further, these agencies did not plan any change in policy since this field was the primary responsibility of the Bureau of Mines.

Because of the broad Government technical representation on CCMRD, I believe the results of polling our members is a valid basis for assuming that the work the Bureau of Mines is planning to undertake in this field is not one which would duplicate an existing Federal program.

Sincerely yours,

I. C. SCHOONOVER,
*Chairman, Coordinating Committee on Materials Research and Development.*

In view of these facts, and with a conviction that enactment of this legislation would materially strengthen the Bureau's research capabilities and, secondarily stimulate the education of young persons for careers in this essential resource field, we again urge passage of S. 1166.

Mr. VOLIN. I am Dr. M. E. Volin from the Michigan College of Mining. I wish to suggest that the American Institute of Mining, Metallurgical, and Petroleum Engineers have had many discussions of this problem of shortage of engineers for the mineral industries and it has much published matter on this and would probably have the information you are asking for as to the number of mining and metallurgical engineers needed by the mineral industries.

Senator BIBLE. I think that will be very helpful, Mr. Chairman. I apologize for interrupting.

Senator GRUENING. I think it would be very helpful and I would like to ask the counsel to explore the situation with the appropriate agencies and see what there is in the way of exchange fellowships and other methods by which we would have a supply of foreign experts. This might be useful when we get testimony on the immigration bill, because they certainly may exist in other countries and I know of no country which isn't happy to send people to this land of opportunity and freedom when they have a chance to do so.

I think we should explore that. Go ahead.

Mr. ANKENY. I have expounded at some length on the illustration concerning process metallurgy. It happens to be the area of greatest current concern to the Bureau of Mines, and if this legislation is enacted, is the area for which most of the initial contracts will be made. But the situation is not restricted to metallurgy, the mining engineering departments of some of the engineering schools have virtually ceased to exist.

It is our opinion that it is incumbent on the Bureau of Mines to take positive action toward sustaining and revitalizing the appropriate university departments. We believe that the proposed bill will help accomplish this purpose. Failure to stimulate the mineral units of our colleges and universities will deprive not only the Bureal of Mines but all of the minerals industry of a supply of properly trained and oriented scientists and engineers.

The dual role of colleges and universities to expand our knowledge through research and to train additional scientists and engineers has been advised by distinguished authorities.

For example, the President's Science Advisory Committee's "1960 Report of the Panel on Basic Research and Graduate Education" definitely recommends that: "basic research should be done in, or at least in association with, universities."

The Committee on Natural Resources of the National Academy of Sciences—National Research Council—came to the conclusion that—

> governmental and nongovernmental agencies and institutions should take full advantage of the resources of the universities, contracting out especially those studies for which the universities are uniquely equipped.

The committee further stated that—

> It has been recognized for some time that fundamental research bearing on mineral resources would progress more rapidly if scientists and engineers from industry, the universities, and the Government would work together more closely.

The May 1963 report of the Committee on National Resources to the Federal Council for Science and Technology recommended expansion of Federal research on extraction—that is mining and production of oil and gas—and on the processing of mineral raw materials emphasizing the utilization of materials that are now of marginal or submarginal quality.

The report stated that—

> funds should be made available for Federal research as rapidly as existing programs can be expanded, and university research should be subsidized wherever it appears to be well situated to use such assistance.

The Committee on Bureau of Mines Metallurgical Research to the National Academy of Sciences, June 1962, stated:

> The Bureau of Mines has a responsibility to help promote education in the fields of the mineral industry by close cooperation with educational institutions * * * and to underwrite diverse activities in the research field in colleges and universities.

In summary, the Bureau of Mines urges the passage and enactment of Senate bill 1166 on the grounds that it will strengthen the Bureau's own program of research, and will benefit the Nation's minerals industry in general by helping to alleviate the growing shortage of mining engineers, metallurgical engineers, and minerals scientists.

Mr. Chairman, we have with us today also Dr. John C. Calhoun, Jr., who is a special assistant and science adviser to the Secretary of the Interior. I understand that he has submitted a prepared statement and he is available to answer any questions that you may wish to direct to him.

Senator GRUENING. We will be very glad to hear him. Do you suggest that we hear him next?

Mr. ANKENY. I understand that he is obligated to get to the Secretary's office very shortly and if he is to present his statement formally I recommend that you hear him now.

Senator BIBLE. Before you do that, Mr. Chairman—I must leave in just a few minutes—I just want to ask Mr. Ankeny one question. How much will this program cost?

Mr. ANKENY. We have given some thought to that. Mr. Rosenbaum has studied this problem.

Mr. ROSENBAUM. We have given some thought to it but we would prefer not to get an open-end authorization. We have in mind that we would explore the facilities that were available in the schools and determine and make some decision as to the work that could be done by various schools.

Senator DOMINICK. Mr. Chairman, if I may interject right there, as one Senator I would never agree to an open-end authorization on this kind of a bill.

Senator BIBLE. I think he said that he did not want an open-end authorization.

Mr. ANKENY. We do not.

Senator BIBLE. But what figure do we put in? We have to look to somebody to give us that.

Mr. ANKENY. We have put in a ceiling figure of $2 million a year. We have in mind a ceiling figure. We assumed that we could come in with an annual budget presentation to document the research and the type we propose to award, applied research or other research activities, along the line.

Senator BIBLE. That kind of terrifies me. You would come to the Appropriations Committee and say that you wanted $2 million a year.

Mr. ANKENY. That is a ceiling limitation. We might initially require $500,000 in the opening year.

Senator BIBLE. Take either amount that you want. Let us split the difference and say you come in and ask for a million dollars. What will you do with a million dollars?

A, B, C, D. What will you do? Will you hire an assistant in the Bureau of Mines who will be in charge of administration of this bill?

Mr. ANKENY. We do not visualize that we want to get into the kind of contracts that would require major administrative problems or major administrative expenses because we have too many other things to do in the Bureau to try to get involved in detailed bookkeeping for numerous small contracts.

We visualize that we could give grants where appropriate for the investigation of fundamental problems. As an illustration, we might award $15,000 to the University of Wyoming to study the characteristics of rocks that are associated with oil shale structures.

Senator BIBLE. How much money have you spent for shale research within your own Bureau of Mines?

Mr. ANKENY. About $2 million. But we are going out into the type of fundamental problems here that is needed in support of research in the Bureau of Mines. We do quite a bit of fundamental research to the extent that we have the people and the facilities to do it. But we need much more basic knowledge and cannot build up our own program because the skills are not available to us.

I think this would be helpful. I also want to indicate again that one of the serious goals here is the education of people for the minerals field.

Senator BIBLE. If you are in short supply of the engineers as indicated wouldn't you come under this college education bill that has just come out of the House Education Committee, if this is an educational problem, to educate more mining engineers? Wouldn't Dr. Volin's Michigan College be entitled to a certain amount of money to help those who wanted to become mining engineers?

Mr. ANKENY. I am not familiar with that.

Senator BIBLE. The reason I asked the question, and maybe I didn't understand your answer, is I thought you said this was to help in the education of mining engineers.

Mr. ANKENY. That development is one of our goals. We have indicated that we have a two-pronged reason for this. One is to help us to get the basic research that we need.

We study the characteristics and strain of rocks and how rocks respond to an explosive so we can learn to get better types of fragmentation. We are doing quite a bit of that, but we are limited in the number of people we have and limited in the number of laboratories we have. We feel we can get quite a bit of help from specialists in these various schools.

Senator BIBLE. The MacKay School of Mines is a mining institution of great renown. I know the Colorado School of Mines has a great reputation. I guess this is the goal, isn't it? What type of a project would you put at the Colorado School of Mines if this bill were to be enacted?

Mr. ANKENY. I am only talking here of illustrations, because the actual specific type of project would have to be worked out.

Senator BIBLE. We always find this is the answer we get. We keep way up in the blue and the first thing we know we have really launched a project that runs into many millions and millions of dollars.

Mr. ANKENY. We are currently spending $24 million a year on general research: mining, metallurgy, coal, and petroleum. I have suggested here that we put a ceiling of some $2 million on this.

I am not attempting to indicate that $2 million is small change. I know this is a lot of money. But certainly it appears to be something in line with the balance of our program.

Senator GRUENING. Mr. Bright.

Mr. BRIGHT. Mr. Chairman, I think the Bureau of Mines is being entirely too modest and it seems to me that the first year a low ceiling is very much in order. I am sure that most people would agree with this, but please don't expect very much in the first year or two if you are going to operate at that level. One of the companies to which I will refer in my written testimony now spends—the Cleveland Cliffs Iron Co.—between a half million and a million dollars themselves—and this is in a sense a small operation—on research and I would claim, since I have had a lot to do with handling some of these Government contracts at the university end, that it should be from a minimum of $50,000 per project, if you are going to involve more than two or three students, to something at the level of $100,000 per contract, or else you can't expect very much.

I think this is one trouble with the people in the Geological Survey and, if I dare say so, in the Bureau of Mines. They don't set their sights high enough.

Senator BIBLE. We find plenty of people that do set their sights high and of course when I picked this $2 million figure I thought that this was the most refreshing figure I had in a long time. I doubt very much that it is a realistic figure, as I sit on the Appropriations Committee, and you can come in the first year and it will be $500,000 and you can bet 21 to 1 that next year it will be $1 million, next year $2 million, next after that $5 million, and then it will be $10 million.

It will go on up. I want it to be realistic. If this legislation moves forward this is certainly going to be the question that our committee people ask: How much does this cost? I have some very personal doubts that you can do very much with $500,000, but I am not so sure in other areas where you are already operating, the Bureau of Mines, or where the HEW is operating in the educational field, that you don't have a lot of overlap.

I think we have probably one of the most overlapping governments in the world if you start looking at all of our agencies, and I think you have to develop this point very thoroughly. I think this bill would be in trouble.

Mr. ROSENBAUM. You mentioned the Colorado School of Mines and I would like to say Dr. Schlechten with whom we discussed this bill is favorable to it.

Senator DOMINICK. Of course he is. If he wasn't there would be something wrong with him.

Mr. ROSENBAUM. That is right, but Professor Schlechten points out, and you are pointing out, that there may be other avenues to get some support from graduate students to help build up this Department of Minerals. However, since such support is not readily obtained this would be an extremely important bill.

At the same time I also want to point out that we are talking, in this bill, and it should be stressed, about fundamental problems such as reaction rate and equilibrium studies. We are not talking here about attempting to go into universities with a lot of applied research and process development. This is the reason that I felt that the cost would be modest in comparison with the ordinary program.

Senator BIBLE. They start out modestly, perhaps.

Senator GRUENING. I am going to ask my office to supply for the record the amount of moneys we have expended since the beginning of the foreign aid program on development of mining in foreign countries.

From this material we will see that our zeal in contributing to minerals development in foreign countries has been far greater than efforts we have made to assist our domestic miners.

(The summary pertaining to foreign aid, referred to by Senator Gruening, is as follows:)

[From the Congressional Record, Mar. 16, 1963]

MINING AND MINERALS

*Industry and mining, fiscal year 1955*

FAR EAST

| | *Amount* |
|---|---|
| China: | |
| Coal exploration | $5,000 |
| Petroleum exploration, CPC | 715,000 |
| Hard rock mining | 5,000 |
| Coal production techniques | 2,000 |
| Geological techniques | 4,000 |
| Mining engineering | 2,000 |
| Indonesia: Mining operations | 32,500 |
| Philippines: | |
| Nonmetallic minerals survey | 28,000 |
| Strategic minerals survey | 37,000 |
| Technical assistance to Bureau of Mines | 22,000 |
| Coal surveys | 35,000 |
| Thailand: Geological survey | 52,500 |
| Vietnam: Coal strip mining survey | 7,000 |

*Industry and mining, fiscal year 1955*—Continued

| | Amount |
|---|---|
| **NEAR EAST, AFRICA, AND SOUTH ASIA** | |
| Afghanistan: Mineral resources and coal production | $67,000 |
| Egypt: | |
| Industry and mining—mining and minerals | 8,000 |
| Industry and mining—photogeology training | 4,500 |
| Greece: | |
| Technical support to mining industry | 22,624 |
| Study of mining methods and ore dressing | 34,300 |
| India: | |
| Exploratory lignite excavation and development | 519,600 |
| Minerals survey and development | 83,873 |
| Iran: Mineral resources development plans | 17,124 |
| Israel: | |
| For petrochemistry | 4,000 |
| Economic geologists | 43,600 |
| For the appraisal and development of mineral resources | 12,500 |
| Mineral technologists | 38,034 |
| For mineral development | 40,000 |
| Mineral resources, potash and salt extraction participantship | 3,000 |
| Dead Sea brines survey | 15,000 |
| Petroleum exploration methods participantship | 3,000 |
| Liberia: | |
| Mining and minerals exploration | 50,000 |
| Mines and geology | 20,000 |
| Nepal: Project for mineral deposit surveys | 20,000 |
| Pakistan: Metal mining engineering | 5,450 |
| Turkey: | |
| Cobalt recovery processes | 10,000 |
| Zonguldak coal basin development, P–1 | 204,400 |
| Oversea territories: | |
| United Kingdom: U.S. bituminous coal mining methods | 4,000 |
| **EUROPE** | |
| Austria: Coal mining experts | 10,000 |
| France: Iron mining experts | 6,000 |
| Spain: Coal mining study | 8,640 |
| Bolivia: Geology | 10,828 |
| Brazil: U.S. Geological Survey mineral resources investigations | 190,213 |
| Chile: Geology | 64,400 |
| Colombia: Development of coal resources of Department of Cauca and the Cauca Valley | 19,238 |
| Cuba: | |
| Mineral analysis and development | 38,000 |
| Basic geological research | 28,700 |
| Honduras: Coal resources survey and development | 7,950 |
| Mexico: USGS—instrument calibration technician | 850 |
| Peru: | |
| Advisory services, mineral resources | 78,961 |
| Advisory services, mining and metallurgy | 81,905 |
| **OVERSEA TERRITORIES** | |
| British Guiana: Mining and minerals project | 10,400 |

*Fiscal year 1956 projects*

FAR EAST

| | *Amount* |
|---|---|
| Cambodia: Mineral development | $25,000 |
| China: | |
| Coal mine improvement | 103,000 |
| Solid fuels and minerals exploration survey | 10,182 |
| Coal exploration | 25,000 |
| Petroleum exploration, CPC | 7,000 |
| Coal mine demonstration | 100,000 |
| Geological equipment | 27,000 |
| Indonesia: Mining operations | 154,959 |
| Korea: | |
| Coal mining operations and management | 1,800 |
| Development of Hambeak coalfields | 550,000 |
| Philippines: | |
| Nonmetallic minerals survey | 53,000 |
| Strategic minerals survey | 240,000 |
| Technical assistance to the Bureau of Mines | 29,500 |
| Coal surveys | 53,000 |
| Thailand: | |
| Geological survey | 45,900 |
| Experimental metal mining operations | 10,000 |
| Minerals experimental center | 30,500 |

NEAR EAST AND SOUTH ASIA

| | |
|---|---|
| Afghanistan: Mineral resources and coal production | 93,000 |
| Egypt: | |
| Industry and mining—mining and minerals | 1,500 |
| Minerals resources development | 58,750 |
| Greece: Technical training in the minerals field | 13,720 |
| India: | |
| Exploratory lignite excavation and development | 9,100 |
| Minerals survey and development | 133,723 |
| Iran: Mineral resources | 2,500 |
| Israel: | |
| Petrochemical research | 39,000 |
| Mineral exploration and development | 105,200 |
| Department of metallurgy (technion) | 40,000 |
| Conservation techniques in oilfield development | 45,000 |
| Jordan: Dead Sea mineral resources | 51,200 |
| Lebanon: Mineral survey | 30,000 |
| Nepal: | |
| Nepal American Minerals Cooperative Service | 5,000 |
| Minerals deposit surveys | 74,000 |
| Pakistan: | |
| Development of Makarwal collieries | 502,000 |
| Bureau of Mines and Geological Survey advisory service | 53,700 |
| Surveys of chemical and industrial potential of Sui gas | 75,000 |
| Turkey: | |
| Zonguldak coal basin development | 661,000 |
| Murgul copper mine expansion program | 401,000 |
| Murgul copper mine sulfuric acid sea line | 100,000 |

AFRICA

| | |
|---|---|
| Liberia: | |
| Mining and minerals exploration demonstration and training project | 20,000 |
| Mines and geology | 23,000 |
| Oversea territories: | |
| Italian: Mineral survey (contract with World Mining Consultants, Inc.) | 485 |

*Fiscal year 1956 projects*—Continued

| | Amount |
|---|---|
| **EUROPE** | |
| Spain: | |
| Coal mining productivity study | $3,840 |
| Coal mining consultants | 11,925 |
| Lead and iron ore mining productivity study | 12,800 |
| POL laboratory equipment, 1956 fiscal year | 100,000 |
| Yugoslavia: | |
| Nonferrous metals and metallurgy | 35,700 |
| Fuels | 12,700 |
| **LATIN AMERICA** | |
| Bolivia: Mining survey | 162,000 |
| Brazil: | |
| U.S. Geological Survey mineral resources | 204,500 |
| Mineral resources development (USBM) | 85,400 |
| Chile: Geology | 86,500 |
| Colombia: Coal resources development in the Department of Cauca and in the Cauca Valley | 23,000 |
| Cuba: | |
| Mineral analysis and development | 32,000 |
| Basic geological research | 29,900 |
| Honduras: Industry, mining coal resources survey | 29,107 |
| Mexico: | |
| Minerals technology cooperation (Bureau of Mines) | 38,000 |
| Industry and mining (U.S. Geological Survey) | 116,800 |
| Peru: | |
| Advisory services mineral resources | 98,338 |
| Advisory services mining and metallurgy | 49,390 |
| **OVERSEA TERRITORIES** | |
| British Guiana: Mining and minerals | 6,000 |

*Industry and mining, fiscal year 1957*

| | |
|---|---|
| **FAR EAST** | |
| Cambodia: Mineral development | 15,000 |
| China: | |
| Coal mine improvement | 782,000 |
| Solid fuels 7 and mineral exploration survey | 25,000 |
| Petroleum exploration, China Petroleum Corp | 5,000 |
| Indonesia: Mining operations | 122,000 |
| Korea: | |
| Test drilling, Ham Raik coalfield | 139,000 |
| Test drilling, Han Kook Geological Industrial Co | 100,000 |
| Geophysical survey and test drilling, ROK Office of Geological Survey | 475,000 |
| Mine development, monazite ore separating plant | 150,000 |
| Mine development, Dae Han coal mines | 3,247,000 |
| Geophysical survey and test drilling, Hwasun & Eunsung coalfields | 136,000 |
| Laos: Mining and minerals survey | 8,000 |
| Philippines: | |
| Nonmetallic minerals survey | 41,000 |
| Technical assistance to the Bureau of Mines | 25,000 |
| Coal surveys | 24,000 |
| Thailand: | |
| Geological survey | 58,000 |
| Minerals experimental center | 22,000 |
| Airborne geophysical survey | 130,000 |
| Vietnam: Nong-Son coal exploration survey | 56,000 |

*Industry and mining, fiscal year 1957*—Continued

| | Amount |
|---|---|
| **NEAR EAST AND SOUTH ASIA** | |
| Afghanistan: Mineral resources and coal production | $875,000 |
| Ceylon: Minerals exploration | 56,000 |
| Egypt: Mineral Resources Department | 22,000 |
| Greece: Technical training in the mineral fields | 14,000 |
| India: Minerals survey and development | 113,000 |
| Israel: | |
| Minerals development | 78,000 |
| Department of Metallurgy | 25,000 |
| Conservation techniques in oilfield development | 2,000 |
| Nepal: Project for mineral deposits surveys | 137,000 |
| Pakistan: | |
| Makarwal collieries | 593,000 |
| Bureau of Mines and Geological Survey | 50,000 |
| Turkey: | |
| Zonguldak coal basin development | 380,000 |
| Murgul copper mine expansion program | 178,000 |
| Western lignite mines | 450,000 |
| Private mining development | 500,000 |
| Preventive maintenance adviser | 20,000 |
| **AFRICA** | |
| Liberia: Mines and geology | 10,000 |
| Libya: | |
| Minerals investigation | 24,000 |
| Minerals investigation | 42,000 |
| **OVERSEA TERRITORIES** | |
| United Kingdom: Southern Rhodesia, metallurgical chemistry | 3,000 |
| **EUROPE** | |
| Spain: | |
| Civil aviation (fiscal year 1957) POL laboratory equipment | 90,000 |
| Iron ore mining productivity study | 6,000 |
| Yugoslavia: Industry, mining, and minerals | 138,000 |
| **LATIN AMERICA** | |
| Bolivia: Mining survey | 199,000 |
| Brazil: | |
| U.S. Geological Survey mineral resources investigation (nonferrous project) | 44,000 |
| U.S. Geological Survey mineral resources investigation (ferrous project) | 209,000 |
| Mineral resources development (U.S. Bureau of Mines) | 44,000 |
| Chile: Geology | 130,000 |
| Colombia: Coal resources development in the Department of Cauca and the Cauca Valley | 13,000 |
| Cuba: | |
| Mineral analysis and development | 18,000 |
| Basic geological research | 19,000 |
| Honduras: Industry mining coal resources development | 75,000 |
| Mexico: | |
| Minerals technology cooperation (Bureau of Mines) | 35,000 |
| Industry and mining (U.S. Geological Survey) | 59,000 |
| Peru: | |
| Advisory services mineral resources geology | 76,000 |
| Advisory services in mining and metallurgy | 42,000 |

*Industry and mining, fiscal year 1958*

| | Amount |
|---|---|
| **FAR EAST** | |
| China (Taiwan): | |
| Coal mine development | $689,000 |
| Mineral development, other than coal | 13,000 |
| Indonesian Republic: Mining operations | 154,000 |
| Korea: | |
| Coal mine development | 245,000 |
| Development metals and minerals mining | 630,000 |
| Mining and geological training | 79,000 |
| Philippines: | |
| Nonmetallic minerals survey | 52,000 |
| Strategic minerals survey | 397,000 |
| Technical assistance to the Bureau of Mines | 25,000 |
| Thailand: Mining development | 52,000 |
| Vietnam: Nong-Son coal exploration survey | 12,000 |
| **NEAR EAST AND SOUTH ASIA** | |
| Afghanistan: Mineral resources and coal production | 164,000 |
| Ceylon: Mineral exploration | 14,000 |
| India: | |
| Exploratory lignite excavation and development | 18,000 |
| Geological survey, India | 279,000 |
| Oil and gas commission | 41,000 |
| Assistance to coal industry | 10,000 |
| Israel: | |
| Minerals exploration and development | 82,000 |
| Conservation techniques in oilfield development | 6,000 |
| Nepal: Project for mineral deposit surveys | 130,000 |
| Pakistan: Geological Survey advisory service | 246,000 |
| Turkey: | |
| Zonguldak coal basin development | 62,000 |
| Preventive maintenance adviser | 20,000 |
| **AFRICA** | |
| Ghana: Geological training project | 8,000 |
| Libya: Minerals investigation | 66,000 |
| **OVERSEA TERRITORIES** | |
| United Kingdom: Increasing productivity of wolfram mining industry | 15,000 |
| **EUROPE** | |
| Spain: | |
| Civil aviation POL laboratory equipment | 12,000 |
| Copper mining productivity study | 11,000 |
| Yugoslavia: | |
| Mining and minerals (coal mining, coke, and coke byproducts) | 308,000 |
| Mining and mineral (nonmetallic minerals, asbestos) | 33,000 |
| Mining and minerals (cement production) | 20,000 |
| Mining and minerals (industrial and household ceramics) | 3,000 |
| Mining and minerals (nonmetallic minerals, chromium) | 33,000 |
| Technical inquiry service support (technical literature and film program) | 10,000 |

*Industry and mining, fiscal year 1958*—Continued

LATIN AMERICA

| | Amount |
|---|---|
| Argentina: Geology and mining training | $24,000 |
| Bolivia: Mining industry improvement program | 120,000 |
| Brazil: | |
| Geological education project | 23,000 |
| U.S. Geological Survey mineral resources investigations (nonferrous project) | 62,000 |
| U.S. Geological Survey mineral resources investigations (ferrous project) | 246,000 |
| Mineral resources development (USBM) | 28,000 |
| Chile: Geology | 217,000 |
| Colombia: Coal resources development in the Department of Cauca and the Cauca Valley | 25,000 |
| Cuba: | |
| Mineral analysis and development | 21,000 |
| Basic geological research | 6,000 |
| Honduras: Coal resources development | 13,000 |
| Mexico: | |
| Minerals technology cooperation (Bureau of Mines) | 38,000 |
| Geological Survey | 19,000 |
| Peru: | |
| Advisory services, mineral resources | 66,000 |
| Advisory services, mining and metallurgy | 60,000 |

OVERSEA TERRITORIES

| | |
|---|---|
| British Guania: Training in prospecting for minerals | 2,000 |

*Fiscal year 1959 projects*

FAR EAST

| | |
|---|---|
| China: | |
| Coal mine development | $996,000 |
| Mineral development | 27,000 |
| Indonesia: Mining operations | 162,000 |
| Korea: | |
| Coal mine development | 963,000 |
| Development metals and mineral mining (other than coal) | 1,249,000 |
| Mining and geological training | 29,000 |
| Laos: Mining and mineral survey | 215,000 |
| Philippines: | |
| Nonmetallic mineral survey | 29,000 |
| Strategic minerals survey | 228,000 |
| Technical assistance to the Bureau of Mines | 38,000 |
| Thailand: | |
| Mining development | 48,000 |
| Airborne geophysical survey | 30,000 |
| Vietnam: Nong-Son coal mine development | 1,630,000 |

NEAR EAST AND SOUTH ASIA

| | |
|---|---|
| Afghanistan: Mineral resources and coal production | 82,000 |
| Ceylon: Minerals exploration | 17,000 |
| India: | |
| Exploratory lignite excavation and development | 8,000 |
| Geological survey in India | 137,000 |
| Oil and gas commission | 12,000 |
| Assistance to coal industry | 27,000 |
| Israel: | |
| Minerals exploration and development | 78,000 |
| Conservation techniques in oilfield development | 6,000 |
| Nepal: Mineral resources development | 148,000 |
| Pakistan: Geological Survey advisory service | 164,000 |
| Turkey: | |
| Undersea coal mining operations | 3,000 |
| Institute of applied geology | 5,000 |

*Fiscal year 1959 projects*—Continued

| | Amount |
|---|---|
| **AFRICA** | |
| Ghana: | |
| Geological survey project | $168,000 |
| Industrial education project | 11,000 |
| Libya: Minerals investigation | 74,000 |
| **EUROPE** | |
| Spain: | |
| POL laboratory | 2,000 |
| USGC School of Photogeology | 4,000 |
| Oil exploration and production study | 8,000 |
| Yugoslavia: | |
| Mining and minerals (coal mining, coke, and coke byproducts) | 266,000 |
| Mining and minerals (nonmetallic minerals—asbestos) | 72,000 |
| Mining and minerals (cement production) | 81,000 |
| Mining and minerals (non metallic) chromium) | 18,000 |
| **LATIN AMERICA** | |
| Argentina: Geology and mining training | 26,000 |
| Bolivia: Increasing and diversifying mining production (supervised mining credit program) | 127,000 |
| Brazil: | |
| Geological education project | 120,000 |
| U.S. Geological Survey mineral resources investigations | 93,000 |
| U.S. Geological Survey mineral resources investigations | 198,000 |
| Mineral resources development | 31,000 |
| Chile: Geology | 274,000 |
| Colombia: Coal resources development in the department of Cauca and the Cauca Valley | 19,000 |
| Cuba: Mineral analysis and development | 24,000 |
| Honduras: Coal resources survey | 18,000 |
| Mexico: | |
| Minerals technology cooperation | 44,000 |
| Geological survey | 37,000 |
| Peru: | |
| Advisory services, mineral resources | 71,000 |
| Advisory services, mining and metallurgy | 54,000 |
| **OVERSEA TERRITORIES** | |
| British Guiana: Phototraining | 2,000 |
| The West Indies and East Caribbean: Preliminary survey—pumice and pozzuolanic earth deposits | 4,000 |

*Industry and mining, fiscal year 1960*

| | |
|---|---|
| **FAR EAST** | |
| China, Republic of: | |
| Coal mine development | $16,000 |
| Mineral development—other than coal | 623,000 |
| Indonesia: Minerals advisory services | 237,000 |
| Korea: | |
| Development of coal mines—diamond drilling | 1,330,000 |
| Metal and minerals development (other than coal) | 1,400,000 |
| Mining and geological training | 92,000 |
| Laos: Mining and mineral survey | 42,000 |
| Philippines: | |
| Nonmetallic minerals survey | 28,000 |
| Strategic minerals survey | 159,000 |
| Bureau of Mines administration improvement | 43,000 |
| Thailand: Mining development | 86,000 |
| Vietnam: Nong-Son coal mine development | 33,000 |

*Industry and mining, fiscal year 1960*—Continued

| | Amount |
|---|---|
| **NEAR EAST AND SOUTH ASIA** | |
| Afghanistan: | |
| Mineral resources and coal production | $163,000 |
| Mineral resources and coal production—reobligation | 16,000 |
| Ceylon: | |
| Minerals exploration | 22,000 |
| Minerals exploration—reobligation | 2,000 |
| India: | |
| Geological survey of India | 124,000 |
| Oil and gas commission | 33,000 |
| Assistance to coal industry | 30,000 |
| Israel: | |
| Minerals exploration and development | 81,000 |
| Conservation techniques in oilfield development | 38,000 |
| Nepal: Mineral resources development | 44,000 |
| Pakistan: Bureau of Mines and Geological Survey advisory | 143,000 |
| Turkey: | |
| Preventive maintenance adviser | 1,000 |
| Institute of Applied Geology | 20,000 |
| Central Treaty Organization: CENTO regional mineral meetings | 7,000 |
| **AFRICA** | |
| Libya: Minerals investigation | 99,000 |
| **EUROPE** | |
| Spain: POL laboratory | 1,000 |
| Yugoslavia: | |
| Coal production and utilization | 257,000 |
| Mining and minerals (cement production) | 135,000 |
| Industrial information service | 48,000 |
| Technical inquiry service support | 5,000 |
| Minerals development | 55,000 |
| Minerals development—reobligation | 9,000 |
| **LATIN AMERICA** | |
| Argentina: Geology and mining training | 103,000 |
| Bolivia: | |
| Minerals survey | 25,000 |
| Minerals management and production study | 25,000 |
| Brazil: | |
| Geological education project | 145,000 |
| U.S. Geological Survey mineral resources—investigations, nonferrous project | 87,000 |
| U.S. Geological Survey resources investigations—ferrous project | 201,000 |
| Colombia: Coal resources development | 17,000 |
| Cuba: Minerals analysis and development | 1,000 |
| Honduras: Coal resources survey | 13,000 |
| Mexico: | |
| Minerals technology cooperation | 34,000 |
| Geological survey | 49,000 |
| Peru: | |
| Advisory services, mineral resources | 14,000 |
| Advisory services, mining and metallurgy | 53,000 |

*Industry and mining, fiscal year 1961*

| | Amount |
|---|---|
| **FAR EAST** | |
| China, Republic of: Mineral development—other than coal | $841,000 |
| Indonesia: Minerals advisory services | 193,000 |
| Korea: | |
| Development of coal mines—diamond drilling | 471,000 |
| Metal and minerals development—other than coal | 275,000 |
| Laos: Mining and mineral survey | 30,000 |
| Philippines: Mineral development | 156,000 |
| Thailand: Mining development | 195,000 |
| Vietnam: Nong-Son coal mine development | 30,000 |
| **NEAR EAST AND SOUTH ASIA** | |
| Afghanistan: Mineral resources and coal production | 472,000 |
| Ceylon: Minerals exploration | 18,000 |
| India: | |
| Geological survey of India | 44,000 |
| Oil and gas commission | 26,000 |
| Assistance to coal industry | 326,000 |
| Israel: | |
| Minerals exploration and development | 39,000 |
| Conservation techniques in oilfield development | 6,000 |
| Pakistan: Bureau of Mines and Geological Survey—advisory | 441,000 |
| Turkey: Institute of Applied Geology | 29,000 |
| Central Treaty Organization: CENTO regional mineral meetings | 14,000 |
| **AFRICA** | |
| Libya: Minerals investigation | 360,000 |
| Malagasy Republic: minerals survey | 13,000 |
| Uganda: Increase productivity of wolfram mining industry | 1,000 |
| **LATIN AMERICA** | |
| Argentina: Geology and mining training | 21,000 |
| Bolivia: minerals survey | 131,000 |
| Brazil: | |
| Geological education | 139,000 |
| U.S. Geological Survey mineral resources investigation (nonferrous project) | 230,000 |
| U.S. Geological Survey mineral resources investigation (ferrous project | 167,000 |
| Chile: Geology | 277,000 |
| Mexico: | |
| Minerals technology cooperation | 50,000 |
| Geological survey | 77,000 |
| Peru: Advisory services, mining and metallurgy | 17,000 |
| **EUROPE** | |
| Yugoslavia: | |
| Coal—production and utilization | 45,000 |
| Minerals development | 390,000 |
| Geological Institute | 47,000 |

Senator GRUENING. I think these statistics have a bearing on the amount for which we want to ask. I hope it will be an amount that will bear some reasonable proportion to the amount you are intending to apply.

Do you have any questions?

Senator DOMINICK. Yes, I have a great many of them, Mr. Chairman. I would like to know first of all whether this has any relationship to the effort that we are all making to try and do something about the development of the oil shale problem we have, working it out?

Mr. ROSENBAUM. A typical example of the kind of thing we might do would be to make a grant to the University of Wyoming for oil-shale studies, with the university's staff working very closely with our own staff at the Laramie petroleum center on oil-shale problems. There might very well be some propects of determining certain characteristics of oil shales such as the relationship of the basic structure of the rock to the heat transfer rate through the rock.

Senator DOMINICK. Mr. Chairman, I would like to say for the record that I just finished giving a speech before the Cyrogenics Engineering Conference in Boulder, Colo., pointing out that approximately 90 percent of the money spent on research now is coming out of the general taxpayer and that part of the problem is that at this point research is now being put into terms of what the Federal program is rather than having the Federal program fit into what the research is supposed to be.

This has created control by the Federal Government of the research aspect all over this country and it is creating a serious degree of problems in my mind on basic research and on the question of whether we are going to advance by the ability of independent researchers of their own ideas or whether they are going to be governed by the Federal Government.

This, I think, is part of the same problem that we are going to face in this bill if we go forward with it, so I just start out that way. Secondly, I want to say that as far as I am concerned I would never agree willingly to pass out a bill from this committee with an open-end authorization.

Thirdly, I do not know why we need more specific research programs authorized by the Bureau of Mines when we have research programs in metallurgy and everything else now authorized under the National Development Education Act, under the AEC, under the National Science Foundation, under so many different agencies and organizations at the present time that if people wanted to go ahead on research in this way they have ample Government facilities to do it right now.

Now, having blown my top to that extent, I would now like to know why it is necessary for the Bureau of Mines to have specific authorization to enter into contractual arrangements with universities for research programs? Do you not now have the authority to do this under your appropriations, or is the general law deficient in it, because the Interior Department as a whole does a good deal of this throughout the country?

Mr. ANKENY. Not only do we not have authority to do it under our general appropriation bills, but it has been determined that we do not have such authority under our Organic Act or any amendment to the

Organic Act, and this bill, as I understand it, virtually is an amendment to the Organic Act of 1910, which will allow us to make these research grants.

Senator DOMINICK. To the extent that you made research grants would you then cut down on your own research within the Bureau of Mines, or would this be an addition to it?

Mr. ANKENY. It isn't contemplated that this will result in cutting down our own research. I think in my statement here we say that we have two purposes. One of them was to help us carry out our primary responsibility of minerals research and, second was the thought generally to develop more technical people in minerals in the field.

Senator GRUENING. May I interrupt to answer your question, Senator Dominick. The Comptroller General's letter, which will be in the record, says that the Bureau is not authorized by existing law to make grants of funds or enter into contracts for research and development work in several broad categories proposed.

Senator DOMINICK. But it is now giving research fellowships, as stated in Mr. Ankeny's own statement.

Mr. ROSENBAUM. That is another thing. These research fellowships are actually assistantships. What happens is that we arrange with the school for a suitable candidate who has to be qualified under civil service regulations and he actually works as a part-time employee of the Bureau of Mines.

He gets paid for such time he actually puts in at the Bureau of Mines or under Bureau of Mines supervision on a particular project.

Senator GRUENING. Wouldn't it be well, Mr. Ankeny, if the Department made a little study which would be responsive to the thought that Senator Dominick has expressed, showing just exactly what the opportunities are in all branches of the Government for this type of research, summarizes the Development Education Act and all the others, so that you could demonstrate, if you can, why there is a need for this. I am not saying that there isn't, but I think it would be useful. I think Senator Dominick has raised a very important question.

Mr. CALHOUN. Mr. Chairman, may I take a crack at answering that? My name is John C. Calhoun. I am science adviser to Secretary Udall. I think Mr. Ankeny does himself a disservice here by phrasing the advantages of this bill entirely in terms of universities. This authority is necessary, in my opinion, if the Bureau of Mines is to do an effective and efficient job in its own program.

The reason Mr. Ankeny needs to tie up with the colleges and universities is not to strengthen them, but to strengthen him. He has to have their talents, and their ideas, and their concepts to put in the mill to back up his basic research.

As I say in my prepared testimony here, knowledge is a resource that has to be developed just like any other resource, and just as it is necessary to do exploratory work in the development of a mineral resource, it is necessary to do exploratory work in the development of knowledge resource.

The whole program of the Bureau of Mines rests on knowledge, and they are missing a significant part of their own program if they do not have the opportunity to explore and develop the knowledge resource that is available to them, which is found in the colleges and universities of this Nation.

This is fundamentally why they need this authority. Now, companion to this, of course, will be two auxiliary results. One, it will strengthen the universities at the same time because of the training of scientists and the advancement of science together. Second, it will provide another thing which he hasn't mentioned. It will provide a broad involvement of many more people in problems of the mineral industries. You broaden out your base of people who are interested and willing to work and bring their ideas to you unsolicited.

If you have a university professor who has, in the locale of his own State, worked on a mining or minerals problem and he has analyzed it within the context of all the local situations, he could bring this analysis to the attention of the Bureau of Mines, which he will not do now because there is no mechanism for his doing so.

Senator DOMINICK. Why not? All he has to do is walk in and give them the paper.

Mr. CALHOUN. It takes more than his walking in and giving a paper. For instance, let us take all the funds from the National Defense Education Act, and the National Science Foundation, the Space Agency, or any other Federal agency you want to mention.

There is not a one of them to which a mining professor can go and get a contract for research on mining engineering because there are none of them that have this specific authority. You must develop an interest among the colleges and universities in your problems if you want them to work on your problems, and there is not, to the best of my knowledge, one of the universities that has been able to crack the National Development Education Act for fellowships in mining engineering, or petroleum engineering, or allied fields.

They have cracked it in physical metallurgy, but not in the minerals development field.

Mr. BRIGHT. For example, we have sent proposals to the National Science Foundation, and agency with which I like to deal, on engineering. They come right back and say "these are not basic. They are applied in our opinion. We cannot consider them." I have had experience after experience in this area.

Senator DOMINICK. I just understood him to say that what you wanted to do was basic research and not applied development.

Mr. BRIGHT. That is his opinion.

Senator DOMINICK. If you do the basic research you can do it under all these acts. If you are doing it and doing applied development it would seem to me that you have the companies and you have the other resources, including for example, the Colorado School of Mines Research Foundation, which does a tremendous job.

Senator GRUENING. I don't see why we should be limited to the view of any one individual here. I think the committee will study this bill and when we hear the other testimony I think we will discover various fields in which such research and such a program is important, and I don't think we can prescribe right now what the limitations of this are going to be.

I don't think we should.

Mr. WALKER. I wonder if I might make my comment here?

Mr. CALHOUN. Mr. Chairman, I am going to have to leave. I received the call from the Secretary's office to brief him at 12:15, and I am a little late.

Senator GRUENING. You will file your statement, will you not?

Mr. CALHOUN. My statement is on file here and I have given it to the reporter.

Senator GRUENING. Thank you, Mr. Calhoun.

(The statement referred to follows:)

STATEMENT BY JOHN C. CALHOUN, JR., SCIENCE ADVISER TO SECRETARY OF THE INTERIOR UDALL

Gentlemen, my name is John C. Calhoun, Jr. I am Special Assistant and Science Adviser to Secretary Udall, Department of the Interior. I am happy to have the opportunity to appear before you and comment upon the appropriateness of Senate bill 1166. As I understand the bill, it would provide authority for the Secretary of the Interior to enter into contracts with and make grants to colleges and universities or to organizations under the administrative control of colleges and universities for the conduct of research and development in programs of the Bureau of Mines.

In my opinion, Senate bill 1166 is much needed legislation. I believe that the Bureau of Mines cannot do as effective a job without this authority as they can do if the authority is granted. Director Ankeny has gone into the details of many of the reasons for the desirability of this legislation, which views I share, and the Department's letter of June 10, 1963, from Assistant Secretary Kelly to Senator JACKSON also outlines these reasons. At the risk of being redundant, I would like, however, to take a few moments of your time to highlight what I think are the underlying principles that make this legislation so desirable.

Research involves, among other things, a search for new ideas. The research mind, to be most effective, must be aware of any concept in any discipline which may have a bearing upon the particular research activity which is of immediate concern. Creative ideas and concepts feed all areas of research and from this we have evolved our notions of the importance of basic research.

It is an accepted fact that the probabilities are much greater for the emergence of new scientific ideas and concepts within the university structure than they are in any other place. After all, it is the universities' business to uncover knowledge. The universities are in the forefront of knowledge in all fields, and it behooves any person or agency engaged in research to avail itself of the benefits of a close relationship with universities.

An analogy may be helpful. Basic knowledge, ideas, and concepts are a resource. Just as it is necessary to do exploratory effort if one desires to develop a mineral resource, so is it necessary to do exploratory effort if one desires to develop knowledge as a resource. The authority proposed by S. 1166 will enable the Bureau of Mines to explore the resource of ideas, concepts and knowledge possessed by the colleges and universities, in order to extract elements that will augment, redirect, and provide greater efficiency to progress on Bureau of Mines research programs. The advantages of this type of close liaison have been demonstrated in many other research fields and, in my opinion, the use of a strong university relationship of this sort is long overdue for the Bureau of Mines program.

A second point that I would emphasize relates to the scientists who are available to work on research programs in the mineral field and to the awareness of problems in the minerals field that is posesssed by members of the university community. The conduct of research and the advancement of science go hand in glove with the education and development of scientists. If the Bureau of Mines is to have access to a pool of scientifically trained young persons having familiarity with minerals problems, it is necessary that the maximum knowledge about the minerals program and minerals problems exist within the university structure.

The impact of university scientists and professors on the career of a young person cannot be overestimated. This is particularly true of graduate students who are learning the intricacies of research and the scientific method and who are becoming imbued with a challenge toward which they can devote their lives. If there is a relatively small number of professors who are imbued with the excitement of research in mineral resources or who are aware of the basic research problems associated with mineral development, then there will be a paucity of graduate students who are also bent in this direction. The most obvious way to interest more high quality graduate students and young scientists in the problems

of research in the minerals industry is to make sure that their professors are also conscious of these problems and aware of what can be done. One very excellent and primary way of achieving this type of relationship is through the mechanism of contracts and grants between the Bureau of Mines and the colleges and universities of America.

In this respect, I emphasize that in the post-World War II years the American colleges of mines and the university programs in the mineral industries have not been able to advance as they should to maintain healthy educational support for our mineral industries. Not only have students been enticed into more glamorous fields, but more importantly, the quality and quantity of university staff members available for these programs has deteriorated. In some universities, departments of mining engineering have gone out of existence. Part of the reason has been the lack of any clear-cut relationship between these educational programs and the Bureau of Mines, a relationship which would have mutually strengthened both the universities and the Bureau of Mines programs. Although these schools of mines are now on the way up, we have lost several valuable years, in my opinion. A total strengthening of the supply of talented scientists for the mineral industries can be achieved through the authority allowed by S. 1166.

Let me emphasize finally that the authority provided in S. 1166 would essentially bring the Bureau of Mines program to the attention of the entire university and scientific community. The effect of this authority would be to create a much broader base of people interested in and willing to work on problems of the mineral industries. It has the further desirable result of providing a two-way channel through which evolving problems in the minerals industries, particularly those of a local nature, can be brought to the attention of the Bureau of Mines scientists. The professor working in a State university will often have analyzed a local mineral industry's problem in context with other local conditions, and will be in an excellent position to bring his analysis to the attention of the Bureau of Mines if a mechanism is provided for his interest and participation. Communication is, after all, a two-way street. Not only would S. 1166 provide a channel for engaging university people and embryonic scientists in the problems of the Bureau of Mines but it would also be a channel for these people to put their ideas and understandings of the mineral industry into the Bureau of Mines program.

In summary, S. 1166 is a forward step for the Bureau of Mines and is the kind of authority which I think is needed to bring the maximum sector of America's scientific talent to bear on the efficient progress of research in the minerals field.

### Supplement to the Statement of John C. Calhoun, Jr.

At the request of the subcommittee chairman, I offer the following supplement to my statement in support of S. 1166, justifying the importance of the legislation and clarifying questions raised during the formal presentation of testimony.

Senate bill 1166 is justified primarily on the grounds that its authority will permit the Bureau of Mines to do a more effective and efficient job of research. Effectiveness and efficiency will be improved in several ways. First, the authority to enter into contracts with and make grants to colleges and universities will permit the Bureau to engage the best talent for the conduct of its research, wherever that talent may exist. The best talent for a given research area often exists in a university or college. Under the present circumstances, without contracting and grant authority, the Bureau has no means for making use of creative research persons who are not directly in the employ of the Bureau. This is to the Bureau's disadvantage.

Second, this authority will improve the effectiveness and efficiency of the Bureau of Mines research program by permitting the Bureau to give attention to new areas of research on an exploratory basis without committing the Bureau to a continuing program. This will be a particularly helpful device when the area of research to be explored is one in which the Bureau has not built up expertise or past competency. The ability to enter into research areas on a small or exploratory basis by making use of selected outside groups of experts is not now possible in the Bureau of Mines. The Bureau can only do this when the experts exist within its own organization.

Third, the effectiveness and efficiency of the Bureau of Mines research program will be improved by the authority under S. 1166 by permitting the Bureau to conduct research in specialized areas without building up a large in-house

competency. Some times the in-house competency may require expensive or specialized equipment or a unique kind of experimental facility that is available in only one university location. Under the present lack of contracting authority, the Bureau has two alternatives. Either it does not do work where specialized and unique facilities are necessary, or it creates its own unique and specialized facilities. University contracting authority would give a third alternative to the Bureau when efficiency would dictate against both of the current two alternatives.

In addition to the primary justification for S. 1166, there are two secondary justifications. One justification is that the contracting and grant authority will bring the Bureau of Mines research program to the attention of more people in the academic community and enlist the capabilities of their particular academic disciplines for the solution of Bureau problems. The involvement and interest of more academic scientists in the particular problems of the minerals industries will create a broader sphere of concern that will be to the advantage of the total growth of science and research in the minerals field.

Another secondary justification relates to the need to improve education of highly specialized and trained people for support of mineral industries research. The Bureau of Mines, like other Federal agencies, must rely upon the universities for the training of creative scientists who are particularly interested in the mission research problems in the Bureau of Mines and are willing to devote their careers to this purpose. The academic person now interested in directing students to the minerals area has no particular Federal channel to which he can turn for support. The fact is that the cadre of academic people who might be allied to minerals research can obtain support for their creative ideas through other mission-oriented Federal agencies. This diverts their efforts to the research goals of those agencies rather than to those of the minerals field.

In my opinion, to build university education and research programs to advance mineral research it is necessary to establish direct relationships between the universities and the Federal agency which has the primary research mission in this subject area; namely, the Bureau of Mines. Only in this way can the talents of the creative students and the stimulating professors be focused upon problems of research in the minerals field.

Mr. WALKER. I am Dr. Walker, Penn State University. I think there are two things here. I would agree with Dr. Calhoun that I think you should turn the thing around and not ask what this bill can do for universities, but in essence what the bill can do for the Bureau of Mines. It seems to me that there are really four different groups or agencies who will benefit under the contract: Industry, universities, Federal Government, and the applied research groups.

If you will look at most of the other agencies of the Government which are responsible for doing this, the AEC, the NASA group, the complete Defense Department group, these agencies all have the right to appropriate some of their funds to universities as they deem necessary to do basic research or good applied engineering research in the fields of interest to them.

It seems to me the question here is: Should the Bureau of Mines have the same right? As long as the Bureau of Mines has the responsibility in certain areas, or happens to have the very broad mineral field, then the Bureau of Mines should have the same right as these other agencies to achieve their overall responsibility.

We can argue a long time about whether some of the types of things the Bureau of Mines might want to be supported in universities is being supported by other groups. This is, of course, a very difficult question. However, I would say in two areas I also know something about, one, process metallurgy, and second, the broad area of coal research, the universities are really being excluded pretty well by the Federal Government so far as any support from the Federal Government for helping these areas advance.

It is true that the National Science Foundation in the Engineering Division does support a fair amount of materials research. This materials research, as has been pointed out previously, is almost entirely in the area of physical metallurgy, in material science effort, but little in the area of the process metallurgy.

I would also say that I think it somewhat unfortunate to talk about how much money this is going to cost when I think of the importance of this, but it seems to me that the basic point here is one of principle and the principle is: Shouldn't the Bureau of Mines have the same opportunity to enlist universities, private research organizations, and industry?

Incidentally, again these other agencies, the AEC, for example, have many contracts with industry also. Should not the Bureau of Mines have the same privilege along with its responsibility in the minerals field?

I might just point out one more thing which I think is of interest. Personally, I happen to be fairly closely connected with the Atomic Energy Commission in research. Senator Dominick made the comment that he was concerned about the possibility of too much Federal control of university research in this broad area. I would say that this, in my judgment, is not happening in these areas.

For example, in the case of the AEC, they are supporting good basic research in areas in which they feel they need help. University professors working in this area then have a built-in contact with people in the AEC installations who are doing more applied research along with some basic research.

It is a built-in back and forth program which has worked to the great enthusiasm of the AEC. For example, the AEC has at the moment 95 programs in physics in American universities costing $21 million. Incidentally, these are 1960 figures. There are 247 programs in chemistry costing $6 million, and 20 in metallurgy, incidentally, costing $4.2 million.

I would simply say again that any agency to really discharge its responsibility in research needs to be able to find and utilize the best brains in industry, in universities, in private research groups, in addition to their own groups.

Senator GRUENING. Thank you very much. I think your testimony, Dr. Walker, is very helpful. I would say that this bill and this hearing are closely related to the point that Senator Bible made, that we want to find out what is wrong with our mining industry and what we can do to help it. It isn't all going to be done in this committee.

It has to do with questions of tariffs, and quotas, and this, that, and the other thing, but that is what this subcommittee aims to try to do and I think it is of importance that we explore this very fully in line with the points that Senator Dominick has raised as to whether this is merely piling an additional layer on existing cake, or whether this is going to do something that will really fill a field that is not now being filled.

I think that is the essence of what we are trying to learn. If it is going to fill a field that needs to be filled we want to go ahead with it. On the other hand, if it is merely duplication, which I think your testimony indicates it is not, we want to proceed with it and spell it out as effectively as we can.

Mr. WALKER. I was raising a very difficult point because many agencies, the Office of Naval Research, the Atomic Energy Commission, NASA, all are supporting sizable university programs in metallurgy, but I want to emphasize again that it is primarily in solid state metallurgy or commonly called physical metallurgy, almost completely lacking in the areas of mining, in the areas of preparation, in the area of the process metallurgy of materials.

These areas are pretty much lacking in these agencies.

Senator DOMINICK. Dr. Walker, is it possible, therefore, that the problem is in the direction of the research rather than in the available research sources?

Mr. WALKER. You mean direction of these other agencies are wrong?

Senator DOMINICK. Correct.

Mr. WALKER. I would say again that the other agencies, as I would see it, do not have the responsibility in mining or in preparation. This responsibility is with the Bureau of Mines. I don't think the Navy, or the AEC, or NASA should primarily have responsibility for the mining or benefication of materials.

Their prime responsibility, which they are taking, is the utilization of the minerals once they are mined and beneficiated. You certainly could have an argument on should one of the agencies take over this responsibility, and I would say again that I think the Bureau of Mines has this responsibility alone.

Mr. ROSENBAUM. If I might substantiate the statement that Mr. Walker made about the lack of support in mining and extractive metallurgy from any other Government agency or any other source, he indicated he thought this was very small. Actually it is essentially nonexistent.

The Atomic Energy Commission at one time, when they first were learning how to process uranium ore, did award some contracts in extractive metallurgy. Currently the only extractive metallurgy contract that the Atomic Energy Commission has out is with the U.S. Bureau of Mines at Salt Lake City.

There is no other and hasn't been any other for 3 or 4 years. The Defense Department is not one iota interested in supporting research that relates to extractive metallurgy and they say, and rightly, this is the function of the Bureau of Mines. They will not touch it.

Senator GRUENING. May I suggest as a result of this conversation—that may be covered in some of your statements—if we could now get a statement that will cover this specific point, that there is a substantial field or fields which are not being covered by this other research and what those fields are and what their importance is, I think that would be very helpful to the subcommittee.

Senator DOMINICK. I do too, Mr. Chairman, and I wonder if we could find out if there is any compilation of the research programs in the mining and metallurgy field which are now being conducted through other agencies. I think this would be helpful to us.

Senator GRUENING. I think the Bureau of Mines would be glad to undertake that.

Mr. ANKENY. Yes.

(The information requested is printed on p. 19.)

Senator GRUENING. That would round out this important question.

Mr. WALKER. I would just add again we should not be misled by the broad term "metallurgy," because there is a great deal of money being spent today, and rightly so, in the field of material science or solid state material science, NASA, and other groups. This is not for mining or beneficiation. I would caution the group to look at this figure for metallurgy very, very carefully, because for metallurgy as a whole it will not have too much meaning.

Senator DOMINICK. I just want to say for the record that the entire Congress is faced with the building of a $10 billion deficit on programs that are going on now. It is a little difficult for me to institute something that is wholly new if some other agency is capable at least of taking care of the problems we are faced with.

Mr. VOLIN. I would like to offer some specific examples that might be of interest to Senator Dominick. I am M. E. Volin, director of mineral research, a division of Michigan College of Mining and Technology, and we are engaged in mineral research, extractive metallurgy research, right now in physical metallurgical research.

I have submitted several proposals to the National Science Foundation for research projects and have had these denied, mostly on the ground that they are not fundamental research. The National Science Foundation is primarily interested in supporting fundamental research, which is considerably in a different field than applied and may overlap basic, but they use the word "fundamental" and they invariably turn down a program if it is not fundamental enough.

I have also submitted several programs to the AEC and found that that Agency was not particularly interested in extractive metallurgy of uranium or mining of uranium. They were more interested in the extraction of uranium metal and the areas that you might call physical metallurgy.

Although my organization has gained quite a lot of know-how in the last 8 years in conducting iron ore research, research in the mining and extraction of iron ore and the processing of it, to a point where it would be a product of the blast furnace, we have not been able to attract or get research support from Federal agencies on this subject or in this area, with the result that we have gone into other areas.

For instance, we have been able to get a project with the Bureau of Public Roads, which is getting out of our field. In other words, I want to bring out the point here that as a result of not being able to find support in our field, we are going out of our field into other fields.

Senator GRUENING. What are the fields, may I ask?

Mr. WALKER. The project with the Bureau of Public Roads is concerned with aggregate for concrete used in highways.

Senator GRUENING. I think that the point that Senator Dominick makes is very well taken. We have research all over the lot. We don't know how coordinated it is. We don't know what duplication there is, and this is a very vital issue. We have this tremendous deficit, and I am personally very sympathetic with the approach, but I think we have to have justification for it. I think the subcommittee would have to feel that this isn't just something else that we are piling on to an existing series of structures.

Mr. VOLIN. I know of no Federal agency where I can present a proposal based on ideas I have or my organization has, this proposal

for the support of research in mining and extractive metallurgy of minerals.

Senator GRUENING. I was just going to suggest would it be possible, now that you are all here together, to get together, pool your respective knowledge, and come up with a report that will answer that very question, that this bill would do something that is not being done or that cannot be done by these other agencies and why that is important.

Mr. VOLIN. I believe that has been brought out.

Senator GRUENING. I think it has, but we would like to have it in a comprehensive form and with all possible detail. I am sure that each of you has several things to contribute here.

Senator DOMINICK. I might add, Mr. Chairman, to that very thing, that it would also be of interest, to me at least, and I would suspect to other members of the subcommittee, to find out why it is necessary to go to the Federal Government for these and why it cannot be done through private industries or other private agencies.

Mr. VOLIN. I would like to try to answer that because in my notes here I had a comment along that line. The private industries are concerned with applied research and developmental research. They want to bring something to a venture with a profitable realization. As a basis for this they need new knowledge. They need new technologists. They need basic information, and many times, the applied research can't go forward because the basic knowledge has not been developed and does not exist.

There is often in other areas, but particularly in the mineral field, a lack of basic information on which new technologies can be built.

Senator DOMINICK. Dr. Volin, I think your testimony has been very helpful, but I do get confused, and maybe it is semantics. It is my understanding that there are existing Government programs which take care of basic research and that yours have been turned down because it is considered it is applied, and now you say that the private industries will do the applied, but not the basic. There would seem to be two areas in which to go.

Mr. VOLIN. There are semantics involved here and it is hard to make a hard and fast definition of basic and applied research. The National Science Foundation has attempted to do this and has published such a definition in their brochure for preparation and proposals.

Mr. BRIGHT. I suggest you bring in a third element which might help it out. I am now referring to National Science Foundation publication, because it brings in—what do they call it? Research and development, or at least product development, and goes to some industries in the home State of anyone of you, and you will find many of the industries spending 95, 96 percent of their research funds in what is really product development. It isn't applied research in the sense in which I think you might be talking about.

Mr. VOLIN. I would like to bring out this figure. It has been published by the National Science Foundation that of all the funds spent for research, only 8 percent of these funds are spent on basic or fundamental research. These are the funds spent by the Government for research, so when you are talking about 95 percent of all research being supported by the Government, only 8 percent of that can be expected to be in the basic category or fundamental category.

Mr. WALKER. I think it is a little bit even beyond that, in that I would say take the National Science Foundation in support, for example, of their materials research program, and you take the AEC in their Basic Research Division. They also have a materials research program. The NSF work is, of course, basic research support of universities, but in the Basic Research Division of the AEC, that research-supported university is just as basic as the NSF program.

Then you might ask why have two agencies, and there are others, both supporting basic research programs in essentially the same area. The answer is, I think, so far as the AEC and other agencies are concerned, that they profit by some contact with universities insofar as their overall objectives and responsibilities are concerned.

Just take the AEC, for example, and their support of research for Midland Carbon Outlay. It is basic research. They have a certain amount there, generally trying to grab students. The AEC has considerable interest in the gas core reactor. Their own installations are doing research, but in my case, I do attend the gas core reactor meetings in New England and at Oak Ridge along with some of the AEC people, so you have this built-in contact where with all of the basic research we are funneling out of the National Science Foundation these agencies could not benefit by the direct university contacts that they now get.

The second point is trying to get people. Again, if a student gets an assistantship or fellowship—you see this all the time with regard to companies—if a student gets a fellowship from a certain company, there is nothing binding to say that this student must go to that company when he completes his Ph. D. work, but the built-in contacts, the fact that the company is supporting somebody at the university, the fact that the company checks him from time to time to see how the student is doing, means that in many cases that student has known that company and chooses to go to that company, and it helps that field of work.

The same thing here. The Bureau of Mines has gone on record that they need well-trained men in certain areas. The best way to get these well-trained men is to have close contact with universities in which students are being trained in these areas; students who can come in contact with the Bureau of Mines during their training program. The Bureau of Mines then has a pretty good chance of getting these students when they finish school. So there is a real reason for these agencies which have more applied missions to also have some basic research support to give the universities to enable them to make the contacts they need with universities.

Senator GRUENING. May I suggest that the hour is getting late. I don't want to foreclose any of this important testimony. I think perhaps the best way of arriving at this is if each one of you would add to whatever you have said and send it in to the committe. I am going to ask Mr. Stewart French to locate it in one report which will have the combined views of all you people. Then you will not have to get together individually and do that. Then we will have a report, the objective of which will be to show why this bill is necessary in your view, why it will do things that are not being done otherwise, and cannot be done otherwise. Is that satisfactory?

Senator DOMINICK. That would help very much, I think.

Mr. VOLIN. Is there any time limit on this? How soon would you like this?

Senator GRUENING. Take your time. Let us say by the middle of next month, the 15th of September. Would that be agreeable?

Mr. VOLIN. Fine.

Senator GRUENING. We will get transcripts of this out as rapidly as possible, and they should be sent to every witness here because this has been a rather unusual round-table discussion rather than the usual thing.

Mr. WALKER. May I just make one more comment on this line?

Senator GRUENING. Yes indeed.

Mr. WALKER. The consideration of this bill was being related to many additional funds that the Bureau of Mines needs. This is, of course, their business, but from my standpoint, it seems to me this is the wrong way to look at it. I am asking the question: Do we have to tie in at this time an increase in appropriations to the Bureau of Mines with recognizing the fact that the philosophy behind this bill is good, that the Bureau of Mines should have the right to contract research with universities? Does this increase in appropriation thing have to more or less muddy the waters insofar as the other factors are concerned?

Mr. ANKENY. I don't think it does. I still say that there should be a limitation on the amount of money that can be spent for this purpose and I think our regular appropriations for the support of our own activities should be kept separate from contract appropriations and I think that contract appropriations should be justified before the Appropriations Committees specifically in each instance. I think with that, if you follow those principles, we are not going to go too far out and spend unnecessary money for research.

Mr. BRIGHT. Mr. Chairman, I would like to ask that my prepared statement be added to the record.

Senator GRUENING. Yes indeed, and would you like to testify?

Mr. BRIGHT. I don't need to because you have covered the important points.

Senator GRUENING. Are there any other prepared statements?

Mr. WALKER. Yes.

Senator GRUENING. They will all be included in the record.

Mr. VOLIN. I only have a handwritten one. May I include this?

Senator GRUENING. Yes indeed. Please do not feel that anything you have already said will be duplicated by this additional testimony, but just duplication that will be useful, because I think we have brought out some of the questions that are in the mind of Senator Dominick and my own mind and I think in the minds of other members of the subcommittee, although I can't speak for them.

(The statements referred to follow:)

PREPARED STATEMENT OF DR. J. RUSSELL BRIGHT, DIRECTOR, OFFICE OF RESEARCH ADMINISTRATION, WAYNE STATE UNIVERSITY, DETROIT, MICH.

Mr. Chairman, I wish to discuss briefly, from the standpoint of significance in our current economy, what this bill means. I want to indicate what I think more active research programs—both "fundamental" and "applied" can contribute to the improvement of the mining industry. I am speaking as a research administrator and as a professor of chemistry at Wayne State University in Detroit, Mich.; with a background of 20 years of teaching and now more than 5 years of full-time experience in research administration at the university level.

A bit later I will refer to Michigan's geological survey division, which was established in 1837. Rather soon I will refer to some specific cases for Michigan. Because of my longtime experience as a scientist and as a research administrator, I see university-industry interaction as a real basis for finding an answer to the problems now inherent in the "decline of the mining industry." As I understand it, S. 1166 relates to—

1. mining;
2. the preparation, treatment, and utilization of mineral substances;
3. health conditions and safety; and
4. efficiency, economic development, and conservation of resources of the mineral and fuel industries.

On a day-to-day basis, the industry solves many practical problems, but somebody needs to find out the "why" in some of the cases. This requires fundamental or basic research which is best done at a college or university. In a recent conversation with Mr. Stanley W. Sundeen, manager of research and ore development, the Cleveland-Cliffs Iron Co., in Ishpeming, Mich., I learned that he agrees in principle with the provisions of S. 1166. We both agreed that the ultimate success of the proposed program of contracts and grants depends in large part on the "mechanics" provided for its implementation. In addition to performance of the basic research, the colleges and universities are well equipped to take the initiative in improving the channels of communication and techniques for collaboration between those who do research and those who are primarily concerned with production and production processes.

The decline of the mining industry in Michigan's Upper Peninsula is notorious. Unfortunately, not enough publicity has been given to some current examples of ways in which the economic climate of Michigan (and therefore, of the United States) has been aided by the type of collaboration to which I just referred. Two examples are given below:

I. "Facing Foreign Competition" in a 600-word brief from the Cleveland-Cliffs Iron Co., of Ishpeming, entitled "Pellets—The Iron Ore Industry Answer to Competition."

II. "Profitable Utilization of a Natural Resource Through College Research" in a three-page statement about Michigan's newest and largest copper mine: White Pine Copper Co.

### Facing Foreign Competition

#### Pellets—The Iron Ore Industry Answer to Competition

In Michigan there currently are four developments which utilize the natural resource—low-grade iron ore—on a large scale. One of these is the Hanna Mining Co.'s Groveland project in Dickinson County. The other three are projects in Marquette County developed by the Cleveland-Cliffs Iron Co. as joint ventures with several steel producing companies. These are the Humboldt Mine, opened in 1954 and expanded to where it now produces in excess of 700,000 tons of pellets per year; the Republic Mine, opened in 1956 and now producing through two major expansions in excess of 2,400,000 tons per year (and being further expanded to 2,800,000 tons per year); and the Empire Mine about to open in late 1963 with an expected pellet output of 1,200,000 tons per year.

It can be conservatively estimated that these four projects involve over $120 million of capital investment. They are expected to operate for a minimum of 20 years. They will certainly employ over 1,300 men steadily and further expansion is foreseeable. The impact of this employment in the local areas is readily appreciated but there are further ranging effects, because of the availability of this very desirable form of blast furnace iron ore, that are less apparent but nonetheless very important as contributions to the overall productivity of the steel industry and therefore our total U.S. economy. Furnace output rates have shown increases as high as 100 percent and commonly 20 percent when pellets have been substituted for conventional natural iron ores in high proportion. This pellet development, therefore, steps up steel industry productivity but it also creates a usable resource from heretofore useless iron formation.

There were at least three prime factors that provided the stimuli which promoted development of the low-grade ores in the Lake Superior iron district which includes Michigan. First, low-grade iron ores occur readily recognizable in vast quantities and thereby excited the interest of the scientists. Prof. E. W. Davis, former director of the University of Minnesota's Mines Experiment

Station, became the father of pelletizing because of this kind of interest and his work. Second, the widespread discovery and development of high-grade foreign iron ores in the 1940's pointed toward an increasing competition for the traditional natural ores of the Lake Superior district. The gradual recognition of this factor lent definition to the existence of a problem for the traditional type of iron mining and thereby evoked the ideas and generated the appropriations for research which resulted in our pellet developments. Third, rapidly rising costs in the steel industry brought pressures for greater efficiencies, not only through search for higher grade ores but experiments that led to the use of better physical form of furnace burden as presented by pellets.

By 1961 it had become painfully apparent that traditional ores were no longer in good demand and underground mines in Michigan were rapidly closing through lack of demand for their product and because of the relatively high cost of this ore.

While the Cleveland-Cliffs Iron Co. had conducted or participated in sporadic research efforts to discover economic methods of beneficiating its low-grade ore reserves since the late 1920's, it wasn't until 1945 that the competitive need began to be dimly seen. Once perceived, however, the company moved rapidly. It sponsored work in research institutes alone and with other companies. It cooperated with the mines experiment station at the University of Minnesota on beneficiation tests of its ores. It gleaned help from the mineral dressing department of the Michigan College of Mines & Technology. It built a half million dollar research facility in Ispheming in 1948 and a three-quarter million dollar pilot plant in 1959. Staffed by 10 to 12 engineers and 45 to 50 technicians, this endeavor has been mainly responsible for developing the processes that now will produce 4¾ million tons of pellets annually from the Marquette Range in 1964. This research effort costs between $500,000 and $1 million annually.

It is pertinent to point out that enlightened leadership of the governmental branches of the State of Michigan have provided the encouragement for new developments, through passage of the specific tax bills applicable to low-grade iron ore projects and, recently, to natural ores under certain qualifications.

On the Marquette Range the future of the iron mining industry looks reasonably favorable, thanks to the efforts of the Cleveland-Cliffs Iron Co. and its partner steel companies; the help and understanding of the public and the union; and the constructive cooperation of the State of Michigan.

### Profitable Utilization of a Natural Resource Through College Research, White Pine Copper Co.

Michigan's newest and largest copper mine is White Pine Copper Co., located 5 miles south of Lake Superior in Ontonagon County, in the western end of the Upper Peninsula. A wholly owned subsidiary of Copper Range Co., White Pine began mining in March of 1953 and the first lake copper was cast in January 1955. Annual production is in excess of 100 million pounds (about three-fourths of Michigan's total copper production), annual payroll and purchases exceed $25 million, and about 1,600 people are steadily employed. Using the number of employees as the determining factor, White Pine is the second largest industry in upper Michigan.

Although the White Pine ore body has been known for over a hundred years, and has been mined by several different companies during that span, it was not put on a paying basis until the present operation was started. The success of White Pine lies in the success of its metallurgy, for a continuing program of metallurgical research succeeded in conquering the problem which had baffled predecessor companies: how to extract the chalcocite (copper sulfide) from the rock.

According to one writer, "the problem of saving the fine copper has been attacked mechanically, metallurgically, chemically, courageously and outrageously by many different inventors, all of whom suffered discomfiture." The beast was finally slain by a hybrid St. George; private industry, the Federal Government, and an educational institution combined their efforts to conquer the problem of unlocking the copper from the waste rock.

Copper Range bought the White Pine property at a sheriff's sale in 1929 and began a drilling program in 1937 to outline the ore body. In 1938, the Michigan College of Mining & Technology began laboratory investigations into means of treating the ore. American Cyanamid Co. did some test work in 1950, and Copper Range set up a test mill circuit at Freda in 1941. After the end of World War II, Copper Range and the Battelle Memorial Institute undertook lab work to in-

crease the amount of recovery from White Pine ore. A metallurgical laboratory was added to the Freda mill and by 1949 was getting an 86 percent recovery in a 27 percent copper concentrate.

When the Korean war brought about an increase in the demand for copper, a Government loan of $66,300,000 and an advance of $13 million from Copper Range Co. were obtained, and development of the White Pine ore body got underway With the metallurgical problem just about solved, large-scale, profitable operation at White Pine became a reality.

The physical development of the plant and townsite also presented its share of headaches. The real problem was to coordinate and control the planning and construction of the project so that they could be accomplished with a maximum economy in both time and money. Turner Construction Co., acting as agent for and on behalf of Copper Range, supervised this operation.

As an indication of the scope of the planning stages, the engineering force required to plan mine, mill, and smelter, to issue requisitions, solicit bids for equipment and the many package jobs, reached a peak of 102 men and involved about 2,500 finished drawings. The powerplant and heating boiler used the services of 100 planners. Another group, reaching a maximum of 150, designed and engineered the nonprocess buildings and townsite.

The room-and-pillar method of mining had been tried in other mining ventures, but never on an ore body such as White Pine's. Through research and experimentation, it was proven successful. Recent mine research in which university faculty members and facilities have been involved include work on rock mechanics, material analysis, roof bolting, and defining the physical characteristics of the component parts of the ore body.

The close relationship between White Pine Copper Co. and Michigan College of Mining and Technology has, beyond a doubt, been beneficial to all concerned. The students have had an opportunity for practical application of classroom learning, and the company has profited greatly from the skills and facilities available at the college. Research projects were thus made possible which would otherwise have been almost prohibitively expensive and might never have been accomplished at all.

Apparently the future of many areas rich in mineral resources lies in the large-scale production of certain metals from low-grade ores.

Truly, I was surprised to learn that the Bureau of Mines is not now authorized to make grants or contracts for research of the type involved in S. 1166. As a physical science, geology deserves increased recognition and support so that by way of this specialized agency, the Bureau of Mines, a logical advance may be stimulated in both graduate enrollments and in the research programs involved. By way of analogy, I wish to mention the very significant roles played by the U.S. Office of Education, National Science Foundation, National Aeronautics and Space Administration, National Institutes of Health, and Department of Defense, among others in strengthening both the science education and research output of our colleges and universities. Let us provide the mechanism whereby the Bureau of Mines may do likewise if it chooses.

What do individual faculty members think of S. 1166? I wish to quote from some notes by Dr. John Sanford, one of our expert geologists at Wayne:

"Across-the-board in the State surveys, practically all of them, with few exceptions, are not putting a great deal of emphasis on fundamental research—not slanted toward industry or creating jobs for that matter. There is a great gap States are not able to fill. In Michigan, the geological survey division (of the department of conservation) is pretty much crippled by lack of funds. Their function is primarily to study the geological and mining resources of the State and report on them to the legislature with recommendations for their development; to make public their findings; and to appraise and assess metallic mines for tax purposes.

Industry, in the areas with which geologists and mineralogists are familiar is pretty much slanted toward needs of present day—not looking ahead too far. There are some companies who think they are, but they really are not. There are a few exceptions who look some ahead, but as a whole, the mining industry does not. There is a job to be done. As Dr. Sanford sees it, if the Bureau of Mines was able to use local people they could effect savings. If there is a need for a particular type of specialization, they could get it without putting a person on some staff or on a permanent basis. They could use people part time. This is particularly true in geology. In chemistry, any qualified person in the United States could work on a specific problem, but in geology it is slanted toward a

particular problem which deals with the specific geology of an area. They need people who are familiar with that geology. If they hire just any geologist, that person often has to go into an area and loses time familiarizing himself with it, while a local person knows what is to be done.

Another problem (remind Dr. Bright we are setting up a subsurface library of samples and cores) is the difficulty for someone in Washington or California to have access to the materials of a particular area. These materials should be on the spot and not in sample libraries. Dr. Sanford recently had a letter from people in Florida wanting material because they are working in Michigan.

Dr. Sanford says that you are liable to hear some "static" because of all the materials that are on the market, but this is not true of a lot of things—not true of oil and gas. They may say why worry about oil and gas because we have plenty of energy from radioactive materials, but this is not true. Actually, more oil and gas is being used in the petrochemical industry—from clothing to food. Need for oil, gas, and coal is not going to be smaller, but greater, even though they are not being used for the supplying of energy. Here in Michigan (and Canada) we have lots of iron, but we will have to use a lot of research. We need local sources. The biggest problem is not where do we get oil and gas, but where do we store it, because we can't pipe it fast enough in the wintertime. Gas companies are doing some work on the problem of storage, but need more fundamental research on storage reservoirs. This is best done by local people because they know the local situation. There will be a lot of change in emphasis with shifts in need and with discoveries—some will be discovered in one place and the need is in another. Should be more fluid. Dr. Sanford believes that the Bureau of Mines should be able to select personnel from all over rather than from a permanent staff. One other point: In view of this demand for oil and gas not only as energy but also as petrochemicals, there has to be a continuous exploration program and very often the companies are tied up with day-to-day exploration—they don't look ahead far enough.

I am strongly in favor of S. 1166. Badly needed research programs in our expanding requirements for materials which come from our mineral resources are staring us in the face. It would be most encouraging to see favorable action on this permissive legislation.

Finally, if strictly speaking water is a mineral and if we take cognizance of the importance of many nonmetallic minerals including sand, gravel, clay, etc., then two questions ought to be raised in connection with this bill:

(1) Would research on subsurface or underground water be permitted under the purposes of this act?

NOTE.—A water summary on a drainage basis is badly needed.

(2) Would reconnaissance studies or progress reports on nonmetallic minerals, as mentioned above, be encouraged—again on a permissive basis?

NOTE.—We are way behind in collecting raw data of this kind in some States. Such basic inventories of all data is needed on an area (e.g., county) basis.

Thank you very much.

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PREPARED STATEMENT OF P. L. WALKER, JR., CHAIRMAN, MINERAL TECHNOLOGY DIVISION, COLLEGE OF MINERAL INDUSTRIES, UNIVERSITY OF PENNSYLVANIA

Gentlemen: The Pennsylvania State University is one of the major academic centers for mineral research and instruction in the United States. Through the years, we have had numerous formal and informal contacts with the Bureau of Mines, as the work of this organization is related in many ways to our own program. Consequently, we are deeply interested in Senate bill 1166, introduced on March 21, 1963, by Senator Hart, of Michigan. This bill would authorize the Bureau of Mines to enter into contracts and make grants for the performance of research and development, the contracts or grants to be restricted to colleges, universities, and to organizations under the administrative control of colleges or universities. With Senator Hart and the Bureau of Mines, we feel that it would provide a sound and most effective means for expanding the Bureau's present program of research and development, by enabling the Bureau to utilize university talent when and where needed. It is recognized that this bill is by no means without precedent, because the Defense Department, the National Aeronautics and Space Administration, the Atomic Energy Commission, among others, now award substantial funds to universities in the form of contracts and grants to conduct research.

It is widely recognized that continuing improvements in mineral exploration, in techniques for the successful winning of materials from the ground at deeper and deeper levels, in methods for separating useful materials from waste, and in coordinating available materials with specific needs are essential to the continuing development of the Nation. Such improvements assuredly have been made in recent years, and problems of obtaining and using mineral commodities are under constant attack at the present time. But these problems become increasingly numerous and more difficult as the larger, shallower, and most readily located deposits are exhausted and as utilization of natural raw materials grows more complex. There now is impressive evidence, of which I am sure you are aware, that the attack must be broadened and intensified if we are even to maintain our present pace in meeting our mineral needs.

Senator Hart already has pointed out that the proposed legislation would enable the Bureau of Mines to supplement and complement existing and future programs by drawing upon large supplies of scientific and engineering talents and technological resources. In addition, it would contribute significantly to the solution of another very serious problem—the current shortage of personnel with adequate training and research experience in mineral sciences, engineering, and technology. On this score we must look to increasing numbers of well-trained students who participate in university or college based research and development projects, a view that plainly is shared by numerous companies (and by the Bureau of Mines) that are participating in the student-trainee programs of educational institutions.

It seems to us that the passage of bill 1166 would further supplement the statements made by the President's Science Advisory Committee in 1960, in the document, Scientific Progress, the Universities and the Federal Government. Extracting several passages, they said:

"In the long run it is dangerous to separate research in any field entirely from education. If a research field is to be attractive to good young men, it ordinarily needs roots in the universities. The pool of graduate students in our universities is the pool from which the scientists of the future must come. These young people do not easily study what is not taught; they do not often learn the meaning of research which does not exist in their environment. A scientific field which has no research life in the universities is at a grave disadvantage in recruiting new members. As learning and teaching require research, so research, in the end, cannot be sustained without teaching. Hence it is always important for research installations to maintain effective connections with students."

"The central proposition of this report is that science and the making of scientists go best together. This means that when it can be managed, basic research should be done in, or at least in association with, universities." * * *

"We note that the separate installations which do the best work are, as a rule, those which have a close and effective connection with academic centers."

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PREPARED STATEMENT OF M. E. VOLIN, MICHIGAN COLLEGE OF MINING AND TECHNOLOGY

I am M. E. Volin, director, Institute of Mineral Research, a department of the Michigan College of Mining and Technology, located at Houghton, Mich. I have been authorized by Dr. J. R. Van Pelt, president of the Michigan College of Mining and Technology, to make this statement on behalf of the college as well as for the institute.

Bill S. 1166, if enacted, would authorize the Secretary of the Interior to enter into contracts and make grants for the performance of research and development in furtherance of the purposes of the act of May 16, 1910 (36 Stat. 369; 30 U.S.C. 1, 3, 5, and 7), as amended and supplemented, relating among other things to mining, and the preparation, treatment, and utilization of mineral substances; and health conditions and safety; and efficiency, economic development, and conservation of resources of the mineral and fuel industries. Such contracts or grants shall be restricted to colleges or universities or organizations under the administrative control of colleges or universities. Implementation of the purposes of this bill could be under the administration of the Bureau of Mines. In effect, the bill would provide authority this agency does not now have to draw upon large resources of scientific and engineering talents and technological facilities in our colleges and universities for the purposes of sup-

plementing and complementing the Bureau's research effort and thereby increase its effectiveness in the performance of established programs and activities and the planning of new programs to properly provide for and safeguard the mineral needs of this Nation.

The authority to be provided by this bill will especially strengthen the capabilities of the Bureau of Mines in basic research. Much work of this nature is needed to solve the complex problems standing in the way of greater utilization of our domestic mineral resources. As an example, new technologies which can come from basic research are needed to solve the problems of utilizing vast deposits of low grade taconite and jastpilite ores occurring in the upper Great Lakes region. The colleges and universities have scientists and engineers who devote themselves to and are specialists in this kind of research, and bill S. 1166 would make the specialized knowledge and skills of these people available for the research programs of the Bureau of Mines.

The bill will be in the interests of the mineral industries. It is a normal procedure for these industries to apply basic knowledge in developing methods and processes for the profitable exploitation of mineral resources. When basic knowledge is lacking, applied research and development cannot go forward. The bill is intended to stimulate basic research related to mineral problems and make the new knowledge available for application by the mineral industries. Thus the bill will promote industrial developments of our domestic mineral resources.

I wish to emphasize that the bill will be helpful to our efforts in higher education. It is a matter of much concern to our mineral-oriented colleges and universities that enrollments in mining and extractive metallurgy curricula are declining. This not only has caused curtailments in these curricula, but also in some schools it has caused elimination of departments offering degrees in these subjects, with the result that fewer young people are seeking professional training for careers in the mineral industries. This situation is diverting some educators into other curricula and departments as well as bringing a shortage of engineers and scientists trained to serve and perpetuate the mineral industries. The bill would provide the mining and metallurgical faculty members opportunities to obtain support for their research efforts where there is a lack of such support now. Such research support will not detract from the educational objectives of the faculties but actually strengthen these primary objectives by making it possible for the educational institutions to continue their mining and metallurgical disciplines and the faculties devoted to them. It is a recognized fact that the performance of research is an activity which assists and complements proficiency in teaching. A healthy volume of research is an infallible sign of an alert faculty which is seeking a position of leadership in a given field. There is a recognized trend for a student, and particularly the graduate students, to be attracted to colleges and universities having faculties of recognized stature in the discipline of interest to him, and likewise there is a tendency for undergraduate students to seek instruction in strong and active departments. Bill S. 1166 would make available to the mining and metallurgical staff members of our colleges and universities the kind of support which tend to reverse the trend in declining mining and extractive metallurgy enrollments. In my opinion, bill S. 1166 will be good for the Bureau of Mines, the mineral industries, and our colleges and universities, and it will be in the interests of the Nation's expanding needs for minerals and of the welfare of the people employed in producing mineral commodities.

SUPPLEMENTAL STATEMENT OF M. E. VOLIN, DIRECTOR, INSTITUTE OF MINERAL RESEARCH, MICHIGAN COLLEGE OF MINING AND TECHNOLOGY

The purpose of this statement is to present information in addition to that given at the hearing of August 29, 1963, and to answer some of the questions brought up at the hearing.

Much of the testimony was concerned with the need of the Bureau of Mines for the kind of authority proposed in S. 1166. Bureau research programs now are done intramurally with the exception of some projects in health and safety, helium and anthracite. The intent of S. 1166 is to give the Bureau authority to perform research extramurally through grants to colleges and universities. The testimony already given indicates that this kind of authority will enable the Bureau of Mines to strengthen its research effort, add to its capability in basic research and have more versatility in conducting its intramural research

programs as a result of a close working relationship with scientists and engineers in our colleges and universities who are aware of and studying our mineral problems, developing new ideas and performing research to solve the problems.

The question was brought up as to how this authority would be implemented. This, of course, would be a policy matter to be worked out by the Department of the Interior, but it would seem that procedures already in use by the National Science Foundation and in connection with the national highway research program would provide a sound basis. Methods of identifying areas of research needs, receiving and evaluating proposals and making grants for research are well developed.

Previous testimony has stressed that need for this bill as a means of revitalizing and sustaining a part of our effort in higher education which is deteriorating; namely, the encouragement and training of mineral-oriented scientists and engineers. In the last 10 years, enrollments in mining and extractive metallurgy curriculums have been declining with the result that teaching staffs have been reduced or diverted to other disciplines, courses of study related to minerals have been deleted and in some instances departments have been dropped or consolidated into others. One example of this trend is what has happened here at the Michigan College of Mining & Technology. As late as academic year 1958–59, there was a mineral dressing department with a teaching staff of 4, and 10 seniors received the B.S. degree in metallurgical engineering (mineral dressing option) that year. At the beginning of the 1959–60 academic year, mineral dressing was made a part of the department of metallurgical engineering, and since then both the numbers of students enrolled and the teaching staff have decreased. In academic year 1962–63, one professor was teaching mineral dressing subjects and three students received the B.S. degree in metallurgical engineering (mineral dressing option). The mining engineering department has shown a similar decline in enrollments.

This same trend has been noted in the mining and extractive metallurgy departments of other colleges and universities. It shows a strong correlation between the number of highly qualified teachers in a particular field and the number of students who are attracted to that field, and that as staffs decline so do enrollments. The result of this trend is that our mineral industries and governmental agencies, such as the Bureau of Mines, are being deprived of an adequate supply of properly trained and oriented scientists and engineers. This has been a matter of great concern to the American Institute of Mining, Metallurgical & Petroleum Engineers, and has become the subject of much discussion at every annual meeting in recent years. While the needs of the mineral industries for mining engineers can perhaps be filled by civil and mechanical engineers, and the needs for extractive metallurgical engineers by chemical engineers, there remains the disturbing situation that fewer teachers in our colleges and universities are concerned about and studying the mineral problems, and that less research on the problem is being done by teachers and graduate students. I believe that S. 1166 could help more than anything else to revitalize and strengthen this part of our educational effort which is declining.

The question was brought up in the hearing as to whether adequate support for mineral research projects is now available through other Federal agencies such as the Atomic Energy Commission, Department of Defense, Health, Education, and Welfare, National Aeronautics and Space Administration, and the National Science Foundation. The answer to this question may be found in part in the latest report by the National Science Foundation entitled "Federal Funds for Science XI." The total national expenditure for research and development in fiscal year 1961, the latest year for which such information is available, was $14 billion, and of this amount, $9 billion was provided by the Federal Government. Of the Federal expenditure, $7 billion went for extramural research, 65 percent to industry, 10 percent to colleges and universities, and the rest to private foundations and other institutions. Five agencies—the Atomic Energy Commission, Department of Defense, Health, Education, and Welfare, the National Aeronautics and Space Administration, and the National Science Fundation—were responsible for 95 percent of the $0.7 billion spent for research and development in educational institutions, and over 90 percent of the funds provided by these agencies were allocated for development and applied research in connection with the specific missions of the agencies. Mineral or metallurgical research is not listed as a specific mission by any of these agencies except the National Science Foundation, which is the only Federal agency with

the broad mandate of furthering basic research and education in all fields of science.

Thus, it would appear that the National Science Foundation is the only Federal agency to which a proposal might be directed for support of a research project specifically concerned with minerals, and the proposal would have to be basic in character. The National Science Foundation defines basic research as that directed toward increase of knowledge in science, or research where the primary aim of the investigator is a fuller knowledge or understanding of the subject under study rather than a practical application of the knowledge, which is termed "applied research." Development is defined as the systematic use of scientific knowledge directed toward the production of useful materials, devices, systems, or methods, including design and development of prototypes and processes.

The National Science Foundation made grants to educational institutions in the amount of about $64 million in fiscal year 1961 for specific research projects covering a spectrum of physical, life, and social sciences. The Foundation supports basic research in metallurgy as a part of the program under engineering sciences, but information about the distribution of funds for this specific field is not published in Federal Funds for Science XI. Since the principal interest is in physical metallurgy, it can be inferred that relatively few grants are made for mineral or mining research projects.

One of the questions brought up in the hearing was concerned with the amount of support given by industry for research on the mineral and mining problems. According to chart XII published in Country Reports on the Organization of Scientific Research, United States, the total expenditure for performance of research and development in primary metals in fiscal year 1961 was about $160 million, of which about $30 million was provided by the Federal Government. Chart XIII in the same publication shows that about $12 million was spent for the performance of basic research on primary metals in fiscal year 1961 and of this amount it can be assumed that the Federal Government provided about $7 million. Although a further breakdown by fields of research is not available, it can be concluded that most of the research and development, perhaps 90 percent, was done in physical metallurgy rather than in extractive metallurgy or other mineral fields. These statistics indicate that industry is performing about 80 percent of the research and development done on primary metals but that practically all of this work is developmental or applied in nature. It is a matter of economic survival for industry to perform research primarily to maintain a competitive position, and this kind of research is largely applied and developmental in nature.

It should be emphasized that S. 1166 can have long-range effects of great importance to our mineral industries and the mineral security of our Nation. Reports by Resources for the Future, Inc., and the National Academy of Sciences forecast that our mineral needs will double in the next 20 years. If demands for minerals by immerging peoples of the world go as expected, our mineral imports will be severely restricted, and thus it will become necessary for us to fill more of our requirements by domestic production and this will mean that present rates of production will have to be more than doubled. This cannot be done economically with our existing technology, and it is imperative that enough leadtime and money be invested in research now so that we will not find ourselves at the mercy of foreign sources of minerals within the next 20 years. The proposed bill is timely in that it would set up the kind of authority needed to bring an important sector of our scientific talent to bear on the mineral problems and guarantee the progress required to maintain a strong mineral position for our Nation.

S. 1166 is a well-conceived bill, and I think its enactment is important to the Nation's mineral security. The authority proposed in the bill will benefit our mineral industries, the Federal Bureau of Mines, and our educational effort in mineral-oriented colleges and universities.

Senator DOMINICK. I would just like to close with two comments if I may. The first is, the remarks I made originally were not in any way intended to be critical of Mr. Ankeny, who I know has been a dedicated person on behalf of the Bureau of Mines. Secondly, it seems to me that what Dr. Walker has just said is a very pertinent point to this bill; namely, that we might just change the Enabling Act under the Bureau of Mines to permit them to use some of their appropria-

tions which they get in the normal course of events for this very purpose and thereby not getting into the additional money stage.

Senator GRUENING. I think that is a very useful suggestion. I would like to have your comment on that, too.

Mr. ROSENBAUM. Basically, this would permit us to justify this expenditure in the line items just as we now justify any other expenditure.

Senator GRUENING. Thank you very much, gentlemen. I hope that none of you has felt foreclosed from saying anything that you want to say. I think we have covered the field pretty well.

Mr. ROSENBAUM. I believe you asked us to give you two statements. One, you wanted some information on the number of mining and metallurgical engineers that were required annually, which we will try to get for you, and I think we will use Dr. Volin's suggestion of contacting the American Institute of Mining, Metallurgical, & Petroleum Engineers for this as a good source, and also you were interested in how much mining and extractive metallurgy research is now sponsored by other Government agencies.

Senator GRUENING. And what agencies and essentially what the projects are.

Mr. ROSENBAUM. And we are concerned here with mining and extractive metallurgy research?

Senator GRUENING. Yes, sir.

Senator DOMINICK. Whatever the research is that is included in the bill. I think this is what we are talking about.

Senator GRUENING. Yes. Thank you very much.

(The correspondence referred to by Senator Hart follows:)

MASSACHUSETTS INSTITUTE OF TECHNOLOGY,
DEPARTMENT OF METALLURGY,
*Cambridge, Mass., August 27, 1963.*

Mr. PHILIP HART,
*U.S. Senate, Committee on Commerce,*
*Washington, D.C.*

MY DEAR SENATOR HART: In connection with your Senate bill 1166 on which Senate Minerals Subcommittee is to hold hearings Thursday, August 29, I am in complete agreement with the purpose of said bill. This was very much in the mind of the Committee on the Bureau of Mines Metallurgical Research of the National Academy of Sciences, of which I was the chairman last year, when they reported to the Director of the Bureau of Mines recommending the action which your bill proposes.

Sufficient implementation of your bill will restore interest in the mineral industry on the part of students. It would also bring new ideas into the fold of the Bureau of Mines staff.

Sincerely yours,

A. M. GAUDIN,
*Richards Professor of Mineral Engineering.*

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UNIVERSITY OF CALIFORNIA,
DEPARTMENT OF MINERAL TECHNOLOGY,
*Berkeley, Calif., August 27, 1963.*

Hon. PHILIP A. HART,
*U.S. Senate,*
*Washington, D.C.*

DEAR SENATOR HART: Research efforts on mineral processing in the United States are lagging far behind similar efforts in Russia. Your excellent proposal to permit the U.S. Bureau of Mines to make grants to universities for research in mining and mineral processing will provide stimulation for research in the mineral field.

As you know, domestic ores are becoming increasingly lower in grade. If worldwide trends continue, American mining companies will not operate in foreign countries and we will have to rely on the low-grade raw materials that occur within our borders. Basic research will be needed on which to base future processes.

In recent years enrollment of students in the mineral field has been decreasing and this will affect the future potential of our country to process low-grade ores. Research programs sponsored by the Bureau of Mines grants will provide a means for supporting graduate research in mineral processing. Thus, your proposal not only should provide basic information for development of future mineral processing methods but also should provide a means of educating students for careers in the mineral field.

Sincerely yours,

D. W. FUERSTENAU,
*Professor of Metallurgy.*

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THE UNIVERSITY OF WISCONSIN,
COLLEGE OF ENGINEERING,
*Madison, Wis., August 27, 1963.*

Re Senate bill 1166.

Senator PHILIP A. HART,
*U.S. Senate,*
*Washington, D.C.*

DEAR SENATOR HART: Thank you for your letter of August 26 regarding the above bill.

Since Prof. Philip C. Rosenthal and I are unable to attend the hearing, we are today writing Senator Ernest Gruening in support of this bill. You are to be complimented on its introduction, and we both feel its passage will do much to increase the research so vitally necessary in this field.

A copy of our letter to Senator Gruening is enclosed.

Sincerely yours,

THEODORE D. TIEMANN,
*Associate Professor, Minerals and Metals Engineering.*

[Enclosure]

THE UNIVERSITY OF WISCONSIN,
COLLEGE OF ENGINEERING,
*Madison, Wis., August 27, 1963.*

Re Senate bill 1166.

Senator ERNEST GRUENING,
*Chairman, Subcommittee on Minerals, Materials, and Fuels, Committee on Interior and Insular Affairs, U.S. Senate, Washington, D.C.*

DEAR SENATOR GRUENING: Senator Philip A. Hart has brought to our attention the hearing on the above bill to be held before your subcommittee on August 29.

Since it is impossible for us to attend the hearing, we are submitting this letter in support of its acceptance and early passage.

It seems to us that there is little question as to the vital need to expand our research efforts on the utilization of our lower grade mineral resources, particularly from the standpoint of our future national economy and security. This is especially true in regard to the upper Great Lakes region where the reserves of high-grade iron ores are being steadily depleted.

Although programs of research in the area of low-grade ore utilization are currently being carried on at a number of institutions, including the University of Wisconsin, it is difficult to obtain funds to carry on this research on a sufficiently broad and penetrating basis.

It is our opinion that passage of this bill will do much to alleviate this situation.

Sincerely yours,

PHILIP C. ROSENTHAL,
*Chairman.*
THEODORE D. TIEMANN,
*Associate Professor, Metallurgical Engineering.*

UNIVERSITY OF MINNESOTA,
INSTITUTE OF TECHNOLOGY,
*Minneapolis, Minn., August 27, 1963.*

Senator PHILIP A. HART,
*U.S. Senate,*
*Washington, D.C.*

DEAR SENATOR HART: I received both your telegram and a copy of bill, S. 1166, and hasten to reply by night telegram as to my feelings on this subject. A copy of that telegram is attached.

This also gives me the opportunity of congratulating you for your interest in the events of the mineral industry and particularly those of the Lake Superior region. In this connection, I am forwarding under separate cover, a copy of the "Minerals Task Force Report" prepared by the Minnesota Natural Resources Council some months ago.

I hope that you will be successful in the passage of bill, S. 1166, and if we can be of any further assistance please let me know.

Sincerely yours,

EUGENE P. PFLEIDER,
*Professor of Mineral Engineering.*

[Enclosure]

MINNEAPOLIS, MINN., *August 27, 1963.*

SENATE MINERALS SUBCOMMITTEE,
*Care of Senator Philip A. Hart,*
*U.S. Senate,*
*Washington, D.C.:*

I have had the opportunity to study bill, S. 1166, introduced by Senator Hart, permitting the Bureau of Mines to enter into research contracts with colleges and universities. I strongly support this approach. Not only will it provide the Bureau with a method of utilizing the talents of many informed people in its pursuit of essential research goals but such a move is needed to permanently attract topflight brains to the solution of problems that are daily becoming more aggravated in the worldwide competition for minerals and mineral markets. Mineral industry education does not, and cannot, compete for capable graduate students today for lack of governmental support. Other engineering and scientific groups on the campuses have numerous agencies fostering immense research projects, whereas our area is limited to NSF proposals and these must be so-called fundamental in nature. As a consequence, the numbers of students entering mineral industry education have fallen off to one-third, and most graduate programs are becoming dependent on foreign students living off miscellaneous assistantships. Shortly, I fear, the industry, the Nation, and the individual States, will suffer from this underemphasis of a basic industry.

EUGENE P. PFLEIDER,
*Professor of Mineral Engineering,*
*University of Minnesota.*

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BERKELEY, CALIF., *August 27, 1963.*

Senator PHILIP A. HART,
*Senate Office Building, Washington, D.C.*

Stimulation of research in universities on the processing of minerals is vitally needed. Student enrollment is decreasing drastically and this will affect the future potential of our country to process low-grade ores. Basic research grants from the Bureau of Mines will support graduate students in this field and will provide basic information necessary for extended utilization of domestic low-grade ores.

D. W. FUERSTENAU,
*Metallurgy Department, University of California.*

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CAMBRIDGE, MASS., *August 27, 1963.*

Senator PHILIP HART,
*Committee on Commerce, Washington, D.C.*

In connection with your Senate bill, S. 1166, on which Senate Mineral Subcommittee is to hold hearings Thursday, August 29: I am in complete agreement with the purpose of said bill. This was very much in the mind of the Committee

on the Bureau of Mines metallurgical research of the National Academy of Sciences, of which I was the chairman last year when they reported to the Director of the Bureau of Mines recommending the action which your bill proposes. Sufficient implementation of your bill will restore interest in the mineral industry on the part of students. It will also bring new ideas into the fold of the Bureau of Mines staff.

A. M. GAUDIN,
*Richards Professor of Mineral Engineering, MIT.*

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NEW YORK, N.Y., *August 27, 1963.*

Senator PHILIP HART,
*Senate Office Building, Washington, D.C.*

This will register my wholehearted support of your bill, S. 1166, authorizing the Bureau of Mines to enter into research programs with colleges or universities to assist the mining industry. The declining reserves of high-grade ores in the United States and the development of such ores in foreign countries have combined to jeopardize the economic position of many segments of the U.S. mining industry.

Research in areas of "mining and the preparation, treatment, and utilization of mineral substances" receives little or no support from Federal funds now assigned to research.

Authorization of the Bureau of Mines to enter into agreements with universities and colleges for research in these areas would be of vital assistance, both to the long-range welfare of the industry, the Bureau of Mines, and mineral industries' education.

NATHANIEL ARBITER,
*Professor of Mineral Engineering, Columbia University, Henry Krumb School of Mines, New York, N.Y., past chairman, minerals beneficiation division, AIMME, past director and treasurer, Society Mining Engineers.*

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RENO, NEV., *August 28, 1963.*

Senator PHILIP A. HART,
*U.S. Senate, Washington, D.C.:*

I have received your telegram of August 26, re a statement of my views on Senate bill 1166. In reply I wish to state that the authorization contained in this is an excellent idea. I believe there are many ways in which both the Bureau of Mines and colleges or universities can benefit by working together on a contract basis. Specifically, some advantages are as follows: college and universities have faculty members who are experts in highly specialized fields their knowledge and experience through contracts and grants can be more readily available to the U.S. Bureau of Mines than is now possible through such contracts; the education institutions can assist worthy graduate students on contract projects under the direction of qualified faculty members; many college and universities have research organizations together with costly equipment and facilities in many fields of research and development; as proposed in your bill, done under contract can make such equipment and facilities available to the Bureau together with trained personnel—this will save duplication of facilities, etc.; economic and conservation studies can be made on a cooperative basis through eliminating posible duplication. I can visualize numerous advantages both to the Bureau and to colleges or universities where schools of mineral industries and State bureaus of mines are estabilshed.

I have discussed your Senate bill 1166 with Dr. Vernon E. Scheid, dean of the Mackay School of Mines, and director, Nevada Bureau of Mines and Nevada Mining Analytical Laboratory, and with Dr. S. E. Jerome, associate director, Nevada Bureau of Mines and Nevada Mining Analytical Laboratory, and they both agree that there can be numerous advantages to such an authorization for research contracts.

Airmail copy of message in mail.

JOHN J. BUTLER.

SOCORRO, N. MEX., *August 28, 1963.*

PHILIP A. HART,
*Minerals Subcommittee, Committee on Interior and Insular Affairs,*
*Washington, D.C.:*

S. 1166 excellent. Would add flexibility to U.S. Bureau of Mines research and allow for desirable cooperation between U.S. Bureau and educational institutions interested in mining and metallurgical research, resulting in fuller utilization of the Nation's most qualified mineral scientists and engineers and greater development of the Nation's minerals resources.

ALVIN J. THOMPSON,
*Director, New Mexico Bureau of Mines and Mineral Resources.*

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GOLDEN, COLO., *August 27, 1963.*

Hon. PHILIP A. HART,
*New Senate Office Building, Washington, D.C.:*

Personally believe any opportunity to utilize educational research facilities for mineral industry needs as detailed in S. 1166 is of unquestionable merit. Colorado School of Mines administration past attitude always in this vein. Experience demonstrates only Bureau of Mines interested in extractive metallurgy research. No duplications of other governmental agencies supported research.

A. W. SCHLECHTEN,
*Head, Department of Metallurgy,*
*Colorado School of Mines.*

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HOPKINS, MINN.

Hon. PHILIP A. HART.
*Senate Office Building, U.S. Senate, Washington, D.C.:*

Thanks for your invitation to comment on S. 1166. It is my opinion that the objectives of this bill are excellent. It would permit closer working relationship between the U.S. Bureau of Mines and the various colleges and universities. It should be helpful to the Bureau of Mines in carrying out its important research program. It should help the schools to keep qualified people on their staffs. It should be helpful in the training of students, and perhaps of greatest importance, it may be helpful in the finding of practical solutions to some of the very serious problems facing most of our mining communities today. I am definitely favorable to the enactment of this legislation.

HENRY H. WADE,
*North Hopkins, Minn.*

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BUTTE, MONT., *August 28, 1963.*

Senator PHILIP A. HART,
*U.S. Senate Office Building, Washington, D.C.:*

In reference to Senate bill 1166, I wish to advise you and the members of the Senate Minerals Subcommittee that I wholeheartedly support and recommend the approval of this bill. Contracts and grants with colleges and universities for the performance of research and development will establish a relationship between the Bureau of Mines and the colleges and universities which will do much to further the wise and effective utilization of our natural mineral and fuel resources. These resources are not of the renewable kind, and it is a mandate upon us all to gain the fullest use from that which is available to us.

Although the trend in technology is to diminish the distinction between applied and basic research, problems of importance because of economic factors and supply situations require solution depending upon scientific and engineering knowledge. To accumulate such a reservoir of knowledge for these situations, background research is necessary. I am confident that significant contributions will be forthcoming from the passage of Senate bill 1166.

To the academic institutions, research is learning; and as a consequence, Senate bill 1166 will do much in advancing knowledge and interest of young people in the minerals and fuels.

I am particularly pleased with the inclusions in the bill as denoted in lines 7, 8, 9, 1, 2, 3, 4, and 5. Of course, the effectiveness will depend upon the administration of such contracts and grants. I note that the administrative control shall rest in the hands of the colleges and universities. It is important in research

that freedom in perspective and endeavor be allowed the researcher. It is my hope that if the bill is passed, that the basic ideas and ideals of research are a part of the administration of these projects. What I am saying is that the projects once granted or contracted shall rest entirely in the hands of the college or university personnel, and that a spirit of cooperation is established with the Federal Bureau of Mines such that confidence is gained by mutual efforts.

Whatever the demands of our increasing complex technology and the needs of our rapidly expanding populations, We are all aware that much of the anticipated requirements are derived from our natural mineral resources. Thus, it is imperative that we prepare through research and development, and this includes certainly the needed interest of young people in the career fields of the mineral industries. Letter to follow.

D. W. McGLASHAN,
*Research Coordinator, Montana School of Mines.*

Senator GRUENING. That concludes the testimony on S. 1166. The subcommittee will now turn to other business.

(Subsequent to the hearing the following correspondence was ordered printed at the request of Senator Hart:)

U.S. SENATE, *September 6, 1963.*

Mr. MARLING J. ANKENY,
*Director, Bureau of Mines,*
*Department of the Interior,*
*Washington, D.C.*

DEAR MR. ANKENY: Enclosed is a copy of a letter I have received from Dean J. D. Forrester of the University of Arizona College of Mines.

I would appreciate knowing under what existing provisions of law the research agreements mentioned in this letter have been entered into.

With every best wish,
Sincerely,

PHILIP A. HART.

THE UNIVERSITY OF ARIZONA,
*Tucson, Ariz., August 28, 1963.*

Hon. PHILIP A. HART,
*Senate of the United States,*
*Senate Office Building,*
*Washington, D.C.*

DEAR SENATOR HART: This is in response to your telegram of August 26, 1963, soliciting my opinion about S. 1166 which you are sponsoring in the U.S. Senate.

Since receiving your communications, I have not had any time of consequence to study all of the possible elements of the legislation you propose, but, unless I misconstrue the significance of the whole matter, I am afraid my comments may not be overly helpful to you. This is because channels presently exist whereby contracts to pursue some types of research enterprises can be established between academic institutions and the U.S. Bureau of Mines. I know this to be a fact inasmuch as research agreements with the U.S. Bureau of Mines have been in effect for several years here in the College of Mines, University of Arizona.

However, I want my considered view and opinion to be completely clear on the matter and should I not comprehend the full purpose of your objective, I wish to state that I believe it is imperative that research on mineral resources and all related aspects of mining operations must be continued and extended. There is no better place to do so, in many instances, than in the mineral industry colleges and universities. Therefore, if the need exists for such legislation as you have sponsored, I am most heartily and vigorously in favor of it.

I hope the above is sufficient for your purposes. Thank you for apprising me of your sponsorship of S. 1166.

Sincerely,

J. D. FORRESTER, *Dean.*

U.S. DEPARTMENT OF THE INTERIOR,
BUREAU OF MINES,
*Washington, D.C., September 17, 1963.*

Hon. PHILIP A. HART,
*U.S. Senate,*
*Washington, D.C.*

DEAR SENATOR HART: With your letter of September 6 you forwarded a copy of a letter received from Dean J. D. Forrester of the University of Arizona, College of Mines. In offering comments on S. 1166 Dean Forrester stated that "* * * channels presently exist whereby contracts to pursue some types of research enterprises can be established between academic institutions and the U.S. Bureau of Mines." Dean Forrester cites research agreements with the U.S. Bureau of Mines and the College of Mines, University of Arizona, as examples of this existing arrangement.

The Bureau of Mines has for some time sponsored cooperative research projects at certain colleges and universities. These projects are actually research fellowships and require that the student be employed by the Bureau of Mines 20 hours per week in a Bureau laboratory and hence can be sponsored only at those schools near a Bureau of Mines establishment. Authority to enter into these cooperative agreements is provided in the annaul appropriations act for the Department of the Interior, Bureau of Mines, in the paragraph on administrative provisions.

We trust that the foregoing satisfactorily answers your request for information on the University of Arizona cooperative agreement. If you should desire additional information please feel free to call upon us.

Sincerely yours,

PAUL ZINNER,
*Acting Director.*