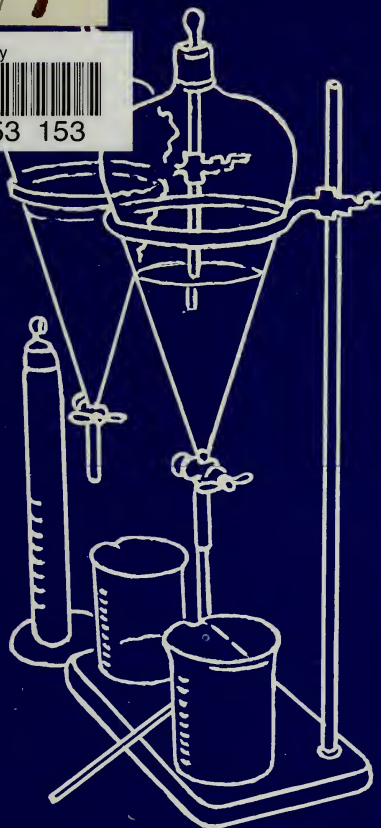


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A WORKING RELATIONSHIP

The Bureau of Mines
and the
Academic Community

UNITED STATES DEPARTMENT OF THE INTERIOR

Educational institutions of the United States have made important contributions to advances in the mineral field. Many of those contributions have stemmed from a cooperative relationship long since established between American universities and mining schools and the Interior Department's Bureau of Mines. The purpose of this booklet is to strengthen that relationship by providing information to universities and mining schools about the Bureau's programs and how to work with the Bureau of Mines.

A WORKING RELATIONSHIP

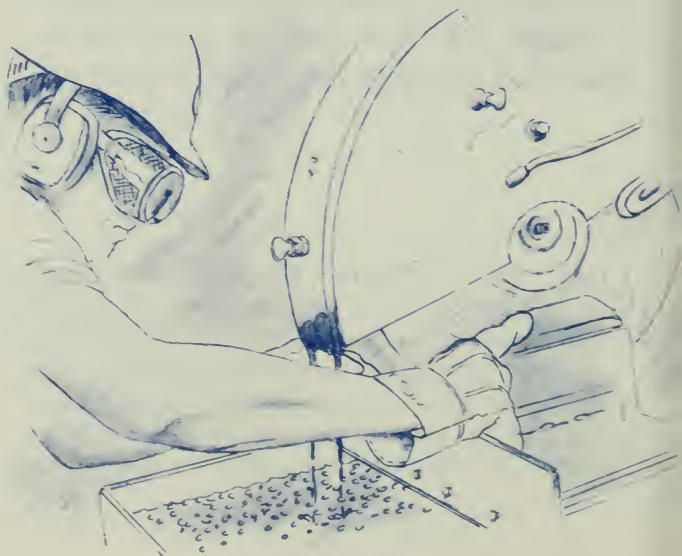
The Bureau of Mines and the Academic Community

For most of the years that have passed since its creation in 1910, the Bureau of Mines has maintained a close working relationship with the Nation's universities and mining schools. After the Foster Act of 1915 authorized the establishment of Bureau field installations, several important Bureau research centers were located

close to, and sometimes actually on, university campuses.

That proximity has encouraged a variety of working agreements. Some make it possible for students to earn while they learn, by working for the Bureau part-time on assignments that complement their formal studies or satisfy requirements for an advanced degree. Others enable university or mining school faculty members to contribute their unique skills and expertise to the advancement of Bureau projects. Still others facilitate the transfer to the classroom and the academic world of new knowledge gained in the Bureau's research and economic studies.

Over the years this constructive cooperative relationship has helped to create and sustain an academic research capability in the minerals field. Today, that capability is being nourished further as a result of the recent rapid expansion



of Bureau efforts in such areas as mine health and safety, mineral environmental studies, mineral resource technology, and mineral information and analysis. Also, the Bureau's university affiliations now extend well beyond the academic centers located close to Bureau facilities. Roughly two-thirds of the Bureau's total program is now performed under contract by organizations outside of the Bureau of Mines, and universities and mining schools are prominent among the Bureau's growing family of contractors.

BUREAU ACTIVITIES AND GOALS

Most of the contracts awarded by the Bureau fall under its Minerals Research activity or its Minerals Information and Analysis activity. The following will provide a general idea of the areas of interest within these programs.

Minerals Research

Research in the Bureau of Mines addresses three main areas: mineral resources technology, minerals environmental technology, and minerals health and safety technology.

Mineral Resources Technology

As rich domestic deposits are depleted, domestic resources are becoming leaner, less accessible, more difficult to mine, and harder to process using conventional technologies. The Bureau's efforts to help the Nation meet its mineral needs economically in the face of these obstacles involve both advancing and applying scientific and technical knowledge concerning

rock mechanics, thermodynamics, and the physical chemistry of mineral processes. The Bureau is also working on the development of practical extraction technology for tapping unused low-grade domestic deposits of such metals as nickel, platinum, and chromium which are critical to our industrial economy, are strategic to our national defense capabilities, and are now supplied almost exclusively by imports.

In another area of research, the Bureau is seeking ways to recover a larger proportion of mineral values from ores that are now being mined and processed. Many deposits contain useful minerals that are not being recovered because they are difficult to extract, or are not economic at current price levels. Some mining technologies also leave a significant fraction of the resource in the ground. The Bureau seeks new or improved technology that will permit maximum recovery of the Nation's mineral resources during the mining and processing stages.

The Bureau also looks for ways to enhance the use of plentiful domestic resources as substitutes for commodities which must now be imported. The objective may be an alternative domestic resource for a commodity now being imported, or a method for using relatively plentiful domestic commodities as substitutes for scarce imported commodities.

For example, the Bureau is currently investigating processes for producing alumina from plentiful domestic resources such as clay to substitute for imported bauxite. At the same time, researchers are developing and testing alloys containing lower proportions of scarce alloying elements such as chromium and cobalt, or replacing these elements with others that are more readily available from domestic sources.



Typical of contracts currently being performed by academic institutions under the Bureau's Mineral Resources Technology program are the following:

Physical and Inorganic Chemistry in Metallurgical Process Engineering

(Clark University)

Thermodynamics of Calcination

(University of Wisconsin)

Kinetics of Iron Ore Reduction by Mixed Gases Under Pressure

(Carnegie-Mellon University)

Characterization of Kaolins as Ores for Aluminum

(Georgia Institute of Technology)

Utilization of Mining and Milling Wastes

(Illinois Institute of Technology Research Institute)

Development of Substitutes for Asbestos

(University of California at Los Angeles)

Heap Leaching Studies on Uranium Ores

(Colorado School of Mines Research Institute)

Minerals Environmental Technology

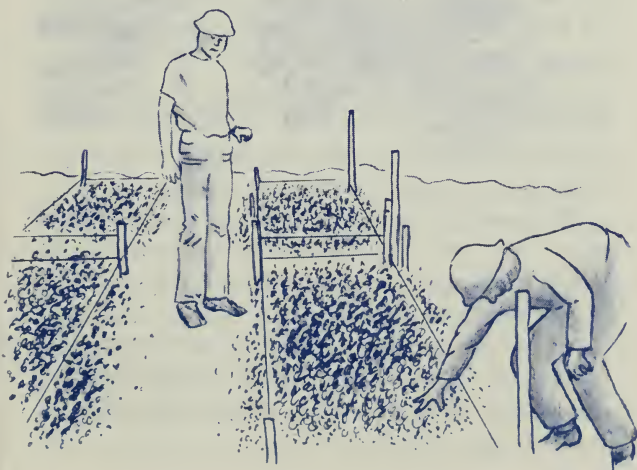
Much of the Bureau's work is concentrated at the interface between minerals technology and the environment. Preventing environmental harm caused by mining and processing minerals is a major aim of the Bureau's program. So is the development and demonstration of practical, economical ways of repairing mineral-related environmental damage that has already happened.

Bureau research is developing basic data on the environmental conditions and problems associated with mining and processing operations. The objective is to find ways to prevent or eliminate harmful environmental impacts from these activities, and to provide better methods for reclaiming land that has been disturbed by mining operations.

For example, mining and mineral processing create large amounts of waste rock and tailings. Bureau researchers are developing efficient methods for returning these materials to the mined out areas, which also help to minimize the subsidence of the surface after underground mining. Other efforts are developing improved methods of storing waste on the surface. A process for disposing of slimy wastes from phosphate rock processing is a target for Bureau research,

which is aimed at ways of releasing much of the slimes' water content for reuse, and of minimizing potential pollution problems in storing or disposing of the slimes. An electrokinetic system for compacting and dewatering sludge residues from coal cleaning operations is also under development. It uses direct-current electric power to separate the mass into clarified water and relatively dry, dense solids.

Both of these projects also involve another major problem area—the management of water displaced during mining operations or used in processing, so that it can be safely reused or disposed of in ways that do not present pollution problems. Other Bureau efforts are developing ways of preventing or controlling subsidence over areas which are being mined or have been mined. Noise, vibration, and dust from operating surface mines affect residents of areas near these operations. The Bureau is developing means for controlling or eliminating these types of disturbance.



A major underground experimental facility has been established in the deep, rich oil shale deposits of Colorado's Piceance Creek Basin. The deep shaft and associated chambers are being used for work on environmentally compatible mining and waste disposal techniques that will be needed when the country's huge deposits of oil shale are developed for their fuel content, and for the aluminum and sodium minerals that occur in close association with some of the western oil shales. Geologic, hydrologic and rock-stabilization studies are underway at the project site, and new experiments are planned in cooperation with private industry to investigate non-polluting measures for fragmenting the shale and preparing it for underground retorting. On the surface, researchers are studying the structure and composition of raw oil shale and shale processing wastes. Their findings will be used to prevent water pollution when shale materials are mined and come into contact with rain and surface runoff.

The Bureau's environmental research is also helping to control pollutants by finding ways to convert them to useful materials. Sulfur dioxide air pollutants emitted by smelters and coal-fired power plants can be converted to elemental sulfur, a valuable product that can be stored until it is needed. The Bureau's Citrate Process, which accomplishes this conversion, is about to undergo full-scale commercial tests.

Reclamation of land previously disturbed by mining activities, developing safe means of closing worked out mines, and assuring the stability of overlaying surface areas are other problems Bureau research addresses. The aim is not only to provide improved technology for eliminating these problems, but also to repair damage from past mining operations.

The Bureau also works to develop alternative processes to produce mineral commodities in ways that prevent the generation of pollutants. For example, a current project aims at developing a process for producing lead and zinc through fused salt electrolysis. Such a process would eliminate the lead fumes and sulfur dioxide emissions that are characteristic of the conventional recovery of these metals.

Under the Bureau's Mineral Environmental Technology program, academic institutions are now performing contracts like the following:

Prediction of Ground Movements by Computer Simulation

(Pennsylvania State University)

Fugitive Dust Study in an Open Pit Coal Mine

(University of Minnesota)

Development of a Load-Haul-Dump Tree Clump Transplanter Attachment

(Colorado State University)

Surface Mining and Water Resources

(University of Arizona)

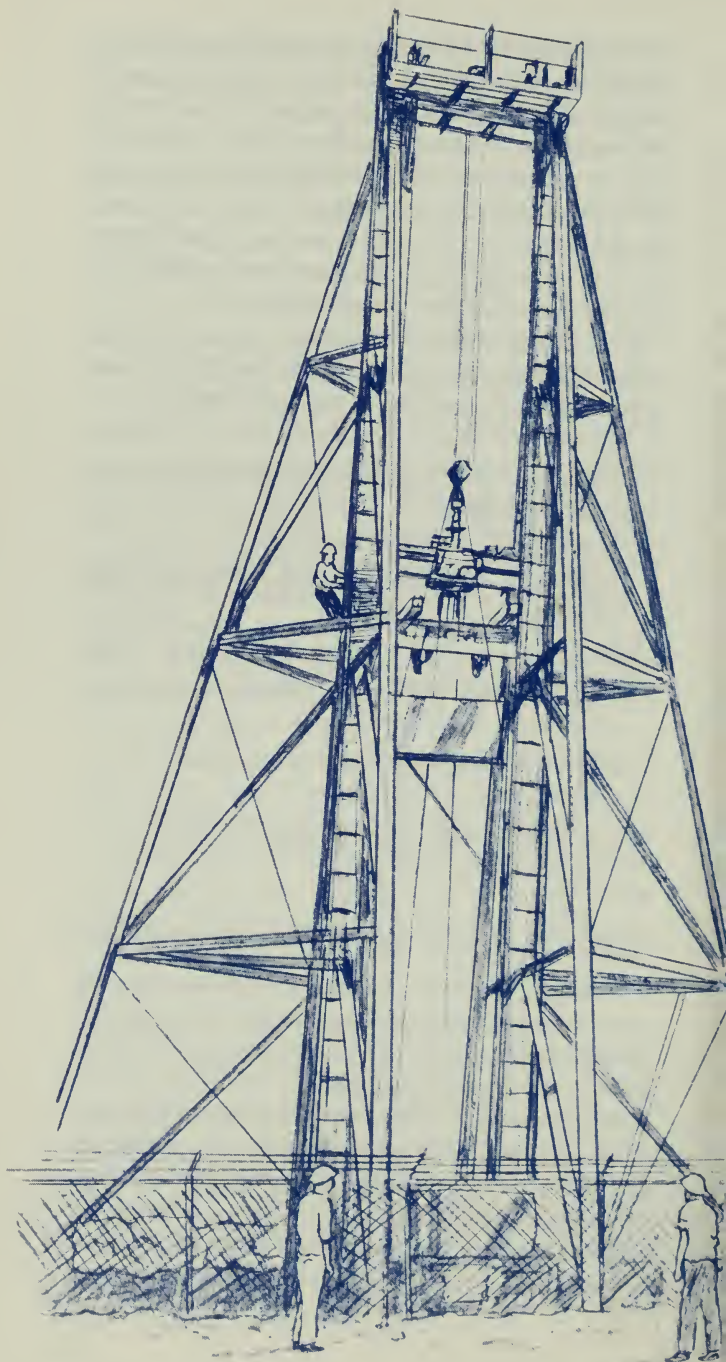
Zinc Sulfide Retorting Without Pollution

(University of Utah)

Minerals Health and Safety Technology

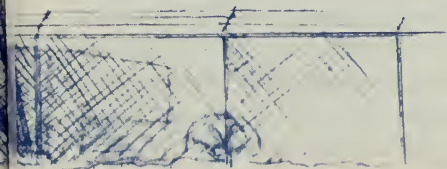
A large part of the Bureau's research effort is aimed at identifying and removing the health and safety hazards that workers are exposed to in mines, mills, and smelters.

A wide array of research and engineering projects is underway to combat respirable coal mine dust, the cause of disabling "black lung" disease (*pneumoconiosis*). Efforts are also underway to reduce the levels of noise that mineral workers are exposed to, in order to prevent hearing loss.



Methods for detecting and warning miners of the presence of toxic and noxious gases are being developed and improved. Work is also in progress to protect underground uranium miners from exposure to airborne radioactive particles, as well as to improve mine ventilation systems and suppress dust.

Bureau research to improve safety conditions in the mining and mineral processing industries includes finding ways to eliminate the major hazards present in these types of operations. Work on preventing fires and explosions, the major causes of coal mine disasters, emphasizes techniques to minimize the presence of explosive coal dust generated in underground mining operations. Methane detection methods are being improved, and Bureau research has shown how to effectively remove this explosive gas from coal deposits before they are mined, thereby removing a serious safety hazard and, at the same time, recovering a useful fuel. Falling rock is a major hazard in underground mines, and causes most of the deaths and injuries in day-to-day mining operations. Bureau research seeks to improve methods to detect changes in rock stability, giving an early warning to take corrective measures or move miners out of the affected areas. Better rock bolting and other ground control methods are also being developed. Safer mechanical, electrical, and transportation systems are being



assembled and tested in an effort to prevent another major cause of accidents and injuries. Equipment and procedures enabling miners to survive major disasters and assist rescuers in locating them when they are trapped underground are being developed. The Bureau is also developing inherently safe mining systems that make it possible for workers to stay out of the most hazardous areas in a mine. The Bureau is also continuing its long-standing program to improve the safety and reliability of explosives used in mining operations.

The following are representative of contracts currently being performed by academic institutions under the Bureau's Minerals Health and Safety Technology Program:

Investigation of the Mode of Action of Extinguishing Agents Used in Coal Mines Against Coal Dust Explosions

(University of Massachusetts)

Delineation of Geologic Roof Hazards in Selected Coal Beds in Eastern Kentucky

(Morehead State University)

Enhancement of Mine Power System Safety and Reliability

(West Virginia University)

Haulroad Berm, Guardrail and Sign Design Study and Demonstration

(Southwest Research Institute)

Interactive Mine Power System Analysis

(Pennsylvania State University)

Evaluation of Stand-alone Interactive Teaching Machines for Mine Vocational Training

(Massachusetts Institute of Technology)

Second Generation Stability Indicators for Front-end Loaders

(Stevens Institute of Technology)

Monitoring of Mine Air Pollutants

(Michigan Technological University)

Design, Construct, and Mine Test a Device for Installing Cement-Grouted Roof Bolts

(Colorado School of Mines)

Development of a Personnel Dosimeter System for Uranium Mines

(University of San Francisco)

Post-Disaster Communication Techniques

(University of Michigan)

Mineral Information and Analysis

Keeping track of how well our supplies of minerals are keeping pace with national requirements is a vital part of the Bureau's work. Planners and decisionmakers in both the governmental and private sectors need to know what minerals we're going to need, and in what quantities; where the minerals are going to come from; how they're going to be used; how they'll be transported; what the costs will be; how the environment will be affected; and a host of other interrelated factors that ultimately determine whether the minerals and metals that we require will be available when we need them.

The objective of the Bureau's information gathering and analysis program is to help anticipate mineral resource problems, and to formulate workable solutions (*technical, economic, political, regulatory, etc.*) before those problems grow critical.

To spot important trends as early as possible, the Bureau gathers and analyzes worldwide statistics on production, consumption, prices, and trade for every commercially important mineral commodity: Results are summarized and disseminated widely to business people, economists, government policymakers, and others who need

the facts to do their jobs.

The process of trend-spotting and statistical analysis also helps in shaping the Bureau's priorities in minerals research. Special economic studies are done, as needed, to complement the statistical work. Such mineral intelligence serves as the basis each year for the Secretary of the Interior's Annual Report to Congress on the Nation's mineral position. The report tells lawmakers how well prepared the country is to supply essential minerals from domestic resources, and recommends legislative remedies for mineral-related problems that have come to light.

The Bureau of Mines is also building the foundation of a computerized storehouse of information about mineral resources and reserves worldwide. The program uses automatic data storage and retrieval technology to speed up the mammoth job of recording, evaluating, and analyzing



volumes of detailed information about individual mines and properties—even abandoned ones, where an earlier generation's off-grade ores and processing residues might someday become important again. Updating and refining the system is a continuing process, which is supplemented as necessary by in-depth studies of particular deposits, regions, or individual mineral commodities of concern.

To help policymakers set the future course for publicly owned lands of special significance, the Bureau of Mines participates with the Interior Department's Geological Survey in mineral assessments of national lands under consideration for designation as parkland, wildlife refuges, and wilderness. The work provides Congress with information needed in deciding how such lands will be used, and serves as the nucleus for a mineral resource inventory of America's public lands.

The following are typical of contracts currently being performed by academic institutions under the Bureau's Mineral Information and Analysis Program:

Foreign Data Compilation and Onsite Evaluation for the Bureau of Mines Minerals Availability System

(Eastern Washington State College)

Impact of Stack Gas Cleanup on Sulfur Availability and Sulfur Mining

(University of Arizona)

Evaluation of Alaska Mineral Resources

(University of Alaska)

Collection, Evaluation, and Classification of Mineral Resources Information on Lead and Zinc in Central Kentucky and Tennessee and Fluorspar in Tennessee

(University of Missouri)

Availability of Copper, Nickel, Cobalt, and Manganese from Ocean Ferromanganese Nodules

(University of California)

Mineral Industry Location System for the State of Wisconsin

(University of Wisconsin)

CURRENT UNIVERSITY CONTRACT ACTIVITY

During Fiscal Year 1979, in conducting the activities just described, 123 Bureau of Mines contracts with a total value of \$10,130,599 were awarded to 57 academic institutions located in 33 States and the District of Columbia. The contracts awarded ranged in value from under \$20,000 to over \$500,000, with the average being about \$82,000. The average academic institution receiving Bureau of Mines contract funding was awarded two contracts with a total value of \$177,700.

As can be seen from the foregoing listing of titles, contract activity by academic institutions and their research affiliates supported the full range of Bureau programs from policy analysis, data collection, and basic research, to development, testing, and evaluation of hardware systems. A broad range of academic disciplines were involved, including economics, computer sciences, education, geology, mining, metallurgy, electrical, electronic, mechanical, civil and chemical engineering, chemistry, and physics.

The \$10.1 million in contracts awarded by the Bureau to academic institutions in Fiscal Year 1979 represents approximately one-fourth of the \$46 million awarded by the Bureau that year for contracts on which universities and mining schools could reasonably expect to be competi-

tive. The remainder of the Bureau's budget goes for supply and construction-type contracts and for the support and conduct of its in-house program. Clearly, there is room for academic institutions to participate even more substantially in the Bureau's contracting program. In so doing, they will help to serve important national needs and will strengthen their own capabilities in the vital areas of mineral resource technology and economics.

WORKING WITH THE BUREAU OF MINES

There are two basic vehicles for initiating contract negotiations with the Bureau of Mines: Request for Proposals (*RFP*) and Unsolicited Proposals (*USP*). An RFP, which originates within the Bureau of Mines, seeks to identify qualified contractors interested in carrying out specific projects considered by the Bureau to be necessary to its mission and/or programs. In contrast, a USP originates from a potential contractor who is seeking, from the Bureau, support of certain activities the contractor believes to be of mutual benefit and interest.

As a matter of law, and in order to obtain outside assistance at minimum cost, the Bureau must generally operate on a competitive procurement basis. To this end, RFP's are routinely announced in the "Commerce Business Daily," soliciting proposals from *all* interested organizations believing themselves qualified to successfully perform the indicated work. Announcements are published under either "Research and Development" or "Research and Development—Sources Sought" headings. Organizations responding to such a solicitation must provide, at a minimum, the following information: (1) A statement of the objectives and general approach that

will be pursued in addressing the task; (2) a detailed statement of work which specifies the mechanics of accomplishing the stated objectives; (3) a statement of the qualifications of the organization and/or individuals who would carry out the work; and (4) an evaluation of the costs for completing the task. The appropriate mailing address and other directions for responding will accompany each RFP solicitation.

A contractor submitting a USP may become a sole source for the proposed work, if certain criteria relating to overall merit, cost, availability, and/or uniqueness can be met. A formal USP submission must include: (1) The objectives of the proposed work and its pertinence to Bureau programs; (2) the methods to be used; (3) the qualifications of the organization and/or individuals who would carry out the work; and (4) the level of funding required to attain the stated objectives. Complete directions are given in the publication: "Guide for the Submission of Unsolicited Research and Development Proposals" obtainable from the Bureau's Branch of Procurement at the address indicated below.

The originators of proposals should be careful to identify, in writing, any sensitive portions of the proposal that they do not wish to be publicly disclosed. Such requests will be honored by the Bureau to the extent permitted by its responsibility to comply with all requirements of the Freedom of Information Act.

Any of the three procurement offices listed may be contacted for additional information concerning procurement procedures.

1. U.S. Bureau of Mines
Chief, Branch of Procurement
2401 E Street, N.W.
Washington, D.C. 20241
2. U.S. Bureau of Mines
Chief, Section of Procurement
Bldg. 20, Denver Federal Center
Denver, Colorado 80225
3. U.S. Bureau of Mines
Chief, Section of Procurement
4800 Forbes Avenue
Pittsburgh, Pa. 15213

Those interested in participating in the Bureau's Fellowship Program for graduate students, its Cooperative Work-Study Program for undergraduates, or its newly inaugurated Stay-in-School Program for high school and college undergraduates who are contending with severe financial constraints should contact the Bureau's Chief Scientist, Dr. Thomas A. Henrie, Bureau of Mines, 2401 E Street, N.W., Room 1017, Washington, D.C. 20241; telephone (202) 634-1340.

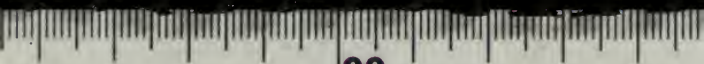


As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interest of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. Administration.





Simulation of the ColorChecker chart



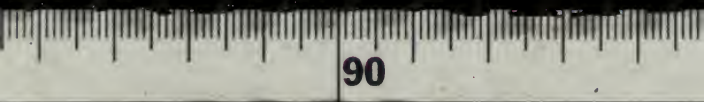
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Simulation of the ColorChecker chart for a digital image



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