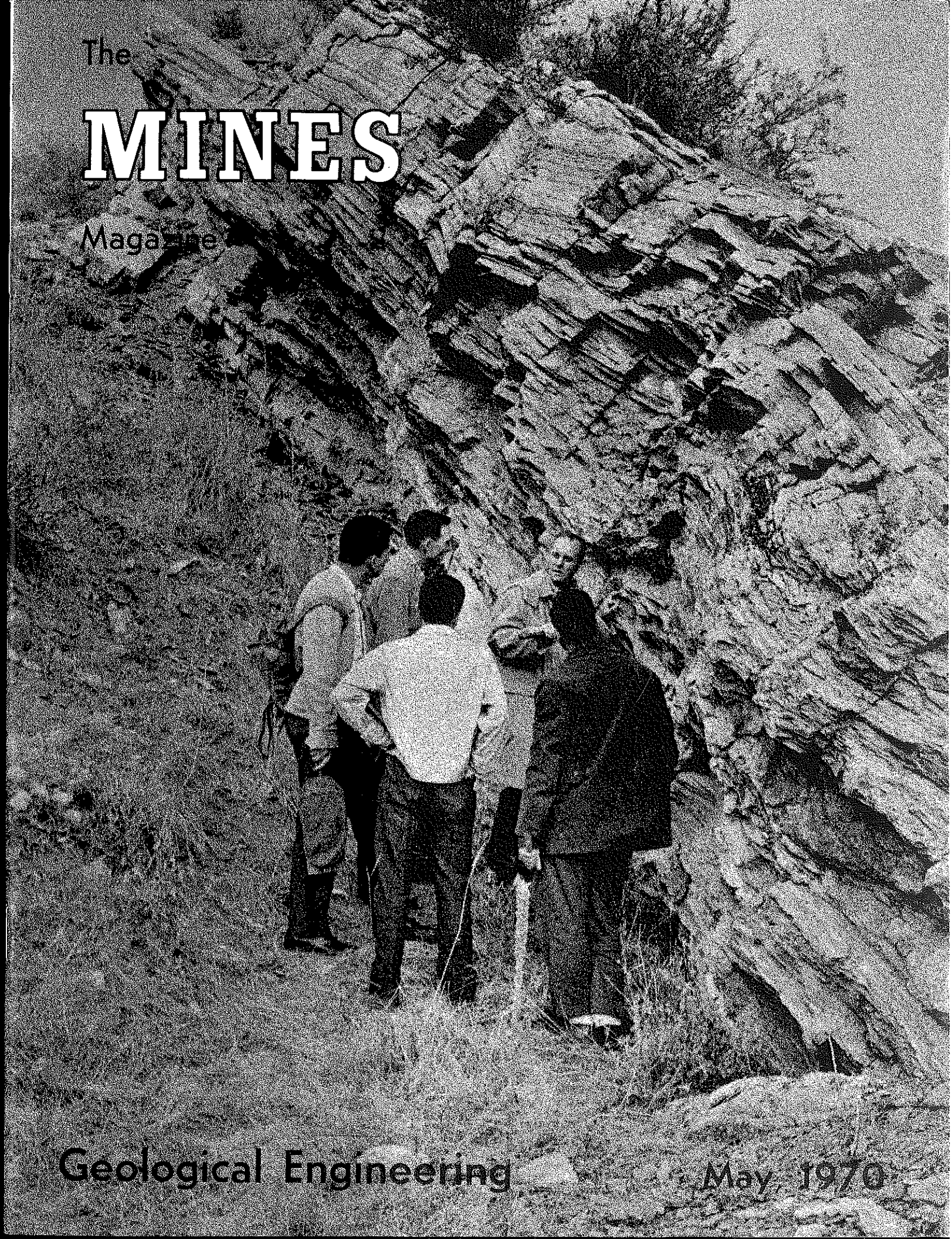
The

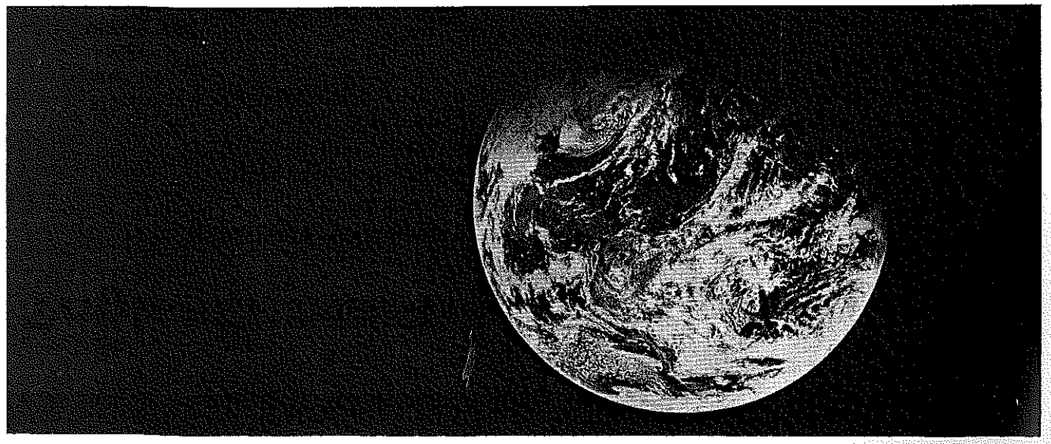
MINES

Magazine



Geological Engineering

May 1970



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Calendar

1970 AIME Pacific Southwest Mineral Industry Conference, sponsored by San Francisco Section AIME, Jack Tar Hotel, San Francisco, Calif., May 27-29.

Mineral Processes: Their Analysis, Optimization and Control, summer school jointly sponsored by Colorado School of Mines and Queen's University, Kingston, Ontario, May 31-June 12.

Symposium on Silicon Device Processing, National Bureau of Standards, Gaithersburg, Md., June 2-3.

9th International Symposium, Techniques for Decision Making in the Mineral Industry, sponsored by CIM, McGill University and Ecole Polytechnique, Montreal, Canada, June 15-19.

Convention of Wyo. Mining Assn., Jackson Lake Lodge, Jackson, Wyo., June 18-20.

AAPG-SEPM Annual Meeting, Calgary, Alberta, Canada, June 22-24.

CSM Alumni Luncheon, during AAPG Annual Meeting, Calgary Petroleum Club, June 23.

North American Materials Exposition, sponsored by ASTM, Royal York Hotel, Toronto, Canada, June 22-25.

1970 Western Resources Conference, sponsored by Colorado School of Mines, C.U., C.S.U., and D.U., at University of Denver, July 8-10.

South African Tunnelling Conference, University of Witwatersrand, Johannesburg, July 21-24.

Symposium on Nuclear Power, United Nations Headquarters, New York, N. Y., Aug. 10-14.

2nd Inter-American Conference on Materials Technology, Mexico City, Aug. 24-27.

Symposium on Advanced Experimental Techniques in the Mechanics of Materials, El Tropicano Hotel, San Antonio, Tex., Sept. 9-11.

1970 Mining Convention, sponsored by American Mining Congress, Hilton Hotel and Brown Palace, Denver, Colo., Sept. 27-30.

52nd ASM Materials Engineering Congress and Exposition, Cleveland, Ohio, Oct. 19-22.

SME Fall Meeting and AIME World Lead Zinc Symposium, Kiel Auditorium, St. Louis, Mo., Oct. 21-23.

The MINES Magazine

Volume 60 May, 1970 Number 5

Front Cover

FIELD STUDY IN GEOLOGY. Dr. Harry C. Kent, head of the Department of Geology, and a group of graduate students examine an outcrop of the Glennon Limestone member of the Lykins Formation (Permian) north of Golden, Colorado, in the Ralston Reservoir area.

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Bonanza Project: One Year Later

By Nancy J. Knepper

LAST April, thanks to the efforts of Professors L. T. Grose, R. G. Weimer, R. C. Epis, and R. H. DeVoto, the National Aeronautics and Space Administration approved the CSM proposal to establish a remote sensor test site for geology in the Bonanza District of south-central Colorado. The NASA-funded grant, which we call the Bonanza Project, was conceived to test and develop the applications of remote sensing to geological analysis and to further education in remote sensing. At present, Professors R. G. Reeves (Principal Investigator) and Keenan Lee (Associate Principal Investigator) are charged with directing the progress of the project and supervising the research, as well as providing instruction in remote sensing courses.

The area chosen for the Bonanza Test Site is in south-central Colorado (**Figure 1**). In this one compact region are encompassed fundamental and economically important geologic features which are being studied by conventional field methods and by analysis of remote sensor data. The greatest progress during the first year has occurred in broadening the base of geologic knowledge of the site itself. In part, this consisted of correlation and synthesis of local studies into a regional geologic framework and in part it was the investigation of critical formerly unmapped areas.

GEOLOGY OF THE BONANZA AREA

The well-exposed rocks in the area include: metamorphic basement terrain of Precambrian age; sedimentary strata consisting of conglomerates, sandstones, shales, and limestones, which together aggregate more than 15,000 feet; shallow intrusive and extrusive volcanic flows and tuffs; granitic plutons; and thick alluvial basin-fill deposits.

The Bonanza area is traversed by the northern terminus of one of the most extensive Recent fault zones in the U. S.—the Rio Grande rift zone—which extends northward from Mexico into Colorado. This and other structures have a direct relation to, if not major control over, the occurrence and movement of ground water in the area. Older fault systems, in combination with volcano-tectonic collapse features, relate to metallic mineralization in the Bonanza, Cotopaxi, Leadville, and other mining districts.

Part of the geologic field work during the past year has been concentrated on determining the detailed geology of three specific areas. These three areas — the Rio Grande rift zone, the Bonanza mining district, and the Sargents area—are critical to an understanding of Bonanza regional geology, and these are the main areas which will be correlated with remote sensor data obtained from NASA flights 101 and 105, to be discussed later.

Work is currently in progress to compile a comprehensive index map of all geologic mapping done in the Bonanza area. The entire area has been mapped on a reconnaissance scale (smaller than 1:250,000); at least 30 per cent has been mapped in detail (1:62,500 or larger). Detailed mapping has been concentrated in areas of economic mineralization, such as the Leadville and Bonanza mining districts, and areas where Phanerozoic sedimentary rocks crop out. Only a small portion of the Precambrian terrain has been mapped in detail. Much of the Sangre de Cristo Range has been studied in detail because of the combination of interesting structure, Pennsylvanian-Permian stratigraphic problems, and excellent exposures. The

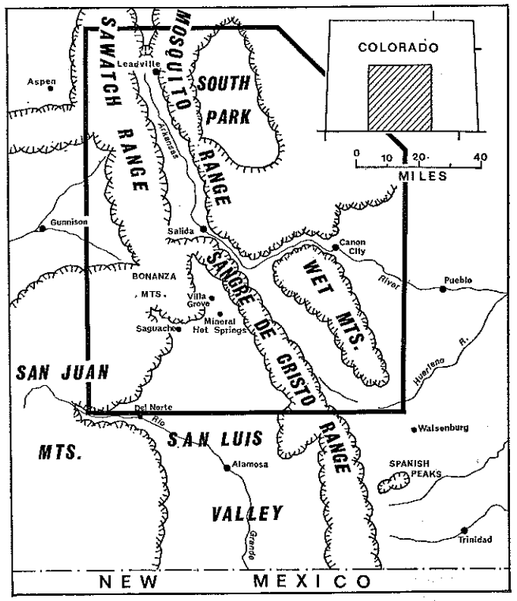


Figure 1. Index map of Bonanza Area in South-Central Colorado.

foothills region along the eastern flank of the Wet Mountains and Front Range, including the Canon City re-entrant, has also received much attention.

ACQUISITION OF REMOTE SENSOR DATA

Problems have arisen in getting remote sensor data to work with, due to difficulty in scheduling of over-flights and uncooperative weather. Some of the flights have been successfully completed, however:

1) A NASA-Ames Convair 990 flew two lines of side-looking airborne radar (SLAR) in the Bonanza area on May 19, 1969. This was part of a test mission for the Venus Fly-By radar system, a long-wavelength SLAR.

2) Mission 101 was two flights over the Bonanza area in August, 1969, to obtain photographic coverage, night-time thermal infrared imagery, and daytime thermal infrared imagery of the entire area. However, due to weather problems, only the first objective was realized.

3) Mission 105 was also hampered by weather. The goals were photography, infrared spectrometry, multi-frequency microwave radiometry, SLAR, scatterometry, and thermal infrared imagery of certain regions within the test site. The first four were flown, and the first two of these have been assessed. Instrumented ground stations were established and manned for the flights. Their primary functions were to provide navigational aid and control, and to monitor ground surface phenomena (contact and radiometric surface temperatures, temperature-depth profiles, soil moisture-depth profiles) and micrometeorological variables (air temperature, relative humidity, wind direction and speed, cloud cover).

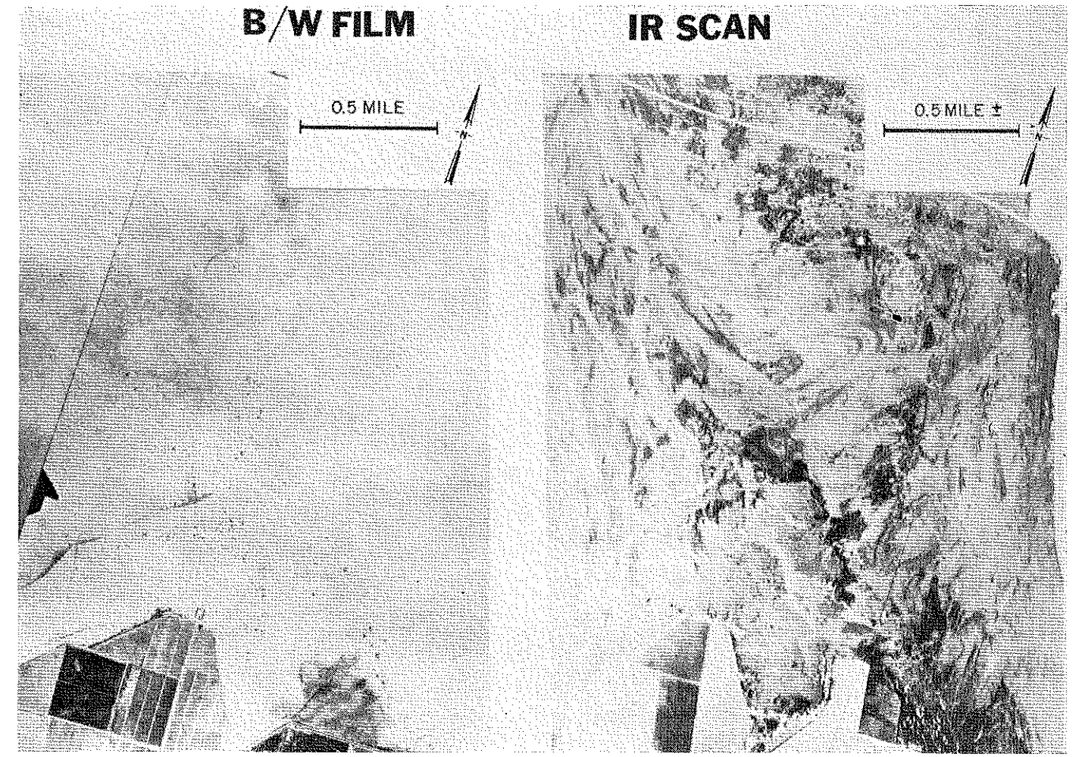


Figure 2. An example of Remote Sensing (infrared Imagery) compared with aerial photography. This illustrates how data from different wavelength regions of the electromagnetic spectrum yield new geologic information. The conventional photography (a) shown at left, shows little of geologic interest, while the thermal infrared imagery (b) on right, clearly shows an anticlinal structure truncated by a northwest-trending fault.

PRELIMINARY DATA ANALYSIS

The resolution of Venus Fly-By radar system is very coarse and generalizes the terrain to such an extent that many features of the area are virtually indistinguishable. The most consistent data available from the imagery are gently curved or straight linear features, or those features which occupy a definite area, such as small groups of trees or areas barren of vegetation cover within a forested region. Major drainage lines in mountainous areas are generally detectable.

Although greatly generalized, major topographic features (major ridges, peaks, and valleys) can be readily detected on the imagery. More subtle features of topography such as secondary stream banks, small ridges and small scarps (less than 15 feet high) are not easily found; however, the selective growth of vegetation does allow some subtle features to be located.

Many prominent mountain drainages are lost on the imagery where they debouch into the adjacent lowlands. Venus Fly-By radar imagery cannot be used to map lithologic contacts. Even highly contrasting units such as Precambrian igneous and metamorphic complex and Pennsylvania-Permian redbeds cannot be seen on the imagery. Even bedrock-unconsolidated sediment contacts can only be determined with reasonable certainty by the changes in topographic expression between the different rock types.

A number of interesting and important geological features can be seen on the color infrared photos from Mission 105. The color-shifted film, recording reflectance in the photo infrared as red, emphasizes geologic structures or changes in lithology. The excellent resolution of the system allows the interpreter to distinguish objects as small as single trees and narrow dirt roads. Drainage patterns are especially emphasized by vigorous vegetation along water courses and the low reflectivity of water in the infrared region, which appears dark on the photos. Cultivated fields are readily distinguishable from pastureland or forests by pattern and color.

Geologic structures in the San Luis Valley show well on both the color and color infrared photography. Faults in Pleistocene and/or Holocene valley fill of the San Luis Valley were detected and mapped where previously none had been delineated, either on USGS air photos or by field mapping.

Color infrared photography of the San Luis Valley west of the Sangre de Cristo Mountains shows gently curving features which are the surface expression of faults believed related to the formation of the San Luis Valley. The pattern of these features is not evident in the field, and only became apparent when viewed from above. The color infrared photography aided in locating and identifying the faults, owing to the emphasis produced by the increased reflectivity of the vegetation along them in the photo IR. The scale and resolution of the Mission 105 photos have permitted more accurate determination of the boundaries of alluvial fans and pediment surfaces in this area.

Several CSM students and faculty and USGS personnel have examined the NASA photos taken along the Sangre de Cristos and the Rio Grande rift zone. They report that the color and color infrared photography allow them to

(Continued on Page 6)

A New Tool for the Paleontologist

By Harry C. Kent

MICROPALEONTOLOGISTS and stratigraphers are overwhelmed by the vast accumulation of literature dealing with taxonomy and occurrence of fossil foraminifers. At present it is estimated that approximately 30,000 species of Foraminiferida have been recognized and described in the literature, and that the present publication rate is about one thousand articles per year. Consequently, it is difficult for workers to keep abreast of the literature. Furthermore, workers must have a consistent taxonomic and nomenclatural framework to enable them to make valid observations and communicate their findings.

As micropaleontological techniques become more sophisticated, not only is information added, but criteria for recognition and delineation of species are changed. Each worker must painfully search the literature to be certain he has accurately traced the history of a species name and considered all possible synonyms. Then, a search must be made to determine geologic and geographic occurrences of species and all supposed synonyms. In summary, micropaleontologists and stratigraphers are faced with the problems of voluminous and expanding accumulations of information coupled with changing concepts, nomenclature, terminology and objectives. These problems led to the formation of the Western Interior Foraminiferal Data Project.

Work was begun in July, 1966, and should soon be available for public use. This project was initially financed by the Colorado School of Mines Foundation, Inc. and was later funded by National Science Foundation Project GN-785. Dr. Harry C. Kent is the principal investigator. Foraminifera data was collected from the systematic paleontology sections of papers pertaining to Cretaceous strata within the States of Alaska, Arizona, Colorado, Idaho, Kansas, Minnesota, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, Utah, and Wyoming, as well as the Canadian provinces of Alberta, British Columbia, Manitoba, and Saskatchewan.

The data abstracted from the available papers include:

1. A general bibliography file of 704 references noted in the western interior papers, and a sub-file of 172 western interior articles of which 112 contained a systematic paleontology section; this file includes papers published up to 1968.
2. Primary species information as noted by the individual author. This includes plates, figures, page numbers, type specimen and repository.
3. Synonymy of the species as noted in each article, as well as the corresponding reference.
4. The stratigraphic and geographic locations as noted in each article. There are over 30,000 items in this file alone.

The collected information is filed on magnetic tape for computer storage and retrieval. From the stored information it is possible to obtain details related to geographic location, the previous work done in the area, species described, locations, and stratigraphic range. Computer programs can be written to obtain the desired information.

The information bank is intended to serve as a basis for more extensive systems of paleontologic information storage and retrieval. It is to be hoped that extensive information systems will serve the paleontologist and geologist in study and research within the near future. The job of abstracting data will be tremendous. but the advantages will be even greater.

Bonanza Project

(Continued from Page 5)

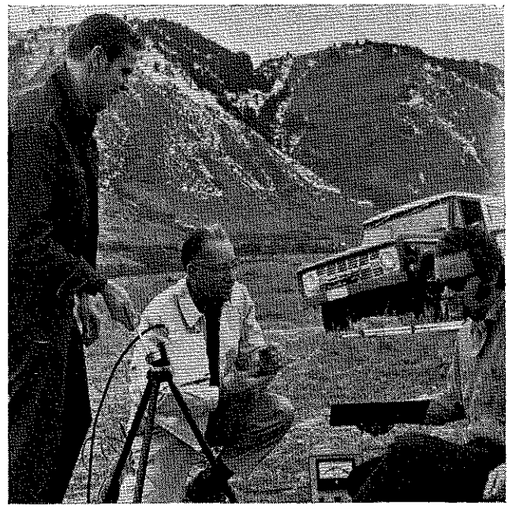
easily discriminate between rock types, particularly in Precambrian terrain and in areas underlain by the complex Pennsylvanian-Permian sedimentary rocks. Several unconformities have been mapped, based on color infrared photography. It has been estimated that perhaps as much as 50 per cent of field mapping time could have been eliminated in several thesis areas covered by the Bonanza data, had the data been available. From a first appraisal, it appears that for this region in general color photography serves best to discriminate lithologic units in the Pennsylvanian-Permian section, and color infrared photos are most useful for rock differentiation in the Precambrian metamorphics.

CURRICULUM IN GEOLOGIC REMOTE SENSING

Professors Reeves and Lee combined to teach a graduate level course in geologic remote sensing for the first time during the fall semester of this year. This two credit-hour course had five students registered. During the present semester, the same course was offered as part of the CSM Continuing Education Series, a series of courses taught in the evening so they are available to professional people working in the Denver-Golden area. Enrollment for this semester consists of 23 registrants (11 professional people) and 10 non-registrants, (including four faculty members).

The geologic remote sensing curriculum has been expanded to include three courses, each of which will be taught next academic year, 1970-1971. These courses will be:

1) Introduction to Remote Sensing
2) Geologic Applications of Remote Sensing
3) Seminar in Geologic Remote Sensing



DAN KNEPPER, GRADUATE STUDENT, Professor Robert Reeves, and Gary Raines, graduate student, check the Infrared Radiometer during a remote sensing overflight. This is part of the ground control equipment, and measures emitted thermal infrared radiation (temperature).

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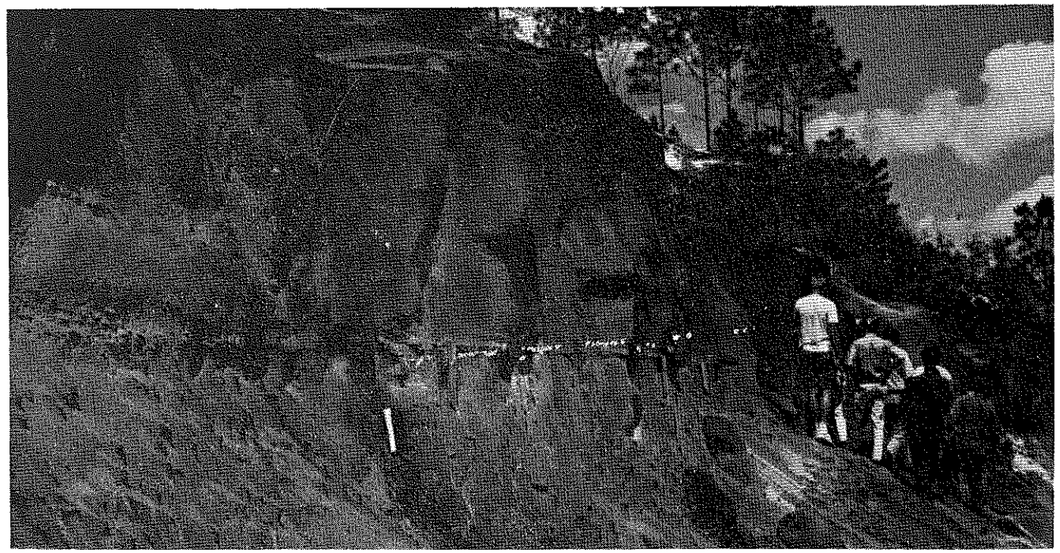


OUTCROPS of Pleistocene rocks originally deposited in backshore (top) and foreshore (bottom) environment. Exposures along Bell's River, Florida. Vertical tubes in lower part of section represent fossilized burrows of the decapod crustacean **Callianassa major** Say.

Modern Sediments Field Program

DURING the past two summers a special field program in the study of modern sediments has been conducted for gradaute students in the Department of Geology. The program was initiated in order that selected groups of students might have the opportunity to observe and study the sedimentary processes and the associated organic and inorganic features which are characteristic of modern coastal environments. It is hoped that this detailed study of modern conditions will provide a firmer foundation for the interpretation of ancient sediments.

In addition to the more academic aspects of basic interpretation of environment of deposition and distribution of sedimentary rocks, the study of modern sediments and sedimentary processes forms an important base for the exploration geologist. Since the localization of economic accumulations of petroleum as well as ore minerals may be controlled by the nature and distribution of the sedimentary rocks, it is important for the geologist to understand as well as possible the basic environmental factors in order to plan an exploration program. The work in the study of modern sediments has been pioneered and emphasized in the United States by many exploration companies, particularly petroleum companies, and the CSM program is designed to provide some of the benefits and insight of such study to graduate students.

The logistics of the modern sediments program have necessitated that the participants be restricted to a small number each summer, and, consequently, six graduate students were involved during the summer of 1968 and four during the summer of 1969. Funds for the operation of the program have come in part from grants made to the Department of Geology by the Humble Oil Education Foundation and the Shell Companies Foundation Incorporated. Students participating in the program provide their own living expenses.

In addition to direct financial support, contributions have been made to the program by Chevron Oil Co., The California Company Division, in providing discussion leaders and the use of a company plane for an air trip over the Mississippi delta; Esso Production Research Co. through a visit to its laboratory in Houston; the Agrico Division of Continental Oil Co. through discussion and visit to the phosphate-mining area of Florida and by Dr. John Hoyt and Dr. James Howard of the University of Georgia Marine Institute at Sapelo Island, Georgia, who have spent several days in the field with the study groups and have made available the facilities of the Marine Institute for our use. Many other organizations and individuals have also contributed to the program through encouragement and providing support in critical areas, including Pan American Petroleum Corp., the Miami Geological Society, and the National Park Service. For the initial two years, the program was conducted by Dr. Harry C. Kent. A similar program is planned for the summer of 1970 to be directed by Dr. Richard H. De Voto.

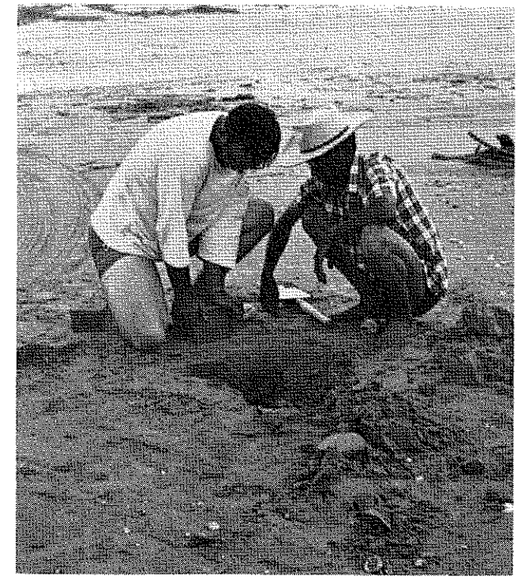
The field study areas of the modern sediments program have included regions of both detrital and carbonate sedimentation. An introduction to the sequence of deposition of barrier islands has been given at Galveston Island, Texas, where the various subenvironments of shoreface, foreshore, backshore and lagoonal sedimentation have been well studied and documented, including the associated sedimentary structures and biota. This work has been supplemented by additional study on the barrier island sequences of Santa Rosa Island and the related sound and bay areas near Pensacola, Florida, in the Appalachicola delta region of Florida, and at Sapelo Island, Georgia.

At each study locality, the physical parameters of environmental energy (including waves, wind and tide); temperature, pH, and salinity of the water; observed sedimentary structures, and associated fauna and flora were recorded. In addition, trenches were dug through beaches and sand dunes and oriented latex peels and photographs taken to record the sedimentary structures. Box cores and other types of cores were made and treated in the laboratory by plastic impregnation so that they could be preserved for future study. A number of beach profiles were also measured in order that the nature of the slope of the beach can be compared between localities and that a comparison may be made from year to year of the changes which might occur at any one locality.

PREPARATION of latex peel of sedimentary structures on foreshore of beach at Galveston Island, Texas. Student: Cooper Land.

In addition to the barrier island studies, the chenier coast of western Louisiana has been examined briefly, and there have been both ground and aerial survey of the Mississippi River delta region. Both of these areas have been treated briefly in the program because of their complexity and of time limitations, but it is to be hoped that the students are able to gain some appreciation of the variation in environments of detrital deposition along the Gulf coast. Another area of brief study has been the Everglades region of South Florida where emphasis has been placed on the environmental factors controlling the distribution of different types of plant growth, and the nature of modern swamp and "grass plain" environments and their relationship to potential coal formation.

Each year, a high point of the program has been the study of environments of carbonate deposition in the Florida Keys. Work has been done both in Florida Bay and on the reef tract in order to learn the nature of sedimentary materials, environmental factors, and distribution of organisms in this area. Additionally, emphasis has been placed on the interpretation of exposed Pleistocene deposits of the Florida Keys in light of the observation of the modern environments.



STUDENTS James Cronoble and Harmoko Taranggono take a box core in the backshore area of the beach at Galveston Island, Texas.

The Pleistocene analogies have also been stressed in outcrops near the Georgia-Florida boundary where it is possible to compare sedimentary rocks which are the products of deposition in several different environments with the equivalent modern environments along the Georgia coast.

Although it is not possible in the short time available for the field program to delve deeply into the problems of any one of the environments of deposition, it is hoped that the students will gain some insight into the interpretation of sedimentary rocks through the understanding of the processes of formation. The program is also one of the examples of enrichment of the curriculum of study which it is hoped will be a hallmark of "Mines" education.

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Geology Summer Field Course

*By Rudy C. Epis**

SINCE 1960, the geology summer field course has involved a mobile program throughout central and western Colorado. Prior to that time, semi-permanent facilities were used during the entire six weeks of the course, and relatively short trips away from the central location provided some degree of variety in geologic settings and problems. Best known among these facilities is the camp at Wildhorse, north of Pueblo, where many hundreds of CSM alumni received their first professional training in field geology.

Because of the significant advances in highways and highway vehicles, a mobile camp is more feasible now than in earlier decades. It seems only logical, therefore, that the department would eventually take advantage of the spectacular examples of fundamental geological field relations so wonderfully exposed throughout the Colorado portion of the Southern Rocky Mountains.

The philosophy behind the field course is to provide students with training, experience, and competence in a variety of geological situations. This philosophy is actually the basis for establishing the mobile aspect of the course; specific areas have been selected to illustrate principles, processes and problems relating to stratigraphy and sedimentation, structural and tectonic geology, plutonic igneous and metamorphic geology, volcanology, geomorphology, and the application of the above to the fields of petroleum, mining and engineering geology. Field trips between areas and lectures in camp emphasize the regional relations of local areas in an effort to bring together a comprehensive understanding and appreciation for the geologic history of a large portion of the Rocky Mountains.

During the past decade, the staff has researched numerous localities and has used them on various occasions for one-week problems. Examples include the eastern Uinta Mountains, Colorado National Monument, Arches National Monument (Utah), Ouray-Silverton district, northeastern San Juan volcanic field, Bonanza district, Cripple Creek district, South Park, Canyon City embayment, Sangre de Cristo Mountains, Mo-

FIGURE 1. The author lecturing to students in camp in the Bonanza district.

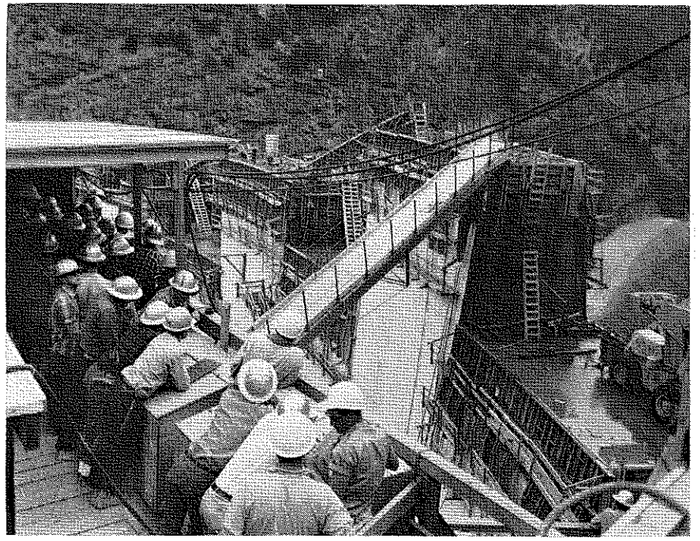

FIGURE 2. Students and staff visiting the Morrow Point damsite on the Gunnison River.

*Professor of Geology, Colorado School of Mines.

FIGURE 3. Professor Grose (left of map) and Professor Weimer (between autos) lecturing students on field trip between Ouray and Telluride.

squito Range, and Middle Park. Anyone familiar with these localities will immediately appreciate the great variety of geology available for study. We have purposely not used the eastern flank of the Front Range in the summer program because it provides excellent week-end problems in field geology attached to our junior level courses during the Spring and Fall semesters.

The program planned for the geology field course for the coming summer (June 7—July 18) is typical of those of the past 10 years. It is outlined below.

Albert C. Harding, '37

Partner, Black Hills Bentonite Co.

Casper, Wyoming

Box 1, Mills, Wyoming

First Week: Field trip—Golden to Colorado National Monument near Grand Junction; five days field work in the Monument including section measurement, analysis of primary sedimentary structures, mapping of folded and faulted sedimentary formations on aerial photographs and topographic maps; field trip—Colorado National Monument to Gunnison, including important stops at the Black Canyon of the Gunnison River and dam sites of the Morrow Point and Blue Mesa dams of the Curecanti Project with personnel of the Bureau of Reclamation.

Second Week: Cochetopa Creek area southeast of Gunnison; five days mapping on aerial photographs and topographic maps of Precambrian granitic pluton and associated metadiorite and metagabbro intruded into foilated metasedimentary rocks; emphasis on structural petrology and plutonic processes of intrusion and metamorphism; short report.

Third Week: Jacks Creek area west of Saguache; five days mapping on aerial photographs and topographic maps of 7½-minute quadrangle; group project with small individual areas to be compiled and integrated on large base map; folded and faulted volcanic and subvolvanic rocks, including ash-flow tuffs, lavas, breccias, plugs, dikes, sills and volcaniclastic sedimentary rocks. Field trip — Saguache to Golden.

Fourth Week: Field trip—Golden to Silverton; five days mapping on topographic maps at Lime Creek south of Silverton; low grade metasedimentary rocks of the Uncompahgre Series and folded and faulted fossiliferous Paleozoic carbonate rocks; short report. Field trip—Silverton to Durango, including one-way trip on narrow gauge railroad along Animas River.

Fifth Week: Five days plane table mapping of folded and faulted Cretaceous strata near Ridgeway; structure contouring and evaluation of petroleum possibilities; one-half day exercise in geochemical exploration using surface waters and stream sediment samples in Uncompahgre River drainage basin.

Sixth Week: Ouray area; five-day problem of student's choice; may select from underground mapping in Camp Bird Mine, regional stratigraphy, structural geology, volcanology, engineering geology, geomorphology, etc. Short report and final examination in the field.

Logistical problems connected with the field course are minimal, even though we generally have 45 to 55 students and travel on an average of 2,500 miles during the six-week period. Students are responsible for their own transportation and camping equipment, usually resulting in three or four students sharing vehicles and tents. For a modest fee, the group is served hot, freshly prepared, chuckwagon style breakfast and dinner and materials for making lunches by a professional caterer. Unquestionably, dinner time in camp is one of the most enjoyable events of each day.

The geology summer field course is one of the highlights of the year for both students and staff. In addition to providing the rewarding geological experiences described above, it also creates close teacher-student relations over an extended period of time. We all get to know each other much better than in most classroom situations and find it easier to communicate with one another more successfully the following academic year. In spite of momentary crises such as flat tires, rain, snow, misplaced field equipment, and the like, we have always been able to survive very well indeed; and the staff generally finds itself looking forward to the next year's program even before the current one is completed.

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Donald R. Stewart '61 — W. H. Thornley, Jr.

Impact of New Technology On the Petroleum Industry

*By John D. Haun**

NEW technology will be important to the future petroleum industry by improving discovery, producing, transportation, and refining efficiency and thereby increasing the rate of reserves additions and reducing costs of finding and exploiting petroleum resources. Technological improvements have been made throughout the history of the petroleum industry and undoubtedly will continue to be made—these have been offset to a large extent by rising costs of materials, labor, and taxes.

Several recent studies by the National Petroleum Council and the U. S. Department of Interior's Office of Oil and Gas have reviewed various aspects of new technology in oil and gas exploration, drilling and recovery, productive capacity, cost reduction, transportation, and oil refining. Important aspects of technological advances that affect the petroleum industry are summarized below.

EXPLORATION

No major breakthrough in improvement of exploration methods has been made in recent years and none is anticipated; gradual improvements are being made constantly. Improved geophysical methods have made possible the discovery of deeper structural traps, but there has been little improvement in ability to find stratigraphic traps in sandstones by the use of geophysics. A trend toward deeper drilling has developed in recent years and this will continue.

Knowledge of depositional environments and geochemistry of modern sediments has increased markedly and this knowledge has been used in interpretation of ancient environments and in evaluating oil and gas potential. With subsurface information, it is possible to reconstruct geographic features as they existed in the geologic past. There is continuing improvement in these techniques and they offer the most promising methods for future exploration. An increase in drilling activity will increase the rate at which subsurface geologic techniques may be applied. Methods of computer processing, analysis and simulation are increasing the efficiency of data usage.

Increased study of pressure, temperature, and fluid movements in reservoir rocks also should lead to a modest increase in exploration efficiency. New tools and well-logging methods, and improvements in present methods, should increase the ability to interpret subsurface conditions. Development of a direct above-ground oil-finding technique does not seem to be a reasonable expectation. Most exploration is the result of the controlled imagination of the petroleum geologist or geophysicist — his education and working conditions are as important as new developments in exploration hardware.

DRILLING AND RECOVERY

A major part of exploration and development expense is allocated to drilling and completing wells. Changes in drilling — rig design and drilling methods have reduced time and expense of drilling some holes. Costs of drilling deep wells have been reduced, but costs of intermediate-depth wells have remained relatively constant. Reductions in expense have been attained through drilling smaller-diameter holes, wider spacing of development wells, and completions in multiple producing zones. Additional cost reductions will continue to be made, but these will be offset by increased labor and materials costs. A new drilling method that would revolutionize exploration and development is a recurrent dream, but it will not be realized in the foreseeable future.

Much basic and applied research has been devoted to the problem of recovering as much oil as possible from the reservoir rock after a field has been discovered. Of the estimated 14 billion barrels of oil discovered in Wyoming, only an estimated four billion barrels (29 per cent), including oil already produced, is recoverable under existing economic conditions and by present recovery techniques. These are probably conservative estimates; an additional billion barrels may be economically recoverable by fluid injection. An estimated additional two to three billion barrels may be physically recoverable by fluid injection and by other means if costs could be reduced sufficiently. Most injection projects use water and/or gas, but much progress is being made in the use of solvents (miscible-agent techniques), steam injection, and in situ combustion (fireflooding).

It is common practice to increase oil and gas production by explosive or hydraulic fracturing. More extensive fracturing is possible through the use of nuclear explosives. Project Gasbuggy in New Mexico, Project Rulison in Colorado, and other nuclear fracturing experiments to be conducted in Colorado and Wyoming, should determine the practicality of this technique in increasing the ultimate recovery of gas.

If these experiments are successful, it is estimated that an additional 200 trillion cubic feet of gas should be recoverable in the Green River basin! Recovery of oil or gas from oil shale and coal by the use of nuclear stimulation, and conjunction with other techniques, is in the planning stage and cannot be evaluated at present. It is obvious that these experiments have great potential importance to the future petroleum industry.

*Professor of Geology, Colorado School of Mines.

U.S.G.S. Geologic References

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Departmental News

THE Outstanding Senior Award went this year to **Stephen D. Schwochow,** and the RMAG Award, also for an outstanding senior, was given to **Wing-On Chu.** These awards are made on the basis of outstanding scholastic ability and achievement in Geology.

Special Lectures on Geology

SEVERAL special lectures were given this year, on diversified areas of geology:

JAMES M. COLE: Humble Oil & Refining Co., Los Angeles, District Geologist. "Geology of the Ventura Basin as an Approach to Exploration of the Continental Margin."

J. O. LEWIS: Consulting Geologist, Houston, Texas, and AAPG Distinguished Lecturer. "Practical Computer usage for Subsurface Geologists."

DR. MASON L. HILL: AAPG Distinguished Lecturer. "New Global Tectonics Related to West Coast Structure."

DR. CLYDE H. MOORE, JR.: Department of Geology, Louisiana State University. "Deciphering the Past."

ROBERT E. RIECKER: Air Force Cambridge Research Laboratories. "Rock Mechanics as Related to Earthquake Source Mechanisms."

HUNTER YARBOROUGH: Humble Oil & Refining Company, Senior Geological Scientist of Headquarters Exploration Group, Houston, Texas. Five Lectures: "Utilization of Geophysics in the Exploration for Oil and Gas;" "Structural Geology and the Entrapment of Oil and Gas;" "The Origin of Oil and Gas and the Sedimentary Environments Favorable for the Occurrence of Petroleum;" "The Exploration Function of the Petroleum Industry and the Economics of Exploring for Oil and Gas;" "Modern Concepts of Seafloor Spreading."

Grants From Many Companies

THE Geology Department is the recipient of many grants from oil companies, mining companies, and others, as well as Federal agencies' funds. These grants may take the form of scholarships for undergraduates, fellowships for graduates, funds for special projects, or unrestricted departmental grants to be used at the department's discretion. A list of sources for these grants read like Who's Who in the Minerals Industry:

AMAX, American Selco Inc., Getty Oil Co., Gulf Research and Development, Humble Oil, Mobile Oil Corp., Pan American Petroleum, Phillips Petroleum, Shell Oil, PPG Industries, Union Pacific Railroad Co., Bear Creek Mining Co., Union Oil Co. of California, Standard Oil Co. of California, ASARCO, FMC Corp., and Garvey Drilling Co.

Federal Government Agency funds come from NDEA, NSF, and NASA, for fellowships and traineeships. Research projects are funded by NASA, NSF, and the CSM Foundation, Inc.

THE Geology Department staff gained two new members last fall: **Dr. Keenen Lee** and **Dr. Donald Grybeck. Dr. Lee** is teaching Remote Sensing and helping supervise the Bonanza Project for NASA. He did his undergraduate work at Rensselaer Polytechnic Institute, then at Louisiana State University, where he received his B.S. and M.S. degrees in Geology. His Ph.D. work was at Stanford University, emphasizing Remote Sensing and Computer Applications in Geology. Expansion of the Remote Sensing Program here at Mines is one of the main reasons for his presence. Dr. Lee's interest in Remote Sensing sometimes takes unusual turns: he is currently thinking about research into snakes' remarkable heat sensing abilities, using his pet rattler for a data source.

Dr. Grybeck received his B.S. degree from the University of Alaska in 1963, where he worked as a research assistant in their Geophysical Institute. He bypassed the Master's program and received his D.Sc. from Colorado School of Mines in 1969, doing thesis work on lead, zinc, and silver ores and minerals in Colorado. He has worked for the last two summers in Alaska for the U.S.G.S., and liked it so much that he has decided to return to the University of Alaska next fall as a Professor. During his year as Professor at Mines, he taught Ore Microscopy, Structural Geology, and Stratigraphy.

Dr. Rogert Reeves, who last year was an adjunct professor in the department, accepted a full Professorship November 1, 1969.

Communications Gap Bridged Between Students and Faculty

THIS year, under the direction of Dr. Harry Kent, acting head of the CSM Geology Department, a committee consisting of three elected graduate students and Dr. Kent has been established to provide a communications link between the graduate students and the department faculty. A similar committee was set up for undergraduates, consisting of the three Geology Club officers and Dr. Kent.

Students having criticisms, suggestions, or recommendations to the department as a whole or to individuals can tell these to any student member of the committees, who then conveys the remarks to Dr. Kent during a committee meeting. The student remains anonymous in the process. Members of the faculty have the same right to convey remarks to the students.

After discussions at periodic meetings, an edited transcript is written by the student members, read and approved by Dr. Kent, and posted for all to see.

Thus far the topics brought to the committees for discussion have been pertinent to academic life around the department, and results have been promising for the future. It is hoped that such committees will eliminate any "rumors" or friction between faculty and students, built up by a lack of communication.

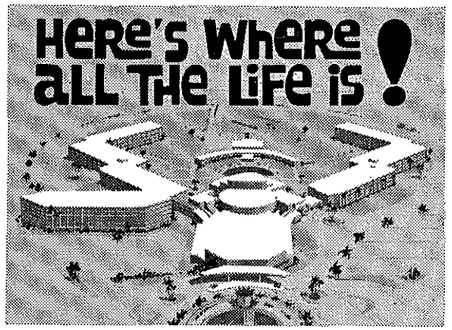
Dr. Robert Weimer Goes North

DR. ROBERT J. WEIMER has been on a one-semester leave of absence from the Department to serve as Visiting Professor at the University of Calgary, Alberta, Canada. A graduate level course on stratigraphic principles and practices was offered at the University for full-time students. The program was also made available as a continuing education course for industry employees in Calgary. More than 80 people attended the lecture series.

In addition, an 18-hour seminar was jointly sponsored by the Continuing Education Division of the University and the Alberta Society of Petroleum Geologists. The seminar, "Stratigraphic Petroleum Exploration of Detrital Sequences," was given in two nine-hour units during Feb. 11-13 and April 6-8, 1970. Approximately 250 geologists from the petroleum industry enrolled for the seminar. The high attendance at the seminar reflects the renewed petroleum exploration interest in the detrital sequences in Canada, especially in the Arctic Islands and the general MacKenzie River delta area, where Imperial Oil recently discovered oil in a Cretaceous sandstone at Atkinson Point.

In February, Dr. Weimer was invited by Dick Siegfried and Mort Kline to address the CSM Alumni Association in Calgary. A large group of Miners and guests attended the luncheon talk on "The Future of Oil Exploration in the Rocky Mountain Area." A similar address was given in March before the Southwestern Legal Foundation in Dallas.

The program in Canada is an extension of Dr. Weimer's interest in continuing education programs. He has been active in developing and offering programs for industry personnel both at CSM and for the American Association of Petroleum Geologists. During the past four years Dr. Weimer has presented nine 12-hour AAPG lecture series on startigraphic petroleum exploration to geological societies in several states and in Australia. In May, the lecture series will be offered to the New Orleans Geological Society.



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Donations Accepted Here

MINERAL specimens of exceptional quality are extremely rare and difficult to obtain—especially if a museum operates on a limited budget as we do. Many classic localities of the world have been depleted of their good-quality material and specimens must be either purchase or traded, at often exorbitant prices. The new localities which have opened up in recent years are, in most cases, the property of mining companies which frown on slowing down their operations to look for individual mineral specimens, no matter how well crystallized or unusual they might be. Of course, rarity caused by these situations only helps to up the price of those few specimens collectors are able to obtain.

Fortunately, many minerals more easily obtained now may turn into the "classics" of the future, when their localities are depleated. The Museum is fortunate to have had good guidance over the years in acquiring many fine examples of this type. And, although not frequently enough, we have been able to trade for some of the more rare classics. However, the collection is always in need of improvement and adidtions. There's nothing more frustrating than having a visitor—alumnus, student, or private collector—who insists on reminding us that our specimens from his home state or a locality he's familiar with are not really the best obtainable, and then not offer to do anything about it!

Museums of all types are having financial and collecting troubles at present, but Mines least of all should be, due to the nature of most alumni and friends. Many still have direct access to minerals through their occupations with mining and exploration companies. Others have fine collections which they began as students here at Mines. We would like to offer our fine display facilities to anyone interested in helping the Geology Museum. Incidentally, donations are still tax-deductible.

1970 Commencement

Annual Alumni Banquet (Stag)

Denver Athletic Club
1300 Block on Glenarm

Thurs., May 28, 1970

Hospitality Hour, 6:30 p.m.

Buffet Dinner, 7:30 p.m.

Price $5.50

Changes in the Geology Museum

WE believe that the Geology Museum plays an important part in the public relations of the School of Mines. After all, it is probably the first—and many times the only—part of the School that most visitors see. Therefore, the Museum should be the best and most active one that we can possibly produce and operate effectively.

After getting such a good start on a fine collection under the able direction of Dr. J. Harlan Johnson, the Museum was dormant from 1957 until Miss Jerri Hamilton became Curator in 1965. In addition to giving the collections much-needed attention and upgrading the exhibit quality, she carried out a very active public relations program in the form of tours organized for Jeffco school children and any other interest groups.

This program is being continued now, and seems to be expanding at a rewarding pace. Even if the Museum served no other purpose—which is far from the case—it would be worthwhile. Actually many different groups benefit from its presence: students, faculty, new student recruiters, and the general public. If we can aid in showing prospective students and other visitors that Mines is progressive and responsible in its educational role, then we will have done our job.

The methods available to the Museum for meeting these needs are meaningful exhibits, information sent to inquirers, and educational material which visitors can take with them. Accordingly, a stepped-up program of new exhibits and publications has been undertaken. Ironically enough, although the Museum is called a Geology Museum, there were no exhibits of a general geology nature included in its plan. Now, a small section has been designated for this purpose, and is about half completed. The outstanding exhibit here will be about the geological formations of the Golden area, complete with cross section model and reconstructions of the area's geological history. Another section in the Museum has been assigned to economic minerals and Colorado mining history. This will include some nostalgia about early mining camps as "atmosphere," although the ores and minerals which made them important will of course be the main attraction.

THE outstanding minerals collection still occupies most of the Museum's main gallery, with the addition of some educational exhibits about the nature of minerals: their physical properties, important localities, special features such as fluorescence, and gem-forming minerals. Each new addition to the collection is extremely welcome, and is first placed on display in the recent acquisitions case, from whence it is circulated to other pertinent exhibits.

Because of its smaller size, the fossils collection shows more of a vast improvement, since we were able to entirely rearrange it. A student assistant has now begun the task of drawing restorations of principal life forms and explaining each geologic period, so visitors can understand more of this aspect of geology.

Many visitors inquire as to literature about the Museum and its collections which they might read to learn more about what they have seen. Until now, we have had to tell them that there was nothing available. Within the next few weeks, we will have printed a pamphlet about the Museum and its collections, to be followed by two others on related subjects. We hope that these initial efforts will lead to such things as a small collection of color photos of outstanding specimens in the Museum, eventually building up a group of informative booklets on many different aspects of geology, especially as it relates to our region.

We would like to invite anyone interested to come and see the new face of the Geology Museum. We think you'll approve!

Mineral Deposits Field Trip

ON MARCH 26, two Geology Department staff members and ten students left for New Mexico on a field trip to the Santa Rita and Tyrone mining districts. While in New Mexico, the students were required to complete detailed mapping problems in the Chino Pit area, in an area across the southern end of the Fierro stock, and underground at the Jersey Zinc mines at Hanover. About one day was spent examining the alteration and mineralization in the vicinity of the new Phelps-Dodge operations at Tyrone.

Throughout their stay in New Mexico, the group worked closely with the resident personnel of the Kennecott, New Jersey Zinc, and Phelps-Dodge Corporations. The ready cooperation that these companies extended was in large part responsible for the success of the field trip.

The value of a field trip devoted to the detailed examination of mineral deposits has long been recognized by the Geology Department as an important addition to the training of CSM economic geologists. Unfortunately, during recent years, funding was not available for such a program. In September, 1969, Mr. Arthur Meyer, representing the Union Pacific Railroad Company, established a three-year grant to be used for the instruction of Geology students in the field at important mining locations. This year it was decided to study the Central Mining District of New Mexico.

In planning the program of study, Dr. R. H. Carpenter acted as coordinator and liaison between the department and the various companies involved. Drs. Grybeck and Wiltse were in charge of conducting the trip and supervising the students in the field.

Dawsonite and Gibbsite In the Green River Formation

By Richard H. De Voto, Douglas N. Stevens†, Duane N. Bloom†*

THICK and geographically widespread mutual occurrences of the minerals dawsonite, $NaAl(OH)_2CO_3$, and gibbsite, $Al(OH)_3$, exist in the kerogen-bearing dolomites (imprecisely termed "oil-shales") of the Green River Formation of the Piceance Creek Basin, northwestern Colorado (**Figure 1**). The gibbsite and dawsonite occupy an interval with a thickness greater than 50 feet and an aluminum content greater than 1.5 per cent over approximately 500 square miles. The aluminum-bearing minerals occur through as much as 750 feet of kerogen-bearing dolomite, which averages 25 gallons of oil per ton. Locally in the section, the dawsonite (and gibbsite) comprise up to 25 per cent by weight of the "oil-shale" (Smith and Milton, 1966, p. 1029). This thick, widespread deposit has created much interest in the gibbsite and dawsonite of the Green River Formation as a potential ore of aluminum.

Discovery.—Dawsonite was first discovered in the Green River Formation in 1959 and described by Milton and Eugster (p. 124) in their comprehensive analysis of the saline "Mineral Assemblages of the Green River Formation." Quantitative analysis of the dawsonite content in two deep drill holes were published by Smith in 1963 (p. 811). Smith's paper indicated for the first time the great thickness and high concentrations of dawsonite in the "oil shales" of the deep part of the basin. In 1964-1965 several core holes were drilled to explore for sodium and thereafter to evaluate the nahcolite ($NaHCO_3$) deposits located within the "oil-shales." The presence of considerable concentrations of dawsonite in strata up to 700 feet thick over a substantial area were discovered by these exploratory holes.

The occurrence of gibbsite ubiquitously with dawsonite was originally suggested by the fact that in many units there is considerably more dilute-acid-soluble aluminum than sodium. Smith and Johnson (1967) first suggested the presence of the mineral gibbsite after carrying out chemical determinations and differential thermal analyses. Chemical and differential thermal analyses of outcrop samples and samples from oil-well holes have confirmed the widespread association of gibbsite and dawsonite in the Green River Formation of the Piceance Creek Basin.

Stratigraphy. — Stratigraphic relationships of the Eocene rocks of the Piceance Creek Basin are summarized on the structural cross section (**Figure 2**) and the detailed transbasinal stratigraphic cross sections (**Figures 3 and 4**).

Varicolored shales, mudstones, and sandstones of the alluvial Wasatch Formation accumulated in the early Eocene and underlie the Green River Formation throughout the Piceance Creek Basin. As the Eocene progressed, recurrent tectonic activity emphasized the surrounding structurally positive areas and caused disruption of the well integrated drainage pattern that prevailed during Wasatch deposition. Thus, during the deposition of the Green River beds the Piceance Creek Basin was a closed

*Geology Department, Colorado School of Mines.
†Earth Sciences, Inc., Golden, Colorado.

Dawsonite Claims Released

FIVE major firms have relinquished their dawsonite claims in the oil shale-rich Piceance Creek Basin of northwest Colorado, the U.S. Interior Department announced Tuesday, Feb. 17.

The 198 claims involve 26,536 acres in Rio Blanco County surrendered by companies closely tied to oil-shale development.

Harrison Loesch, assistant secretary of interior for lands, identified the companies and the number of claims involved as Atlantic Richfield Co., 114 claims; Marathon Oil Co., 43 claims; Cameron Engineers of Denver, 31 claims; Pan American Petroleum Corp., 6 claims, and The Oil Shale Corp. (TOSCO), 4 claims.

The relinquishment is seen by Interior as a major stepping stone to clearing away a complex maze of legal matters which have in large part hobbled oil shale development.

Loesch said he's confident other claimants will realize their dawsonite claims are invalid and follow the example set by the major firms.

"When this complication is cleared away, we can get on rapidly with developing an oil-shale program to serve national needs," Loesch said.

But Interior and its agency handling oil-shale matters, the U.S. Bureau of Land Management, has a long way to go.

Not all of the 26,536 acres of relinquished claims has been cleared legally for others claim them too, Al Leonard, coordinator in Denver of BLM efforts to clear title to oil-shale lands, said.

He said 4,235 additional dawsonite claims have yet to be cleared in Rio Blanco County and others remain in other northwest Colorado counties.

Interior contends the mining claims are invalid because they come under the mineral leasing act of 1920 and not the 1872 mining law.

Dawsonite, an aluminum-bearing mineral, was discovered in 1966 in the area and for several months many claims were filed under the free-wheeling 1872 mining law that permits minerals on public lands to be exploited.

Interior moved to stop this because of its clouding of oil-shale claims. Dawsonite and nacolite ores are found in conjunction with oil shale.

The relinquished claims don't include oil-shale placer claims located prior to the Mineral Leasing Act in 1920, Loesch said.

Many of those oil-shale claims are now before the U.S. Supreme Court where Interior is trying to gain leasing rights after losing earlier legal rounds in the dispute.

BLM is involved in a long-term search of county records to clear up title matters involving oil-shale lands. The search and processing is expected to take years. It involves Colorado, Wyoming, Utah shale beds, the richest in the nation.—*Denver Post*, Feb. 17, 1970.

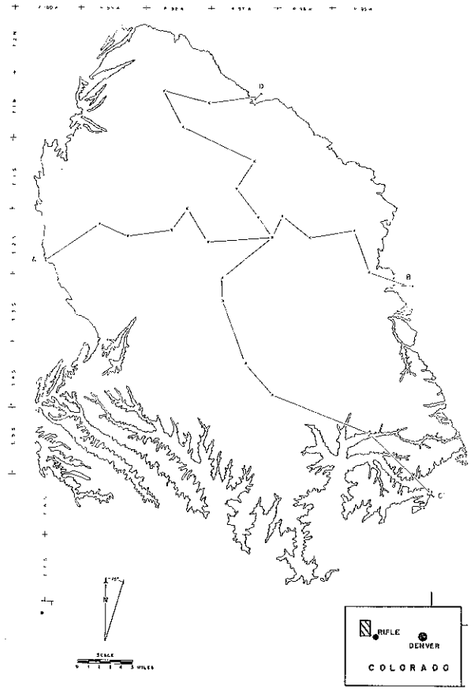

Figure 1. Index Map, Piceance Creek Basin, showing location of stratigraphic sections and contact between Parachute Creek and Evacuation Creek members of the Green River formation.

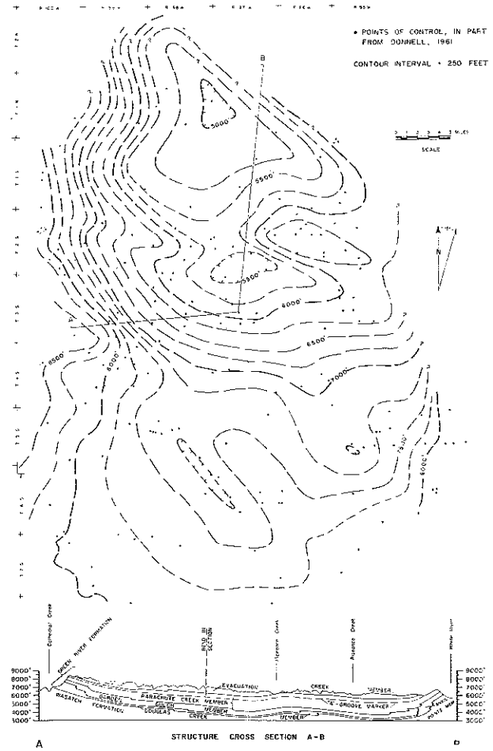

Figure 2. Structure Contour Map, ("A"-Groove) and Cross Section, Piceance Creek Basin, Colorado.

depression and lacustrine deposition prevailed. Consequently the characteristic lithologies of the Green River Formation are well laminated, lacustrine mudstone, shale, marlstone, and dolomite. The Green River Formation can be subdivided on the bases of sandstone content and presence or absence of substantial quantities of kerogen into five mappable members (from oldest to youngest): Douglas Creek, Anvil Points, Garden Gulch, Parachute Creek, and Evacuation Creek (Donnell, 1961) (see **Figure 2**).

The Douglas Creek and Anvil Points Members are dominated by brown to buff, cross-bedded, ripple-marked sandstone, algal and oolitic limestone, and gray shale, which is barren of kerogen. These beds accumulated at or near the shore of the newly formed Eocene lake in the high energy environments of the delta, shoreline, and alluvial plain. The Douglas Creek and Anvil Points Members thin abruptly basinward by facies change to the well laminated shales and kerogenous marlstones of the Garden Gulch and Parachute Creek Members.

The Garden Gulch Member is composed dominantly of well laminated shale which is barren of kerogen. Locally marlstones, thin sandstone beds, and limestones occur in the Member. The principal difference between the Garden Gulch Member and the overlying Parachute Creek Member is the relative lack of kerogen and carbonate in the Garden Gulch. Locally in the center of the basin, the Garden Gulch Member does contain significant concentrations of kerogen. **Figures 3 and 4** display the facies relationships of the Garden Gulch with the overlying Parachute Creek and underlying Anvil Points and Douglas Creek. The shoreward divergence of the bedding planes and time lines within the Garden Gulch Member shows that a greater thickness of allogenic lacustrine mud was accumulating near the shore than in the center of the lake during the same time.

The Parachute Creek Member contains the gibbsite, dawsonite, nahcolite, halite and the thickest and richest kerogen-bearing beds in the Green River Formation. The Member is composed almost entirely of dolomite and marlstone, most of which yield oil when distilled. The thickness and oil yield grade of the kerogen-rich dolomite increases greatly toward the center of the basin from all sides, as shown on **Figures 3, 4, and 5** (Stanfield, 1966, p. 36). The coincidence of the present structural low of the basin and the thickest area of rich "oil shale" shows that chemical stratification of the lake must have controlled the preservation of the organic material on the lake bottom. Thus, the relatively clear and fresh surface water supported a prolific flora, while the bottom conditions beyond a critical depth were reducing and saline, favorable for the preservation of the organic debris. **Figures 3 and 4** show that the basal 1000 feet of kerogen-bearing dolomite accumulated in the center of the basin while kerogen-lean marlstones were deposited nearer the edges of the lake. The gibbsite, dawsonite, nahcolite and halite are concentrated in this same interval.

The gibbsite and dawsonite are concentrated in a stratigraphic interval between 400 and 1400 feet below the A-groove marker bed (**Figures 3 and 4**) in the center of the basin within the richest "oil-shale" units. The shoreward convergence of the bedding planes and time lines within the Parachute Creek beds below the A-groove marker bed illustrates that the chemical-density stratification of the lake allowed a greater thickness of kerogen-rich dolomite to accumulate in the deep central part of the depositional basin than near the edges during contemporaneous deposition. This same chemical-density stratification allowed the preservation of a

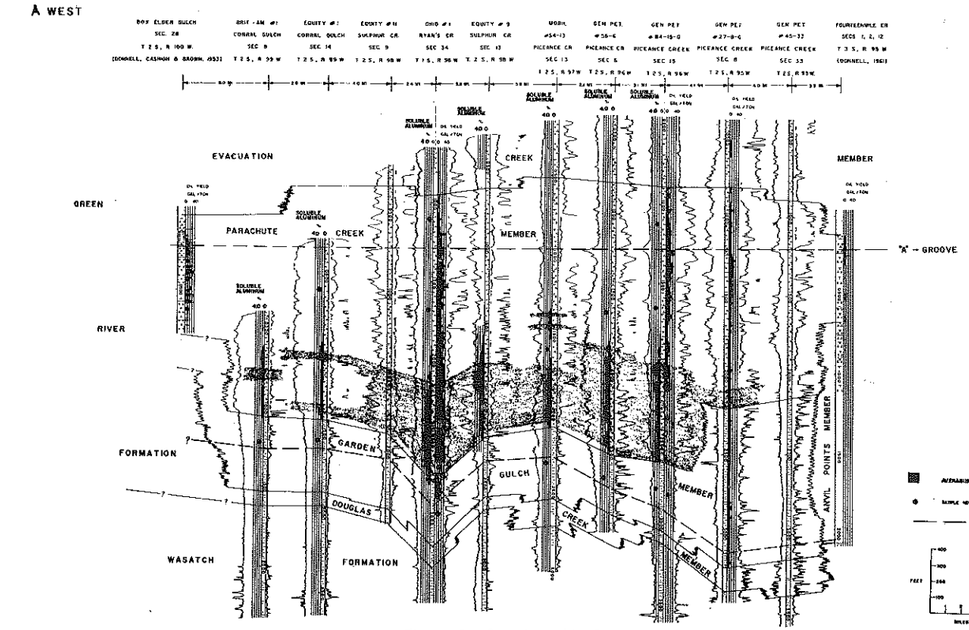

Figure 3. Stratigraphic Section A-B.

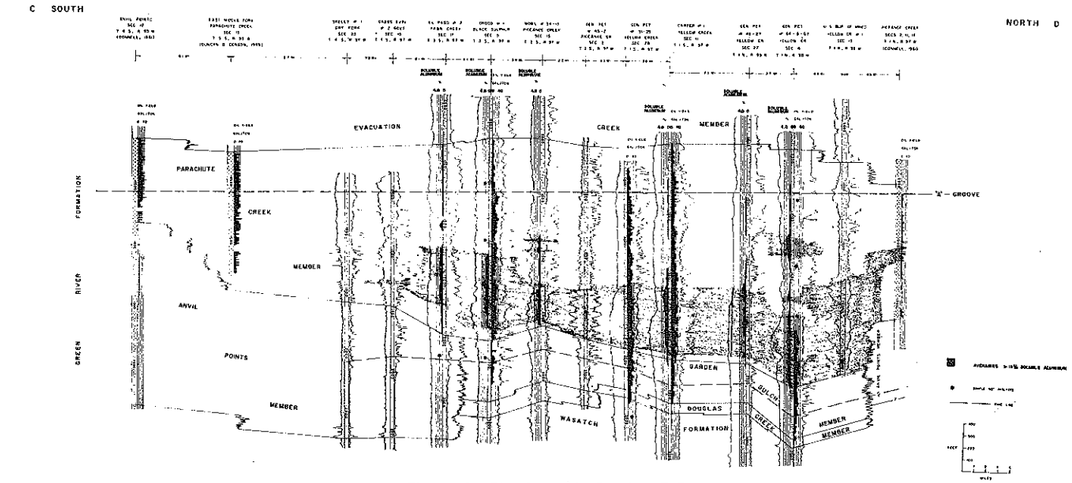

Figure 4. Stratigraphic Section C-D.

greater concentration of organic debris and was probably a factor contributing to the formation of the gibbsite, dawsonite, and nahcolite. The conditions which allowed the preservation of the organic debris became more widespread with the passage of time, permitting the accumulation of the basinwide kerogen-rich Mahogany zone ("a Mahogony Ledge") near the top of the Parachute Creek Member.

The A-groove marker bed is a widespread, thin, relatively kerogen-lean, tuffaceous dolomite bed which can be used effectively as an electric-log marker for correlation purposes. Hence, the stratigraphic sections (**Figures 3 and 4**) are hung on this marker. The upper 800 feet of the Parachute Creek Member contains dawsonite, gibbsite, and nahcolite in significant quantities, although it is much more irregularly distributed than in the lower portion.

The Evacuation Creek Member is composed of buff to brown, lenticular sandstones, siltstones, kerogen-lean marlstones, and shales, which accumulated in the waning stages of the lacustrine deposition. Thus, the Member included interbedded facies resulting from varying depositional environments: lacustrine (laminated marlstones and shales), shoreline, deltaic, and alluvial (standstones, siltstones, and nonlaminated shales). The gradual restriction of the lake caused the contact between the Parachute Creek and the overlying Evacuation Creek Members to be gradational and a facies relationship. Hence, kerogen-bearing marlstone deposition persisted in the much-restricted lake in the basin center long after non-lacustrine conditions overtook the rest of the basin.

Dawsonite and Gibbsite.—The distribution of significant concentration

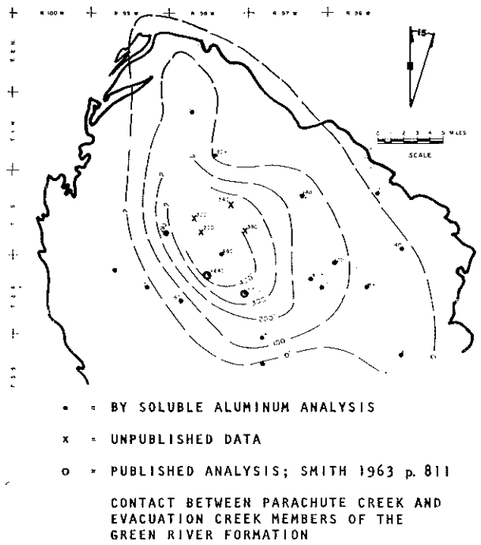

Figure 5. Soluble Aluminum (Dawsonite-Gibbsite) Isopach Map, Piceance Creek Basin, Colorado.

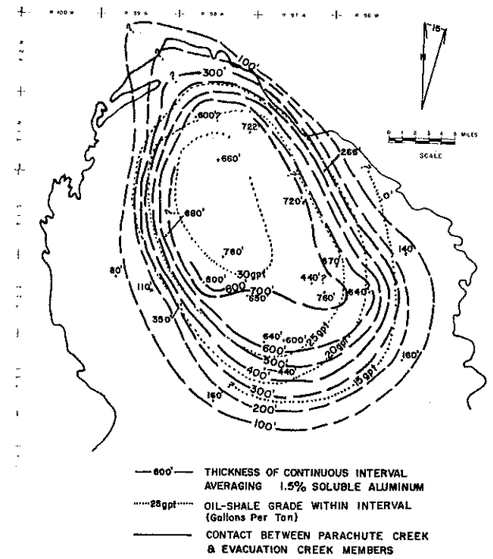

Figure 6. Total Thickness of Intervals Averaging 2.8% Soluble Aluminum (Dawsonite & Gibbsite), Piceance Creek Basin, Colorado.

of dawsonite and gibbsite is summarized on **Figures 3, 4, 5 and 6.** A 500-foot-thick continuous interval averaging greater than 1.5 per cent aluminum (and an average of 25-35 gallons of oil per ton) extends over approximately 250 square miles, being confined essentially to a northwest-southeast-trending area which conforms roughly to the present basinal axis. A significant thickness of the 1.5 per cent aluminum zone extends to the outcrop in the northwestern corner of the basin.

The dawsonite in the Green River Formation is difficult to recognize megascopically because the crystals are so small. The original discovery of the dawsonite in the Green River Formation by Milton and Eugster (1959, p. 124) and the later more detailed quantitative evaluations performed by Smith (1963, p. 811), and Smith and Milton (1966, pp. 1034-1035), were made with X-ray diffraction techniques. Smith and Milton have also used index of refraction measurements in their dawsonite determinations.

In the quest for rapid, inexpensive, quantitative, analytical tests for dawsonite, various chemical techniques were tried. It was found that by maintaining careful control of Ph and leaching time, a 30 per cent hydrochloric acid solution would dissolve dawsonite and gibbsite and would not appreciably attack the aluminum silicates, i.e., various zeolites, clay minerals, and feldspars. The percentage of aluminum in a sample was then determined by simple colorimetric methods. This inexpensive quantitative technique enabled rapid evaluation of thick sequences of the Green River Formation from gas-well, rotary, drill-hole cuttings from throughout the basin.

The chemical analyses indicate that another acid-extractable aluminum-bearing mineral occurs within the "oil shales" along with dawsonite. Soluble sodium analyses were performed with sodium-ion electrodes and checked by flame photometry. Virtually all samples analyzed for soluble aluminum contain less sodium than that necessary to combine with the aluminum to form dawsonite, $NaAl(OH)_2CO_3$. The ratio of the other acid-extractable aluminum-bearing mineral to dawsonite, as determined by chemical analyses, ranges from 4/1 to 1/4.

Differential thermal analyses, as originally performed and suggested by Smith and Johnson (1967), illustrate that the other soluble aluminum-bearing mineral displays an endotherm 20-30°C below the temperature of the dawsonite endotherm (**Figure 7**). This other aluminum-bearing mineral also displays a broad endotherm at 540-580°C. The differential thermal analysis results indicate that dawsonite and the other soluble aluminum-bearing mineral occur as distinct mineralogical entities.

Smith and Johnson note that the non-dawsonite aluminum-bearing mineral (1) is readily soluble in acid, (2) contains no sodium, (3) degrades thermally in two steps, one at 330-350°C, and another at 540-580°C, (4) is not detectable by X-ray diffraction, and (5) occurs in kerogen-rich dolomite ("oil shale") with dawsonite. They also note that gibbsite, $Al(OH)_3$, adsorbed on clays or organic material or too finely particulate to be detected by X-ray diffraction or optical techniques, has all of these characteristics. Differential thermal analysis of chemically pure gibbsite displays a two-step thermal degradation similar in all respects to that of the aluminum-bearing natural mineral, except for a slight endotherm shift due probably to the occurrence of the natural compound in the "oil shale" matrix. The two endotherms are probably the result of release of water from the gibbsite in partial steps.

Several photomicrographs which illustrate the various habits of dawsonite in the Green River Formation have recently been published by Smith and Milton (1966, pp. 1030-1035). Much of the dawsonite is disseminated as 0.05 to 0.2 mm (65 to 250 Tyler mesh) particles throughout the kerogen-bearing dolomite. It is also often found in thin (0.05 to 0.2 mm) lenses or sheets parallel to bedding, filling fissures transverse to bedding, or as amygdular masses (1 mm to - cm) or vug linings scattered throughout the kerogenous dolomite. The analytical data indicate that the dawsonite and gibbsite occur together in the Green River Formation.

The genesis of the aluminum and sodium minerals has been studied in detail by Smith et al (1966, 1967, personal communications) and by Hite and Dyni, 1967). The available facts suggest that the dawsonite and gibbsite formed together in an alkaline, CO_2-rich, organic carbonate sludge at the lake bottom either (a) by direct growth from solution or (b) as a result of the alteration of feldspar and clay minerals to dawsonite, gibbsite, and nahcolite.

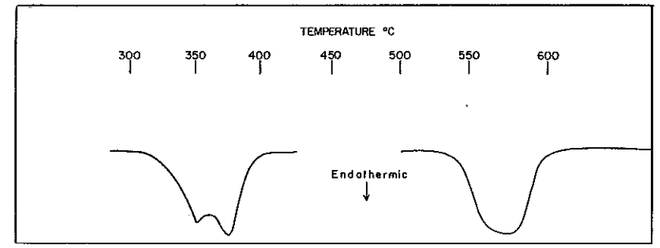

Figure 7. Typical Differential Thermal Analysis Curve for Dawsonite and Gibbsite-Bearing "Oil Shale," Piceance Creek Basin, Colorado.

Economics.—The continuous intervals averaging greater than 1.5 and 2.8 per cent aluminum have a minimum gross value in the ground of about $8 and $14 per ton soluble extractable aluminum, respectively, using a value for aluminum of 25 cents per pound. The gross value, in place, of the kerogen contained in this same zone (averaging 25 gallons of oil per ton) is approximately $1.75 per ton. The ultimate value of this rock could be controlled more by its value as aluminum ore than by its value as a source of oil. Every square mile (of the 250 square miles) that has a 500-foot thickness of continuous interval averaging 1.5 per cent aluminum contains between ¾ and 1 billion tons of potential ore. Final economic evaluation of the net value of this material clearly depends upon extraction and refining costs.

The gibbsite and dawsonite of the Green River Formation of the Piceance Creek Basin represent a tremendous domestic resource as a potential source of aluminum. The United States presently imports over 10 million tons of bauxite ore annually (86 per cent of its needs). This gibbsite and dawsonite resource could, if and when developed, make the United States more than self sufficient in aluminum.

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"Special machinery to process the food.

"Special machinery to transport the food.

"And most important, special machinery that can stand up to the sea.

"Machinery made of materials that will last. Reliable materials priced reasonably enough to make large, intricate machinery self-sufficient and financially practical.

"That's my job at International Nickel," says Tuthill. "Working with the marine industry, interpreting their needs to our researchers. In an effort to develop special materials that will resist the sea's extreme pressures and corrosion.

"We already have alloys of copper and nickel, nickel alloy steels and certain stainless steels, that fulfill these requirements.

"Nickel maraging steel enabled Lockheed's *Deep Quest* to dive to a record depth of 8,310 feet withstanding fantastic pressure and stress.

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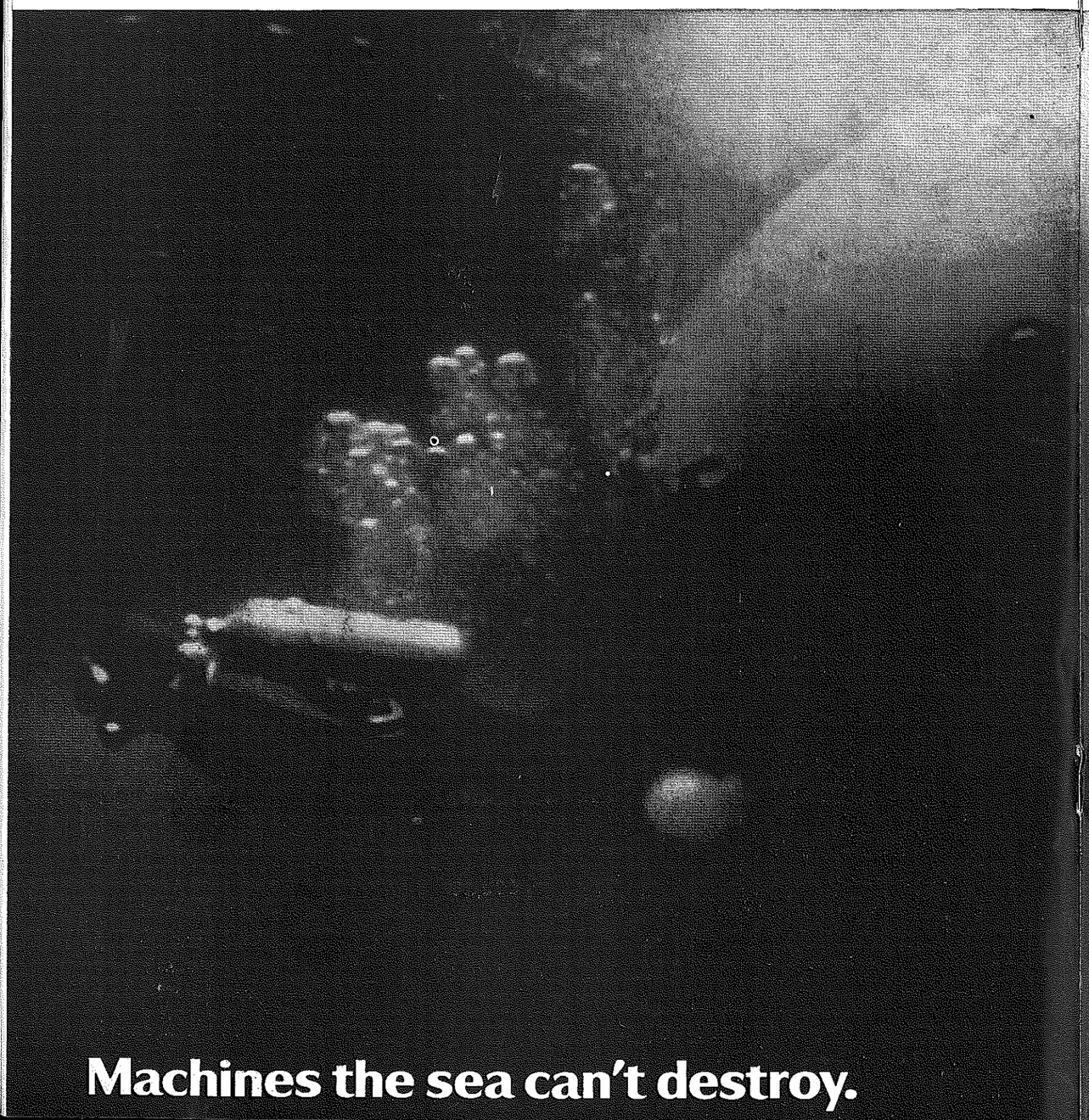


Machines the sea can't destroy.

Lockheed's *Deep Quest*

Ed Crabtree Retires as Director Of CSM Research Institutes; Succeeded by Dr. Herman Ponder

EDWIN H. CRABTREE, director of the Colorado School of Mines Research Institute at Golden since 1955, retired April 1 and was succeeded by Dr. Herman Ponder, former director of Research of the Institute's Mining Division.

The Colorado School of Mines Research Institute is a not-for-profit organization serving the scientific research needs of the mineral industries throughout the world in the metallurgical, chemical, mining, ceramic, and nuclear fields.

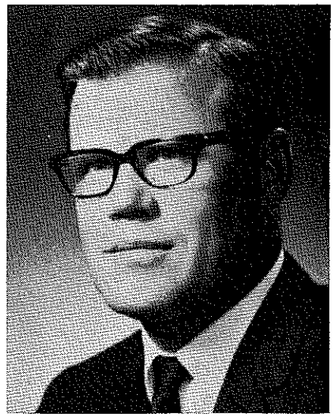
The joint announcement was made by Dr. Orlo E. Childs, president of the Research Institute's Board of Trustees and president of the Colorado School of Mines.

"The Trustees of the Research Institute salute Mr. Crabtree for his 43 years of service to the mineral resources industries and for his 15 years of inspiring leadership of the Institute," Dr. Childs said. "At the same time, we are pleased to announce the promotion of Dr. Ponder from within the staff of the Institute."

Dr. Childs added that Mr. Crabtree has been elected to the Board of Trustees of the Research Institute and will continue to serve in a consulting capacity.

A 1927 graduate of the Colorado School of Mines, Mr. Crabtree in 1964 received the School's select Distinguished Achievement Medal awarded to outstanding alumni. In 1966 the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME), of which he is a member, honored him with its Robert H. Richards Award for significant contributions to the mining industry. This year he was named to "Who's Who in America."

Crabtree



Ponder

In 15 years as director of the Colorado School of Mines Research Institute, Mr. Crabtree guided the organization from project income in 1955 of $431,000 to $3.2 million last year; increased the value of property, plant, and equipment from $120,000 to $2.4 million; and enlarged the staff from 35 to 200 people.

In 1969 the Institute conducted 392 research projects for 147 industrial firms and government agencies.

Succeeding Mr. Crabtree as director, Dr. Ponder has been associated with the Colorado School of Mines Research Institute since 1963. As director of Research of the Mining Division, he has been responsible for the planning and administration of earth science projects including those related to geology, mineralogy, minerals exploration, and mining.

Dr. Ponder is a 1955 graduate of the University of Missouri and gained his doctorate in geology at Missouri in 1959. He is a member of the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) and is a Registered Professional Engineer in the State of Colorado.

Mr. Crabtree will continue to assist the CSM Research Institute in the development of the Table Mountain Research Center on a 72-acre site at West 59th Avenue and McIntyre Street near Golden. The Institute has constructed a number of buildings at this location for lease to government and industry for research in mining and metallurgical fields, and in addition is offering portions of the area for lease in the first phase of a planned Mineral Research Center.

Mr. Crabtree was deputy manager of the Grand Junction, Colo., Operations Office, U.S. Atomic Energy Commission, before becoming director of the CSM Research Institute. Prior to that time, he held various positions in mining and metallurgy with mineral industry firms.

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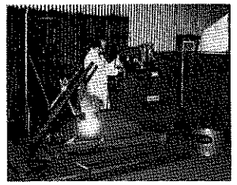
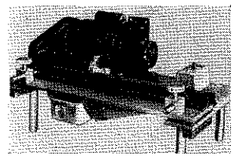


Cone Crusher Rebuilder (531)

A new automatic welding system for hardsurfacing and rebuilding cone crusher mantles and liners has been developed by Rankin Manufacturing Co., 616 S. Marengo Ave., Alhambra, Calif. 91803. The unit, called Ranomatic 60, features automatic advance of the arc up the face of the mantle or liner. In just a few minutes the parts are positioned on a variable speed turntable that has a design capacity of 20,000 pounds and rotated beneath a stationary welding gun. **Circle 531 on Reader Service Card.**

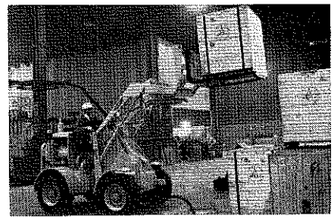
Measuring Device (532)

A new portable measuring device that will provide instant measurement of coal dust levels is now being field tested by Research Appliance Co., Allison Park, Pa. The unit, developed by scientists at the Pennsylvania State University, provides continuous, instant readout so that dangerous levels of coal dust can be determined immediately. Present methods of measuring coal dust take between 12 and 36 hours. By that time, two or three shifts of minrs have been subjected to the dust and to the dangers of explosion. **Circle 532 on Reader Service Card.**



Bon Core Grinder (529)

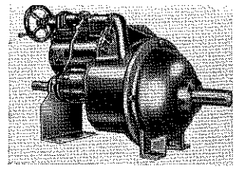
A new machine called the Bon Core Grinder, which grinds core to 80 per cent minus 100 mesh for chemical or spectographic analysis in one step, is now available from J. K. Smit Diamond Products Limited, Toronto, Ont. Speed, economy and convenience is greatly increased as compared with conventional sampling which necessitates impact breaking or sawing of core followed by crushing, grinding and subdivision for assay. According to he manufacturer, field tests have shown an over-all reduction of better than 50 per cent in time and labor with the Bon Core Grinder. **Circle 529 on Reader Service Card.**



Fork-Lift (525)

A fork-lift attachment for their 5000 tractor/loader is now being offered by Waldon, Inc., Fairview, Okla. 73737. The lift attaches to the boom after easy removal of the bucket. Three pins fasten the lift which features 48-inch forks and a 1,500-pound lift capacity.

Excellent for industrial uses, the Waldon 500 tractor loader features hydrostatic drive-making shifting of gears unnecessary. This is particularly advantageous for maneuvering in close quarters. **Circle 525 on Reader Service Card.**



Hydraulic Transmission (526)

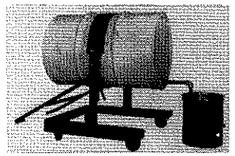
Output speeds are infinitely variable from 0 to 1200 RPM. This heavy-duty transmission can be driven with any 2 to 10 HP motor or engine. Designed for continuous duty, rugged industrial use. Delivers smooth, constant speed with instantaneous speed selection that is easy and precise . . . and just as simple with remote control. Among its many features are neutral off position; high efficiency; extremely compact design; ball and roller bearings throughout. (Roberts **Electric Co., 849 W. Grand Ave., Chicago, Ill. 60622). Circle 526 on Reader Service Card.**

Sound-Suppressing Cab (528)

Quieter conditions for miners are achieved with a sound-controlled cab, developed by the Gardner-Denver Co. of Quincy, Ill. The unit, a Universal I Jumbo equipped with three hydraulic booms and Model D93 rock drills, enables one man to control multiple drilling in comfort. **Circle 528 on Reader Service Card.**

Denver "CenTeroL" Crusher (530)

The new DENVER "CenTeroL" Crusher offers high-reduction ratio (up to 12:1) and high-capacity (up to 1000 pounds per hour) in a single-pass operation. Because of design simplicity the cost is low. Test results indicate the DENVER "CenTeroL" Crusher is equal to or superior to comparable jaw crushers, cone crushers and coffee-mill crushers in price, reduction ratio, capacity and ease of cleaning. Due to the high ratio of reduction, it is often possible to eliminate the necessity of crushing rolls in sample preparation. The fineness of the crushed product is easily controlled by throat opening adjustment. **Circle 530 on Reader Service Card.**



Drum and Barrel Cart (527)

A new, specially designed cart for mixing, moving, pouring and emptying large drums, has just been introduced by General Scientific Equipment Co., Limekiln Pike and Williams Ave., Philadelphia, Pa. 19150. Termed the Drum and Barrel Cart, its one-man, time-saving operation not only adds great safety to the handling of heavy drums but is of all-steel welded construction and fitted with 4-in. Phenolic wheels that are non-sparking and impervious to water, grease, oils and acid type chemicals. **Circle 527 on Reader Service Card.**

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Plant News

Atlantic Richfield Modernizes Its Refinery in Houston

Atlantic Richfield Co. has completed a multi-million dollar plantwide modernization program at its Houston refinery. A new 32,000 barrel-per-day delayed coking unit and four other new or improved units are included in the project. A major factor in the program was modernization and expansion of air pollution control equipment, particularly as applied in the conversion of high sulphur content heavy residual oils into more valuable lighter, low sulphur petroleum and petrochemical products.

Companies Form Joint Venture To Develop Mineral Deposits

Bethlehem Steel Corp., Mine Finders, Inc., and Coolbaugh Mining Corp. have formed a joint venture for the exploration and development of a broad spectrum of mineral deposits and recoverable metals.

Bethlehem's Edward P. Leach, vice president, mining, identified his company as the major partner in the new joint venture. The agreement, he said, provides for a long-term program involving the exploration and development of economic mineral deposits in Western United States and Western Canada.

Mine Finders is a newly-formed Colorado corporation staffed with highly trained and experienced geologists and supporting exploration personnel. Dr. Stewart R. Wallace, its president, is a leading exploration geologist under whose direction several important economic mineral deposits have been located and developed. Mine Finders will be responsible for the exploration effort of the joint venture, supplying the many proven tools and techniques of practical and scientific search available today.

Coolbaugh Mining, another Colorado company, is organized for the purpose of developing and operating economic mineral ventures. Frank Coolbaugh, president of the firm, is a former chairman of the board and past president of American Metal Climax Inc. Coolbaugh Mining will direct the development phase of the joint venture mineral projects established and recommended by Mine Finders and acceptable to all participants.

Coolbaugh Mining and Mine Finders will work closely on matters involving negotiations, engineering and administration. Bethlehem Steel, with its long experience and extensive assets in mining, will assist the other two participants in carrying out a comprehensive and productive program of search and development, Mr. Leach said.

Headquarters for Mine Finders Inc. and Coolbaugh Mining Corp. are both in Lakewood, Colo.

Walvoord Designs Plant For Standard Metals Corp.

Completion of the new flotation plant near Kingman, Ariz., by Standard Metals Corp. has been announced by Boris Gresov, chairman and president.

The new facility was engineered, designed and constructed by O. W. Walvoord, Inc. of Denver, Colo.

The plant, which has a minimum 250-ton-per-day feed capacity, will produce copper, zinc and lead concentrates from Standard's Antlers mine and from the adjacent recently acquired Copper World properties. In addition, the new plant will produce a soil additive high in iron-sulphur (pyrrhotite) from the tailings. This soil additive will be marketed to chemical and fertilizer companies.

Annual production of concentrates was estimated by Mr. Gresov to be approximately 15,000 tons. He stated that pyrrhotite production would be about 60,000 tons per year.

IRCCA Office in Caracas

Interamer Research Corp., C.A., (IRCCA) opened its new office in the Edificio Blandin, Plaza Chacaito, Caracas. IRCCA is affiliated with Interamer Research Corp., New York, which specializes in research in behalf of public institutions, government and private industry. IRCCA, under the direction of Prof. Allen E. Abrahams, general manager, was formed in 1969 to serve as the center of all Interamer projects in Latin America.

Anaconda Copper Smelter Modernization Program

Arthur G. McKee & Co. has received a letter of intent from the Anaconda Co. for the award of a multi-million dollar contract for extensive modernization of the furnace gas handling system at Anaconda's copper smelter at Anaconda, Mont. The facilities will be installed as a turn-key project by McKee's Western Knapp Engineering Division of San Francisco. The first of the new facilities are scheduled to be in operation by August of this year and the project completed in early 1971.

Alcoa Builds Plant in Florida For Production of Fluoride

Work is officially under way at Ft. Meade, Fla., on Alcoa's new, multi-million dollar Central Florida plant for the production of fluoride chemicals used in the smelting of aluminum from alumnium oxide. Following clearance of the plant site on Florida State Route 630, construction will begin on the plant buildings, scheduled for completion in late 1970.

Purinton Joins CF&I Engineers

CF&I Engineers of Denver, Colo., has announced the appointment of Raymond F. Purinton, Jr., 3005 South Xeric Court, as Sales Engineer with major responsibility in custom metal fabrication and custom machining. Mr. Purinton holds a degree in Mechanical Engineering, with honors, from the University of Colorado at Boulder. His record includes 23 years of experience in sales engineering in the Rocky Mountain region.

Anti-Pollution Lease Plan For Mining Equipment Industry

An Anti-Pollution Lease plan which offers the mining equipment industry new options in long-term financing of equipment has been introduced by Liberty Leasing Co., Inc., Chicago.

Liberty's new program, the first to facilitate installation through leasing of all types of pollution-control equipment, enables a mining equipment company to obtain an immediate commitment for long-term financing but to assume its costs in annual stages, as equipment is actually installed.

A. W. Grier Named Manager Of GeoData International

Ben F. Rummerfield, president of GeoData Corp., has announced that A. W. Grier has been appointed managing director of GeoData International, Ltd., with offices in London, England. This is the most newly formed subsidiary of GeoData Corporation of Tulsa. Norman S. Morrisey, vice president of GeoData, is secretary-treasurer of GeoData International.

"Purpose of GeoData International," Rummerfield said, "is to provide the petroleum industry with exploration data, goods and/or services by exchanging exploration data currently in a company's files for comparable data through our International Data Bank concept. This approach enables companies to reduce exploration costs and to convert data in their files to a form of exploration currency."

Lufkin Changes Its Name To Strengthen Service Functions

Lufkin Foundry & Machine Co., manufacturers of Lufkin oilfield pumping units, gas engines, industrial and commercial gears, marine gears and truck-trailers, has changed its name to Lufkin Industries, Inc. by action of the stockholders at the annual meeting held March 17, 1970. Lufkin is recognized world-wide as manufacturer of oilfield pumping units. However, it also is becoming more widely known as manufacturer of precision gears for industry and trailers for the transportation field.

Catalogs and Trade Publications

BLASTING EMULSION (600)
Atlas Chemical Industries, Inc., Wilmington, Del. 19899, has a technical bulletin on AQUANAL, blasting agent designed for use in open pit mining, quarrying and on construction projects. Developed by the Explosives Division of Atlas, AQUANAL comprises a method of encapsulating minute explosive particles in wax and oil. The intimate contact between the explosive ingredients causes AQUANAL blasting emulsion to attain the same high velocity in all diameters. Other commercial explosives exhibit detonation velocities which vary with diameter. **Circle 600 on Reader Service Card.**

ELECTROSTATIC PRECIPITATORS (601)
A four-color, 20-page brochure detailing design and construction features of Wheelabrator electrostatic precipitators has just been released by the Air Pollution Control Division of The Wheelabrator Corp., 400 S. Byrkit St., Mishawaka, Ind. 46544. Major components of the precipitators, such as housings, collecting surfaces, discharge electrodes, rapping devices and gas distribution systems, are individually detailed. Successfully-operating installations in the cement industry, metallurgy, steel production, power generation, chemical processing and municipal incineration are shown and described. **Circle 601 on Reader Service Card.**

ELECTRIC SET SELECTION (602)
A new 20-page selection guidebook for diesel or gaseous fueled electric sets is available from Caterpillar. The booklet simplifies the selection of prime or standby power electric sets. Both 60Hz and 50Hz continuous and standby kilowatt ratings are listed for all electric set models and configurations. Included in the guidebook are specifications for the recently announced 3100 Series Electric Set. These are accompanied by illustrations showing typical options available with the standard set, such as base-mounted fuel tank, mufflers, battery and instrumented control panel. **Circle 602 on Reader Service Card.**

ACCUTRONIC TRUCK SCALES (603)
Bulletin No. 6851A, available from Howe Richardson Scale Co., 680 Van Houten Ave., Clifton, N. J. 07015, describes the company's Accutronic Truck Weighing Scales, featuring a patented load cell mounting assembly that fully shields the load cell for shock and side load effects, assuring sustained accuracy and long service life. Included in the brochure is a detailed and fully illustrated description of the unique mounting assembly, as well as other design and construction features of the Accutronic Scale. The brochure also contains information on the wide variety of solid state electronic indicating and recording systems available. **Circle 603 on Reader Service Card.**

STEAM PLANT INSTRUMENTATION (604)
"Beckman Steam Plant Instrumentation for Combustion Control and Water Purity Analysis" is the title and subject of a new technical bulletin just released by Beckman Instruments, Inc., Fullerton, Calif. 92634. Bulletin 4099 describes the full range of Beckman electronic and pneumatic combustion control instrumentation and shows typical systems. Water purity analytical systems are shown for both conventional drum-type boilers and once-through boilers. Illustrated with photographs, diagrams, and flow charts, the 20-page brochure includes descriptions of an inexpensive and reliable combustion control system for a small boiler using one or more fuels and metering control systems for parallel and series operation. Two-element feedwater control systems are also discussed. **Circle 604 on Reader Service Card.**

TRAILER AXLES (605)
The Automotive Divisions of North American Rockwell, 415 Clifford, Detroit, Mich. 48231, have published a new booklet describing Rockwell-Standard RN, RQ-Series trailer axles with 22,500 to 25,000 pounds capacity. Among the many special features of the Rockwell-Standard axles described are: positive wheel bearing adjustment, beam of uniform wall thickness, welded-on, forged steel brake spiders, choice of brakes and precision lightweight hubs. Also described in the booklet is the "perfect combination" of RN, RQ-Series trailer axles, "P" series or Stopmaster brakes, and Taper-leaf springs which can slice up to 350 pounds per tandem off of truck weight. **Circle 605 on Reader Service Card.**

WIRE LINE CABLE SWIVEL (606)
A new cable swivel, especially developed for use in wire line core drilling operations, has been announced by E. J. Longyear Co., Minneapolis, Minn. 55414. According to the manufacturer, the new swivel permits the wire line inner tube assembly to rotate freely as it is being hoisted from the hole. This is said to extend the life of the cable two to three times and cut cable maintenance and replacement costs by as much as 75%. In addition, it eliminates many costly hours of non-productive down time. An important feature is the convenient external grease fitting which is readily accessible for lubricating the bearing. **Circle 606 on Reader Service Card.**

Send Us Your Bulletins

Send your publications to The MINES Magazine, 2177 W. 7th Ave., Denver, Colo. 80204, for review in these columns.
To all MINES readers these publications are FREE, and may be ordered by giving index number.
On requesting publications from manufacturers, please mention the MINES Magazine.

TYPE-R VALVES (607)
Catalog 569, available from the Walbridge Co., 803 Patterson Bldg., Denver, Colo. 80202, gives the dimensions of and presents the advantages of the Jaco Type-R Valves manufactured by Linatex Corp. of America. Some of the advantages of this valve are: (1) the steel reinforced sleeve flange prevents flange failures common to other designs; (2) the patented fabric construction allows the valve to close drip-tight on solid particles at a low pressure differential; (3) the Linatex abrasion and corrosion resistant lining assures a tight seal on solid slurries, corrosive fluids or granulated solids. **Circle 607 on Reader Service Card.**

RESISTIVITY EQUIPMENT (608)
A new four-page bulletin on resistivity equipment has been published by Geophysical Instrument and Supply Co., 900 Broadway, Denver, Colo. 80203. The versatile resistivity meter is used for geophysical studies in ore prospecting, water exploration, determination of depth to bedrock and for shallow oil exploration. Called the Terrameter, the instrument is compact, lightweight and has a high sensitivity. Depth penetrations to 2000 feet are possible under certain conditions. **Circle 608 on Reader Service Card.**

NEW OVER-LITE SYSTEMS (609)
Over-Lowe Co., 2767 S. Tejon St., Englewood, Colo. 80110, manufacturer of OVER-LITE mobile floodlighting systems, has introduced a completely new line featuring improved trailers and optional equipment. New design trailers are welded rectangular structural steel tubing. Retractable outriggers have maximum spread of nine feet. Choice of three telescoping towers from 20 to 40 feet. Metallic or mercury vapor floodlights. New optional equipment includes storage compartment for floodlights and electrical gear, and new front caster wheels for industrial applications such as aircraft maintenance. All power plants, both diesel and gasoline driven, are 100% American built. **Circle 609 on Reader Service Card.**

INDUSTRIAL BELTING (610)
The Industrial Belting Division of PORTEC, Inc., 1750 S. Kilbourn Ave., Chicago, Ill. 60623, has published a brochure entitled "The Wide World of PORTEC Inc. Imperial Belting." In it are specific case histories on performance of PORTEC Imperial brand belting on conveyors and elevators. The booklet relates how the Beltimation process, the recommending of specific brands of belting for specific applications by the PORTEC sales and engineering group, has resulted in superior performance for the 24 plants mentioned in 18 different industries. **Circle 610 on Reader Service Card.**

COMPUTER TERMS (611)
Esoteric words coined by the computer industry are defined in a new brochure from General Automation, Inc., 706 W. Katella Ave., Orange, Calif. 92667. Titled "Glossary of Commonly Used Computer Terms," the brochure covers the word gamut from "access time" to "zero suppression." Definitions provide cross references, synonyms and/or antonyms, and table illustrations where necessary. In defining abbreviations, root words are given in addition to the explanation. For instance, "FORTRAN: Formula Translator. The language for a scientific procedural programming system." A GA "Glossary" may be obtained free of charge upon request. **Circle 611 on Reader Service Card.**

EPOXY COATING (612)
Colma Sol, Sika's versatile epoxy protective coating, is now available in a new, convenient 1:1 ratio by volume between components. A new brochure, CS-70, is also available. It illustrates nine different applications of the paint-like epoxy and also provides product description and advantages, how-to-use data, and exposure-test ratings. The piece may be obtained by writing Sika Chemical, P. O. Box 297, Lyndhurst, N. J., 07071, or by checking off No. **612 on the Reader Service Card.**

EAR PROTECTION EQUIPMENT (613)
A new catalog sheet W6902 "Willson Ear Protection" has been published, describing a complete line of Sound Barrier® equipment by Willson Products Division, ESB Incorporated, P. O. Box 622, Reading, Pa. 19603, to help you meet the requirements of the revised Walsh-Healey Act. Design and construction features include tough, noise-deflecting earcups; soft, sound-absorbent sponge earcup inserts; fluid-filled ear cushions. Many styles of headframes for use with safety cups, built-into safety helmets, over the head type, or nape strap type are available. Also described in the illustrated catalog are ear protective Sound Barriers with communications equipment and the Willson EP-100 Sound Silencer® insert ear plugs. **Circle 613 on Reader Service Card.**

EXPANSION JOINTS (614)
Bulletin J-1269 (Controls, Inc., Hainesport, N. J. 08036) contains the most complete general information, dimensional specifications, and correct installation procedure for rubber or teflon lined expansion joints. These units are available with rubber, synthetic rubber, or TFE teflon liners at temperature ranges of minus 40°F to plus 400°F. The primary purpose of Spansorb units is to isolate or reduce vibration caused by heavy motive equipment, dampen transmission sound because of the steel-rubber interfaced joints and mating flanges, compensate for lateral transverse and angular movement, preventing damage and undue down time, compensate for expansion and contraction movements due to thermal change or hydraulic surge effects. **Circle 614 on Reader Service Card.**

NEW DISTANCER (615)
A new, solid state distance measurer, the Wild DI-10 Distomat, puts an end to tedious methods of measuring short and intermediate distances. Distances up to 1,000 meters can be measured with the DI-10 with centimeter accuracy. In most cases there is no need to apply temperature and air pressure reduction. Measurements are made by a modulated infrared beam, reflected by retroprisms. The DI-10 may be retrofitted to any Wild T-2 Theodolite, or used as a separate measurement system. Complete information is available in Bulletin DI-10, Wild Heerbrugg Instruments Inc., Farmingdale, N. Y. 11735. **Circle 615 on Reader Service Card.**

WELDING TORCHES (616)
New Product Bulletin describes two new light weight welding and cutting torches made by the Harris Calorific Co., 5501 Cass Ave., Cleveland, Ohio 44102. The torches are similar in features. Model 15-3F is for oxy-acetylene work and Model 15-3N for work with oxygen and other fuel gases. The light weight 7 ounce balanced design facilitates handling the torch for welding and brazing materials up to ⅜" thick and cutting materials up to 1" thick. Harris Bulletin 690916 describes the features of the torches, the tips and accessories available, and provides data charts for welding cutting and brazing that indicate tips and pressures to be used for various plate thicknesses. **Circle 616 on Reader Service Card.**

WANT MORE INFORMATION?

Use MINES Magazine's convenient READER SERVICE CARD, circling numbers that correspond to items interested in, then drop card in mail. No stamp needed!

Alumni Business

MEETING — BOARD OF DIRECTORS
Colorado School of Mines Alumni Foundation
March 19, 1970

MEETING was called to order by President Hal Addington at 7:30 p.m. Those present were: Hal Addington, president; David Squibb, director; Dick Vincent, director; Donald Craig, director; Bob Magnie, treasurer; Neal Harr, secretary; Bill Burger, alumni staff; Jay Mayhew, chairman, Legislative Committee.

The minutes of the previous meeting were read and approved.

The financial statement of February, 1970, was presented by Bill Burger, discussed, and approved.

OLD BUSINESS

1. Jay Mayhew has been appointed Chairman of the Legislative Committee and accepted this position.
2. Boettcher & Company was contacted advising them of resolution appointing Robert Magnie and Col. Fertig to transact business in the name of Life Membership Account.
3. Freshmen scholarships granted annually by the Alumni Association will be reviewed at the next meeting with information to be supplied by Donald Craig and Neal Harr.

NEW BUSINESS

1. A student loan of $640 was requested by Paul Brown. A motion to grant the loan was moved, seconded, and unanimously approved.
2. R. B. (Ike) Downing, Oklahoma City, has applied for associate membership in the CSM Alumni Association. A motion, approving application was made, seconded, and approved.
3. Mr. Nils Swenson was recommended by Russell Volk for honorary membership in the CSM Alumni Association. A motion to approve this recommendation was made, seconded, and unanimously passed.
4. The next meeting of the Board of Directors will be held Thursday, April 16, 1970.

Meeting adjourned at 8:45 p.m.

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Denver, Colo. 80202

Executive Secretary

For the past month Colonel Fertig has been recuperating from a cataract operation. He expects to be back on the job soon.

Be sure to send in your reservations for the Annual Alumni Banquet to be held May 28 at the Denver Athletic Club!

Edward J. Johnson, '49

Petroleum Geology

Room 300

3535 N.W. 58th Street

943-8536, Office; 721-5353, Home

Oklahoma City, Okla.

Edward P. Jucevic, '60

Consulting Mining and Metallurgical Engineer

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Reno, Nevada 89507
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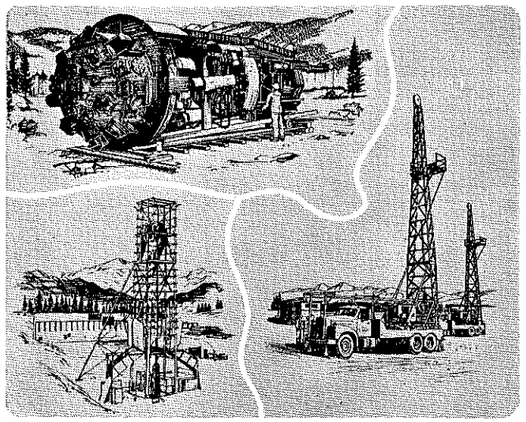

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Personnel Placement

THE COLORADO SCHOOL OF MINES ALUMNI PLACEMENT SERVICE functions as a clearing house for alumni and former students who wish to receive current information about employment opportunities for which they may qualify. It also serves the oil, gas, construction and related industries and many government agencies by maintaining current listings of openings they have for qualified engineers, technical and management personnel.

Companies needing qualified men with degrees in Geological Engineering, Geophysical Engineering, Metallurgical Engineering, Mining Engineering, Petroleum Engineering, Petroleum Refining Engineering, Engineering Physics, Engineering Mathematics, and Chemistry are invited to list their openings with the CSM Alumni Placement Service, Guggenheim Hall, Golden, Colorado.

Listed below are coded references to the graduates of the Colorado School of Mines who were available for employment at the time this issue of The MINES MAGAZINE went to press.

Client's Code Number	Degree	Age	Marital Status	No. of Children	Preferred Fields of Work	Locality Preferred	Languages Spoken
MN 18	Mining	44	M	2	Mining-Metals Mill	Colorado	English
MN 19	Mining	34	M	2	Mining Engineer	Western U.S.	English
MN 26	Mining	23	M	0	Engr. Management	Open	English
MN 29	Mining	51	M	0	Sales Management	U.S.A.	English
MN 30	Mining	26	S	0	Mine Exploration or Heavy Equipment	Alaska/Western U.S.A.	English
MN 33	Mining	27	S	0	Mining or Construction	Open	English
MT 41	Metallurgy	29	M	2	Metallurgical Engineering Management	U. S.	English
MT 42	Metallurgy	25	S	0	Sales or Technical Representative	Open	English
MT 43	Metallurgy	28	M	2	Metallurgical Engr./Nuclear Fuel Rod Mfg.	U. S. except N.E.	English
MT 44	Metallurgy	28	M	2	Mechanical Metallurgy	Open	English
MT 45	Metallurgy	33	M	5	Physical Metallurgy	Western U.S.A.	English
MT 47	Metallurgy	33	M	3	Mill Operation	West. U. S.	English
MT 48	Metallurgy	35	M	2	Development, Project Management	Colorado	English, Spanish
MT 49	Metallurgy	24	M	2	Project Metallurgy—Production Metallurgy Sales Eng.	Rocky Mt. Region	English
MA 05	Mining—Math	26	M	3	Operations research, Systems analysis		
GE 30	Professional Engineer	35	M	3	Engineering—Civil—Geology	Open	Thai, Spanish and English
GE 31	Professional Degree	25	S		Geological Exploration Development, Management	Western U. S. A.	English
GE 32	Geological Engr. N/A	35	M	3	Chief Mine Geologist or Senior Geol. Eng.	Western U. S. A. Will consider other	English
GE 35	Mining Geology	39	M	1	Chief Geologist (Mining)	Open	English & Spanish
GP 15	Geophyics	49	M	3	Petroleum Expl.	Rocky Mountains	English
GP 17	Geophysics	34	M	1	Geophysics	Colorado	English
GP 18	Geophsyics	23	S	0	No Mgmt. Trainee	Rky. Mtn.	English
GP 19	Professional Engineer	24	M	0	Mineral Exploration	Southwest U. S. or South America	English
PE 11	Pet. Engrng.	26	S	0	Pet. or Sales Engineering	Denver	English
PE 15	Petroleum	24	S	0	Reservoir Engr.	Rocky Mtn. Region	English
PE 16	Pet. Eng.	27	M	2	Prod. Engr.	Rocky Mtn., Canada or Alaska	English
PE 17	Pet. Eng.	34	M	4	Pet. Engr.	Open	English
PH 02	Physics	23	S	0	Engineering Physics	Rocky Mtn. Region	English
PR 11	Masters in P.R.E.	30	M	2	Management Systems	U.S.A.	English

Address Changes

1920-1939

Robert D. Ferguson, '22, c/o U. S. Geological Survey, Casper, Wyo.
Duncan E. Harrison, '24, 2500 So. 15th East, Salt Lake City, Utah 84106.
Vernon L. Mattson, '26, P. O. Box 685, Estes Park, Colo. 80517.
Robert N. Hastings, '30, 7 Cornell Drive, Longmont, Colo. 80501.
Philip A. Pelton, '35, Pelton & Smith Co., Inc., 102 West 2950 South, Salt Lake City, Utah 84115.
Lt. Col. Dudley O. Rae, '36, 1091 So. Holly, Denver, Colo. 80222.
Jack W. Peters, '38, P. O. Box 900, Dallas, Tex. 75211.
Allen S. Crowley, '39, P.O. Box 571, Leadville, Colo. 80461.

1940-1959

William Everett Haldane, '42 1535 N. 25th St., Grand Junction, Co'o. 81501.
John W. Hyer, Jr., '42, 3511 S. Hillcrest Dr., Denver, Colo. 80237.
James R. Leonard, '42, 1753 Santa Ana Ave., Apt. 99, Costa Mesa, Calif. 92627.
H. W. Addington, '43, 1615 Petroleum Club Bldg., Denver, Colo. 80202.
Thomas H. Cole, '43, 5261 N. Bryn Mawr, Fresno, Calif. 93705.
Hugh M. Henneberry, '43, 364 Saddler Road, Bay Village, Ohio. 44140.
Kenneth E. Gibbs, '44, 802 La Plata, Aztec, N.M. 87410.
Jack V. Hill, '44, 2800 Mitchell Dr., Walnut Creek, Calif. 94598.
Edwin D. Bieber, '47, P. O. Box 218, Morenci, Ariz. 85540.
Julian E. Simpson, '47, 14440 Virginia Foothills Dr., Reno, Nev. 89502.
Philip R. Hammond, '48, American Leisure Lands Co., 100 California St., Suite 122, San Francisco, Calif. 94111.
Henry G. McCleary, '48, 46/47 Pall Mall, London S.W.1, England.
Virgle L. Easterwood, '49, Rm. 303, State Health Bldg., 47 Trinity Avenue S.W., Atlanta, Ga. 30334.
H. Evans, Jr., '49, Hudsons Bay Oil & Gas Co., 320-7th Ave. W., Calgary, Alberta, Canada.
Philip K. Houston, Jr., '50, 5270 Dover St. N.E., St. Petersburg, Fla. 33703.
Howard K. Loenshal, '51, 47 Carbeen Ave., St. Ives, N.S.W. 2075, Australia.
Herbert D. Torpey, '51, 1860 El Camino Real, Burlingame, Calif. 94010.
Kirt O. Linn, '52, Australian Island Exploration, 7 Havelock St., West Perth, W. A. 6005, Australia.
John B. Fersntrom, '53, 7096 Inca Way, Denver 21, Colo.
Robert G. Jacobsen, '53, 1001 Howard Ave., New Orleans, La. 70113.
Thomas J. Ryan, '53, c/o Schiavone & Sons, 135 Front St., New Haven, Conn. 06516.
Edward F. Ziolkowski, '53, 235 Birch St., Green River, Wyo. 82935.
Wm. F. Baumann, '54, P. O. Box 1136, Uvalde, Tex. 78801.
Mario Guerra, '54, Box 603, Golden, Colo.
Mr. Henri Freyss, '57, Geopetrole Ave., Leandro Alem 651, Buenos Aires, Argentina.
Dr. Norman E. Goldstein, '57, 231 Detroit St., Denver, Colo. 80206.
Thomas E. Randall, Jr. '57, British-American Oil Bldg., 707-7th Avenue S.W., Calgary, Alberta, Canada.
Charles N. Strong, '58, P. O. Box 336, Bartlesville, Okla. 74003.
Charles R. Wilderson, '58, 8014 Ridgeview, Houston, Tex. 77055.
Larry R. Faulkner, '59, 2501 Beech Court, Golden, Colo. 80401.

1960-1970

William H. Gerdes, '60, 4801-7th St., Apt. 12, Port Arthur, Tex.
Jean Pasquali-Zanin, '60, P. O. Box 18, Golden, Colo. 80401.
Robert A. Sultzbach, '60, R.R. #3, Box 560, Dandy, Ore. 97055.
Ninos B. Benyamin, '61, c/o National Iranian Oil Co., P. O. Box 1863, Dept. of Geology, Tehran, Iran.
Howard P. Christiansen, '61, 6 Duke, Pueblo, Colo. 81005.
George R. Downs, Jr., '61, P. O. Box 95, Brandywine, Md. 20613.
Joseph F. Fisher, '61, c/o Goodnews Bay Mining Co. Platinum, Alas. 99651.
Robert C. Johnson, '61, c/o J. S. Smit, P.O. Box 61287, Marshalltown, Transvaal, South Africa.
James E. Sharp, '61, P. O. Box 938, Van Horn, Tex. 79855.
Gerald W. Berk, '62, c/o Phillips Petroleum Co., P.O. Box 76, Alexandria, United Arab Republic.
Leslie L. Ludlam, '62, P. O. Box 1569, Grand Junction, Colo. 81501.
Donald L. Bingham, '64, 19 Paramount Parkway, Lakewood, Colo. 80215.
Jeffrey D. Goodman, '64, 14390 Berry Road, Golden, Colo. 80401.
David N. Harrison, '64, 2535 Charles St., Pampa, Tex., 79065.
Dr. Dudley James McCracken, Jr., '64, Ballistics Res. Lab. Aberdeen Proving Ground, Md. 21005.
Douglas F. Miller, '64, P. O. Box 949, Sidney, Mont. 59270.
Boyd D. Watkins, '64, 11849-26th So., Seattle, Wash. 98168.
Stayley Paul Goudey, '65, 610 Main St., Yarmouth, Nova Scotia.
Richard L. Hickman, '65, 15 Chaucer Dr., Newark, Del. 19711.
Ernest L. Bradley, '65, 359 Coach Lamp Lane, Houston, Tex. 77037.
Robert L. Dunn, '65, 10755 W. 7th Place, Apt. #4, Denver, Colo. 80215.
John A. Turley, '65, 808 W. 10th St., McCook, Neb. 69001.
Norman H. Zivin, '65, 135 South La Salle St., Suite 2157, Chicago, Ill. 60603.
Paul A. F. Lewis, '66, c/o SURALCO, P. O. Box 1810, Paramaribo, Suriname, S. A.
Thomas E. Luebben, Jr., '66, Bear Creek Mining Co., Div. of Kennecott, 1826 Kennecott Bldg., 10 E. So. Temple, Salt Lake City, Utah 84111.
Dr. Hans J. Boving, '67, 5, St. Jozeflann, Blenwezel Mol (Antw.), Belgium.
Gary E. Butts, '67, 7740 Quitman, Westminster, Colo. 80030.
David L. Chua, '67, 612-24th St., Golden, Colo. 80401.
Harm DeBoer, '67, 3003 Wendy's Way, Apt. 8, Anchorage, Alas. 99503.
John D. Mayhew, '67, Union Oil Development Corp., P. O. Box H68, Sidney, N.S.W. 2000, Australia.
Clyde Eugene Morrison, '67, 1528 Anita, Sulphur, La. 70663.
Robert G. Wilken, '67, P. O. Box 126, Inspiration, Ariz. 85537.
Brent C. Black, '68, 173 E. Tioga, #26, Tunkhannock, Pa. 18657.
Lt. Edward O. Church, '68, "A" Co., 317 Engr. Bn., APO New York 09757.
Abram A. DeHerrera, Jr., '68, 2400 No. Dustin, Apt. 111, Farmington, N.M. 87401.
Michael Richard Barr, '70, Mobil Oil Co. GSC, P. O. Box 900, Dallas, Tex. 75221.
David Gardner Bellamy, '70, 250 Iven Avenue, #3B, St. David's, Pa., 19087.
Jon Nelson Dull, '70, 4929 Trend Terrace, La Crescenta, Calif. 91412.
Miss Catherine Adams King, '70, 921 19th St., Apt. #4, Golden, Colo. 80401.
Steven E. Plant, '70, 1614 Laurette Dr., Colorado Springs, Colo. 80909.
Joseph Philip Aiello, '70, P. O. Box 484, Coleman, Alberta, Canada.
Michael Richard Barr, '70, Mobil Oil Co. GSC, P. O. Box 900, Dallas, Tex. 75221.
Marshall Barber Belden, '70, MB Oil and Gas, Canton, Ohio 44707.
Robert Gail Burley, '70, 7680 Tejon, Denver, Colo. 80221.
Richard Julian Carlson, '70, 819 N. Logan, Colorado Springs, Colo. 80909.
Cordell C. Chapman, '70, P. O. Box 5, Paonia, Colo. 81428.
Thomas Joe Christians, '70, 4911 W. 33rd Ave., Denver, Colo. 80212.
Monty Lee Christo, '70, 623 Quitman St., Denver, Colo. 80204.
Fred F. Ciochetto, Jr., '70, 114 Prospector Park, Golden, Colo. 80401.
Gary Joseph Colaizzi, '70, U.S. Bur. Mines, Env. Affairs Fld. Off., 19 North Main St., Wilkes-Barre, Pa. 18701.
Larry James Compton, '70, 3155 S. Washington, Englewood, Colo. 80110.
C. Patrick Costin, '70, 1707-1011 Beach Ave., Vancouver, B.C., Canada.
Jon Nelson Dull, '70, 4929 Trend Terrace, La Crescenta, Calif. 91412.
Daniel Lee Everett, '70, 1027 Pine Street, #1, Boulder, Colo. 80302.
John Joseph Faltis, Jr., '70, 311 N. 7th St., Burbank, Calif. 91501.
Dale Alan Fitzgibbons, '70, 1915 Cheyenne St., Golden, Colo. 80401.
Richard Jeffrey Fox, '70, 11350 Racine, Warren, Mich. 48093.
Richard John Gardner, '70, 7878 Applewood Lane, Denver, Colo. 80221.
John Chester Glenn, '70, Stearns-Roger Corp., P. O. Box 5888, Denver, Colo. 80217.
Charles Robert Grigg, '70, Amoco Canada Petroleum Co. Ltd., Calgary, Alberta, Canada.
Philip Randolph Hammond, Jr., '70, P.O. Box 302, Diablo, Calif. 94528.
James Speed Herb, '70, 25 Flower Hill Court, Glendale, Mo. 63122.
Carter Welling Kaanta, '70, IBM, Essex Junction, Vt. 05451.
Matthew J. Kapushion, '70, 1419 Downing St., #302, Denver, Colo. 80218.
Robert E. Killillay, '70, 122 Prospector Park, Golden, Colo. 80401.
Miss Catherine Adams King, '70, 921 19th St., Apt. #4, Golden, Colo. 80401.
Roger Eric Knight, '70, 110 Marjorie St., Milliken, Colo. 80543.
Jack A. Krug, '70, 2620 S. Zurich, Denver, Colo. 80219.
Jim F. Lemons, '70, 888 S. Swadley, Denver, Colo. 80228.
James Michael Love, '70, 2545 S. Raleigh St., Denver, Colo. 80219.
Eben Mabibi Makonese, '70, 815 12th St., Golden, Colo. 80401.
Daniel Wayne McClenahan, '70, 1257 South St., Wheatland, Wyo. 82201.
Steven Andrew McGhee, '70, P. O. Box 700, Lordsburg, N.M. 88045.
Terrence Earl McKown, '70, 423 E. Lombard, Davenport, Ia. 52803.
David Edward Miall, '70, Ralph M. Parsons Co., 617 W. 7th St., Los Angeles, Calif. 90017.
Mr. Melvyn Ray Millett, '70, 400 N. Sherwood Drive, Grand Junction, Colo. 81501.
Lee Moore, Jr., '70, 605 S. 5th St., Douglas, Wyo. 82633.
Howard Wayne Musgrove, '70, Tenneco Oil Co., E. 16th Ave. & Grant, Denver, Colo. 80203.
James Russell Oltmans, II, '70, c/o Cities Service, Houston, Tex. 77000.
Stephen A. Onorofskie, '70, 1869 W. Campus Road, Golden, Colo. 80401.
Dale Allan Pierce, '70, Phelps Dodge Corp., Morenci, Ariz. 85540.
Steve Edw. Plant, '70, 1614 Laurette Dr., Colorado Springs, Colo. 80909.
Thomas Leonard Rising, '70, Hughes Tool Col., Oil Tool Div., P. O. Box 2539, Houston, Tex. 77001.
John Kenneth Robson, '70, P. O. Box 661, Unadilla, N.Y. 13849.
Mr. Mark Gordon Sanders, '70, 3955-17th St., #26, San Francisco, Calif. 94114.
Henry Joseph Schmidt, '70, 322 Killarney Dr., Walton, Ky. 41094.
Gary R. Snowbarger, '70, Pipe Line Technologists, Inc., 5433 Westheimer, Houston, Tex. 77027.
Richard K. Swinney, '70, Sun Oil Company-DX Div., 907 S. Detroit St., Tulsa, Okla. 74102.
Allan F. Tittes, '70, 4177 Vrain St., Denver, Colo. 80212.
Loren Gilbert Thompsen, '70, Inland Steel Co., East Chicago, Ind. 46312.
Herschel Frank Vaughn, '70, 1288 Winona Ct., Denver, Colo. 80204.
Andrew C. Weinzapfel, '70, Continental Oil Co., Minerals Exploration-Uranium, Casper, Wyo. 82601.
Paul Moyer Westbrook, '70, R. #1, Voorheesville, N.Y. 12186.

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Class Notes

1930

Robert N. Hastings, P.E. 1930, retired on Feb. 1, 1970, after many years with Pan-American. The Hastings have moved to Longmont, Colo. 80501, where their new address is 7 Cornell Drive. Bob says, "I am returning to Colorado early and this will satisfy a long-standing desire on the part of both of us. I am also looking forward to the re-union of the class of 1930."

1940

John P. Dempsey, Met.E. 1940, wrote from Germany: "Have been in Germany for a month now and will be in Cologne until the end of May. Thereafter, I am moving to Yugoslavia as construction superintendent and expect to be there two years. Please continue to send my *Mines Magazine* through our San Francisco office."

1950

Leroy L. (Luke) Fournier, Geol.E. 1950, formerly area geologist with Sinclair International Oil Co. in Peru, is now associated with Roy M. Huffington, Inc. as a field geologist in southeast Borneo. Until Luke gets a new address, he will receive his mail at P. O. Box 164, Moody, Maine 04054.

1952

E. L. Colthurst, P.R.E. 1952, wrote to say that he is with Howe-Baker Engineers, Inc. at Tyler, Texas. He wrote: "I have been with Howe-Baker for about 18 months, and now I wonder why I waited so long to join this wonderful organization—but that is another story." **Carl E. Bochow**, P.R.E. 1952, is president of the Howe-Baker Engineers, Inc.

1956

Bruce M. Miles, P.E. 1956, of Calgary, Alberta, Canada, has formed a new exploration and production company known as Heritage Resources Ltd. He has been associated with the oil industry as a petroleum engineer and in 1965 joined the oil and gas department of a Canadian bank. His offices are located at Suite 284, Pacific Plaza, 700 6th Avenue, S.W., Calgary, 1, Alberta, Canada.

1959

Ozbek Saran, P.E. 1959, who was recently on a business trip to the U.S.A., came out to Golden to see Dean Burger and some other friends in the community. He is the president of the "Ekima" Consultnig Engineering Firm in Ankara, Turkey. Any miners who happen to be in Ankara, please give him a call. He will be happy to take you for a sight-seeing tour of Ankara and the vicinity. His address and telephone number are as follows: Ekima Consulting Eng. Firm, Ankara, Turkey. Telephone: 126653 or 1845 F 1.

1964

Robert D. Carnes, E.M. 1964, has recently completed his tour of military duty in the Corps of Engineers. He has accepted a position with the Alaska Barite Co. in Petersburg, Alaska and will be moving to our 49th state this spring. Until he has a new address to give us, any correspondence may be addressed to him in care of his parents at 1509 Minnesota Ave., Bessemer, Ala. 35020.

George G. Heiser, Met.E. 1964, has been enrolled as a graduate student at Mines since last September. He has just recently accepted a position with Mid Continent Coal & Coke Co. with operations near Carbondale, Colo. George and his wife will live in Glenwood Springs, Colo. 81601.

1966

Paul A. P. Lewis, E.M. 1966, formerly assistant shift boss, Open Pit Mine with Chile Exploration Co. of Chuquicamata, Chile, is now supervisor, MOENGO Mine with Suralco Division of Alcoa in Suriname. His new address is: Paul A. P. Lewis, c/o Suralco, P. O. Box 1810, Paramaribo, Suriname, S. A.

Letters

1202 Rimmer Ave.,
Pacific Palisades, Calif. 90272
April 13, 1970

Dear Wendell:—

Some weeks ago I received a copy of the OREDIGGER and a letter soliciting sugscription. In the letter was an assurance that changes at MINES would be "responsible." This, I hope, may always be true. Anyway, I took a year's subscription, partly as a matter of loyal support but chiefly to know more about events there.

A letter from Mr. Jack L. Rivkin, published in the Mar. 17, 1970 issue of the OREDIGGER strikes me as being an unfortunate emotional display of personal feelings quite opposite to my own. I think you deserve a lot of credit for "keeping your cool" in the face of very trying circumstances. It seems to me that the whole Alumni Association owes you a debt of gratitude for getting out a reputable magazine that is a credit to the school and the industry. If Mr. Rivkin wants to follow all of the petty bickerings within the school he might subscribe to the OREDIGGER, as I have done. That sort of mud-slinging may be more appropriate there than in the MINES MAGAZINE.

Very sincerely yours,

SIDNEY W. FRENCH
Sidney W. French, Met. E. 1908

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E. J. Mayhew, '41
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Crestview 9-2313 Golden, Colorado

Alumni Headliners

Johnson

McMahon

Johnson Joins Occidental As Staff Metallurgist

CLYDE V. JOHNSON, Met.E. 1945, has been appointed to the position of staff metallurgist with Occidental Minerals Corp., a wholly-owned subsidiary of Occidental Petroleum Corp. In this capacity, he will work out of the Denver headquarters, and he will be involved in mineral evaluations and metallurgical planning related to our domestic and foreign mineral development programs.

Until recently, Mr. Johnson held the position of manager of Central and Western Sales, Denver Equipment Division of Joy Manufacturing Co. He was president of the Colorado Mining Association in 1966, and has been a director of that organization since 1959. He also is an active member of the American Institute of Mining Engineers and the Colorado School of Mines Alumni Asociation. He graduated with honors from the latter institution in 1945 with a Metallurgical Engineering degree.

Mr. Johnson and his wife have one daughter and are residents of Lakewood, Colo.

Barry K. McMahon Transferred To Dames & Moore Australia Office

BARRY K. McMAHON, D.Sc. 1968, has been transferred from Dames & Moore's Denver office to its Australian office located in Sydney. A native of Australia, he is returning home after obtaining a D.Sc. from the Colorado School of Mines.

A geological engineer with particular experience in rock mechanics, Dr. McMahon has traveled widely in his employment with Dames & Moore. Recent jobs have included open-pit slope stability studies in Chile, the United States and Mexico; block-caving studies in Chile and the United States; a highway alignment study in Spain and a pier foundation study in Australia.

Blakeslee

Clay

Peters

Bochow

Blakeslee Manages Halliburton Operations in West Germany

F. M. BLAKESLEE, P.E. 1935, who was formerly assistant manager, has been promoted to manager of Halliburton operations in Germany, Holland and Denmark. He is headquartered in Celle, West Germany.

Van L. Clay Commissioned Lieutenant in U. S. Air Force

VAN L. CLAY, Met.E. 1969, son of Mr. and Mrs. August B. Clay, Snyder, Colo., has been commissioned a second lieutenant in the U. S. Air Force upon graduation from Officer Training School (OTS) at Lackland AFB, Tex. Lieutenant Clay, selected for OTS through competitve examination, is being assigned to Webb AFB, Tex., for pilot training.

A 1963 graduate of Paonia (Colo.) High School, he received his professional degree in Metallurgical Engineering in 1969 from the Colorado School of Mines.

Peters Promoted by Cominco To Assistant Superintendent Of Magmont Lead Mine

JOHN W. PETERS, E.M. 1963, has been promoted to assistant mine superintendent by Cominco American, operator of the Magmont lead mine near Bixby, Mo. In his new capacity, Mr. Peters will assist Mine Superintendent A. F. "Gus" Rambosek in the various mine department functions.

Magmont, a mine and mill complex located in the "new lead belt," is owned jointly by Cominco American Incorporated of Spokane, Wash., and Dresser Industries, Inc., of Dallas, Tex.

Mr. Peters has served as the mine engineer since he joined the Magmont operation in 1967. He is a 1963 graduate of the Colorado School of Mines. He and his family reside in Salem, Mo.

Carl Bochow Named President Of Howe-Baker Engineers

CARL E. BOCHOW, P.R.E. 1952, has been named president of Howe-Baker Engineers, Inc., Tyler, Texas. The firm provides design engineering and fabrication services on a world-wide basis, with petroleum companies making up its biggest market. The Tevas company is a subsidiary of Nalco Chemical Co., Chicago.

A native of Salina, Kans., Mr. Bochow graduated from high school there in 1946. He entered the Colorado School of Mines after Naval service as an electronics technician.

He was a member of Sigma Phi Epsilon, Blue Key, Sigma Gamma Epsilon, Student Council, Glee Club, Octette, Oredigger, Scabbard and Blade, E-Day Committee, Talent Show, Petroleum Club and S.A.M.E. He received a professional degree in Petroleum Refinery Engineering in 1952.

Mr. Bochow's business experience has been with Humble Oil and Refining Co., Baytown, Texas; Columbia Southern Chemical Corp., Corpus Christi, Texas; and Suntide Refining Co., also at Corpus Christi.

Bochow's work at Howe-Baker has involved extensive travel since the firm provides petroleum process plants to companies in all parts of the world. An avid skin-diver and fisherman, he has managed to work in some time for these sports at various coastlines and exotic "fishing holes" in remote corners of the globe.

Mr. Bochow has served Howe-Baker as process engineer, manager East Coast Division, assistant chief process engineer, and vice-president, Process Design and Technical Sales.

He is a Registered Professional Engineer, State of Texas, and a member of the American Petroleum Institute and the National Petroleum Refiners Association. He has authored technical articles and has served as panelist at professional meetings in the petroleum field.

He and Mrs. Bochow have three children—Carl, Jr., 10; Tom, 9, and Robbie, 6.

Mike Carr Opens Denver Office

MICHAEL E. CARR, P.E. 1957, consulting petroleum engineer, has opened offices in the Midland Savings Building, Denver, and in McCook, Neb. A 1957 graduate of the Colorado School of Mines, Mr. Carr formerly was an area production manager for Pubco Petroleum Corp.

Ferguson Transferred by Humble To Eastern Marine Division

ALAN R. FERGUSON, Geol.E. 1955, has been appointed to the position of professional geologist for Humble Oil & Refining Co.'s Eastern Marine Division. He is currently assigned to the Offshore Frontier District, Houston.

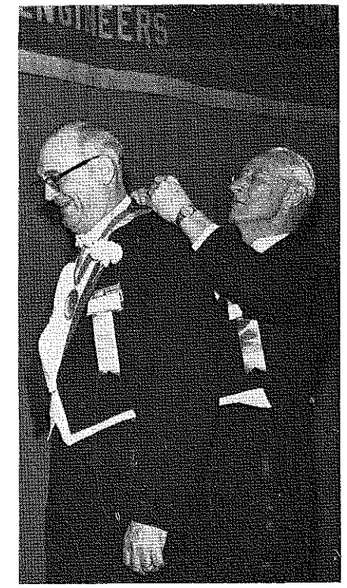
Ferguson's promotion is in recognition of outstanding professional achievement in the field of subsurface geology. He began his geological career with Humble in 1955 soon after graduating from Colorado School of Mines with a professional degree in geological engineering. He was on varied assignments in Gulf Coast states before joining the Eastern Marine Division in 1967.

L. A. Garfield Forms New Consulting Firm

LAWRENCE A. GARFIELD, E.M. 1950, a vice president of White Pine Copper Co. at White Pine, Mich., has resigned from that company to offer a consulting engineering service to the mining and construction industries. The new firm will specialize in engineering services and development of equipment specifications for open pit and underground mines and rapid excavation projects of all types. Mr, Garfield, who grew up in Fort Collins, Colo., earned an engineer of mines degree from Colorado School of Mines in 1950. He served in the air force during World War II.

Prior to joining White Pine in 1953, Mr. Garfield had extensive experience in Alaskan gold mining and served as a mining engineer in a Kansas gypsum mine for two years. He began his White Pine career as a mine engineer, and progressed through a succession of supervisory positions in mine development, production and research until he was appointed vice president in 1960.

At White Pine, Mr. Garfield's responsibilities as vice president included mining operations, planning and research. He attended the Alfred P. Sloan School of Management at Massachusetts Institute of Technology in 1965, and has participated as a speaker and panelist in a wide variety of research and management seminars, including those dealing with the adaptation of computer technology to the mining industry.



DR. JAMES BOYD (right), 1969 president of AIME, and president, Copper Range Co., fastens the Institute's Honorary Member Medallion on the 1969 recipient—LLOYD E. ELKINS, production research manager, Pan American Petroleum Co., Tulsa, Okla. Mr. Elkins was elected an AIME Honorary Member by the Board of Directors "in recognition of his distinguished leadership in the engineering profession and the petroleum industry, and for his manifold contributions to AIME." The presentation was made at AIME's Annual Banquet on Feb. 18, 1970, a part of the Institute's 99th Annual Meeting held in Denver, Feb. 15-19, 1970.

Basil Swanson Joins Staff Of Los Alamos Laboratory

BASIL IAN SWANSON, Chem.E. 1966, has recently joined the staff of the Los Alamos Scientific Laboratory in New Mexico to work with the Chemical and Metallurgy Division.

Dr. Swanson received his Chemical Engineering degree from the Colorado School of Mines and his Ph.D. in Inorganic Chemistry from Northwestern University, Evanston, Ill. He is a member of the American Chemical Society. Dr. Swanson and his wife, Dennise, are the parents of a son, Derek Sean.

G. C. Weaver, '26
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J. M. Love Accepts Position With General Electric

JAMES M. LOVE, a 1970 engineering graduate from the Colorado School of Mines, has accepted a field engineering position with General Electric's Installation and Service Engineering Department (I&SE).

Love will attend I&SE's Field Engineering Development Center in Schenectady, primary site for the development of new I&SE engineers, to pursue on-the-job and classroom instruction in mechanical and nuclear field engineering. He is on assignment in Schenectady.

Headquartered in Schenectady, I&SE has a team of more than 2,200 field service engineers in more than 85 cities in the United States. The department offers the technical assistance for installation, adjustment, testing, start-up and a full range of management, planning and engineering services on GE mechanical, nuclear, electrical and electronic equipment, as supplied to defense, industry and electric utility customers.

A native of Denver, Colo., Love is the son of Mr. and Mrs. James M. Love of 2545 South Raleigh St., Denver. He was a member of Alpha Phi Omega, Village Council and S.A.M.E. while in college. He is married to the former Mickey L. Taggart of Denver.

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Oredigger Sports

Outstanding CSM Athletes Recognized

Four Colorado School of Mines athletes have been honored by the Outstanding College Athletes of America, and will be honored in the 1970 volume of their publication Nominated by their schools earlier this year, these athletes were chosen to appear in this awards publication on the basis of their achievements.

Outstanding College Athletes of America is sponsored by the Outstanding Americans Foundation, a nonprofit organization dedicated to honoring Americans of achievement.

Jim Taylor, a senior in mathematics, lead the RMAC conference in rushing in 1968 with 680 yards and eight touchdowns, and has received all-conference first team recognition for the past two years in the RMAC mountain division conference.

Michael Collodi, a sophomore in petroleum engineering, received conference recognition in both 1968 and 1969 for his performance in football as a brilliant receiver and flanker.

Charles Crew, a senior in metallurgy, has been recognized as an outstanding athlete both in track and swimming. He holds records for the 50-yard free-style event in swimming, and the 50-yard high and low hurdles for Mines.

Jay Godley, a senior in mathematics, has received recognition in the RMAC conference for outstanding basketball achievements for the past four years. During this period of time Jay scored over 1,500 career points in college basketball for Colorado School of Mines, the highest ever scored by a CSM player.

CSM Baseball Nine Split Their Season

In weekend play, the CSM baseball team split their season with a 2-2 record and a 1-1 record in the RMAC conference. Mines' first game was at Denver University and the Orediggers fell 10-1, only getting six hits. DU's righthander Skip Korty went four for four and drove in three runs.

The Miners came back on Friday, April 10, and defeated Metropolitan State College 10-8 in a six-inning game that was called due to darkness. CSM drove in eight of their 10 runs in the first inning.

On Saturday the Orediggers traveled to Regis College and won their first RMAC season play game by surpassing Regis 6 to 5. Mines rallied in the fourth inning and drove in four runs for their 6-5 lead and victory. Jim Dionosio of Mines hit a single homerun,

The tides turned Sunday when CSM again returned to Regis' home diamond and the Miners fell 16 to 8. In homeruns, Mike Collodi soloed in the first and Ron Haines picked up one in the seventh. Mines had 10 hits to Regis' 21. Both Regis and Mines are now 1-1 in RMAC play and CSM has a 2-2 record.

Elmer R. Wilfley, '14

Wilfley Centrifugal Pumps

Denver, Colorado

7th Annual High School Invitational Track Meet

Colorado School of Mines again hosted the 7th Annual Indoor Invitational High School Track and Field Meet, at Steinhauer Field House on Mar. 21. In total 40 high schools participated with 175 entries for the 13 events.

Three new records were broken, with a new time of 4:26.2 for Mike Peterson of Mapleton High School in the one mile run, bettering last year's record set by Glenn of Greeley Central. The following new records were both in field events, with Douglas of Wheat Ridge High School covering 44′ 8¾″ in the triple jump, stretching last year's record by ¾″, and a new pole vault height of 14′ 1½″ set by Kleiger of Regis High School, expanding the 1968 record by 4⅞″ by Johnson, who attended Wheat Ridge.

Mike Peterson of Mapleton High School was awarded the outstanding trackman trophy by CSM's track coach Joe Davies, following his record one mile run, and Jim Kleiger of Regis High School and Mark Cooper of Wheat Ridge High School were awarded the outstanding fieldman trophy. Kleiger was responsible for the new pole vault record and Cooper placed second in the pole vault competition.

50 yard dash—Kensinger, Loveland, 5.5
50 yard high hurdles—Kehmeier, Cedaredge, 6.5
50 yard low hurdles—Kehmeier, Cedaredge, 6.1
220 yard dash—Kensinger, Loveland, 23.7
440 yard dash—Lavoie, Arvada West, 50.6
880 yard run—Maxwell, Arvada, 2:02.0
One mile run—Peterson, Mapleton, 4:26.2
Two mile run—Trujillo, Pueblo Centennial, 10:06.5
Shat put—Mills, Alameda, 55′4″
High jump—Biar, Thomas Jefferson, 6′2″
Long jump—Hudley, East Denver & Franz, Boulder (tied) 21′7½″
Triple jump—Douglas, Wheat Ridge, 44′8¾″
Pole vault—Kleiger, Regis, 14′1½″

Spring Practice Throughout April

The week of April 6th marked the start of spring practice for the Coloralo School of Mines football team. The "Orediggers" will be practicing four days out of the week for the next month, concluding their practice with the annual Alumni-Varsity Football game, which will be played May 8, at Brooks Field in the evening.

Second year head football coach Marv Kay will have 40 candidates out for practice with 30 returning lettermen from last year's season. The bulk of spring training, Kay said, "will be emphasis on development of offensive and defensive skills, with an overall expansion of the capabilities of the team."

Other lettermen who will be participating in other sports will be all-conference end Nelson King, flankerback Mike Collodi, running back David Gensch, and defensive cornerback Gary Priddy, who are all participating on the CSM baseball team; and tackle John Shoenhair and receiver Kurt Lechtenberg, who are participating with the track team.

CSM Thinclads Win Invitational

Colorado School of Mines thinclads rolled up 85½ points during their invitational outdoor track meet April 10 to take top honors. Other team standings were: Chadron State of Nebraska 80½, Western State College 43, University of Denver 29½, Regis College 21½, Fort Lewis 17, and Metro State College 11.

CSM had four first places in field events. Outstanding athletes were John Shoenhair, who won the hammer throw; Brett Bristol, who won the high jump and triple jump, and Joe Kraft, who won the pole vault.

Previous to this meet, Mines had outscored four other teams Tuesday to win at D.U.'s quadrangular track meet. Mines had gathered ten first places against University of Denver, Colorado College, Regis and Metro State College.

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Campus Headlines

Scholarship Winners at Engineer's Day

THREE Colorado high school students were presented Engineers' Day Scholarships at the 36th Annual Engineers' Day at the Colorado School of Mines.

These scholarships are awarded to Colorado residents who will graduate from high school in May or June of the year of the award. The scholarships are for five years and will carry the recipient through one year of graduate study at the Colorado School of Mines. The recipients are selected on the basis of a state-wide competitive examination in English, mathematics, physics or chemistry.

The recipients this year are: **Steven David Diamond,** son of Mr. and Mrs. Morris Diamond, 1500 Fremont Ave., Pueblo, Colorado; **Richard John Wissbaum,** son of Mr. and Mrs. Lawrence K. Wissbaum, 11151 West 60th Ave., Arvada, Colorado; and **Martin Dale Rymes,** son of Mr. and Mrs. Ivan R. Rymes, 305 South Ninth St., Rocky Ford, Colorado.

Steven Diamond attends East High School in Pueblo. He has participated in the Pueblo Civic Symphony, Colorado Frontiers of Science Institute, and the Radio Club. He is a member of the Honor Society and is an amateur radio operator. Steve is a National Merit Scholarship Semi-finalist.

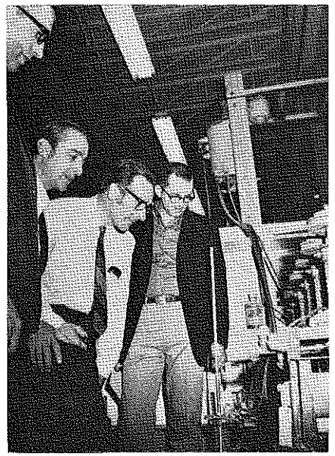
Richard Wissbaum attends Arvada West High School in Arvada. He is a member of the National Honor Society, Math Club, Latin Club and Chess Club. He has taken part in student government, and is a National Merit Scholarship Semi-finalist.

Martin Rymes attends Rocky Ford High School in Rocky Ford. Martin has participated in the Band and Pep Band, the Thespians, Forensics Team, Chorus and Directors Choir and the International Relation Club. He has held office in his Church Choir and Fellowship Group, is an Eagle Scout, and was a "Chief" of the Koshare Indian Dancers. He is a National Merit Scholarship Semi-finalist.

$3,000 Check Given By Union Carbide

John F. Emerson, general manager of the Colorado Plateau Operations of Union Carbide Corp. in Grand Junction recently presented to Dr. John J. Reed, representing the CSM Mining Department, an unrestricted check for $3,000. Each year Union Carbide has given an unrestricted check to one of the major departments on campus.

A GROUP OF 15 COMBAT-INJURED SOLDIERS from Fitzsimons General Hospital visited the Colorado School of Mines during Engineers' Day (Apr. 17-18) as guests of the student chapter of the Young Americans for Freedom. Part of the group is pictured above with their Red Cross hostess, Katherine Payne, as they examine one of the many exhibits in Steinhauer Fieldhouse. They were honored at a luncheon in the Holland House given by Adolph Coors Co. in cooperation with the Golden Chamber of Commerce.



IBM PERSONNEL surround Dr. Rex Bull of the Department of Metallurgical Enginering during a special training program for IBM personnel in the computer application in the mineral industries. Left to right are: Ron Mathews, IBM sales representative, Larry Diaz, IBM training coordinator, Dr. W. Rex Bull, and Mike Kaas, IBM training coordinator.

New Housing Policy

Kenneth E. Bellamy, director of Student Housing for Colorado School of Mines, has announced a new policy for women residents attending CSM. Effective the fall semester of the 1970-71 school year, no women students will be required to live in the Women's Residence Hall.

Prior to this announcement all coed students at Mines were required to live in the Women's Residence Hall for their freshman and sophomore years unless they commuted to the campus.

Mines Assists IBM In Training Program

THE Colorado School of Mines is assisting the IBM Corp. in helping to train a special group of IBM personnel in computer applications in the mineral industries.

In a new program for IBM, 30 of the company's sales representatives and systems engineers who deal with mining companies are participating in a week-long classroom and field project designed to expand their knowledge of computer utilization in the earth science fields.

Use of computers in mining and related activities is one of the fastest growing developments in industry today, according to IBM officials.

On April 8 Dr. W. Rex Bull of the CSM Metallurgy Department gave the IBM class, composed of company representatives from all over the nation, a concentrated course in computer applications in mineral processing. He also led the group on a tour of the department's laboratories.

On the following day, the CSM Mining Department conducted a course which involved an underground tour of the School's Experimental Mine at Idaho Springs and visits to the Urad Mine and the Henderson Mine of the American Metals Climax Corporation.

The Mining Department program was led by Prof. Charles O. Frush.

Outside of the School of Mines phases of the program, classes are being conducted at the Holiday Inn West by IBM coordinators, Mike Kaas of Chicago and Larry Diaz of Salt Lake City. Diaz received his master's degree in metallurgy at Mines in 1967. The program concluded April 10.

IBM officials feel the cooperative project with Mines will give its representatives firsthand exposure to education and industry, and lead to further advances in computer use in the mineral resources industries.

Crew

Charles Crew Awarded CEC Silver Medal

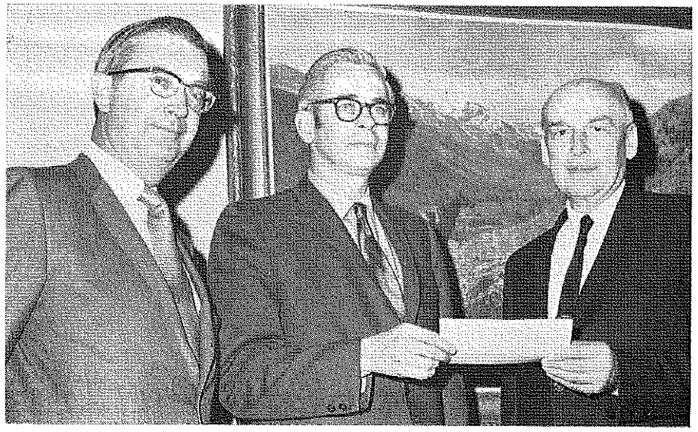
CHARLES CREW, graduating senior at Colorado School of Mines received the Colorado Engineering Council Silver Medal award during the opening ceremonies of the 36th Annual Engineers' Day on the CSM campus Friday, April 17.

Crew, whose hometown is Golden, will graduate in metallurgy this spring during the May commencement. During his four years at Mines he has served as Senior Class President, three years on the Student Council and two years on the Barb Council. He is a member of Theta Tau and Scabbard and Blade honoraries, and also has professional affiliations with the American Institute of Mining, Metallurgical and Petroleum Engineers, and the Society of American Military Engineers. Charles was granted an Adolf Coors Annual Leadership Award Scholarship during his freshman year and maintained this scholarship for his four years at CSM.

Only the night before, Charles Crew received the coveted Dave Johnston Trophy for Outstanding Senior Athlete at the CSM 23rd Annual Athletic Awards Dinner. Crew lettered in swimming four years and was voted most valuable player each year. During this year he placed 5th nationally in the NAIA 100 yard freestyle event. Charles was also outstanding as a trackman lettering four years, awarded the Outstanding Trackman Award his junior year, and placing 6th in the NAIA, and 8th in the NCAA national competition in the 120 high hurdles during his junior year.

Charles is single and resides at 12900 W. 16th Drive with his parents, Mr. and Mrs. Wynn Dudley Crew, in Golden.

Following graduation, Crew will serve in the U.S. Corps of Engineers as a Lieutenant for fulfillment of his ROTC training. Later he plans to work for Caterpillar Tractor Co. as a metallurgical engineer at Peoria, Ill.



ALCOA FOUNDATION DONATES $13,000. Mr. D. Schaffer, quality assurance manager of the Davenport Works of Aluminum Company of America (center) presents to Dr. Paul G. Herold, (right) department head of the CSM Metallurgical Department a $10,000 unrestricted foundation grant to be used by the Metallurgical Department and a $3,000 scholarship grant for the CSM scholarship program. The scholarship will be awarded to four juniors, two in the Physical Metallurgy Department and two in the Mining Engineering Department. The scholarships will be $750 each and apply to the 1970-71 school year. Dr. A. W. Schlechten, vice president for Academic Affairs at CSM looks on.

Welding Joining Class at Mines

A one-day class on "Welding and Joining" was conducted April 17 at Colorado School of Mines in conjunction with the Annual Education Program of the Rocky Mountain Chapter of the American Society for Metals, and the Colorado Section of the American Welding Society.

Studies in basic welding metallurgy and two afternoon sessions 1.) New Methods of Joining and 2.) Welding Design will be offered starting at 8:00 a.m. in Hill Hall on CSM's campus, according to Dr. Don Klodt of the Office of Research Services.

Participants were welders, inspectors, shop foremen, engineers, and metallurgists from local industries.

Roger Olsen of Mines Nominated for Award

H. B. "Doc" Kniseley, commissioner of the Rocky Mountain Athletic Conference, has announced the nomination of Roger Lee Olsen for the RMAC Scholar-Athlete Award from Colorado School of Mines for the current school year.

Olsen, a sophomore at Mines, maintained a 3.8 grade point average for his freshman year, A native of Wray, Colorado, Roger is majoring in chemical engineering.

He has played football for two years at Mines and received his varsity letter this year as a guard and linebacker for the Orediggers.

23rd Athletic AwardsDinner

The CSM Athletic Council held their 23rd Annual Athletic Dinner on April 16 in the College Union on the campus.

This dinner, which is held on the evening preceding Engineers' Day, is in honor of Mines students who won a varsity letter during the past calendar year. Over 140 CSM students lettered last year and were invited to the dinner for recognition. Approximately 40 graduating seniors were in attendance.

The attendance in the past has generally exceeded 250, including CSM students, guest high school coaches and students, and the sports news editors and directors in the metropolitan Denver area.

Mr. Lou Saban, head coach and general football manager of the Denver Broncos Professional Football Club, was the principal speaker for the evening.

Typographical Errors

Prof. W. J. Cieslewicz has called our attention to the following typographical errors in his article entitled "Some Recent Information on Soviet Earthquake Studies:" p. 3, should be W. J. Cieslewicz; p. 4, col. 2, paragraph 4, line 11: should be: . . . 10 cm outside diameter . . . ;p. 6, col. 2, paragraph 4, line 6, should be: . . . which employ . . . ."

Two NSF Grants Totaling $30,000

COLORADO School of Mines has received two research grants, supported by the National Science Foundation, which became effective April 1, 1970, and amount in value to $15,000 each.

The first grant was awarded to the Basic Engineering Department, under the direction of Dragoljub M. Kesic, and will deal with "Research Initiation—Structure of Scalar Fields Mixed by Turbulence for Arbitrary Schmidt Numbers." This grant will exist for a period of 18 months.

The second grant was received by the Physics Department and will deal with "Research Initiation—Mossbauer Studies of Permalloy Alloys." The director of research will be Joseph A. Moyzis, with the period of research being 18 months.

Last Performance In Guggenheim Hall

The Golden Thespians, a local theatrical production group now in their 40th year and the oldest continuous group in the state, presented a three-act comedy, "Here Lies Jeremy Troy," by Jack Sharkey in the CSM Guggenheim Hall Auditorium April 16-18.

This production was the last to be performed in Guggenheim Hall Auditorium on the Colorado School of Mines campus following 30 consecutive years of use by this group. Renovation of the building will force the group to locate another auditorium facility for future productions.

Crew and Sadok Place At N.A.I.A. Championships

Freestyle swimmer Charles Crew of Golden and 1-meter and 3-meter diver Richard Sadok of Lakewood each placed high in the N.A.I.A. National Swimming and Diving Championships held in LaCrosse, Wis.

Charles Crew, a senior in metallurgy, took 10th in the 50-yard freestyle event with a new Mines team record time of 22.3 seconds, and also set a new team record in the 100-yard free-style event with a time of 49.0 seconds. The 50-yard free-style time ties the pool record also for Mines.

Richard Sadok, a senior in chemistry, placed 16th in the 1-meter diving events and 14th in the 3-meter diving events.

"Both men did an exceptional job," was the praise given by their swimming coach Bob McCandless. Mines placed 19th out of the 31 teams entered in the championships,

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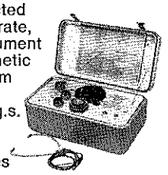

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Book Reviews

Graphite Determinations

A book explaining how graphite determines the strength, ductility, and other properties of Gray, Ductile and Malleable iron castings is available to students at the special price of $1.50 (cost to the general public is $3.50). The book, which contains over 50 illustrations and over 100 selected references, is available from Malleable Founders Society, 781 Union Commerce Bldg., Cleveland, Ohio 44115.

Although published by the Society, the principal text was written by Professors Wallace, Bates and Wieser, Case Institute of Technology, Cleveland, Ohio.

Natural Gases Of North America

This book in two volumes by B. Warren Beebe, editor, and Bruce F. Curtis, associate editor, contains 184 case histories and stratigraphy and structure of North American Basins. In the book are some 146 papers by 225 authors with (1) information on how and where to explore effectively and economically for natural gas, with emphasis on nonassociated gas; (2) with the most comprehensive treatment of geological and engineering aspects of natural gas exploration and production now available; (3) with chemical analyses and discussions of compositional variations of gases from various regions.

Price per set (postpaid) from the American Association of Petroleum Geologists, Box 979, Tulsa, Okla. 7401, is $40. A 25 per cent discount is made to AAPG and SEPM members.

Earthquake Research

PB-188 636 — **Earthquake Engineering Research,** Committee on Earthquake Engineering Research, National Academy of Sciences, Washington, D. C., 1969, 325p. . . . Discusses socioeconomic aspects of earthquakes, earthquake ground motion, soil mechanics and earth structure, structural dynamics analysis, structural synthesis and design, destructive motions of coastal and inland waters generated by earthquakes, utilities and public service utilities, post-earthquake inspection and study, foreign cooperation in solving common problems of destructive earthquakes, and educational requirements for solving the major problems of earthquake hazards.

Cost of paper copy of this book is $3.00 and 65 cents for microfiche; U.S. Dept. of Commerce, Clearinghouse for Federal Scientific & Technical Information, Springfield, Va. 22151.

Silver-Bearing Copper by Dr. Walter L. Finlay

Copper and silver-bearing copper qualify as among the most useful metals ever available, according to a new book, **Silver-Bearing Copper** by Dr. Walter L. Finlay, Corinthian Editions, New York, $12.50, 356 pages.

No metal has served mankind so well, for so long, and in so many essential ways. Copper, containing traces of silver, was man's first engineering metal, the first malleable material he could hammer into tools and weapons to provide the first giant stride toward civilization.

Silver-bearing copper looks and acts like copper in most respects. But 12 to 25 ounces of silver in a ton of copper give copper the highest combination of conductivity and strength in its service temperature range of any material. Silver-bearing copper also has significant advantages over ordinary copper in such characteristics as oxidation, wear resistance, and resistance to creep.

Hundreds of facts about silver-bearing copper have been compiled by Dr. Finlay, Director of Research for Copper Range Co., in the new book, which will be primarily helpful to those responsible for designing, specifying, fabricating and processing special-property copper metals. These are designers, manufacturers, students, and engineers.

The book delineates the properties and characteristics of copper and silver-bearing copper, its applications through the centuries, and its great stability and versatility which enable it to meet and answer demands of constantly changing sets of requirements.

The book is designed by S. Neil Fujita and written in an easy-to-understand manner. Its highlights include:

1. The in and outs of the oldest profession in the world—the mining and metallurgical utilization of silver-bearing copper. Nature started the operation 1.1 billion years ago at what is now White Pine, Mich. on the southern shores of Lake Superior. This billion-year-old metal is called **native** copper to distinguish it from man-produced copper.

2. First metallurgists in the Western Hemisphere were the Old Copper Indians, of 3,000-5,000 B.C. On the back cover of **Silver-Bearing Copper** is a life-sized color photo of native silver, as formed by Nature a billion years ago on a piece of native copper. As noted on the inside back cover, this unique piece suggests an Old Copper Indian head in profile.

Prof. Earl Parker, Met.E. 1935 of the University of California and president of the American Society of Metals in 1967-68, said (page III); "Only one atom of silver to five thousand atoms of copper can produce this great change in properties!" These great advantages are higher creep and stress-rupture strength (page III and Chapter IV); highest combination of conductivity and strength in its service temperature range of any material (page VII and Chapter 110); higher resistance to heat softening (Chapter 111); and higher oxidation resistance (circle on front cover described in front end papers).

3. Man requires about 0.0002 per cent of his body weight as copper in order to live: oysters have more copper than any other food which may be suggestive; and there are those who believe copper absorbed by the body wards off arthritis (page 3, appendix I).

4. Compared to copper's healthy ruddy color, gold is a pallid yellow, titanium, a blackish-white, silver, aluminum and all the other metals a bleached-out white. To what does copper owe its unique red color? Why is copper black in green light, and green by transmitted white light (Appendix H).

5. Copper made civilization possible (pages 3-5) and silver-bearing copper helps to sustain an advanced civilization by being the best material for such applications as: Electric commutators and rotor winding (Chapter XI); Auto radiator fins (Chapter X); Busbars (Chapter XII); Photoengraving plates (Chapter XV); Inferno facers (Chapter XIV).

The purest ore available, White Pine's silver-bearing copper is the result of a complex metallurgical extraction process that was done in a gigantic geologic classification operation a billion or more years ago. One of three metals provided by Nature in the metallic state, copper gave birth to the art of smelting metals from their ores.

Silver-bearing copper is extracted, milled, and refined in the White Pine, Michigan installation of Copper Range. It occurs naturally in Michigan's remote Upper Peninsula as part of a vast table-shaped orebody which cover hundreds of square miles and already assures adequate reserves for 50 years of mining. It is said to contain about 15 per cent of known U. S. copper reserves.

Dr. Finlay, director of research for Copper Range Company, is a graduate of Lehigh and Yale Universities. He has had wide experience in both nonferrous and ferrous metals, and has several dozen patients involving copper, aluminum, lead, titanium, and steel developments. A charter member of the Titanium Founders Society, he holds more than a dozen titanium alloy patents, covering most titanium alloys currently in production throughout the world.

While Director of Research for Crucible Steel Co. of America, Dr. Finlay was awarded the American Iron and Steel Institute's Elbert H. Gary Medal for a paper on the vacuum degassing of high performance alloy steels.

Technical Societies

1970 Western Resources Conference July 8-10 At Denver University

THE 1970 Western Resources Conference will be held at the University of Denver on July 8, 9, and 10. The Conference theme will be "Urban Demands on Natural Resources."

The effect of urbanization on the use and development of our natural resources will be considered under five topics—Air, Water, Raw Materials, Land, and Choices. Over 20 speakers from the Rocky Mountain region and other parts of the United States will appear in the five sessions.

This is the twelfth in a series of conferences that began in 1959. The University of Colorado, Colorado State University, Colorado School of Mines, and the University of Denver are members of the inter-university group that sponsors the conference series.

John J. Schanz, Jr., professor of natural resources and a member of the Denver Research Institute's Industrial Economics Division, has been named general chairman for the 1970 conference.

Mullins Named Chairman Of NCPC; Warns Energy Shortage Possible

T. C. Mullins, president of Peabody Coal Co. of St. Louis, one of the world's major coal-producing companies, has been elected chairman of the National Coal Policy Conference, Inc., a Washington-based organization which represents all segments of American industrial life engaged in the production, transportation and utilization of bituminous coal.

Mr. Mullins succeeded W. A. Boyle, president of the United Mine Workers of America, who has served as chairman of the organization for the past three years, the longest tenure in the history of the 11-year-old group.

Mr. Mullins, who is out of the country on business, warned in a statement which was read for him at the meeting by Peabody Vice President Hugh B. Lee, that "this Nation is on the verge of moving from an era of energy sufficiency to one of energy shortage" and that some government officials, in an effort to meet this changed condition, are attemping "to downgrade domestic energy fuels—oil, natural gas and coal—and to seek sufficiency through greater reliance upon imported fuel."

Such an answer to "a serious national problem, is fraught with grave implications for national security and for the national welfare and must be rejected," he declared.

ALASKA TECTONIC SYMPOSIUM

THE second Alaska Tectonic Symposium, organized by the Alaska Geological Society in cooperation with Alaska Methodist University, recently brought together some of the world's most eminent earth scientists to discuss Alaska and its relation to global tectonic patterns and continental drifting. These new concepts are especially important now that Alaska has become a focal point for exploration and research by geologists and geophysicists.

Dr. J. Tuzo Wilson, professor of Geophysics at the University of Toronto, discussed the life cycle of ocean basins with particular reference to the Arctic. He applied the concept of spreading outward from oceanic ridges to the rifting and fracturing of continents and the development of ocean basins.

Dr. Michael Churkin, Jr., USGS, Alaska Branch, discussed the correlation of fold belts between Alaska and Siberia and their relation to continental drift. Cordilleran fold belts apparently correlate well with belts in the Kamchatka and Chukotsk Peninsulas. Evidence thus far suggests no drifting between the Siberian Platform and Alaska. The Verkhoyanskiy Mountains, west of the Chukotsk Peninsula probably represents the border between North America and Asian blocks. Spreading of the Canada Basin along an older rift system is speculative. Churkin suggested that source material for the Paleozoic geosyncline rimming the Arctic Basin was derived from a marginal orogenic belt that bordered the continents. Wilson proposed the source was the Asian continent prior to drifting.

Robert Stonely, British Petroleum Co., discussed the "New Global Tectonics" as reflected in the structure of parts of Alaska. The Yakataga area shows tectonic patterns typically associated with the underthrusting of the oceanic crust at a continental margin. This underthrusting results in uplift with overthrusting of shelf sediments oceanward.

Dr. H. W. Menard of the Scripps Institute of Oceanography has recently done work in the North Pacific Basin which promises to be of major importance in understanding Alaskan tectonics.

John Moody, senior vice president of Mobil Oil Corp., discussed the geometry of wrench fault tectonics. He believed that there is a worldwide distribution of maximum stress directions either east-west or north-south. His views are, as Menard put it, in "mortal conflict" with plate tectonics and continental drift.

Geophysical Training Program in Wisconsin

FIVE sessions of the Soiltest, Inc. geophysical training program at Baraboo, Wis., have been announced for the 1970 season.

Subjects covered at the sessions include the use and application of seismic and resistivity apparatus plus other related equipment used in subsurface exploration and investigation. The objective of these sessions is to provide training in shallow depth subsurface exploration for engineers, geologists, government personnel, contractors, and students.

All training facilities are at Soiltest's 600 acre Proving Ground and Training Center located just outside Baraboo, Wis., in the geologically-significant "driftless area." The wide variation in the subsurface conditions of this area makes it ideal for such training.

Classes begin on Thursday morning and run through noon on Saturday. Sessions start on May 21, June 18, Sept. 17, Oct. 8 and Oct. 29.

Complete information on the geophysical training sessions is available from Soiltest, Inc., 2205 Lee St,, Evanston, Ill. 60202.

Infrared Sensing Experiment Results Now Being Exhibited

BENDIX Aero Space Systems of Ann Arbor, Mich., and Heinrichs Geoexploration Co. of Tucson, Ariz., are currently exhibiting results of a comprehensive airborne infrared sensing experiment over the Lone Star Mining District near Safford, Ariz.

The new results were shown to the public at the Washington Hilton Hotel at the annual meeting of the American Society of Photogrammetry March 1-5.

The imagery obtained further refines the available information on techniques and applicability of the infrared method for regional mineral exploration.

Bendix Aero Space is among the leaders in avionics remote sensing instrumentation. Heinrichs Geoexploration Co. is an internationally known consulting and contracting exploration firm active in minerals search.

The Lone Star Mining District is the site of a proposed underground nuclear test to be conducted by the Atomic Energy Commission and Kennecott Copper Corp.

Imagery may be viewed by prior arrangement at headquarters offices of GEOEX in Tucson and Sydney, Australia, and Bendix in Ann Arbor, Mich., and will shortly be published as a scientific paper. A brief preliminary report is available now on written request at no cost.

U.S. Uranium Industry Sets Drilling Record

Surface exploration and development drilling by the U. S. uranium mining industry in calendar year 1969 totaled a record 29,900,000 feet, the Grand Junction, Colorado, Office of the U. S. Atomic Energy Commission announced today.

The 1969 drilling figure was 25 percent greater than the 23,800,000 feet drilled by the industry in 1968, the previous high year, and almost triple the 10,800,000 feet drilled in 1967. The 1969 record represents 21 percent of the total 140,000,000 feet of surface drilling for uranium since 1948 when the AEC began to record industry drilling figures.

At the end of 1969, estimated U.S. uranium ore reserves were 97 million tons with an average grade of 0.21 percent U_3O_8. These reserves contain 204,000 tons of U_3O_8 recoverable at $8 per pound of U_3O_8 or less. This compares with 161,000 tons a year earlier and shows a gain of 43,000 tons during 1969.

New reserves developed in 1969 contained an estimated 56,000 tons of U_3O_8. After adjustment for ore mined and shipped to mills, there was a net increase in reserves during 1969 of 43,000 tons of U_3O_8. This increase is the greatest of any year since 1957.

As one stows away the snow shovel at the end of the season, the joy is somewhat diluted by what appears to be a fiendish metallic chuckle which comes from the lawn mower standing beside the implement rack.

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1969 Mineral Production in U. S.

ACCORDING to estimates by the Bureau of Mines, U.S. Department of the Interior, total value of mineral production for these states in 1969 was as follows:

Alabama, $28.4 million, an increase of 8 per cent above 1968. The increase in value was due mainly to higher production of coal, cement, lime, and sand and gravel.

Arizona, $850.5 million, 38 per cent above the 1968 total and an all-time high. The state led the nation in copper production (797,350 short tons), ranked second in silver production (6.1 million troy ounces), and was fourth in gold production (110.300 troy ounces).

California, $1.88 billion, up 4 per cent from $1.81 billion in 1968. Increases reported for mineral fuels (6 per cent) and nonmetals (3 per cent) more than compensated for a decrease in metals (14 per cent).

Colorado, $370.9 million, $8 million more than the previous high set in 1966. Part of the increase was due to greater production and higher prices of lead, molybdenum, vanadium, and zinc.

Florida, $301.9 million, a decrease of 1 per cent below 1968. The overall decline in value of mineral production is attributed to slow phosphate sales and lower prices. Nonmetals accounted for 94 per cent of the state's total mineral production value.

Georgia, $201 million, an increase of 16 per cent over the previous record value in 1968. Minerals produced were predominantly nonmetals, but a small percentage were metals. Bauxite nearly doubled in quantity and value.

Kentucky, $582 million. The state ranked second in U.S. coal production with 102 million tons valued at $434 million. About 80 per cent of the state's mineral wealth was from coal.

Nevada, $172.5 million, 44 per cent higher than that in 1968. Copper production accounted for 67 per cent of the total value of the state's mineral production. Declines in production of iron ore, lead, zinc, and tungsten were more than offset by increased outputs of copper, gold, silver, mercury, and molybdenum.

New Mexico, $966.3 million, an increase of $72.5 million over 1968. Dollarwise the greatest gain was in mineral fuels with natural gas and petroleum leading; percentagewise the value of metals production made the greatest increase (copper, lead, zinc, and gold).

North Carolina, $85.3 million, exceeding by 3 per cent the $82.8 million of 1968. Higher production values of asbestos, cement, feldspar, scrap mica, olivine, phosphate rock, sand and gravel, dimension sandstone and crushed granite contributed to the increase.

South Carolina, $53.2 million or 3 per cent over 1968 production. New records were set in the production of masonry cement, crushed limestone, feldspar and vermiculite. The state ranked second in the nation in the production of kaolin and vermiculite, and third in the production of kyanite

Tennessee, $213 million, an increase of 6 per cent over the $201.3 million reported in 1968. There were production and value increases in Portland cement, phosphate rock, pyrite, zinc, copper, natural gas, and crude petroleum.

Utah, $539.1 million, or 20 per cent more than the previous high in 1966. Value of the metals group increased $104.4 million and showed losses only in the values of lead, silver, and uranium. All commodities except natural gasoline in the mineral-fuels group showed increases in value.

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Texas Gulf Sulphur Joins Cleveland-Cliffs Iron In Australian Project

Texas Gulf Sulphur Co. has agreed in principle to join with The Cleveland-Cliffs Iron Co. in the development of the $300-million Robe River Iron Ore Project in Western Australia. That announcement was made jointly by Dr. Charles F. Fogarty, E.M. 1942 and D.Sc. 1952, president of Texas Gulf, and H. Stuart Harrison, president of Cleveland-Cliffs.

"We are pleased to team up with Cleveland-Cliffs on this important project," said Dr. Fogarty, "and, together, our expertise in mineral development should make a definite contribution to the success of the operation."

Under arrangements now being worked out, Texas Gulf Sulphur would have a 10½ percent interest in the total Robe River venture through a 35 percent interest in Cleveland-Cliffs' subsidiary, Cliffs Western Australian Mining Co. Pty. Ltd., and one or more other U.S. investors would have minority interests. Cliffs Western Australian Mining Co. would have a 30 percent participation in the Robe River Project. Australian financial institutions and investors would have a 35 percent participation in the project.

In Memoriam

Clyde I. True

CLYDE I. TRUE, E.M. 1935, died suddenly at his home (1404 Maple St., Golden) on Dec. 15, 1969. At the time of his death he was employed as a mining engineer by the Cotter Corp., Canon City, Colo.

Born Oct. 12, 1906, in Longmont, Colo., he was graduated from Loveland High School in 1926 and in 1935 he received his Mining Engineering degree from the Colorado School of Mines. From 1928 until January 1941 when he joined the Army's Corps of Engineers as a first lieutenant, he was employed by Anaconda Copper Co. in Butte, Mont.; Shenandoah-Dives Mining Co. in Silverton, Colo.; and the Colorado State Highway Department in Denver. He served five years (1941-1946) in the Corps of Engineers, retiring as a major.

For over eight and a half years, Mr. True was mine superintendent of the Schwartzwalder Uranium Mine near Golden. He was also employed as a mining engineer with the Atomic Energy Commission at Grand Junction, Colo.

He was a member of the Professional Engineers and Land Surveyors, Retired Officers Association, Colorado School of Mines Alumni, A.T.O. Fraternity, American Legion Post No. 178, American Rifle Association and the Coors Rifle Club, He was also a retired Major of World War II.

Survivors include his wife, Violet B. True; a son, Glenn A. True of Arvada; a daughter, Mary H. Farr of Lakewood; and a brother, Kenneth True of Ann Arbor, Michigan.

Harold F. Browne

HAROLD F. BROWNE, P.E. 1928, died May 18, 1969 at his home in Ft. Worth, Tex. (4100 Hampshire Blvd.). Mr. Browne was supervising safety engineer, United States Bureau of Mines. Mr. Browne attended South Denver High School and was a member of the wrestling team at the Colorado School of Mines, where he received his Petroleum Engineering degree in 1928. On Dec. 25, 1930, he and his high school sweetheart, Miss Sarah Briggs of Denver, were married in Epiphany Episcopal Church.

Charles H. Cotterell

CHARLES H. COTTERELL, Geop. E. 1959, physicist at Marathon Oil Co.'s Research Center, was killed April 18 in an automobile accident in Kansas. His obituary will appear in next month's In Memorian section of the magazine.

Walter H. Jackson

WALTER H. JACKSON, E.M. 1901, died several months ago. On Jan. 30, 1970, we received a return envelope with the word "deceased" stamped on it. Mr. and Mrs. Jackson were living at the Exeter House, 720 Seneca St., Seattle, Wash. 98101.

Capt. Otis W. Swainson

CAPT. OTIS W. SWAINSON of Piedmont, Calif., a former officer E. M. 1910, in charge of the U. S. Coast and Geodetic Survey's western district in San Francisco, died Dec. 31, 1969.

During his 38-year career with the Geodetic Survey, he conducted experiments which determined the correct path of sound in sea-water, which became the forerunner of methods used by the Navy to detect submarines at great distances. For this, he was made a member of the honorary scientific society Sigma Xi.

A graduate of the Colorado School of Mines, he became commanding officer of the USS Research in the Philippines in 1915. He later was made chief of party of topographic surveys and commanded many ships making hydrographic surveys and collecting other oceanographic data in various waters, including most of the coast of California and San Francisco Bay.

During the course of the sound wave experiments, he invented a hydrophone that could be lowered to any depth of water without losing its sensitivity.

He was also officer-in-charge of the Northwestern District and chief of the Division of Terrestrial Magnetism and Seismology (now Geophysics) in Washington, D. C. He retired in 1949.

Capt. Swainson was on the board of directors of several organizations designing and promoting additional traffic crossings of San Francisco Bay, including the Reber Plan.

His other affiliations included the American Geophysical Union; American Society of Civil Engineers; Structural Society of Northern California; Washington, D. C. Philosophical Society; the Seismological Society of America of which he was once Eastern section president; and the Washington, D. C. Academy of Sciences.

He is survived by his widow, Mrs. Bernice Swainson.

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Donald N. Sheff

CAPT. DONALD N. SHEFF, E. M. 1965, was killed in an air accident in New Mexico on Dec. 5, 1969 while flying as a navigator in an F-4D. Donald had completed his tour of duty in Thailand, where he had flown more than 180 Combat Missions and was decorated several times for bravery. He returned from Thailand a few weeks prior to his death and was stationed at Holiman Air Force Base in New Mexico.

Donald Sheff was born on Oct. 31, 1941 in New York City. He completed his high school education there and enrolled at the Colorado School of Mines, graduating in 1965 with a degree in Mining Engineering. Captain Sheff is survived by his wife, Mrs. Donald Sheff, formerly of Denver and two daughters, Elaine May, two years old, and Elizabeth Ann, one year old. In addition, Capt. Sheff is survived by his father, Bertron Sheff, 102 Parkridge Avenue, Trenton, N. J., and three brothers.

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From the Local Sections

Section news should be in the Alumni Office by the 20th of the Month preceding Publication.

SECTION	PRESIDENT	VICE-PRESIDENT	SECRETARY-TREASURER	TIME AND PLACE OF MEETING
Alabama Birmingham			Wm. Haynes, '54	On call of the president.
Alaska Anchorage			Reginald S. Y. Lee, '67 628 E. 5th Ave., Anchorage 99501	
Arizona Arizona	Guerdon E. Jackson, '52	William E. Saegart, '53	James D. Sell, '55 2762 W. Holladay St. Tucson, Ariz. 85706	Annual Meeting, Dec. 7, 1970, Western Motel, Tucson.
California Bay Cities	Carl Foget, '61	Dave Strandburg, '61	Tom Aude, '62 54 Woodford Drive Moraga, Calif. 94556	Meetings held on call of the Secretary.
Santa Clara Valley			Stanley Y. Ogawa, '53	
Sacramento	Gail Penfield, '56		F. B. Sweeney, '57 6619 Auburn Blvd., Citrus Heights	
San Joaquin Valley	R. A. Ganong, '47		B. A. Ellison, '61	
Southern California	Dick Richards, '62		Neal Schmale, '68, Sec.	
Colorado Denver	Earl Ostling, '54	Allen McGlone, '54	Ted Seep, '68 2790 S. Steele St., Denver	Luncheon meeting held third Tuesday of each month, Denver Press Club, 1330 Glenarm Pl.
Grand Junction	Arch F. Boyd, '26	Robert H. Sayre, '34	Robert F. Barney, '35	
District of Columbia Washington	A. A. Wyner, '25	Louis DeGoes, '41	Charles T. Baroch, '23 2001 N. Daniel St. Arlington, Va.	Regular meeting at noon, second Tuesday of each month at the Shrine Temple, 1315 K St. N.W.
Illinois Great Lakes	C. R. Fitch, '49 7915 Exchange Ave. Chicago 17, Ill.			
Kansas Wichita	Francis Page, '39		James Daniels, '51 307 Schweitzer Bldg., Wichita, Kans. AM 5-0614.	Meetings called by secretary. Contact secretary for date of next meeting.
Louisiana New Orleans	Charles Tyler, '53	Joseph L. DuBois, '50	Monte Richard, '60 Pan American Petr. Corp. P.O. Box 50879 New Orleans, La. 70150	Regular luncheon meetings — last Wednesday of the odd-numbered month except July.
Lafayette	John J. Wallace, '51	Edward J. Gibbon, '68	Stephen D. Chesebro, '64 P. O. Box 51345 Lafayette, La. 70501.	Regular luncheon meetings at Lafayette Petroleum Club on fourth Thursday of each month.
Minnesota Iron Ore Range	Paul Shanklin, '49			
Missouri St. Louis	H. A. Dumont, '29 227 Crane St. Edwardsville, Ill.			
Montana Butte	John M. Suttie, '42 Continental Dr. Butte			
Nevada Northern Nevada	Paul V. Fillo, '40	H. R. Fitzpatrick, '36	James H. Bright, '52 1450 E. 2nd St. Reno, Nev. 89502	Meetings held four times per year at call of the Secretary.
New Mexico Carlsbad	John Magraw, '53			
Four Corners	Bill Cutler, '48		Lou Amick, '50.	Special meeting at the call of the president.
New York New York	Robt. B. Kennedy, '38	Board of Governors: Ralph Hennebach, '41 C. D. Michaelson, '32 C. Bellm, '34 R. B. Kennedy, '38	E. T. Benson, '33 1175 Broadway, New York, N. Y.	Meetings on call every month or six weeks from September to May, usually at Uptown Mining Club, 49th and Park Ave.
Ohio Central Ohio			Raymond M. Schatz, '35 Battelle Memorial Institute Columbus	
Cleveland	Bob Garrett, '45	Carl Nowak, '62	Richard Pitney, '60	Meetings held on call of president.
Oklahoma Bartlesville	G. T. McIntyre, '30	Bill Fredrick, '56	Charles Strong, '58 Box 336, Bartlesville, Okla.	Regular meetings held every Tuesday at noon, YWCA, 411 S. Johnston St. After September, group will meet every Friday.
Oklahoma City	Ed Johnson, '49 844 First Nat'l Bldg.			Regular meeting held at call of the president.
Tulsa	Todd C. Storer, '47		Jerry McLeod, '57 1708 East 60th Pl. Tulsa, Okla. 74105	Meetings held at call of the president.
Oregon Lower Columbia River Basin	Michael DiLembo, '58	D. H. Griswold, '30	Wendell Cloepfil, '62	On call of the president.
Pennsylvania Eastern Pennsylvania	Samuel Hochberger, '48	Arthur Most, Jr., '38 1345 Woodland Cr., Bethlehem		
Pennsylvania-Ohio	Vincent G. Gioia, '56		David P. Rihl, '58 Dravo Corp., Pittsburgh and Terrace Rd., Carnegie, Pa. 15106	Meetings held first Wednesday of each month (noon), Cafe "B," Golden Triangle YMCA, 4th and Wood Sts., Pittsburgh.
Texas Coastal Bend	Ray Gouett, '52	Charles R. Russell, '54	Irwin M. Glasser, '43 Humble Oil & Regining Co. Corpus Christi, Tex. 78401	Luncheon Meeting — First Wednesday of each month at the Petroleum Club.
El Paso	Peter A. DeSantis, '51	William F. Dukes, '50	L. G. Truby, '48 4320 O'Keefe Dr. El Paso, Texas 79902	Meetings held on last Wednesdays of January, March and May. Special meetings on call.
Houston	Ronald E. Diederich, '57	Edward B. Reynolds, '66	James K. Applegate, '66 Marathon Oil Co. 2300 W. Loop, South	Luncheon meetings held at 12 noon on first Thursday of each month at White Horse Cellar, 1211 Fannin St.
Permian Basin	Hal Ballew, '51	Harry B. Hinkle, '59	Al Wynn, '65 4313 Princeton, Midland, Tex. 79701	Meetings held in Jan., Mar., May, Sept., and Dec.
Dallas-Ft. Worth	Wallace Tucker, '49	Frank A. Ausanka, '42	Peter H. McQueen, '50 2129 Hildring Dr. West Ft. Worth, Texas	Meeting held on call of president.

Pacific Northwest Section Meets April 6 in Seattle

Ten alumni and their wives of Pacific Northwest Section attended an alumni meeting April 6 in Seattle. These included: Boyd Watkins '64, Dick Barnes '55, Sid Peyton '54, Bill Allen '47, Bob Kerwin '53, Bob Vinnedge '50, H. Ray Lee '23, Lou Bonneford '57, Al Nesbitt '38, Bob Cederstrom '60.

A very enjoyable time was had by all present. The program included brief remarks by Fritz Brennecke concerning campus developments and the athletic program at Mines. Films of the Mines 35-14 win over Colorado College last fall were shown to conclude the program.

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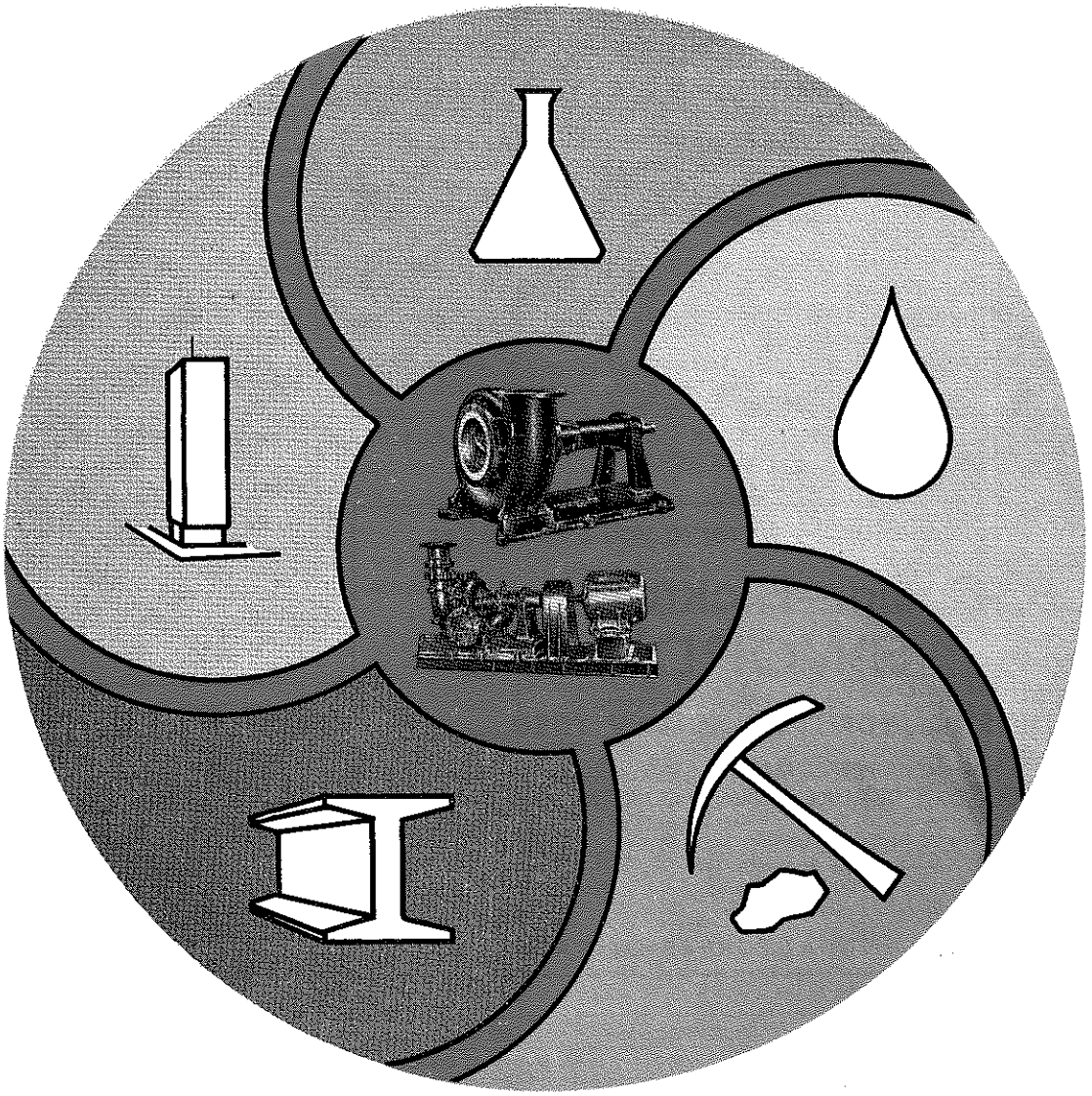
Ben F. Zwick, '29

SECTION	PRESIDENT	VICE-PRESIDENT	SECRETARY-TREASURER	TIME AND PLACE OF MEETING
South Texas			William A. Conley, '19 1515 Haskins Rd. San Antonio	Meetings held at 7 p.m. on first Thursday of February, May August, November at Old Town Inn, 416 8th St., San Antonio.
Utah Four Corners	See N.M. for officers			
Salt Lake City	Allen D. Trujillo, '62	Wallace W. Agey, '48	Carl D. Broadbent, '64 5750 Glenbrook St. Salt Lake City, Utah 84121	Four meetings annually on dates set by officers.
Washington Pacific Northwest	Sidney B. Peyton, Jr., '54		Boyd Watkins, '64 10427 Aqua Way S. Seattle, Wash. 98168	
Eastern Washington			Arden Bement, '54	Meetings on call of president; annual August picnic.
Wyoming Central Wyoming			George S. Rogers, '59 3209 Aspen Drive Casper, Wyo. 82601	
Canada Calgary	Richard C. Siegfried, '50 Canadian Superior Oil Ltd. 703 6th Ave., Calgary Tel.: 267-4110 Local 429			Calgary Section meets for a noon luncheon on the 3rd Monday of Sept., Nov., Jan., Mar., May—at Calgary Petroleum Club. Visiting alumni invited to attend.
France	Resident or visiting alumni may contact Bernard Turpin, '60, 33 Rue de la Tourelle, 92-Boulogne, France.			
Libya	Haldon J. Smith, P.E.53. Corresponding Secretary. Derbasi-Geode Co., P. O. Box 529, Tripoli, Libya.			
Peru	Martin Obradovic, '53			Meetings first Friday of each month (April thru December). 12:30 p.m., Hotel Crillon. Other meetings on call
Philippines Baguio	Francisco Joaquin, '26			
Manila	J. R. Kuykendall, 41	Jesus Jalondoni, '40	M. E. Natividad, '40 c/o Northern Motors United Nations Ave., Manila	Meetings held at noon, second Tuesday of each month.
Puerto Rico	Resident or visiting alumni may contact L. L. Hagemann, '60, Apt. 17, El Monte Apartments, Avenida Munoz Rivera, Hato Rey, Puerto Rico.			
Turkey Ankara	Alumni visiting Turkey contact Ferhan Sanlav, '49, Turkiye Pettrolleri A. O. Sakarya Caddesi 24, Ankara, Telephone 23144.			
Venezuela Caracas	Z. Sancevic, '57	Jean Pasquali, '60	Ian Achong, '58 Cia. Shell de Venezuela Aptdo. 809, Caracas	



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