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What's More Valuable Than Gold?

by Marshall C. Crouch III, '67

As the Alumni Association enters a new year, it's time to recognize those whose work has advanced the Institution's goals through 1979. Your Association is designed to be a volunteer organization which has been a part of the company since 1945. President: Marshall Crouch, '67, Vice-p President: Thomas Neagley, '74, Treasurer: Richard Daniele, '60, Secretary: and Board Members: John Beers, '53, Niles Groves, '50, John Lockridge, '50, Robert Reed, '49, and Steve Moore, '58. Directors of the CSM Foundation, Inc., were Art Meyer, '50, and Donald Craig, '48. Links James Link, '59 sat on the several Foundation committees.

The Board met at least monthly and often more frequently from February through June and August through January. The regular Board meetings, which are open to all alumni, are held on an evening in the second or third week of the month in Guggenheim Hall. Each time, date and agenda may be obtained from the Association office, or through the CSM Foundation, Inc.

Information and Oertians were made to needy students in the amount of $25,000 were made to needy students through June and August, and the Directors were mailed to all of you in August. Articles to the magazine were contributed by a large number of alumni.

The MINES Awards was established by those alumni who might not be able to graduate with an institution's Alumni Activity. The MINES Awards was published monthly except during the months of July and August. The CSM Foundation, Inc. has renewed the MINES Awards through May 1980.

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Each year three or more individuals have been recognized by their fellow students for their outstanding service to alumni and the school by an Honorary Membership in the Alumni Association. Those honored last year were: Linda Berken, '71; David Cole, '52; Edwin Crabtree, '27; and Charles Fugate, '42. Their nominations were made by the Honorary Membership Committee consisting of Linda Berken, '71; Richard Eichler, '71; and Steve Mooney, '59. A new committee of the Alumni Association has been charged with the responsibility of working with the Local Sections. John Lindemann, '64, past president of the Denver Section is Chairman and Rod Eichler, '71, past president of the Denver Section, is helping out.

The annual election for Association officers was conducted last year and was just concluded with a small election committee. An election committee was made up of candidates selected by the CSM Foundation, Inc. and the alumni. The election committee was made up of Art Meyer, '50; James Link, '59 and Art Meyer, '50. The task of counting over 2,000 ballots fell to the Teller Committee of Walter Dunke, '29 and Francis Smiley, '41.

Each of us who attended a meeting sponsored by a Local Section last year is grateful to those Local Section officers and volunteers who gave freely of their time so we could all get together.

A new committee of those who helped the Association during 1979 will be complete with recognition of the diligent Alumni Association's Loan, Operating and Trust Funds. The Finance Committee, which was made up of Thomas Neagley, '74, Chairman; Richard Daniele, '60, Richard Arneson, '50, David Springer, '65, Stewart Squares, '74, and Dunn Kraft, '54, reviewed the Association budget, monitored actual income and expenses and made Trust Fund investment recommendations. A more complete financial statement will be made to you in the MINES Magazine by the Treasurer after the annual audit has been completed. More alumni paid dues to the Association in 1979 than ever before. Out of 4,000 known, living alumni, 3,959 or 8700 known, living alumni, 3959 or 45.5% were members. The increase in 1979 than ever before. Out of 4,000 known, living alumni, 3,959 or 87% were members. The increase in 1979 than ever before.
Geothermal Energy

by Dr. George V. Keller

At half a dozen places around the world, steam produced from holes drilled deep into the earth is used to spin turbines that generate electric power. At Lardarello, in the Tuscany Hills of Italy, electric power has been generated from geothermal steam for a half century, and at present, plants in the vicinity of Lardarello and Monte Amiata have a capacity of about 600 megawatts. Near Lake Taupo, on the North Island of New Zealand, geothermal steam has been used for nearly 20 years to supply a generator station with a capacity of about 190 megawatts. In 1973, the Republic of Mexico brought on line a modern geothermal generating plant with the capacity of 60 megawatts, located near an insignificant volcano named Cerro Prieto. At half a dozen other locations around the world, heat energy from the earth is being used to provide inexpensive electrical power for local communities.

The geothermal industry has also had a relatively long history in the United States, with the first production of electricity having been undertaken at the Geysers Resort, north of San Francisco in the Myacmas Mountains, in the 1920's. This early generation was fed with steam produced from shallow boreholes and amounted to only a few kilowatts of capacity. It has been realized that this Geysers geothermal field may be the world's largest. The generating capacity of operating plants at the Geysers is about 500 megawatts, with other plants under construction or in design to double the capacity within a few years. To place the scale of geothermal energy in proper perspective, one must compare the projected capacity of the Geysers field, which will be about 1,000 megawatts, with the nation-wide demand for electricity, which is currently less than 400,000 megawatts. Geothermal sources currently provide less than a quarter of one percent of our generating capacity.

While the Geysers field is the only operating geothermal field in the United States, exploration over the past few years has been successful in delineating several other fields which are capable of being developed for the generation of electric power at competitive prices. In the past two years, some 30 deep test wells—wildcats—have been drilled in the western United States in the search for new, previously unrecognized geothermal reservoirs. Some of these, such as the test wells drilled at Chandler, Arizona, at Brady's Hot Springs in Nevada, at Mountain Home and in the Salt River Valley in Idaho, and at East Mesa in southern California, have encountered high temperatures at shallow enough depth to indicate some potential for development, but definition of the size of the potential has not yet been made. Even more preliminary work, consisting of geological and geophysical studies, has been carried out over several hundred potential prospects.

Among its advocates, the promise for rapid expansion of geothermal power generation is bright, but for others, it is difficult to see how an industry which is so small at present can expand rapidly enough to have a significant impact on the power industry within time to contribute to the solution of our current problems in energy delivery. This dichotomy of viewpoint has led to a number of conflicting projections of the future. While the Geysers field is the only operating geothermal field in the United States, exploration over the past few years has been successful in delineating several other fields which are capable of being developed for the generation of electric power at competitive prices.
from 280°F to 100°F, the amount of heat obtained is very great, amounting to 4.4 x 10^14 calories/cubic mile.

Some geologists make it impossible to convert all this heat owing to the quantities of water that would have to be moved to bring about the required quantity of electricity. Assuming that a generator has an efficiency of 10%, it would probably be able to convert only about 20 percent of the heat energy to usable power. If the amount of electrical energy obtained from each cubic mile of rock could be converted into electricity, the power produced would be sufficient to meet all our present electrical demands for a period of 109,000 years.

This calculation is probably unrealistic in detail as well; one can easily envision steady state heat flow. However, it indicates that the resources base—that is, the total amount of stored heat energy on which we may draw—is dramatically larger than we may actually do. In this case, it is possible to speak of the full amount of heat energy, but we may be unwilling to pay the price.

At the present time, we cannot produce electricity from geothermal heat competitively with other energy sources unless we have a very high-grade concentration of energy, in a form commonly called a "geothermal reservoir." The characteristics of these geothermal reservoirs are rather poorly known, and this is the primary cause for the uncertainty about the potential for the occurrence of economic geothermal systems.

Resources fields of several cubic miles, and this large size is whether we can inventory our hyperthermal systems. How To Inventory Hyperthermal Resources

An inventory of hyperthermal geothermal systems is accomplished only through a program of geochemical, geologic, and geophysical exploration, verified by experiments which test exploration techniques may be effective in locating geothermal resources.

How To Inventory Hyperthermal Resources

The average temperature gradient in the United States is 1.8°F per 100 feet. The gradient is less in some areas and more in other areas. These values of gradient might be thought of as representing some statistical distribution with a mean of 1.8°F per 100 feet and a standard deviation is ±30% of the median value. This would mean that 95% of the area of the United States, the temperature gradient is more than 2.1°F per 100 ft; the remainder of the country, the gradient is greater than 2.7°F per 100 feet, over 2 percent of the country; the gradient is greater than 3.3°F per 100 feet, over 1% of the country, and 0.5°F per 100 feet, over 0.1% of the country. The one percent area, which amounts to 35,000 square miles, could be considered to be a hot, dry rock resource, in that the temperature at 10,000 feet depth would be above 530°F. The recoverable heat and electricity from this reservoir would be 20 to 4 times greater than in the case of an average heat reservoir. The total amount of heat generated both by letting some of the water flow to steam to generate power and the circulating of flow water to turn a water turbine could be developed here. Geostatistical geopressured systems seem to be the only hindrance to developing such systems.

Molten Rock Systems

Some researchers feel that molten rock reservoirs are a possible source of geothermal energy, in view of its high heat content and high pressure. Cooling a mass of molten rock from a temperature of several thousand degrees F to 100°F would produce about ten times the heat calculated for normal heat flow. As the higher temperature, the efficiency of converting heat to electricity could be improved significantly. A cubic mile of molten rock could supply electrical energy to the entire United States for a period of about 200 days. The cost of our resources of molten rock is poorly known; it may be 100% or even much lower. It is not improbable that some of the volcanic areas of the earth are3.5°F hot rock.

Geopressured Systems

Another type of geothermal reservoir may occur in areas where sediments are being deposited rapidly, as along the Gulf Coast of the U.S. Normally in areas of less than rapid sedimentation, rock may become lithified and support the weight of overlying sediments without compressing. In such a condition, one may observe the pressure of the fluids in boreholes which form the rock and that is the same as though one had an open column of water over the rock; that is, the pressure of the water in the rocks is only hydrostatic. In rapidly sedimenting systems, the rock may not become lithified rapidly enough to support the pressure from above. The rock at depth is then compacted, at the expense of pore space. In order to reduce pore space, water must be forced out of the rock, and this results in a pore pressure greater than hydrostatic. In extreme cases, the pressure on the pore water at depth represents the weight of both the overlying water and solids, so that the pore pressure amounts to 2.0 to 2.2 times the hydrostatic pressure. Such rocks are said to be "geopressed." If a hole is drilled into a geopressed or permeable zone in a geopressed section, great volumes of water will flow to the surface. This is often catastrophic when an oil well is drilled into a geopressured zone unexpectedly.

A geopressed zone can be consid­ered a geothermal system if it lies at 15,000 to 20,000 feet depth, where the temperature is 500°F to 600°F, and it has a fluid that can generate both by letting some of the water flow to steam to generate power and the circulating of flow water to turn a water turbine. Molten rock reservoirs are rather poorly known, and this is the primary cause for the uncertainty about the potential for the occurrence of economic geothermal systems. Molten Rock Systems

Some researchers feel that molten rock reservoirs are a possible source of geothermal energy, in view of its high heat content and high pressure. Cooling a mass of molten rock from a temperature of several thousand degrees F to 100°F would produce about ten times the heat calculated for normal heat flow. As the higher temperature, the efficiency of converting heat to electricity could be improved significantly. A cubic mile of molten rock could supply electrical energy to the entire United States for a period of about 200 days. The cost of our resources of molten rock is poorly known; it may be 100% or even much lower. It is not improbable that some of the volcanic areas of the earth are poorly known, and this is the primary cause for the uncertainty about the potential for the occurrence of economic geothermal systems.

How To Inventory Hyperthermal Resources

An inventory of hyperthermal geothermal resources is accomplished only through a program of geochemical, geologic, and geophysical exploration, verified by experiments which test exploration techniques may be effective in locating geothermal reservoirs.

Geothermal Indicators

Direct evidence of anomalous heat flow is not always present in geothermal reservoirs. This is provided by dramatically low specific heat values, from 0.15 to 0.20, and more dramatically by warm springs or slightly elevated temperatures in water from which the heat has been removed. Wells in water, which are only reduced to a more quantitative basis by making use of geochemical geother­mometers. For example, the amount of silica in suspension in spring water can often be used to tell the temperatures of the reservoir from which that water came. The ratios of various alkali ions in solution can be used in the same way. The techniques are based on the fact that the water in equilibrium with rock in a reservoir will have a very limited amount of specific elements. If these waters then migrate rapidly to a surface spring, the ions may not have a chance to re-equilibrate under the new temperature conditions, and be characteristic of the reservoir temperature. Dilution with surface waters or rapid reactions with the rocks in the spring would pass can cause problems. However, the hydrogeochemical data is strongly encouraging in prospecting for a hyperthermal system.

Electrical Resistivity Surveys

The most diagnostic property of a geothermal reservoir that can be tied directly to the electrical resistivity. This comes about because a rise in temperature causes the electro­conductivity, absolute value of the electrical conductivity, to increase, and this in turn causes a rise in the temperature of the rock. The technique is based on the fact that the water in equilibrium with rock in a reservoir will have a very limited amount of specific elements. If these waters then migrate rapidly to a surface spring, the ions may not have a chance to re-equilibrate under the new temperature conditions, and be characteristic of the reservoir temperature. Dilution with surface waters or rapid reactions with the rocks in the spring would pass can cause problems. However, the hydrogeochemical data is strongly encouraging in prospecting for a hyperthermal system.
It is well known that many geodetic levels are characterized by high levels of seismic activity. Despite these problems, the concept of using geothermal systems can be used to provide a valuable tool in understanding the geothermal resource base. The geothermal reservoirs have been shown to be relatively free of problems. Despite these problems, the potential for geothermal energy is recognized by a large fraction of the scientific community.

**Environmental Problems**

Geothermal energy is often considered to be relatively free of problems in environmental impact. Perhaps the most difficult problem is disposal of waste water, particularly in systems where a mixture of water and steam is produced from wells. Often the water is too saline for any constructive use, and contains undesirable elements such as boron and mercury at potentially hazardous levels. It appears that there is no solution other than reinjection of the waste water into the same reservoir from which it was produced.

**Legal and Institutional Problems**

The legal status of groundwater, oil and gas, and commercial minerals has been established and defined to a high degree of precision over the years. Geothermal energy is no exception, and all of these at the same time. The lack of clear legal distinctions between geothermal energy rights and other property rights is a severe impediment to orderly development of a geothermal industry.

Will geothermal energy provide a significant part of the solution to our problem of obtaining energy sufficiency in the United States? I believe it will, but only time, in the form of five to ten years of strenuous exploration and development, will tell.

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The following statement was made by a proponent of oil shale development at Colorado School of Mines: "One of the first oil wells to produce enough petroleum to meet the enormous demand now existing for oil and its products! The answer is doubtful. Will new oil fields be discovered to meet the increased demand in the future? The answer is extremely doubtful.

Yet this is the age of oil. Oil we must have. The supply must come from our great deposits of oil shale. If oil is the "long," oil shale is the "here apparent."

With the development of the country's vast shale reserves still considered one of the long-term solutions to the country's energy supply problems, the statement could have been made in 1960. It wasn't. It was made more than 60 years ago by Victor C. Alderson, then president of Colorado School of Mines in the October 1919 issue of the CSM Quarterly. It was a time when forecasters were worried about the country's 6 million vehicles using more than 3.5 billion gallons of gasoline.

Alderson cited a Bureau of Mines warning that foreign governments were assuming power to control the potential supplies of crude outside the United States, and that conservation measures were necessary to reduce waste and ensure supply.

"Petroleum and natural gas are not being replaced by nature, and once gone cannot be replaced except from sources involving greater costs," Alderson quoted the bureau as reporting.

It's almost too easy to draw parallels between the post-World War I era and the post- oil embargo era of the 1970s and 1980s. The number of vehicles in the United States has increased to almost 440 million, a 24-fold increase from the figures Alderson used, and they use 120 billion gallons of gasoline each year.

And oil shale, as well as other synthetic fuels such as coal and liquids, are being looked to as a partial means of attaining increased energy independence for this country.

During the last six decades, Colorado School of Mines has maintained a close interest in the development of a synthetic fuels industry. The CSM Research Foundation operated the Bureau of Mines' Avold Points Research Center near Rifle, Colo., from 1954 to 1968, and James Gary, a professor in the chemical and petroleum refining engineering department since 1960, began organizing annual oil shale symposia at the school 16 years ago.

Interest in the oil shale industry waned in the late 1960s, so the symposium was not held for a few years. But with President Carter calling for synthetic fuels to replace 2.5 million barrels of imported fuel a day by 1990, enthusiasm is on the upswing again.

And CSM researchers, with the help of government contracts, are in the thick of the action.

Bob Baldwin, assistant professor in the chemical and petroleum refining engineering (CPE) department, points out that the school's $1 million in research contracts make it "one of the five largest operations in the nation in forms of synthetic fuels research."

Professors in the CPE department, where most of the research is underway, are looking at many of the basic chemical processes involved in coal gasification and liquefaction. In metallurgical engineering, researchers are developing a welding technique that could significantly reduce the amount of time needed to weld the massive vessels in which commercial-scale synthetic fuel development will take place.

The chemistry and geochemistry department has studied trace elements in the oil shale region of western Colorado, and the school's Earth Mechanics Institute is studying the effect of in situ reprocessing on oil shale pillars. Other research is being conducted in the mining engineering and mathematics departments.

Baldwin is one who believes that basic research is needed to understand the processes involved in the development of the self-lodging synthetic fuels industry. The emphasis of the Department of Energy, which is funding most of the CSM projects, however, is on the more expansive plants and equipment, he said.

"Hardware has more visual appeal because it is tangible, and thus easier to justify," he said. "University research tends to be long range. It may be 20 years, but it will have some impact."

Gary added that a balance must be struck between hardware and basic research. "There is a lot of hype in synthetic fuels, because the first plant is always inefficient, and nobody wants to be the one to build it," he said.

As for the variety of synthetic fuels alternatives, he said, "We need to work on all of them; in the petroleum industry, for example, there will always be the need for additional basic research, and we have been producing for 70 years."

Baldwin noted that a coal liquefaction research program in the chemical and petroleum refining engineering department started out on a very applied basis during the early 1970s but is now stressing a basic approach. "You really can't make improvements in the applied aspects unless you understand the basics," he said. The project, now in its third stage, began more than six years ago with a study of removing sulfur from coal through solvent refining. Baldwin, Gary and Richard Bain are working on the project, which first involved converting the solid coal to liquid and removing sulfur and ash.

In the process, the sulfur content of the coal increased from 10,000 or 12,000 to 16,000, sulfur decreased from 4 to 1 percent, and ash was reduced from 15 percent to zero.

The second phase of the project looked at the solvent refining process on a larger scale. The research resulted in the school having the only operating continuous flow bench scale coal liquefaction system in the country in a university atmosphere, according to Baldwin.

He said, "We were the only university to attempt to do experiments on a scale comparable to that used in industry."

The third stage of the project is taking...
the researchers to what Baldwin termed "more traditional chemical engineering work," a study of the kinetics involved in the process. "We hope to make some fundamental contributions to the science of coal," he said.

Yesavage, an associate professor in the department, spent three years with department head Philip Dickson studying whether shale oil would be an appropriate chemical feedstock. Putting two different shale oils through a distilla-

tion process, they determined that even the weak oils produced more styrene than is normally produced.

Yesavage said he research has long-
horn implications and is "three years ahead of its time." He said, "Shale oil will be around for a very long time. In 100 or 200 years, it will be the only fossil fuel available for petrochemicals. We can come up with all sorts of alternatives for other energy uses, but chemical com-
panies are getting worried about future supplies of stock."

Yesavage and Art Kidnay, a professor in the department, are working on another project to predict the enthalpy, or physical and thermodynamic properties, of coal liquids. Kidnay said they have designed and built the equipment and measured the data base.

The next step is to develop a final engineering correlation so that measurements won't have to be made on each sample of coal liquid.

Michael Grabowski, an associate pro-
fessor in the department, has finished a project on microwave pyrolysis of coal, which examined whether the process increases yields over conventional tech-

niques. He is working now to adapt the process for biomass gasification, which he said is expected to produce more favorable results than it did for coal.

He and E. Denby Starn, an associate professor, have developed an instru-
ment to measure the thermal condu-

city of synthetic fuels with the idea that thermal conductivity is a basic parameter for heat transfer.

In another project, Sloan is studying a new process for producing carbon monoxide and hydrogen from carbon, in the form of coal, and water. The point is to get the product in the form of combustible fuels, said Sloan.

On a more applied level, Anthony
Hirwa, an associate professor, is work-
ing on two research projects—one to clean up a retort water with solids, and another to use the spent shale from retorting to produce liquids and gasses.

The retort water can be cleaned by a hot gas stripping process, in which the water is put into contact with hot gases, causing the pollutants to separate and leave the water at the end of the process. In secondary processing, resin or activated carbon is used to remove organic materials that are not removed with the hot gas stripping process.

Although the chemical and petroleum refining engineering department is lead-
ing the school's efforts in studies of synthetic fuels, other departments also are doing work in the area.

In metallurgical engineering, depart-
ment research is focusing on a study of electrolytic welding for use in welding together the 160 foot cylinders that will be used for coal liquefaction.

Jerald Jones, assistant welding research professor, said the electrolytic process is much less time-consuming than the traditional arc welding process, but that it has a reputation of poor service resistance.

Using steel with a ratio of 2% parts chrome to 1 part nickel (donated by Stearns-Roger), the research is examining the travel speed of the weld, the continuous electroslag process, as well as voltage and current. A study of the interaction of these three has shown that there is a minimum maximum critical heat input needed to provide the strongest weld, said Jones.

The project is only one of the several on welding research being worked on in the department, which has about $1 million a year in welding research grants.

In other synthetic fuels research Ron Klaasen, a professor in the chemistry and geochemistry department, has completed reconnaissance work on stream sedimentary, surface soils and selected plants along the Colorado River on the federal C-a and C-b tracts as well as at the Anvil Points site.

The study, as well as associate pro-
fessor Tom Wildeman's work on mass balance studies on oil shale retorting, are part of a larger DOE study being done in conjunction with the University of Colorado and Colorado State Univer-
sity.

The school's involvement in synthetic fuels extends beyond research. Baldwin teaches is course on synthetic fuels processes. Yesavage and Dickson teach a continuing education course on synthetic fuels, and members of the department are discussing the possi-

bility of a class geared towards the public.

Gary, the former vice president for academic affairs and dean of the faculty, is chairman of an Office of Technology Assessment subcommittee on oil shale. The group has advised the OTA on a major oil shale study for Congress that examines the technology, economics, risks, and policy alternatives for oil shale development in the United States.

And Dickson is writing a chapter on oil shale for the third edition of the Encyclo-
pedia of Chemical Technology.

The school's relationship with oil shale and other synthetic fuels development has been a lasting one, and one that promiss to grow as the country's con-

cern with available sources of foreign oil mounts.

The research going on at the school shows that the development of synthetic fuels industry is complex, much more so than realized by early pro-

ponents such as the late CSM President Alderson.

In 1919 he wrote, "In the minds of those men who are best informed on the technical and business phases of the oil shale industry, it has passed the experi-

mental stage and has arrived." In six decades later, Gary says of the industry, "We need to get started some-

time. Whether development will be will depend on the competitive prices of fuels at the time. It's not that far off, when you talk about clean fuels."

Leanne Gibson is the former Public Informa-
tion officer at CSM. She has recently re-
signed from this position to pursue a Master's degree in Mineral Economics at the School. Ms. Gibson is a graduate of Colorado University.
Transporation in this country consumes 10 million barrels of oil per day. This represents about 26 percent of all energy used in the daily and more than half the oil the private automobile, in turn consumed in fueling than half of the transport sector's energy. The energy crisis is, in large part, an inability to supply domestic resources.

While it is difficult to conceive of synthetic liquid hydrocarbon fuels produced from oil shale and coal, as replacing a major portion of imported crude oil, the successful development of economically viable oil shale retorting and coal liquidification processes could make a significant contribution to reducing U.S. dependence on foreign crude oil resources.

Private industry will develop these processes. Sandia laboratories is conducting supportive research and development projects to assist industry in better understanding critical phenomena and, hence, in improving process efficiency. These projects are sponsored by DOE's Division of Fossil Fuel Extraction and Fossil Fuel Conversion.

Oil Shale

Efforts to recover hydrocarbons from the nation's vast deposits of oil shale have, until recent years, been focused on surface processing methods. Such methods require the shale to be mined, transported to a processing site, crushed and screened, and then heated in a retort vessel to convert the solid organic constituent (kerogen) in the rock to recoverable liquid and gaseous hydrocarbons. While the technology for surface processing is proven, application on a scale broad enough to significantly impact the nation's demands for petroleum products may not occur because of concern about surface damage, water requirements, and spent shale disposal. Additionally, economic constraints will restrict use of these methods only to oil shale seams that satisfy certain richness, thickness, and methods only to oil shale seams which damage, water requirements, and spent oil shale recovery methods.

Laboratory studies and theoretical analyses support the feasibility of in situ shale applications. Theoretical descriptions of oil shale have led to the formulation of computer models to quantitatively describe explosive fracturing events. The immediate payoff of these studies is that instrumentation systems for field experiments can be effectively designed and operated. Ultimately, however, the laboratory, field, and theoretical work will lead to the ability to conduct controlled, non-mineable methods for processing. Work in rock mechanics also is being used to study the strength and creep of materials at ambient and elevated temperatures to provide information on subsidence or collapse of underground oil shale beds or surrounding rock masses.

Evaluation of the physical state of a rubber bed (dimensional voids, flow rate, fluid flow characteristics, etc.) are being developed for use when retort beds are characterized by much lower void fractions. The void fraction difference implies that fluid-flow properties also differ; the result is that modified in situ processing methods offer a greater chance for near-term success than do true in situ methods. As a result, the bulk of DOE's in situ research effort is currently directed toward developing modified in situ processing methods.

Sanda's oil shale projects are multi-faceted. Focusing in large part on modified in situ processing, but also bearing on true in situ processing and surface processing. Activities include laboratory and field experimentation and theoretical analysis, rock fracture and rockbed instability, process chemistry, and instrumentation technology.

Field programs are conducted at various sites throughout the country to monitor and evaluate explosive fracturing and retorting operations. The work is done in conjunction with the Laramie Energy Technology Center. Instrumentation systems are used to monitor the dynamic events that occur during a blasting operation, to evaluate the physical state of the formation both before and after a blast, to monitor and control retorting operations continuously, and to provide information about the stability and integrity of a rubber bed and the surrounding rock mass before, during, and after a retort.

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In a recent experiment, scientists at the General Motors Research Laboratories studied changes in chemical bonding during the dissociation of oxygen molecules on platinum. Preliminary surface work has explored an interesting new phenomenon: the mechanism of oxygen dissociation over a wide range of temperatures.

Oxygen on Platinum

A simplified schematic illustrating the reaction potential energy surface for oxygen adsorption on a close-packed platinum surface.

An electron diffraction pattern which shows diffraction patterns from an oxygen-covered hexagonally close-packed platinum surface at 0°C.

UNDER what conditions will oxygen molecules dissociate into single atoms on a platinum surface? What is the mechanism for oxygen dissociation? These are some of the questions that Dr. John Gland and his colleagues at the General Motors Research Laboratories are investigating to get a better understanding of the chemistry behind catalysis.

Their work has valuable practical implications for the automotive field, where catalysis is used to remove harmful emissions from automobile exhaust. Most cars built in the U.S. use catalytic converters filled with beads containing platinum to chemically transform carbon monoxide and unburned hydrocarbons into harmless CO₂ and water.

While it has long been known that catalysts are an effective way to convert these gases, little is known about precisely why and in what order the basic atomic reactions occur. In seeking answers to these questions, surface chemists study the elemental composition and geometric arrangement of atoms in the first few atomic layers of the surface and the means by which atoms and molecules from the gas phase bond to the surface.

In his most recent work, Dr. Gland has been studying the adsorption and desorption of oxygen on platinum single-crystal surfaces. This is important because oxygen is the agent that must be adsorbed on the surface to react with carbon monoxide and hydrocarbons to form CO₂.

The experiments were conducted in a stainless steel ultrahigh vacuum system equipped with an electron energy analyzer and a mass spectrometer. The electron energy analyzer allows one to measure the concentration and character of the oxygen adsorbed on the platinum surface. The mass spectrometer is used to measure the desorption of O₂ as the platinum surface is heated. Mathematical analysis of the desorption process allows one to characterize the chemical bond between the oxygen and the platinum surface.

In these experiments, the platinum surface is covered with oxygen at extremely low temperatures of −179°C (almost the temperature of liquid nitrogen) by exposing it to gaseous O₂ molecules. The oxygen remaining in the gas phase is pumped away, and then the desorption of oxygen from the surface is observed.

The oxygen was found to desorb from the surface in two distinctively different temperature regimes—part at −125°C and the rest at about 455°C. By using the oxygen 18 isotope, it was established that the low temperature desorption represents oxygen that was adsorbed on the surface in a molecular form while the higher temperature desorption corresponds to oxygen desorbed in the atomic form. From an analysis of the desorption process, it was possible to establish the complete energetics of the oxygen molecules from the gas phase to the surface.

The oxygen covered platinum surface can either desorb into the gas phase (37 kJ/mol) or dissociate into atoms (33 kJ/mol). The atoms are bonded very strongly (200 kJ/mol) to the surface.

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From the desorption analysis, it was also possible to deduce the mechanism for the dissociation process. The interesting conclusion that results is that the formation of O atoms on platinum is a two-step process: oxygen is adsorbed in a molecular state and then dissociates to form atoms.

The GM scientists were most interested in learning how this adsorbed molecular species is bonded to the platinum surface. Fortunately, another technique was available to determine the bonding. The technique is called electron energy-loss spectroscopy and is quite new—there are only six or seven such instruments in the world. The measurements not only confirmed the existence of the adsorbed molecular oxygen but also showed that it was bound by the transfer of two electrons from the platinum surface into the antibonding oxygen 2p orbitals of oxygen.

"This was most exciting" said Dr. Gland, "because this is the first time that this type of oxygen bond has been observed on a metal surface. From the oxygen-covered platinum surface at 0°C, we are getting closer and closer to a more specific understanding of catalysis," says Dr. Gland.

"We are getting closer and closer to a more specific understanding of catalysis," says Dr. Gland. "This is the first time that this type of oxygen bond has been observed on a metal surface. We are getting closer and closer to a more specific understanding of catalysis."
Wave Power for Britain?

by Peter Rodgers

Mr. Rodgers believes that as an alternative to an energy crisis Britain's industrial development deserves government funding on a limited scale, but that some of the traditional enthusiasts' enthusiasm for wave energy needs to be tempered. Mr. Rodgers says: 'The wave energy project in the Borderie East is a truly strange project. It has all the characteristics of the American Energy Act as at least the same project in the UK Atomic Energy Act. A good deal of the money was spent on research projects, but the technology had not been proved. The government has so far only allocated £4.9m for research and development, and the idea that the cost of one million could be a significant factor in the decision to go ahead with wave energy is clearly not justified. It is true that the British companies involved have a great deal of experience in the field, but the technology is still in its infancy and the projects need to be watched very closely before they can be considered for commercial use.'

Mr. Rodgers also argues that the government should take a more active role in promoting wave energy. He says: 'The government has been slow to take action on this issue, but it is now time for it to show the way. The government should provide a lead by announcing its intention to invest in wave energy. This would send a strong signal to the business community and would help to stimulate the development of new technologies.'

Mr. Rodgers concludes that wave energy is a promising alternative to conventional energy sources, but that it is not yet ready for widespread application. He says: 'The government should take a measured approach to wave energy development, but it should not be afraid to invest in new technologies. Wave energy has the potential to become a major source of energy, and the government should not be deterred by the challenges it faces.'
Rifle Bar Drifter Drills. Large reversible plunger hammer for power and direct air flow provides faster penetration. Integral muffler for quieter operation. Full hole size drilling.

Valvesless Rock Drills. Large reversible plunger hammer for power and direct air flow provides faster penetration. Integral muffler for quieter operation. Full hole size drilling.

Independent Power Rotation Drills. These tunnel boring machines make lots of holes with just a little air.

To match a Gardner-Denver percussion drill to your rock, contact your Gardner-Denver Representative. Or write us at P.O. Box 1020, Denver, Colorado 80202. Gardner-Denver—The measure of performance.

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Dr. Michael Nykols, Dr. Guy T. McBride, Jr., and Dr. Wilhelm Mueller officiate at the awarding of diplomas during the Mid-Year Commencement ceremonies.

Dr. William Mueller, MSc. Met. E.'52, PhD. Met. E. and Gerald Loehrke, Jr., on the relationship of the School and the Alumni Association, pointing out the mutual advantages of the interaction. Some very pertinent and interesting information on the School was the subject of a brief address by Dr. Guy T. McBride, Jr., (see box), who congratulated the families of the graduating students on the attainment of their family degrees.

Many questions are asked about the state of engineering schools in general, and, from our alumni and friends, the state of Mines in particular. Answering some of the questions dealing with students and their interest in engineering today, a brief study of Mines classes has been done by the Registrar's office, under the direction of Dr. Harold Chevrest, Registrar. A direct response to questions posed by the Trustees of CSM, the study had some intriguing points. Sampling of freshman classes for the years 1969-75 were undertaken to determine the percentage of interest in the program, minority student retention, and the rate of female completion of studies. Comparison figures were obtained from the Personnel Office of the Educational Statistics. The cut-off date of 1975 was used, since the class of 1976 would not have fully moved through the four-year program.

The national percentage rate comparison for all students remaining in school and completing a program, in all institutions of higher learning, is 51.1%. Mines students completing their chosen engineering program averaged 57% overall. Sampling of minority students showed, from 1975-1977, that of a total of 83, 57 students graduated or are still in school, with a retention percentage of 68.7%. The rate for female students sampled was slightly lower than the institutional rate. 313 women students entered and 173 graduated, or are still in school, for a retention rate of 55.8%. CSM appears to be above the national level in retaining students, and has an above average success in the area of minority and women students completing study programs.
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RETIRED is quite sufficient.

exists. It was bought by ICI, whose name in

B. In fact, I retired three years ago, have

in serious trouble if our business

managers don’t wake up soon.

Very truly yours.  
Charles J. Baruch '54

Editor's note:  
Many thanks to Mr. Baruch for his support and
interest. An upcoming feature of MINES Magazine will focus on the nuclear
industry. I would be most interested in receiving comments from our readers on the
disadvantages and disadvantages of nuclear power and its management in the U.S. and
the world today. If you have an article or speeches for the industry, please submit them
to me, and I will expand the discussion.  

Patrick Curtis Petty

G. H. Bryant, '53  
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NEW YORK

The November meeting of the New York chapter of the Society of Mining Engineers was held on November 1, and was
attended by many of the Society's officers and members.  

Among those present were: Bill Breeding, '39; Norm Donat, '39; Herb Goodman, '48; Ned Wood, '51; Charles irish, '49, and his wife Joan Spickelmiller; Albert Schneidewolf, '64; Bally Price, '23; Charles J. Baruch '54; and many others.

This group of politically interested

alumni update

"Norman J. Christie, Geol.E., has re­ceived his first serious offer of employ­ment since leaving the company. Mr. Christie is the director of the company's re­source division. He has been with the company for two years and has been a key figure in developing the company's mining operations in various parts of the world."

"Robert L. Merk, P.E., and Medalist, 1975, has been appointed the new vice president of the company's mining division. Mr. Merk is a leading expert in mining technology and has published extensively on the subject."

"H. Richard Richards, Geol.E., is now president of the company's domestic operations. Mr. Richards has a long history with the company, having served in various senior roles, including vice president of exploration and development."

"James W. Gustafson, E.M., is now the director of the company's exploration division. Mr. Gustafson has worked for the company for over 20 years and has been instrumental in developing the company's exploration programs."

"In other news, the company has announced that it will be investing heavily in new mining technologies and equipment. This includes the development of new methods for extracting valued minerals from the earth."

"The company has also announced that it will be expanding its operations into new areas, including the development of new mining projects in Africa and South America."

The meeting was well attended and included many enthusiastic discussions on the future of mining. The group expressed its support for continued research and development in the mining industry.
in memoriam

Emeritus Professor Paul Bartuneic
Dr. Paul F. Bartuneic, professor emeritus of physics at Colorado School of Mines, died Thursday, Dec. 27 at the Georgetown House in Lakewood after a long illness. He was 76. A memorial service will be held at a future date.

Bartuneic joined the CSM faculty in 1950 and served until 1969. A native of Nebraska, he earned his bachelor's and master's degrees in physics from the University of Nebraska and his Ph.D. in physics in 1933 from the University of Michigan.

Before moving to Golden, he taught at Massachusetts Institute of Technology, the University of Michigan, Rensselaer Polytechnic Institute, Lehigh University and the University of Maryland.

He was a member of a number of professional societies and served during the early 1950s as regional counselor in Colorado with the American Association of Physics Teachers and the American Institute of Physics. Bartuneic worked to improve the quality of high school physics teaching in Colorado.

And his wife and Rachel were active in the Golden community, where he served for 12 years as treasurer of the Golden Civic Orchestral Association. Mrs. Bartuneic died in 1969. His body was cremated.

Karl H. Schmidt
Karl Schmidt Geol. E. 1936, died on November 4, 1973 in San Antonio, Texas. Mr. Schmidt was a consultant in the petroleum industry at the time of his death. Following graduation, Schmidt worked for several petroleum companies and the U.S. Bureau of Mines in Wyoming. He later became an independent consultant.

He was married and the father of two children.

Danforth Barney

Born in Ft. Schuyler, N.Y. in 1905, Barney spent his early years in Michigan, where his father was a mining engineer and civil engineer following graduation. Schmidt worked for 37 years with the Alcoa Company, first as a workman in the Rolling Mills and later as a manager in the Technical Services Department.

He and his wife, Rachel were active in the Golden community, where he served for 12 years as treasurer of the Golden Civic Orchestral Association. Mrs. Bartuneic died in 1969. His body was cremated.

2. Does the professor motivate the student to think for himself?

3. Does the instructor establish rapport with the student?

4. Is his technical ability and knowledge reflected in the course?

5. Why do you think he is an outstanding teacher?

6. Does he stress a sense of professionalism, integrity and responsibility into the student?

7. What do you think is his outstanding teaching technique?

Each year three (3) teaching awards of $1,000 each are made available to CSM students.

Awards were given to:

- Stephen A. Gratton, Chemistry 8
- Stephen R. Daniel, Chemistry 8
- Paula Bartuneic, Geology 8

Nominating Letters
Nominations are encouraged from undergraduate and graduate students, faculty and staff members. Detailed information about the award will be provided to the students and faculty members who are interested.

Amoco Foundation Teaching Awards

Purpose
To recognize superior teaching at the undergraduate level and to provide encouragement and incentive for teaching achievement.

AWARDS
Each year three (3) teaching awards of $1,000 each are made available to CSM from the Amoco Production Company.

Criteria for Award
1. Is Amoco satisfying to the students and does he install interest in his courses? Does his express interest as well as install it?

2. Does the instructor establish rapport with the student?

3. Is his technical ability and knowledge reflected in the course?

4. Has he his ability in presenting interesting and informative lectures?

5. Does he stress a sense of professionalism, integrity and responsibility into the student?

6. Why do you think he is an outstanding teacher?

7. In comparison with your other teachers, why is he outstanding and the others not?

8. What is his availability to students?

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The second energy field institute, a program operated by the Colorado School of Mines to give Congressional and executive officials a firsthand look at Western energy, was awarded a Gold Pick Award from the Colorado Chapter of the Public Relations Society of America. The award was given for the most outstanding public relations work in the field of non-profit public affairs for 1979. Janice Hepworth, project director, and Chuck Morris, CSM public relations director, accepted the award Dec. 11 at a reception at the Denver Marriott Press Club. Members of the society's New Mexico chapter judged the program nominations submitted from the Colorado chapter for the annual contest.

The institute, in use of public relations techniques in planning and conducting an annual tour of energy sites in Colorado, Wyoming and Montana, past summer 36 aides who were energy specialists for Congressional committees, executive departments and federal agencies took part in the week-long program. Local media in the three-state area covered the institute as participants they showed coal, uranium, oil and gas, and oil shale operations.

WAIME Scholarship Applications

Students working for degrees in engineering sciences within the minerals field (mining, geology, metallurgy, petroleum, mineral science, materials science, mining economics) who can show financial need, are eligible to apply for up to $1,000 from the Scholarship Loan Fund of the Women's Auxiliary to the American Institute of Mining, Metallurgical, and Petroleum Engineers. The scholarship is 50% grant and 50% loan, the loan portion to be repaid within ten years of graduation.

Both graduate and undergraduate students are invited to apply now for awards for the academic semester beginning Fall 1980. The deadline is March 1, 1980.

Applicants may telephone Mrs. Bruce (Monica) Peers, 986-0851, or may write to her at 948 S. Alkire Street, Golden, Colorado 80401—278-0462.

Oregidgers Named to All-RMAC Football Team

Two members of Colorado School of Mines 1979 football team were named first team All-Rocky Mountain Athletic Conference (RMAC) and first team All-NAIA District 7 in balloting announced recently.

In addition, four Oregidgers were selected for second team RMAC honors and eight more received honorable mention. The awards were honored at the team's football banquet Thursday, December 6.

 Tight end Tom Netzel, a 6-3 200-pound junior from Longmont, and defensive lineman Mike McKenty, a 6-5 244-pound defensive lineman from Dearborn Heights, Mich., were named first team All-Conference and All-District 7.

Netzel, who received second team RMAC honors last year, caught 42 passes this year for 536 yards and two touchdowns. He averaged 5.4 yards per game and almost 13 yards a catch. McKenty, a repeater from last year's first team, was credited this year with 53 tackles, 31 assists, 5 pass deflections, 5 quarterback sacks and 2 fumble recoveries.

Named to the second team this year were quarterback Chuck VanAllen, fullback John Claussen, defensive back and return specialist Ron Powell (selected in both positions), and free safety Dennis Jelden.

VanAllen, a 6-2, 190-pound senior from Lompoc, Calif., led the RMAC in passing this year with a 155-yard-per-game average, and he added another 21 yards a game rushing for a total offensive effort of 177 yards a game.

CISM quarterback Chuck VanAllen and free safety-kicker Dennis Jelden were voted co-captains of the 1979 football team by their fellow players. The honors, based on leadership qualities determined by the players, were announced Thursday, Dec. 6 at the team's annual banquet.

VanAllen was also named most valuable player and outstanding offensive player while Jelden received the Tom Mead Spirit Award. Lineman Mike McKenty was named outstanding defensive player, and center Kevin Harmon received the outstanding freshman honor.

VanAllen finished his two year career at Mines by loading the Oregidgers to a 6-4 season, their best record since 1975. A second team All-Rocky Mountain Athletic Conference (RMAC) selection, the 6-2, 190-pound Lompolo, Calif., senior led the conference in passing yardage with 1,766 yards. He passed for 11 touchdowns and ran for 3 more during the year.

Jaden, the team's leading tackler, was credited with 66 tackles, 36 assists, 2 interceptions and 7 pass deflections on the year. In addition, the 6-4, 183-pound senior from Greeley kicked 4 field goals during the year and converted on 16 of 23 points-after-touchdowns.

McKenty, a first team All-RMAC selection, was credited this year with 59 tackles, 31 assists, 5 pass deflections, 5 quarterback sacks and 2 fumble recoveries. The 6-3, 244-pound Dearborn Heights, Mich., senior received the outstanding defensive player award for the second year.

Harmony, a 6-0, 250-pound freshman from Edgewater, received honorable mention in RMAC balloting this year. In compiling their best record in four seasons, the Oregidgers ranked fifth in the conference with a 5-3 RMAC record at season's end. The team was third in scoring defense (14.6 points a game), first in passing defense (108.6 yards a game), second in passing offense (173.0 yards a game) and third in total offense (324 yards a game).

In addition to the award winners, sophomore Dan Morley ranked third in receiving with a 55-yard game average and senior return specialist Jim Mahoney ranked first in punt returns with a 22.3 yards return average.

Oregidgers named to the honorable mention team were:

- Steve Kearney, sophomore wide receiver.
- Steve Kearney, sophomore wide receiver.
- Kevin Hammon, freshman center.
- Mitch Knapton, junior tailback.
- Rick James, senior linebacker.
- Jim Mahoney, senior defensive back and punt returner.
- Kevin Patterson, senior defensive back.
- Foster Beckett, junior defensive lineman.

Football Players Honored

Jaden, the team's leading tackle and kicker, is a 6-4, 193-pound senior from New Mexico, who was selected for second team RMAC honors.

The awards for the academic semester students are invited to apply now for scholarships will be Interviewed by the school's financial aid office. For undergraduate students working for degrees in petroleum, mineral science, materials science, mining economics who can show financial need, are eligible to apply for up to $1,000 from the Scholarship Loan Fund of the Woman's Auxiliary to the American Institute of Mining, Metallurgical, and Petroleum Engineers.

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He was responsible for 1,766 total yards on the season.

Glauser, a 6-2, 220-pound senior from Steamboat Springs, rushed 62 times this year for 380 yards, an output of 6.3 yards per carry. Powell, a 5-10, 182-pound senior from Golden, returned 18 punts this year for 185 yards, an average of 9.4 yard average, and he returned 13 kickoffs for 990 yards, an average of 22.3 yards.

As a defensive back, he was responsible for 36 tackles, 27 assists, 3 interceptions, 12 pass deflections and 2 fumble recoveries.

Jaden, the team's leading tackling and kicking, is a 6-4, 193-pound senior from Greeley. He was responsible for 68 tackles, 36 assists, 2 interceptions and 7 pass deflections.

Graeme B. L. Waverly,صندوق بائع دجاج، وشام للطعام، وشام للطعام، وشام للطعام.
The Office of Resource Education (ORE) was created in 1978 by the Dean of the Graduate School of Colorado School of Mines to help inform women, minority groups, and others of the career opportunities available to Colorado School of Mines graduates in the mineral engineering field. Now, under the auspices of the Office of Admissions, ORE serves as a liaison between the technical expertise of Mines, the educational community, and the community at large. ORE is active in many areas to achieve the goal of publicizing mineral engineering careers. One of the focal points is a public school system. It is important to reach children in the early grades in order to foster interest in the sciences. ORE has received many accolades for its work with the public school system. For example, one administrator writes “Experience throughout the country has indicated that exposure to engineering needs to be integrated into the school curriculum, and that carefully designed programs of career exploration need to be used to interest young people in the study of engineering. The ORE program at the Colorado School of Mines is the only program in Colorado which attempts to explain mineral, petroleum, and energy related subjects to children and science to school-age children. ORE is providing a valuable service by strengthening earth sciences and energy related science curricula in the schools.

The Office of Resource Education also participates in various school career days by providing informational materials which point out the many advantages of pursuing a science oriented career. In addition, ORE pilot tests whole science teaching units for use in the K-12 school curriculum. Public school teachers benefit from in-service courses sponsored by the Office of Resource Education to upgrade their science educational methods. As Cases Sanger, District Science Specialist for Adams County Schools, says of one of the Pre-College Teacher Development courses, sponsored by ORE "We particularly needed and benefited from the NSF Pre-College Teacher Development courses. They were most valuable in bringing us up to date on the latest in science and engineering. ORE is very active on the Mines campus in terms of setting up workshops for Mines students, working with women and minority groups on campus, and in aiding the Office of Admissions in its recruitment efforts. One of the unique functions of the Office of Resource Education is its ability to fill the role of facilitator between CSM students and industry as evidenced by the ongoing series of workshops presented for students by ORE, the Placement Office, the Student Activities Office on Career Choices and Issues, and the OSM Alumni office. These workshops have featured speakers from industry who gave practical advice to the students on job seeking and career development. Students at Mines are faced with a bewildering array of career possibilities and decisions particularly in this time of tremendous energy development. They need the help of programs like the one at Mines to help them in making these decisions and to help publicize available employment opportunities. Industry will benefit as well from having these Mines graduate engineersǫ in their employ. It is early enough to think of career management. In addition, the Office of Resource Education, in cooperation with Dr. Betty Cannon’s Technical Writing class, has designed a Public Relations Specialist program for Mines students to write for mineral engineering careers. These writing projects include such subjects as “How to Choose an Engineering School” and “Preparing for a Plant Visit”. These reports will be extremely valuable to students as they are preparing to enter the job market.

ORE assists the Office of Admissions by reviewing and updating the CSM Bulletin and by designing counselor learning packets for dissolution to school counselors. These packets encourage students to think about their thinking on possible entry into science or engineering careers. The Office of Resource Education also works as a consultant for private and public schools and may sell a unique hands-on science learning project for use in the schools called “What’s Happening with Energy in Your Home.” The project is designed to teach students about energy efficiency and energy conservation. Jim Dorrin, Educational Specialist for Public Service Company, which will distribute the project, said of ORE, “The Office of Resource Education is in the best possible position to assist high school students in the choice of careers in various fields of engineering. Public Service Company of Colorado feels the continued support for the ORE critical, if enough engineering students are to be graduated to meet the technological needs of the next decade.

The Office of Resource Education coordinates the efforts of people within the Mines community and the Denver metro area as a natural outgrowth of its on-going contacts with both the private and public sectors, and these contacts have helped Mines to become an invaluable resource center for many diverse groups seeking people and expertise in various fields. These lists of contacts are, of course, open to anyone on campus who would wish to use them. ORE welcomes visitors. Call or write Room #413/Paul Meyer Hall, CSM, 303/743-3000, ext 2996.

ADMISSIONS COUNSELOR: The Colorado School of Mines anticipates an opening for an Admissions Counselor. Responsibilities will include student recruitment for a major scholarship program, student counseling, and organization of admissions projects for a college of mineral engineering. The position is open at the present time. Applicants should have at least a bachelor’s or master’s degree in secondary and college counseling. A science or engineering background is desirable. Position would start August 1, 1980. Send resume later than March 15, 1980, to A. William Young, Director of Admissions, Colorado School of Mines, Golden, Colorado 80401. An Equal Opportunity/Affirmative Action Employer.

Problem of Exponential Growth

Often forgotten in the “optimistically erroneous” material on the nation’s energy crisis are simple mathematical equations that point to the danger of exponential growth in population and energy consumption, according to an article in the most recent edition of the Colorado School of Mines Mineral and Energy Resources (Vol. 22 No. 3). Albert A. Bartlett, professor of physics at the University of Colorado in Boulder, considers the problem of exponential demand for fossil fuels to the rapid reproduction rate of bacteria. With the repeated doublings characteristic of such growth, Bartlett writes, a few such doublings can lead to enormous demand in very little time.

In “Forgotten Fundamentals of the Energy Crisis,” Bartlett urges the reader to be aware of the difference between “authorities” and “administrators,” concerning the energy situation and the results of “simple calculations.”

Decker Reprints

Betsy C. Decker of the CSM Alumni Association staff has resigned after 19 years of service with the Mines. Mrs. Decker has not indicated her plans for the future. She will continue to live at 1220 17th Street, Golden, in the house near the Mines campus which she has rented from the School of Mines for a number of years.

Well known to many Mines alumni, Mrs. Decker has been very active in campus and community activities. Mrs. Decker is the Blue Key advisor, having been the first woman elected to that honorary service fraternity. She is an honorary member of the CSM Alumni Association, having been elected in 1978.

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The mines magazine • February 1980

I am looking for a name for this column—loved the idea of calling it "Mason's Filing Cabinet," since that's really where my office is located. That seems to lack a bit of dignity, so I thought about such things as "Perspective," "My View," "From My Vantage Point," "Birds-eye View," or "Looking Across the Commons." Thus far, nothing has caught my fancy, so this will have to be an untitled opus—1.

The beginning of a semester is always exciting—and nerve-racking for the students of friends of students who've just gotten their grades. I've been encouraged by the number of people who've come to chat with smiles instead of frowns and groans. Maybe they're working harder, maybe they're caught up in the technical aspects of their professions...all with a view toward going to work. I don't see it that way, along with a lot of empty rhetoric, a paradox in governmental policies which should be providing these people and others with an opportunity to solve our problems.

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