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America urgently needs top-flight mineral and energy engineers. Because Mines needs to keep offering first-class engineering education to meet the nation's demands, Trustees of the School adopted a new financial policy this year, as you have heard. We now need your help. The past increases student tuition and at the same time raises the challenge to increase levels of student financial assistance. While we are at work to make a Mines education the best possible, we need to keep the doors open here for those who are desiring and best able to succeed as students and future engineers.

Those who have benefited from a Mines education do have a particular interest in seeing the School succeed. We now have a well-defined program that needs your support—the Annual Student Assistance Program (ASAP). We have 926 first-year reasons for supporting ASAP this year. That the number of students the School has determined will need additional financial resources to continue at Mines each semester. Colorado resident tuition for 1980-81 is nearly doubled—$693 per year to $1,292. Tuition for nonresidents rose from $3,076 to $4,563. The increase in operating budget which the tuition income makes possible is going mainly for three purposes, all essential for improving the quality of education Mines offers: an increase in faculty salaries that keeps up with inflation; hiring of faculty support personnel such as secretaries, technicians, and lab assistants to help the faculty be more effective in teaching; and the addition of a few persons to help with admissions, counseling, and advising students.

The School's Board of Trustees has become increasingly concerned since 1975 about the steady erosion of state support of higher education at Colorado School of Mines. By the 1979-80 academic year Mines had only $4 to spend in operating costs on each student's education for every $6 had in 1970, in constant value terms. Rather than watch the quality of the Mines education proceed downhill, the Trustees embarked on what the Denver Post called a "bold and risky path." The public raised and obtained permission from the Colorado Legislature to institute the innovative policy on a trial basis.

The decision was reached after thoroughly exploring all available options and consequences. A major factor in the Trustees' final decisions was faith that Mines alumni will step forward and help support the new policy with their own money when they understand what it is and why it was adopted. Essential to the success of the plan is the ability of the School to provide a financial aid package so that all qualified applicants accepted at Mines who need financial assistance can obtain it. In addition, the School must have the resources to compete for superior high school students who might be attracted to schools in other professions. The population estimates of the college-age group for the next few years indicate this competition will be intense.

In this academic year, we estimate that the total amount available for undergraduates at the School will be about $3.65 million in loans, grants, work study, and scholarships. Approximately 60 percent of all undergraduates currently receive some form of aid, with an average award of $2,728 per student. The Financial Aid Office nonetheless has estimated that an additional $573,000 will be needed this year to offset the higher tuition rates and sustain our ability to offer a sufficient financial aid package to qualified students.

As you are aware, the CSM Alumni Association Board of Directors has agreed to devote alumni fund-raising efforts to raising student financial aid requirements through ASAP. Our friends in industry, who also have much to gain by insuring that the School maintains its quality, are being asked to increase their support of students through academic achievement scholarships. Alumni of the School are fortunate in having had the opportunity to receive a high quality engineering education with the need so great for mineral engineers, students must have a similar opportunity to come to Mines with the knowledge that potential financial barriers will not be a problem. You are encouraged to join forces with CSM and with industry to make it possible for talented students to attend Mines who might be attracted elsewhere or who may not otherwise be able to afford a Mines education. Through the ASAP, you have the opportunity to assist young people seeking the kind of education only Mines can offer.

The nation needs more talented individuals to take up the challenges involved in meeting the nation's mineral and energy demands. The Colorado School of Mines is determined to do its part in supplying talent. I congratulate the Alumni Association for coming forward with a program to help sustain the School in its mission, to attract its share of the nation's best high school students, and to guarantee that America's needs for mineral engineers will continue to be met.
Minerals & National Defense

by General Alton D. Slay

I would like to give you my assessment of the current U.S. defense posture and some of the trends that are very disturbing to me. The commentary that I will make on the relationship of your industry to my industry, defense, will then be completely unadorned by any political obfuscations.

The theme that I will dwell on is an unpleasant one for me and I think unpleasant to every thinking American. Our position in the international pecking order, of military power, industrial power, technical power, and economic power as it relates to the defense business is slipping badly. We are damaging the "arsenal of democracy" that President Roosevelt correctly tagged about 40 years ago. In fact, unless we see some definite change for the better over the next five years, we will reach a point where we cannot even accurately characterize the arsenal for the United States.

Twenty-five years ago, we were the strongest military nation in the world, perhaps in the rest of the world combined. But I believe that future historians will mark that time as the age of five percent in real terms—year in, year out—every year.

Sixty percent of the equipment used in the aerospace industry is over 20 years old. The Soviets are outproducing us in every aspect of military production. For every armored vehicle we produce, they produce ten. For every artillery tube, they produce ten. For every fighter, they produce two and a half. For every helicopter, they produce three. They field 18 surface-to-air missiles for every one we produce. In many instances, their force is so many times as many submarines and twice as many naval surface combatants as we do.

They are now and have been for 20 years on an R & D and acquisition offensive that is a constant forward thrust which we lack, a constant forward acceleration. We lack that. I have been discussing the "baddies," the Soviets. Let's look at our friends, our allies but worldwide for scarce materials. There are only three remaining U.S. suppliers of large tonnages, the kind that we need for aircraft landing gear and engine components. We are now being impacted by the closure of literally hundreds of foundries which occurred in the last few years. The German, Japanese, and French plants which produce titanium sponge.

The strategic implications of a situation like that are not very good. The strategic implications are even more parlous to contemplate if you add another fact, that the nations and supranational groups with which we are allied are even more dependent on imports that are more than as we. Let's take last in Germany, for example. They are totally dependent on imports for aluminum, tungsten, nickel, titanium, molybdenum, vanadium, antimony, molybdenum, magnesium, chrome, zinc, and copper. They are 98.9 percent import dependent on copper; 93 percent in lead, 77 percent in aluminum, and 80 percent in zinc. Every one of those materials is essential to defense production. We rely greatly on German production of our NATO forces. Even where we have adequate supplies of the basic materials, we often cannot produce them in at least invasion-capability. Titanium sponge is a good example of that. We only have three plants which can produce titanium sponge.

The shrinking industrial base, coupled with increasing demand not only nationally but worldwide for scarce materials,
The hole shootin' match from Gardner-Denver.

Get the drop on any rock job with one of these percussion rock drills, from Gardner-Denver. They're Gardner-Denver reliable for shift after shift, performance, Gardner-Denver fast for hole penetrator, and Gardner-Denver backed.

With one of these percussion drills, you can get the drop on any rock job. These Gardner-Denver drills are designed to make your job easier and more efficient. They're the industry favorites make lots of impact and rotation.

Independent Power Rotation Drills. Large reversible piston hammer for surface long hole or single pass drilling. Independent Power Rotation Valveless Rock Drills. Large reversible piston hammer for operation. Full hole size is guaranteed. Pressure and rotation are separate control of surface long hole or single pass drilling. Independent Power Rotation.

Gardner-Denver backed.
The Mining Department tops the list of departments at Colorado School of Mines which have received funding for contract research this year. That's an enviable position from the point of view of the graduate students and the professors supervising this research. It is a vote of confidence by industry in the ability of this department to solve problems and provide answers. It is also a matter of some concern to the head of the department, Dr. Thys Johnson.

While Johnson is pleased with the variety of programs possible in the department because of this funding, he is also balancing this against other forms of research, particularly on an undergraduate level. He is considering implementing methods of integrating the funded research programs into the full curriculum of the department.

Together with the professors with whom he works, the other faculty on campus, and information garnered from mining department alumni, Johnson is evaluating almost every area of the current instructional mode, the type of student, the number of short courses given for continuing education programs and the future of the department. This is quite an undertaking, and, coupled to assuring there are overlapping courses. Recent additions to the curriculum addressing this problem are: underground mine design and evaluation, advanced surface design, advances in handling mining techniques and more emphasis on rock mechanics.

Other philosophical and practical questions with which the faculty hopes to find some help were presented in the November, 1980, MINES Magazine. Dr. Donald Gentry, head of the curriculum committee, in the department, is anxious that the alumni of the department return to the questionnaires provided for their response.

Engineer or Technician

The question constantly arises in the mining engineering community to mining, the expansion of computer applications, the greatly expanded computer applications, the greatly expanded computer applications, the greatly expanded computer applications, the greatly expanded computer applications, the greatly expanded computer applications, the greatly expanded computer applications, the greatly expanded computer applications, the greatly expanded computer applications, the greatly expanded computer applications, the greatly expanded computer applications, the greatly expanded computer applications, the greatly expanded computer applications, the greatly expanded computer applications, the greatly expanded computer applications, the greatly expanded computer applications, the greatly expanded computer applications, the greatly expanded computer applications, the greatly expanded computer applications, the greatly expanded computer applications, the greatly expanded computer applications, 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Technical literature, in both quality and quantity, is improving, Hustrulid says. He sees a real improvement in the availability of hard information on research and new techniques, and the whole spectrum of mining development is being covered more thoroughly. CSIM professors are contributing to this vastly larger pool of information with articles for textbooks and journals, with Dr. Robert Trent, of the mining department, being the latest. He is the author of a chapter in the new Society of Mining Engineers Handbook on Mine Plant Design.

Hustrulid agrees with Gentry that the mining engineer is often a very special person, coming from a special background. This has led, he feels, to a philosophy in the teaching of mining engineers which stressed descriptive, technical teachings in some aspects of the industry. Today's trends are toward problem solving with hard calculation techniques. Students now have tremendous increased capability with modern calculators to arrive at answers more quickly, to seek many different approaches to problems. The "art" of mining might not be appealing to today's students, brought up on calculators and computer technology...hard information is their real desire.

Questions posed by Hustrulid are provocative—is it the responsibility of the School to teach only the essential fundamentals, then up to the company employing the graduate to complete specific training for specific object? Or, is the reverse best? That is, does the School put too much emphasis on broad training now, and should it be more narrowly focused? He also stresses that mining engineers and engineering technicians are not to be confused. There are schools of mining technology in the U.S., and there are engineering schools, such as CSIM. He suggests that in some cases, the company employing engineers imperfectly understands the differences between the two, and can therefore be disappointed in its hiring results.

DRAINAGE STUDY

Like many of the professors in the mining department, Hustrulid currently has a number of funded research projects in place—all with government funding, channeled through industry sources. Nuclear waste disposal, oil shale, raise boring and rock mechanics programs are being investigated by graduate students under his supervision. A particularly interesting project underway is methane drainage, under the search for unconventional energy sources.

This problem investigates the possibility of utilizing methane gas as an energy source before the coal in which it occurs is mined. A source of explosive and deadly emissions now, methane could become a marketable resource under the proper conditions. The project is studying a system of hydraulic fracturing, wherein drilling and injection of a variety of fluids could be utilized to concentrate the methane in a central recovery area. It could then be diverted into a collection system, pumped to the surface and used.

In order to test the various aspects of this, a special materials "sandwich" has been put into place in leading frames at the Edgar mine. The "sandwich" consists of coal, limestone and sandstone, and is subjected to both vertical and horizontal pressures outside and to internal pressures, applied to holes drilled in the blocks. The study covers fracture initiation and the subsequent propagation of the cracks in the block. A major question is the migration of cracks through a given formation, and if the migration can be controlled. The current study deals more specifically with the formation of the cracks and fluid recovery, and the maintenance of fractures in each bed of the sandwich. If pressure changes are excessive after the fluid and methane are collected, would this destroy the stability of coal beds so treated is also a major investigation.

Hustrulid points out that research projects are actually business ventures, with saleable economic and technical data. If a specific need for research is not seen by a company, there is often reluctance to fund research of a "pure" nature, with the result that important information is often lost or delayed. Fewer and fewer U.S. citizens are going into the graduate program, preferring to enter industry immediately, with the result that much technical expertise is being lost. He feels that companies should consider more employees-graduate student relationships, although the public information requirement on new processes might intervene. The result of new emphasis on research from such a program would be extremely beneficial to the industry and would increase interest to do graduate research.

LONGWALL RESEARCH

Longwall coal mining in a new technique is a graduate research project being conducted by Dr. Donald Gentry. Based on a German breakthrough in longwall mining, the research, being carried out at the Mid-Continent Resource Company's Carbondale property, is called a multiple-stage system of mining. Two sequence mining, involving two cuts at the coal, rather than the one used in conventional longwall systems, is being used. For the thick coal seams found in the Western U.S., this system would result in greatly increased recovery of the very valuable resource.

Factors in the study include the measurement of stability, stress, pressure build up, and especially stress ahead of the face. If this technique can be proven, it will result in better mine design and effective mining. Advance longwall mining, rather than the retreat system, has been used at this mine previously, and the effectiveness of this is also part of the study. The team working on this project is composed of graduate students working on...
both master's and doctor's degrees, plus occasional lab of undergraduate students and postdocs.

Another one of Gentry's projects consists of an important study in rock mechanics and the response of rock to long-wall mining. A 35% pitching coal seam is being examined for its response to various kinds of equipment, the type of engineering required to maximize production, and the correlation of surface effects of subsidence due to the underground operation.

Gentry's team is working under direct grants from the Department of Energy, and he points out that this is one of the few government expenditures directly related to increasing the coal commonly burned.

Equipment Evaluation
Moving from underground coal production to surface mining, another research project is being overseen by Mathew Hrebar, who has extensive industrial experience in the construction industry. Hrebar, who worked as an engineer for Bucyrus Erie, primarily on Western mine sites, is working with a graduate student on equipment comparison projects involving working with a graduate student on an engineering student's thesis, a research project involving computer simulation of various kinds of equipment, the type of equipment required to maximize production, and the correlation of surface effects of subsidence due to the underground operation.

First, two new courses. Mine Safety Management and System Safety Engineering have been approved by the curriculum committee. These courses, in conjunction with existing courses in the Safety and Health Program, will give students a broader understanding of the field.

One research paper, "Cost of Safety and Health at Selected Western Coal Mines," has been sponsored and published by the Institute of Industrial Hygiene, Mino Regulators and Selected Topics—Health and Safety, provides information on significant advances in coal mining and safety. Hrebar has been dragline simulation models and advanced surface coal mining planning.

Although a great deal of computer oriented work is not used at the undergraduate level in this particular area, Hrebar emphasizes the value of a software contour mapping package made available to the mining department by Radion Corp, Austin, TX. The package, DFS-1, is valued at $50,000, and would not have been accessible to the department without this cooperation. Hrebar sees software packages for the simulation necessary in much of the equipment evaluation tests as being of primary necessity for the future.

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John F. Abel, Jr., received his bachelor's, master's, and doctorate degrees from the Colorado School of Mines. He has been in the industry for 24 years, during which time he has served as an engineer for various mining operations, including a tour of duty with the Mining Branch, Conservation Division of the U.S.G.S. Prior to coming to Mines he has served as chief engineer and project manager for Gates Engineering Co.

James M. Riddle received his bachelor's degree in mining and mining engineering from Mines, and then went on to Virginia Polytechnic Institute and State University for his Ph.D. in the industry since 1965, he worked in several mines in Colorado before entering the teaching field at Pennsylvania State University.

Robert N. Trent graduated from the University of Utah in mining engineering and later received his master's degree from the same school. He has worked for mining companies across the United States and is currently consulting for companies in Colorado, Wyoming, and Montana.

Rock Mechanics Faculty
John Abel, widely recognized for his work in rock mechanics, has planned and implemented a large block-caving frame facility, to be installed in the research area of the new Brown Building. This work will be capable of handling much larger masses of rock than has been used for this project in the past. Abel says that rock fragments up to 6-inch size can be examined, drawn column heights of up to 45 times the width of the draw can be investigated, significant variations in rock fragment size and shape can be studied and some 3-dimensional testing of drawpoint spacing can be examined.
In the Oquirrh Mountains' Pine Canyon of southwestern Utah, hard rock miners with pack mules, picks, and blasting primer cord crawled over craggy slopes to stake-mining claims in the late 1800s. Abandoned tramway cable riggings and wooden ore bucket pulley towers are silent testimony to the incredible hard work, slow production success and limited ore recovery they endured.

Today, the Anaconda Co. is mining the same mineral lands with modern equipment, a technique called vertical crater retreat, laser beam technology, a gravity-based concentrator flow, metric measurements and computer/cathode ray video terminals.

After a five-year, $216 million investment, Anaconda's Carr Fork Mine southwest of Salt Lake City at Tooele is producing about 4,000 metric tons per day of copper ore grading out about two percent net. Production began in September 1979 and by June 1981 approximately 10,000 metric tons per day will be mined routinely.

Nevertheless, the equation for success at Carr Forks today remains much the same as it did for the pick and pack mule brigades—2 percent copper, 98 percent hard work.

Anaconda's undertaking is making use of some new or first time mining circumstances. Art Ditto, project manager, says, Carr Fork's potential to be a 21st century mine is evident here. At left is Anaconda's modern production shaft headframe and nearby service shaft headframe. (L.B. Foster photograph)

A contrast of the old and the new in the Bingham District's Pine Canyon at Tooele, Utah is evident here. At right is the 60 to 100-year-old steel cable tower tramway used for mining before the turn of the century. At left is Anaconda's modern production shaft headframe and nearby service shaft headframe. A five-year, $216 million investment was made at Carr Fork, one of the very few large underground base metal mines developed in the last 10 years in the United States. The mine is the first of its kind in the nation to be designed in metric measurements.

Carr Fork is one of a limited number of deep mines which makes use of a mining method called Vertical Crater Retreat (VC). Large diameter holes are drilled from the top sill through the ore to an undercut draw opening. Explosives blast chunks of ore downward to the undercut. The method retreats upward until the top sill is reached.

Other unique aspects include a gravity-based concentrator flow requiring only five process pumps. The system takes advantage of the slope slope. The method retreats upward until the top sill is reached.

The track haulage system is considered a key element in the production process by Ditto and mine management personnel. More than 300 tons of 115-lb. rail and nearly 5,000 hardwood crossties, pressure-treated for longer life in wet underground conditions, were supplied by L. B. Foster Co. Foster specializes in rail, pipe, piling, constructing 80-lb. and 85-lb. relay rail. Installation of the rail, supplied through Foster's Los Angeles Division, involved utilizing the two-deck, men/materials cage in the surface shaft headframe. Six 39-ft-long rails at a time were hoisted to the underside of the cage floor and lowered to both main levels at elevations of 970 and 1,200 meters above sea level.

Rail strings are spiked to hardwood ties with shield plate overlays. Huck bolts were used on all joint bars. Concrete spalls, steel ties and pailnail plates on concrete ties were considered but rejected for the haulage system for various reasons. The overriding goal is for a safe, secure track haulage system that minimizes production downtime.

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Heavy Duty Trains Used

Two trains of Asea 12-cubic-meter cars are being used in the haul runs. Each train is composed of 20 cars and is moved by two General Electric 30-ton locomotives. The trains can be controlled from either the front pulling locomotive or the rear pushing vehicle. The second unit responds automatically to the operator's commands. The trains also can be controlled by radio commands transmitted by an operator at the loading chute.

Carr Fork utilizes a blend of manpower and computers. Project development and actual mining necessitates a workforce of 700 to 800 persons, the majority of which are miners. Anaconda operates its own miners training classes in which trainees are screened, selected monthly, paid for class work and classified. The goal is to fill the necessary 500 miners jobs to operate three and four man crews, three shifts a day, seven days a week.

Computers Quantify Progress

Approximately 25 video display terminals are in use throughout the various departments to provide quick access to a variety of facts, figures, charts, projections and design ramifications. It allows personnel of several departments access to relevant data. Several computer systems have been used already, and more are scheduled to keep pace with mine growth.

The bottom line at Carr Fork is soon as a low-cost copper mine that will return a profit on investment over the long term. Fluctuations in the copper market and mineral speculation will have an effect on Carr Fork's success level. However, mine management has faith in the future and in the timing for the facility to hit its production peak. Anaconda's 60-plus years of patience in the Tooele area investment has every indication of paying off soon.
### CSMAA Honorary Membership

The CSMAA Alumni Association annually confers honorary memberships in the Association on individuals who have been significant to the Colorado School of Mines and its Alumni. In order to be recommended as a member of the Association for this honor, an Honorary Membership Committee will recommend candidates to the Association Board of Directors for final selection.

Several criteria are used in selecting individuals for this honor:

- The recipient must have rendered distinguished service to the Association and/or the Colorado School of Mines.
- The recipient need not be a graduate of the Colorado School of Mines.
- The recipient should be able to be present in person to receive the honor at the May 1981 Alumni Reunion.

Please submit your recommendations for this honor to the Honorary Membership Committee, Alumni Association, Golden, Colorado 80401, prior to January 15, 1981. Please include a brief synopsis on the background and service of each individual with your recommendation.

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Englewood, CO 80112
The Turbulence Parameter

Energy-efficient operation of the internal combustion engine requires the highly turbulent movement of fuel and air in the chamber. Recent advances at the General Motors Research Laboratories provide a new basis for determining what degree of turbulence will get the most work from each drop of fuel.

Without turbulence, the highly agitated exection of cylinder gases, combustion would take place too slowly for the gasoline engine to function. Predicting combustion behavior in order to design engines with greater fuel efficiency depends upon understanding the relationship between vital, turbulent gas motions and burning rate. The challenge is to quantify this relationship—a complex task made more difficult by the requirements of measuring a transient event occurring in a few milliseconds within a small, confined space.

New knowledge of how turbulence affects flame speed has been revealed in fundamental studies conducted at the General Motors Research Laboratories by Edward Groff and Dr. Frederic Matekunas. Their investigative results have been incorporated into a model that successfully predicts the effect of engine design and operating conditions on power and fuel economy. Because the researchers separated their experiments into two phases, they determined flame speeds over a broad range of operating conditions. Testing took place in a specially designed, single-cylinder engine equipped with a transparent piston to permit high-speed filming of the combustion event.

High-speed anemometry was applied to measure the turbulent flows while the engine was operated without combustion. Instantaneous velocities were calculated from the anemometer signals and simultaneous measurements of gas temperature and pressure. More than 400,000 pieces of data were processed for each ten-second measurement period.

The significant measure of turbulence is its "intensity," defined as the fluctuating component of velocity. Because conditions in the cylinder are both transient within cycles and variable between cycles, separating the fluctuating and mean components of velocity is inherently difficult. The researchers overcame this problem by using a probe with two orthogonal wires properly aligned with the direction of the mean flow.

In the combustion phase, tests were performed at over one hundred operating conditions of varied spark timing, spark plug location, engine speed and intake valve geometry. Detailed dynamic analyses were applied to the recorded cylinder pressures to calculate flame speeds throughout combustion. High-speed films were analyzed frame by frame to validate flame speeds and to characterize how gas motions influence the initial flame.

The researchers used these measured flame speeds, turbulence intensities and the conditions under which they occurred to formulate a burning law for engine flames. They divided the combustion event into four stages. The initiation stage begins with ignition and ends as the flame grows to consume one percent of the fuel mass. In the second stage, the flame accelerates and thickens in response to the turbulent field. The third stage exhibits peak flame speed. In the final stage, the thick flame intersects increasingly with the chamber walls and deaccelerates.

The researchers also observed that the burning velocity in the second stage increases in proportion to flame radius, and that in predicting the energy release rate from the burning velocity equation, it is necessary to account for the finite flame-front thickness. "The form of our burning equation," says Dr. Matekunas, "shows a satisfying resemblance to expressions for non-engine flames. This helps link complex engine combustion phenomena to the existing body of knowledge on turbulent flames."

"We see this extension," adds Dr. Groff, "as a significant step toward optimizing fuel economy in automotive engines."

The Men Behind the Work

Drs. Matekunas and Groff are senior engineers in the Engine Research Department at the General Motors Research Laboratories. Both researchers hold undergraduate and graduate degrees in the field of mechanical engineering. Dr. Matekunas (right) received his M.S. and Ph. D. from Purdue University, where he completed graduate work in advanced optics applications. Dr. Groff (left) received an M.S. from California Institute of Technology and a Ph. D. from The Pennsylvania State University. His doctoral thesis explored the combustion of liquid metals. General Motors welcomed Dr. Matekunas to its staff in 1973, and Dr. Groff in 1977.
in memoriam

Wallace W. Agey
Wallace W. Agey, Met. E. 1939, died September 4, 1980, in Salt Lake City, Utah. He was 73 at the time of his death. Born in Chicago, Illinois, his family moved to Kansas City where he attended high school and the Kansas City Junior College in 1950. He later worked for Phelps Dodge Copper Corp. in Arizona. One son.

Arthur C. Smith
Arthur C. Smith, P.E. 1937, died September 16, 1976, in St. Petersburg, Florida. He had been retired here since 1954. While at Mines Smith was a member of Blue Key, Beta Theta Pi, Skull and Blade and Sigma Tau. After graduation he was employed as petroleum engineer for Lago Petroleum, a subsidiary of Standard of New Jersey, in Maracaibo, Venezuela. He later moved to Create Petroleum Corporation. He retired as drilling superintendent for Eastern Division in Quiriquire, Venezuela.

Robert S. Spalding
Robert S. Spalding, E.M. 1883, died September 24, 1980, at St. Anthony's Hospital in Denver. Born February 11, 1899, in Denver, he attended Princeton University and the Colorado School of Mines, graduating in 1923. He was employed as metallurgist and engineer for firms in Colorado, Arizona, New Mexico, Alaska, and Nevada throughout his career. Several of his metallurgy inventions were patented during the time he worked for the Remington Arms plant. He also invented a fuel injection system. Spalding was instrumental in bringing a planetarium to Denver and was a member and past president of the Denver Astronomical Society. He also was a sponsor and board member of the Spalding Planetarium Center.

Joyce, Olin Foundation; and Bill Orton, '53; Don Roberts, '41; Allen Schexnader, '63; Jay Spikolmer, '59; Ned Wood, '43; George Wirth, '39; Bill Yopp, '56; Joan Irish; Michael Joyce, Olin Foundation; and Bill Quinones, Texas Gulf.

Petroleum Engineers

The Southern California Gas Company, the largest distributor of natural gas in the nation, has excellent career opportunities for individuals interested in engineer- ing and drilling.

Reservoir Engineer

The individual will join a group of staff engineers in a general reservoir engineering staff. Will work on well history, production and material balance; water influx calculations, and basic geologic interpretation of storage reservoirs. Will develop and direct well evaluations of underground storage fields owned and operated by the company. This will include doing material balance, water influx calculations, and basic geologic interpretation. Knowledge of reservoir engineering and well drilling is essential. One to two years related experience desirable.

Drilling Engineer

The responsibilities of this position include planning and executing the drilling of new wells and the remobilization work required on existing wells. This involves establishing cost effective drilling programs for the company's many different projects. Will be responsible for the design, materials, developing drilling and remedial programs, obtaining necessary permits, monitoring necessary staff in regulatory agencies and directing the work of drilling and drilling service companies. The successful candidate should have a degree in engineering and industry experience in drilling and workovers. Positions offer immediate responsibility, a rewarding future, a challenging career with growth opportunities and a competitive salary. Excellent opportunities for advancement with a wealth of experience and ability. Please send your resume and salary history to:

Mr. V. Jones
Professional Employment Representative
Southern California Gas Company
P.O. Box 3248
Terminal Annex
Los Angeles, CA. 90051

Equal Opportunity Employer M/F.
Dear Mrs. Petty,

I attended the luncheon at the Hilton (Eisenhower) yesterday and picked up a copy of the September Magazine. Your request for identification of those in the picture on page 31 is the reason for this letter. Both my Mother and Father would be angry if I didn't identify Dad in the front row. I have attached a photocopy of the print with his circle. I also noted that Underhill is Underhill.

Enclosed is a copy of the picture that appeared in the September Mines Magazine; also a list of names that are my recollection of the men shown. There are other familiar faces but I can't fit a name to them.

The picture brings back a lot of great memories and I hope to get the chance to see some of those fellows at the 50th reunion.

Very truly yours,

Ezell Flournoy, '32

The actual operation of a business in a foreign country requires accommodation to the local government laws. It is difficult and usually unwise to attempt to impress American business, political, and cultural ways on the host people. One thing, however, is usually feasible. The fact the business is allowed to operate and locates in the host country means it is perceived to be needed. The degree of accommodation which a company achieves in the host country usually measures the success it achieved and its continuity. It must be valuable to the host country.

Dear Mrs. Petty:

I have just read your article in the September Mines Magazine—it gets here a little later now that it comes by air. I refer to the article entitled "Construction and Philosophy," I am not an authority on subdivision off theory, but the article deals also with the subject of foreign operation. In the field of foreign operation, I am not exactly an expert, but I have had some experience in Latin America mostly and I was somewhat involved at a couple of the ideas involved—particularly as they might be applied to those "foreign" countries where I have worked—usually for contractors, but mostly for American corporations, and mobilization planning.

Your subject, Provost, mentions the U.S. tax structure as something adverse to "American working overseas." He mentions "double taxation" as one of the common features of overseas activity. Unless the situation has changed greatly in the last few or so years since I was actively employed, this would continue to be true, I think. It was the most favorable situation with respect to income taxation that I have ever enjoyed. The situation is favorable to Americans working overseas in that they are above my normal living expenses over a period of many years. First, income taxes in Latin America, at least, are far below the rates applicable in the U.S. Second, they are usually deductible from the U.S. income tax.

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Patsy Wegner is unique—an East Helena, Montana farmgirl who is making an impact on higher education in the West. It isn't often that a doctoral graduate has not one, but two college presidents attend a graduate ceremony in her honor, much less have one add a solid kiss to the formal occasion.

Yet that's what happened to Patsy, daughter of Howard and Mabel Wegner, when she earned her Ph.D. in Student Personnel Administration at the University of Northern Colorado in Greeley this past summer. UNC President Richard R. Bond was there to congratulate her graduation—with Patsy, now Dr. Patsy, a kiss deemed more fitting than a handshake.

In the audience was Colorado School of Mines President Guy T. McBride, Jr., waiting for his Director of Student Activities to accept her congratulations and his injunction to come back to work at Golden.

Wegner had left CSM for a one year leave of absence, to pursue her doctoral degree at UNC. Her doctoral thesis, “Values of Conflict Between the Development of Career & The Orientation to Marriage and Family Among Engineering Students,” was based on three years of work at Mines as Director of Student Activities.

Wegner was Mines’ first such director when she came to CSM in 1970. Prior to that, she was the first program director for residence halls at Montana State University in Bozeman.

“Student activities are the other side of higher education,” said Wegner noting that the learning, growing and maturing outside the classroom has lasting value. Throughout higher education, student activity programs are receiving high marks for enrollment retention, teaching stress and organizational management. “The whole mission of student activities and student development is to help students have a successful college experience,” said Wegner.

“My job does not entail babysitting or being the “party lady” to a bunch of party-loving students. I’m a professional educator, and I teach management, communication and leadership skills to students who want and need those skills,” said Wegner.

Some of the expanded programs include a new counseling office, development of a campus-wide counseling network, stress management workshops, leadership seminars and work on an alcohol abuse program for students. All of this grew in four years.

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From Farm to Ph.D. by Brodie Farquhar

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Colorado Gold

"There’s gold in them there hills!" not gold only.
But silver, zinc, copper and moly.
But silver, zinc, copper and moly.
But silver, zinc, copper and moly.

They brought the whiskey; but few, if any
In dirty overalls and pleated vest
Of that there hills!

And timbers, and carbide lamps;
To stand a lonely guard.

They had a place to hang their names.
They blasted rock and ore.

In cracks and fissures, with quartz and
That heavy black gangue.

That was the story.
In a little pit called the Silver Bell.

They struck the mother lode a couple miles
In ‘76 a territory gave birth
And luckless ’49’ers back from California
On horse and mule they came.

He hadn’t heard of Aspen, but then he hadn’t
In a little village it’s called Tincup.

In comparison with other teachers,
And Pandora’s came on line
And Pandoras came on line
And Pandora’s came on line

Amoco Foundation, Inc. providing the
The rails changed things some
The rails were those that were to jump the lever.

A wealth of good learning, a hundred years
He beaded for Colorado Gold.

To canvas cities, and it didn’t take a day.
It shut the boom towns down, and closed a
In a little village it’s called Tincup.

With long legged wooden water tanks
They mixed the chemical to float the metal;

With wooden doors and dance hall floors.
With tall poles and timbers hung between
And Pandora’s came on line
And Pandora’s came on line

The rich, the poor; the young, the old,
And spruce, above the Bristle-Cone pine to
On horse and mule they came.

They came in search of gold.
And the sluice box days were numbered;
And timbers in the shafts and head frames
And sluice box days were numbered;

And the sluice box days were numbered;
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They had a place to hang their names.
They blasted rock and ore.

In cracked and fissured, with quartz and
That heavy black gangue.

That was the story.
In a little pit called the Silver Bell.

And luckless ’49’ers back from California
On horse and mule they came.

He hadn’t heard of Aspen, but then he hadn’t
In a little village it’s called Tincup.

In comparison with other teachers,
And Pandora’s came on line
And Pandora’s came on line
And Pandora’s came on line

Amoco Foundation, Inc. providing the
The rails changed things some
The rails were those that were to jump the lever.

A wealth of good learning, a hundred years
He beaded for Colorado Gold.

To canvas cities, and it didn’t take a day.
It shut the boom towns down, and closed a
In a little village it’s called Tincup.

With long legged wooden water tanks
They mixed the chemical to float the metal;

With wooden doors and dance hall floors.
With tall poles and timbers hung between
And Pandora’s came on line
And Pandora’s came on line

The rich, the poor; the young, the old,
And spruce, above the Bristle-Cone pine to
On horse and mule they came.
Environmental Sciences Program

The Colorado School of Mines' Environmental Sciences Program is offering a series of courses this spring that cover a host of environmental issues, problems and solutions. The program is the only one of its kind in the state and specializes in information that is readily utilized by business and professional people. Courses are scheduled for once a week, one to four hours in the evening.

Course titles include:

- Fundamentals of Life Sciences
- Ecology Field Camp for Engineers
- Air Pollution—"Control and Technology"
- Seminar in Environmental Sciences
- Special Problems in Environmental Sciences
- Biological Oceanography and Marine Pollution
- Toxicology of Metals, Fuels and Industrial Substances
- Ecology of Metals, Fuels and Industrial Substances
- Analysis of Environmental Problems
- Current Topics of Environmental Analysis
- Investigations in Environmental Sciences
- Energy, Environment and Natural Resources Law
- Ecological Considerations in Industrial Site Planning

The courses will be taught by a faculty group led by Dr. Beatrice E. Willard, professor of environmental sciences and director of the ES program. Willard's expertise is in plant ecology, particularly high tundra studies, in which she is a recognized authority. She is backed up by Dr. John C. Emerick, an environmental biologist with a special focus on environmental impact on the marine environment.

Dr. Gregory B. McKee has an extensive background in plant and environmental biology, and has developed new computer techniques for site selection and reclamation projects. Finally, Roger P. Haasen, a Colorado attorney, has had extensive experience in environmental impact analysis, land use planning, environmental law and environmental permitting. His specialty is creating and managing interdisciplinary teams of scientists and technical specialists.

For further information about class descriptions, schedules, course credit and enrollment costs, contact the Environmental Science Program at the Colorado School of Mines, Golden, CO. 80401, or call Jean Shadwell at 279-0300, extension 2427.

Prank Time

Jim Shaughnessy found his office strangely decorated on Halloween morning. Shaughnessy is purchasing agent for the CSM business office in Guggenheim Hall.

Above, students from the Single Student Housing Association show off their 1980 Homecoming Queen. At right, the Orediggers get set for their Western New Mexico University 41-10 drubbing.

Above, Kay Shafer of Sigma Alpha Epsilon is crowned 1980 Homecoming Queen. At left, the traditional burro race pits Theta Tau against Alpha Gamma Delta at halftime. The burro won.
Sports Wrap-Up

The duo of Ted Dikmen and Mike Murray of the Colorado School of Mines tennis team took third place last weekend at the Michelob Light Tennis Tournament, in the men's doubles competition. Mines competed against 14 Colorado universities and colleges, at the Gates Tennis Center in Denver. Dikmen is a freshman Oredigger, and Murray is a sophomore. The front row from left to right are Matt Brons, Mike Murray, Jeff Goulet, Jon Schubert and John Schrann.

Mines Tennis

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According to the July edition of Mineral & Energy Resources "Oil Sands: Resource, Recovery and Industry," the oil sands of Alberta, Canada and Utah could make a significant contribution to solving our energy problems.

Oil sand, tar sand, bituminous sandstone, oil-impregnated sandstone or bituminous sand has been identified in almost every country in the world and in almost every state in the United States. Alberta reserves are estimated at 1,000 billion barrels, while the United States has an estimated reserve of 30 billion barrels—29.5 of it in Utah.

An overview of oil sand industry, "Oil Sands: Resource, Recovery and Industry," was written by two project engineers in the Energy Division of the Colorado School of Mines Research Institute—Mr. Christopher H. Cox and Dr. Gary L. Baughman. To date, only the oil sands of Alberta have yielded synthetic liquid fuels on a commercial scale, according to Cox and Baughman. Ironically, the Albertan oil sand industry would be lucrative for those involved, and its implementation would demonstrate the commitment of the United States to use its multifaceted domestic energy sources.

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The opportunities for hearing exciting presenta-
tions of one sort or another have been so greatly expanded at Mines that it is a real temptation to neglect one's daily routine and just attend lectures, special events, lunch-
and faculty sessions. Figuring prominently in these events lately is the Humanities department, sponsors of guest lectures and actively involved in much of the intellectually challenging atmosphere on campus. The AMAK professor, Dr. Roger Wescott, has conducted interesting seminars and talks, with special emphasis on art and architecture, and has added to the intellectual atmosphere among students.

Dear Mr. Smith,

I am writing to you as the new chairman of the Board of Directors for Colorado School of Mines. We have been quite active lately due to the current programs, as an example of exceptional Humanities emphasis—another recommendation for a school already recognized as one of the best in the engineering teaching grounds!

The need to be told that the United States is facing a critical time is, or should be, self-evident. For a long time we have had a chance to be effective. Use this opportunity—now!

Richard Banks '53
Tulsa, Oklahoma 74103

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