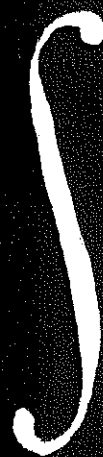
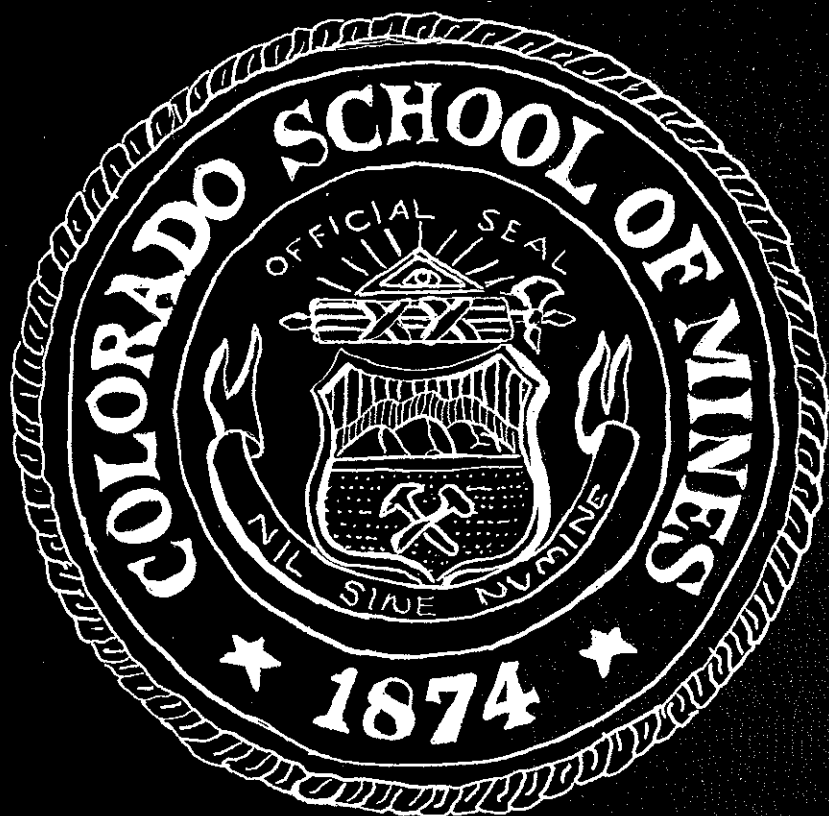
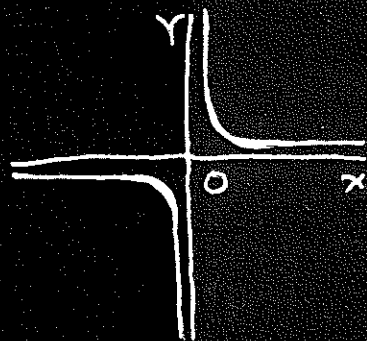


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# MINES

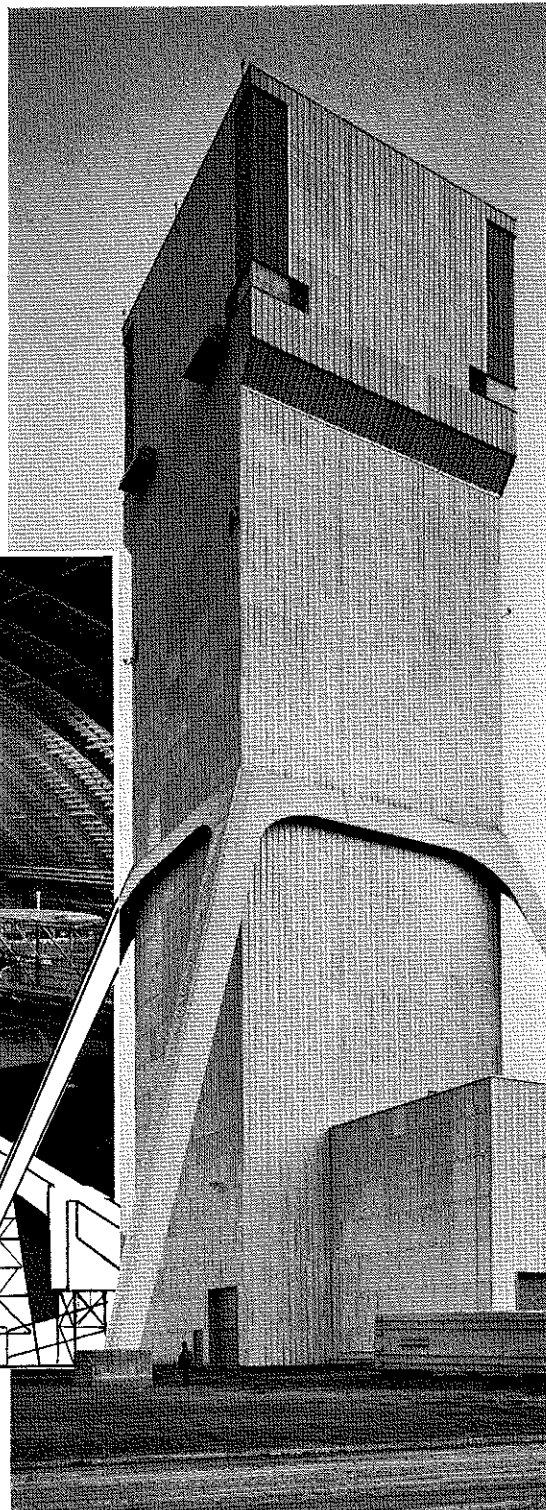
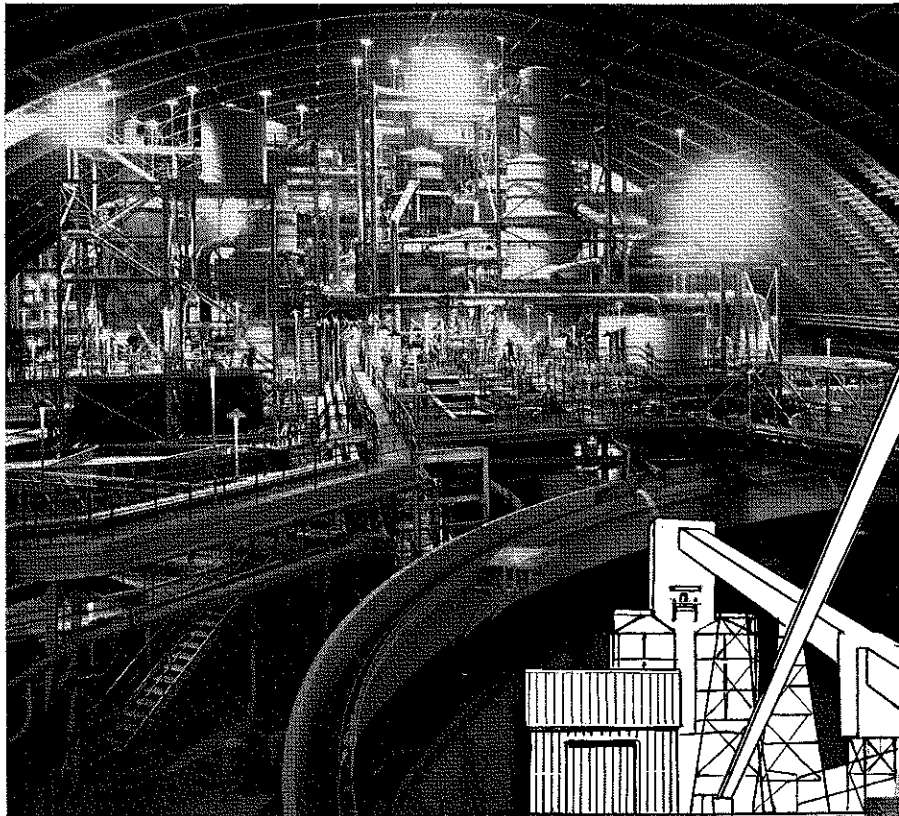
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# Mathematics

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## Calendar

Course in Operations Research for  
Immediate Application, Presi-  
dent's Room in Student Union,  
CSM Campus, Golden, Colo.,  
Jan. 19-21.

Engineering Graphics Midwinter  
Meeting, ASEE, California State  
Polytechnic College, San Luis  
Obispo, Calif., Jan. 21-23.

Mines Alumni Annual Meeting and  
Installation of Officers, Lake-  
wood Country Club (for Mners  
and their Ladies), Pre-Game  
Activities 6:30 p.m. and Dinner  
7:30 p.m., Friday, Jan. 23.

73rd National Western Mining  
Conference and Exhibition, Den-  
ver Hilton, Denver, Colo., Feb.  
13-14.

Mines Alumni Breakfast, Hilton  
Hotel (tickets may be purchased  
at registration), 7:30 a.m., Sat-  
urday, Feb. 14.

20th Annual National Engineers  
Week, focusing on "Engineering  
... Environmental Design for  
the 1970s," Feb. 22-28.

API Southern District Meeting,  
Rice Hotel, Houston, Tex., Mar.  
4-6.

1970 Joint Meeting of Southwest  
Section of AAPG and SEG at  
Statler Hilton Hotel, Mar. 8-11.

Western Metal & Tool Exposition,  
Great Western Exhibit Center  
and Biltmore Hotel, Los Angeles,  
Mar. 9-13.

API Southwestern District Meet-  
ing, Inn of the Golden West,  
Odessa, Tex., Mar. 18-20.

AAPG Pacific Section Meeting,  
Newport Beach, Calif., Mar. 19-  
20.

1970 API Mid-Continent District  
Meeting, Broadview Hotel, Wich-  
ita, Kans., Apr. 8-10.

1970 API Eastern District Meeting,  
Ramada Inn, Evansville, Ind.,  
Apr. 15-17.

Annual Engineers' Day, Colorado  
School of Mines Campus, Friday  
and Saturday, Apr. 17-18.

Offshore Technology Conference,  
Albert Thomas Center, Houston,  
Tex., April 22-24.

# The MINES Magazine

Volume 60

January, 1970

Number 1

## Front Cover

Shown on the front cover are three of the symbols com-  
mon to advanced mathematics and the official seal of the  
Colorado School of Mines. The cover was designed by Miss  
Jacqueline Prier, daughter of Mrs. Betty Decker of the CSM  
Alumni Association.

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## Mathematics at Mines, 1970

IN June, 1964, the Colorado School of Mines awarded to two students the degree of Mineral Engineering—Mathematics, the first students to receive the new degree authorized by the Board of Trustees. In 1969 the college awarded the same degree to 16 seniors, plus one Master of Science degree in Mathematics and one Ph.D. interdisciplinary degree in Mathematics and Mining. In the intervening years the complexion of the mathematics faculty has changed to keep pace with the new demands on it. Where there had been only one professor holding the Ph.D. degree, there are now eight. At this writing the Colorado Commission on Higher Education has under consideration a proposal, approved by our Board of Trustees, for granting the Ph.D. degree in Mathematics.

With these changes taking place at Mines, the Alumni deserve a full accounting of where Mathematics is at Mines and where it is going.

First of all, it must be recognized that applications of mathematics are becoming so numerous and problems admitting a mathematical solution so pervasive in our industrialized society that the concept of what is applied mathematics has had drastic revisions. This has been expressed well by Dr. Henry O. Pollak, director of the Mathematics and Mechanics Research Center of Bell Telephone Laboratories, when he wrote in *Educational Studies in Mathematics*: "The first folk theorem which happens to be untrue is that calculus, differential equations, partial differential equations, and some further successively more difficult fields are applied mathematics, and that everything else is pure and irrelevant to applications. It is amazing how untrue this has become, in recent years, particularly with the rise of combinatorial mathematics and probability. No one, when he is thinking rationally about the problem, really believes this folk theorem; but a deeply ingrained, irrational, mystique that values the fields of classical analysis almost infinitely above all other branches of mathematics often stands in the way."

The mathematics curriculum at Mines, while still requiring three semesters of calculus of every student, has been enlarged to include additional courses in statistics, probability, linear algebra, operations research, and modern analysis, to name some of the broad areas of study. In fact, operations research and linear analysis have become so important to the mineral industry that the thrust of the mathematics graduate program at Mines is directed along these lines. (See report below.)

Enrollment in such traditional courses as advanced calculus, complex variables, and partial differential equations is at an all time high, and analytical techniques necessary for operations research and linear analysis rest securely on fundamentals of classical mathematics. Thus, the changes taking place do not imply a retrenchment of applications in the traditional areas, but rather an expansion of applications in new areas. That these areas are of vital importance to the mineral industry can hardly be questioned.

The attention paid to graduate study and research has not resulted in neglect of the undergraduate program. In fact, the acceptance by the mineral industry of Mines

graduates with a first degree in Mathematics has been one of the most gratifying aspects of the increasing mathematical activity. Salary-wise the mathematics graduate has gone from the bottom of the list to well above the average, and the number of companies requesting interviews with seniors in the mathematics option has increased correspondingly. Mines graduates in Mathematics are attending first-rate graduate schools in all parts of the country and are distinguishing themselves and their schools, ac-mathematics courses (more hours than are required by cording to reports received in Golden).

The undergraduate curriculum includes a full stable of most colleges) and traditional humanities and basic science courses; in addition the student takes at least 12 hours' credit in mineral engineering courses and nine hours of basic engineering courses related to these. The resulting combination makes the Mines graduate unique in his potential contribution to mineral technology. He knows the problems of the line engineer and, although not ready for top posts in Research and Development with only the first degree, can relay those problems and assist in their solutions. We are confident that those who complete advanced degrees in Mathematics at Mines will be correspondingly well received at higher levels.

As part of a general program of self analysis and preparation for further developments, President Childs invited a Visiting Committee to meet on the Mines campus in October, 1969, to review the progress of the Mathematics Department and make recommendations for its further direction. The committee that assembled, representing alumni, industry, government, and education, included the following:

Dr. Thys B. Johnson, Mines Systems Engineer,  
U. S. Bureau of Mines, Denver  
Dr. William P. LeVeque, Chairman,  
Department of Mathematics,  
University of Michigan, Ann Arbor  
Dr. Albert W. Musgrave, Geophysicist,  
Mobil Oil Company, Dallas.

The Mathematics Department received valuable advice from the committee and will benefit from their dedicated efforts.

It seems appropriate to include here excerpts from the Proposal for the Ph.D. Degree submitted to the Board of Trustees and to the Colorado Commission on Higher Education, and also excerpts from the report of the Visiting Committee.

In the 1968-69 William Lowell Putnam  
Prize Examination, administered by  
the Mathematical Association of  
America, five students in Colorado  
placed among the top 500 in the country.  
Four of them were at MINES!



# Mathematics for Miners

By A. W. Schlechten

Vice President for Academic Affairs

**M**ATHEMATICS is probably the most important tool available to the practicing engineer. The degree of sophistication in mathematics that is required will vary widely from one branch of engineering to another and within any one branch. However, it seems quite obvious that the increasing complexity of technology requires a greater understanding of mathematics by the engineer.

A typical university mathematics course can be content with teaching the operations of mathematics, but at the Colorado School of Mines the students must learn both the theory of mathematics and how it can be used. It may well be that the second step is more difficult than the first.

At our School the ideal faculty member in mathematics must either be that rather unusual individual, a mathematician with an interest in engineering or an engineer competent and willing to teach mathematics.

The Colorado School of Mines is fortunate in having a mathematics faculty that is sympathetic with the needs of the engineering student. Not content with the routine of elementary and orthodox courses normally taught, they have pioneered new courses and new approaches to improve the training of the engineering student and to produce mathematics majors with a knowledge of the problems of the mineral industry.

## CSM Mathematics Department Proposal To Offer Degree of Doctor of Philosophy

By Dr. Joseph R. Lee\*

**T**HE growing need for more powerful mathematics at high levels to support the advanced study of Mineral Engineering at the Colorado School of Mines prompts the Mathematics Department to request the Ph.D. program with specialties in Operations Research and Linear Analysis in Mineral Engineering.

These two fields are in increasing demand by the mineral industry. Operations Research is important to management in developing new methods of exploration, recovery, and commercial processes; Linear Analysis represents the most comprehensive area of modern research

It should be emphasized that although the proposal is for a Ph.D. program in Mathematics, research projects will be directed at topics in mineral technologies. Thus students will be expected to demonstrate knowledge in one of these fields while pursuing an advanced degree in for mathematical analysis in the fields of Petroleum Refining, Metallurgy, Geophysics, and others.

\* Head, Department of Mathematics, Colorado School of Mines, April 29, 1969.

mathematics. The Mines graduate already has at least 12 hours of study in his mineral-resource specialty, and orientation will be provided for students from other institutions. Each will be expected to become familiar with present technology in the mineral field in which his research will be done.

At its meeting on Dec. 19, 1969, the Colorado Commission on Higher Education approved the request of the Colorado School of Mines that it initiate a new program leading to the Ph.D. degree with specialties in operations research and linear analysis, in mineral engineering.

It is explicitly the Commission's understanding and intent that this program preserve its mineral engineering orientation through requirements such as those Dean Jordan and Dr. Lee have cited respecting admissions, graduate course requirements in mineral engineering, and thesis topics, and that cooperation with other engineering institutions be developed where this can promote economy of operation and/or improvement in the programs of the institutions.

## Information Requested

### By Colorado Commission on Higher Education For Review of Proposed New Degree Program

**T**HE PROPOSED Ph.D. program with majors in Operations Research and Linear Analysis in Mineral Engineering is a natural outgrowth of specialization of the Mathematics Department in the last few years. It is not a request for a comprehensive graduate program such as is available at institutions of 10,000 to 20,000 students. It represents the thrust along mathematical lines into advanced areas recognized as the particular responsibility of the Colorado School of Mines.

Operations Research is sometimes described as the study of optimization. In applications to the mineral industry it is used to analyze everything from the best location of a new plant to the best methods to be used in exploration and recovery. The mineral industry "... is faced with the evergrowing need to develop present and find new methods of exploration and of recovery of the common metals and fuels, and at the same time to develop commercial processes for the less common, but extremely important, metals and for new energy sources."

It is difficult to see how the above problems can be successfully attacked in modern society without many of the tools developed by Operations Research. Indeed, some of the largest users of Operations Research in the country today are petroleum and mining companies. Mobil Oil, for example, has about 25 O.R. men at their corporate headquarters in New York with supporting groups at each of their divisions for specialized implementation. Kennecott Copper employs about 30 at their headquarters in Salt Lake City.

The study of Linear Analysis is, in our opinion, the best support in standard mathematics for advanced study in engineering and specialization Operations Research. It requires a broad background at the elementary graduate level in such topics as classical analysis, algebra, topology, and numerical analysis (courses already available at the Colorado School of Mines) with advanced specialization in topics with direct applications of mathematics to other fields, e.g., partial differential equations and Linear Systems Analysis as employed in Chemical and Petroleum Refining, Petroleum Engineering, Metallurgy, Geophysics, and Physics. As a field by itself it represents some of the most challenging and fruitful areas of research today; as a background for the mathematically well-trained engineer and the Operations Research specialist, it provides the capacity to assimilate much modern research in applied fields useful in industry. Many staff members in other departments have the mathematics background to profit from having advanced work in this area in progress at Mines.

**T**HE ENTHUSIASM shown by students and faculty in other departments of the Colorado School of Mines for Operations Research and Linear Systems Analysis indicates the close relationship between these disciplines and others in the School. We believe that they deserve advancement and support on their own merits; however, their usefulness in Mineral Engineering emphasizes the importance of including this proposed program in the curriculum of the Colorado School of Mines.

The long-range plans of the School indicate a continued emphasis on mineral engineering and concern for industrial, governmental, and educational progress in this area.

We believe that Mathematics, and especially the two major fields we are proposing, will play an increasing part in this progress.

**R**EASONS FOR adding the proposed program are all concerned with furthering the aims and purpose of the Colorado School of Mines "... to educate men and women for scientific and engineering careers in investigation, exploration, exploitation, processing, and utilization of resources in the mineral and allied fields, including all aspects of earth sciences."

The increasing importance of Mathematics in educating men and women for the scientific and engineering careers described above is certainly not challenged today. The reasons for seeking the Ph.D. program as a means to this end are primarily concerned with the level of excellence at which we can contribute to this education.

The combination of Mineral Engineering and Operations Research at the Ph.D. level is obtainable at only a few institutions in the country, and at none in Colorado or in the region. The excellence of the faculty and students alike is a measure of the contribution of the department to the educational aims of the School; and certainly the Ph.D. program attracts research faculty and students who would not otherwise be apt to come to Mines.

During the last five years the proportion of staff members holding the doctoral degree has increased from about eight per cent to about 60 per cent, many advanced courses have been added, and a new computer has been made available (see Appendices). We believe that the progress of the department to date portends the increased stature that a Ph.D. program demands. This progress will continue, and service to other departments at the Colorado School of Mines will be increased, by the superior faculty and students that such a program will attract. Already theses in other departments show more mathematics influence, research requests by the School include mathematics sections, and consulting in the Mathematics Department by students and faculty in other departments is increasing. These activities will be limited unless we have an open-end program with which to attract men of the calibre we need for these purposes.

Many scholarship plans (e.g., N.D.E.A.) are not open to us without the Ph.D. program, and support from private sources is much easier to obtain when the School has already voted its support of the department. It should be emphasized that the reason for seeking this support lies in the contribution that mathematics can make at a higher level to the mission of the School. To quote again from the Task Force report, "... and in mathematics, the graduate level bias might be numerical analysis and its applications to systems analysis and operations research into mineral exploration and production problems." In other reference, the Task Force recommended "... offering such degrees in the discipline itself rather than combining the discipline with engineering." It then went on to say that specific research, however, should be mineral oriented. We believe that both Operations Research and Linear Analysis in Mineral Engineering offer great opportunities for this kind of advanced work.

**M**UCH of the ground work for this program has already been done. For example, library additions

have been increasing both in number of books and number of periodicals.

The Mathematics Department is increasing its staff by one man for the 1969-70 session and feels that an additional man will be justified before the program reaches a level of about 36 students as explained in the feasibility study. In some sense the additional staff pays for itself, and there is a kind of "multiplier effect" through the use of graduate students as teaching assistants. Thus, 100 new freshmen might justify the addition of one man on the staff; by contrast, if that man is used for graduate courses, the resulting Teaching Assistants will actually contribute more teaching at the freshman level than the one man would do. The Mathematics Department has experimented with the procedure of saving students spend approximately half their class hours in a lecture by a senior professor and the other half in small recitation classes directed by a Teaching Assistant and has found it to work very well.

The following is a tentative description of allocation of manpower in the Mathematics Department if the proposed program is approved.

We at present have 500 students in the freshman math courses, Math 101, 111, 112 in the Fall semester. Assuming a total of 600 students for the sake of argument, these 600 could be taught under the present system in sections of 40 students each by the equivalent of five instructors. (At the undergraduate level the teaching load is three courses,  $5 \times 3 \times 4 = 600$ .) These 600 students could also be taught by having them take two hours in a lecture class of 120 students taught by a senior professor, and two hours in a recitation class of 25 students directed by a Teaching Assistant. Each T.A. could handle two sections of two hours each under this arrangement, so 12 Teaching Assistants could handle  $12 \times 50 = 600$  students. The lectures for these 600 students could be handled in five groups of 120 men each by the equivalent of less than two professors.

With this saving of three-plus professors and the addition of two more as explained above, we have the equivalent of five-plus professors who could handle 10 new graduate courses, plus reading courses, plus thesis direction. We at present teach three graduate courses at any given time, so the total number of graduate courses for an operational program of 36 students would be 13 per semester. Additional plans for visiting lecturers and elective courses in other departments will enrich the program with little additional cost.

It should be re-emphasized that most of the above expansion plans are already in effect for the Master's degree program. For example, a total of six graduate courses is planned for Fall, 1969, with further expansion possible under existing conditions.

A new computer had been planned for the campus without regard to the expansion by the Mathematics Department into a PhD. program and is, therefore, not a cost attributable to the new program. However, extensive use will be made of the new computer, and, in fact, the new program would not be possible without it.

Space needs of the department were acute before any graduate programs were considered. The new Graduate

\*"Directions for the Colorado School of Mines." A Report to the Colorado Commission on Higher Education (the Task Force Report).  
†Colorado School of Mines Bulletin, 1968-1969.

and Professional Center will help alleviate the situation somewhat, as the large lecture rooms will be used for lecture classes described above, and some space allotted to the computing center will be used for needs of the Operations Research program. Office space and small classroom facilities, however, will remain tight until new facilities are provided.

**N**O OTHER school in Colorado at present offers work in Operations Research leading to a degree, with the exception of the Air Force Academy, and theirs is only the B.S. degree. We list below institutions in the United States offering a program in Operations Research, and in another list, institutions with Mineral Engineering programs. The symbol \* denotes a common listing. It should be noted that the Operations Research groups are located variously in Mathematics, Engineering, or Business departments, but the following list includes all of them. The schools in the second list offer the PhD. degree unless otherwise indicated.

It can be seen that opportunities for Operations Research are scarce in this part of the country, and the combination of Mineral Engineering and Operations Research is indeed a rarity. We have already commented on the large staffs of O.R. men employed by Mobil and Kenecott. Other mineral companies (American Metal Climax, for example) are forced to resort to contract work for their O.R. needs.

The PhD. program in Mathematics will be administered by the Graduate School, through the department, as are all graduate programs at the Colorado School of Mines. The general requirements for all PhD. degrees granted by the Colorado School of Mines, as listed in the catalog, will apply.

**T**HE PRESIDENT of the Colorado School of Mines has appointed a visiting committee for the Department of Mathematics consisting of the following:

Mr. Lincoln Elkins, Sohio Petroleum Co.  
Dr. Thys Johnson, U. S. Bureau of Mines  
Dr. Albert W. Musgrave, Mobil Oil Corporation  
Dr. William J. LeVeque, Chairman, Department of Mathematics, University of Michigan

Since this committee is not expected to meet until October, 1969, its main function regarding the PhD. program will be one of implementation. After consulting with the Colorado Commission on Higher Education, the Mathematics Department wishes to appoint a review committee (possibly a subcommittee of the above) for the purpose of making immediate recommendations and passing its findings on to the full visiting committee.

**T**HE PROGRAM should be announced as soon as possible after the review mentioned above and approval by the Colorado Commission on Higher Education. The earliest date for awarding the first PhD. degree in Mathematics should be June, 1971.

**T**HIS PROGRAM has been approved and recommended unanimously by the Graduate Council, the Graduate Council, the Graduate Faculty, and the Curriculum Committee of the Colorado School of Mines. On June 13, 1969, it was approved by the Board of Trustees.

**G. H. Bryant, '53**

Mineral Industry Consultant  
700 Denver Club Building  
Denver, Colorado 80202  
303-255-8010

**C. Newton Page, '42**

Consulting Geophysicist  
Box 5572, Midland, Tex.  
Telephone MUtual 4-6862

**Albert C. Harding, '37**

Partner, Black Hills Bentonite Co.  
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# Report of Visiting Committee To CSM Mathematics Department

THE specific purpose of this visitation was to investigate the present capability and future potentiality of the Mathematics Department, and to arrive at a recommendation concerning the proposed institution of a doctoral program within the Department. The findings of the Committee are presented below.

**1. Relationship with other units.** The study began with a visit by LeVeque to the Mathematics and Statistics Department of Colorado State University, and to the Mathematics Department of Colorado University. He found that all three units were entirely agreeable to having a doctoral program at Mines, that they felt there would be no overlap of function with programs already being carried on at this institutions, and that they foresaw little or no competition for graduate students in mathematics, because of the different functions of the various programs.

When the Committee convened in Golden, it interviewed representatives of three of the most advanced mathematically-oriented departments at Mines, namely Geophysics, Mineral Economics and Chemical and Petroleum Refining, as well as representatives from the Department of Mining Engineering. Everyone the Committee talked to from these departments felt that the quality of the Mathematics Department has improved remarkably within the past few years, and that the Department has been most cooperative and successful in providing courses genuinely useful to their students. They attributed part of this progress to the institution of a master's degree program, and uniformly felt that a doctoral program would provide even greater benefits both to the Mathematics Department and to the students in the fields of application.

In short, the Committee found strong support within the Colorado School of Mines, and no opposition sister institutions, to the establishment of a doctoral program in mathematics at Mines.

**2. Curriculum.** The Committee feels that the present B.S. and M.S. programs in mathematics are well-founded and contain material of genuine relevance to the mission of the institution. Although Department members are reluctant to specify any courses as being absolutely required for the doctorate, the Committee did examine two versions of core curriculums, which would closely approximate minimal requirements for course work, and feels that on the whole, the students having the training indicated would be well qualified as Ph.D.'s in Mathematics, although on a rather narrow basis. We did feel that more courses in scholastic processes should be required or semi-required (a minimum of one at the M.S. level and three at the Ph.D. level), especially for students in the operations research program as well as more work in classical analysis—transforms, differential and integral equations, complex variables, etc.—for students in linear analysis. Certain aspects of the latter topics are taught in some courses given by Geophysics, but on an ad hoc basis, with the mathematics being developed only to the extent necessary to solve the physical problem at hand. We doubt that this kind of training is optimal for Ph.D.'s in Mathematics, who must be prepared to solve not individual problems, but entire

classes of problems, for which a deeper understanding of the underlying mathematics is necessary. Thus the offering of courses of the type indicated would not duplicate the present efforts but rather would supplement them, in a way that would obviously be advantageous to mathematicians and very probably to physical scientists and engineers as well. On the whole the present graduate course offerings seem to satisfy the needs of students in other departments, although when it becomes feasible it will probably be wise to institute further courses in probability theory, control theory, and non-linear partial differential equations.

**3. Staffing.** The Department presently has one unfilled position, and anticipates two requirements at the end of the present academic year; if these three positions are filled by men of the same level of competence as other recent appointments, the Committee feels that the Department will have a reasonably good basis on which to build a doctoral program. That a stronger statement than this cannot be made is in the nature of the situation; it has been impossible to attract really high level mathematicians to the Department because of the lack of a doctoral program; but the Department has been moving up very strongly in recent years, and it is to be expected that the overall quality will improve even more strongly and more rapidly after the institution of the doctorate. The present staff has had little experience in the direction of doctoral theses, although several of them have served on mathematics doctoral committees at other institutions or have collaborated in the direction of inter-disciplinary doctoral degrees at Mines. The Department gives highest priority, in its hiring plans, to obtaining two additional specialists in operational research and one applied mathematician; the Committee agrees that these priorities are appropriate. It appears to us that the average work load in the Department is somewhat high, and that there would be full justification in providing for at least one additional staff member, even without any increase in enrollment. The Department has been meeting its responsibility to other departments extremely well; several staff members came in for repeated praise from members of other departments, both for their mathematical competence and for their teaching abilities. We would hope that the growing stature of the Department is recognized across the campus, and that members of the Department can more fully be used as consultants in other units, for example, by the School of Mines Research Institute.

**4. Physical facilities.** The Mathematics Library seems to be adequate to the needs of the staff, and no constraints have been placed upon the acquisition of needed books and journals. It appears that the computer that is soon to be installed will be entirely adequate to the needs of the Mathematics Department, assuming that its actual performance is consonant with the claims made for it by the manufacturer. The Mathematics Department is presently housed in a rather antiquated building, with somewhat inadequate space; the Committee understands, however, that the Department will be allocated some space in the

Graduate Center, and it appears that this will alleviate present space problems.

**5. Logistics.** The Department has had on file for some time a request for an additional secretary, and such a person seems to be needed independently of the inception of a doctoral program. On the other hand, the doctoral program would not call for still more secretarial support. The Department does not feel pinched in respect to routine supplies—paper, typewriters, etc.

**6. Financial support of the staff.** Salaries offered to the new Ph.D.'s who have recently been hired are comparable with nationwide figures. This is less satisfactory than it might seem, because the Department is not yet highly attractive to mathematicians, and it will probably prove to be necessary to go somewhat above the usual level to attract young men of real promise. Salaries for Associate Professors and Full Professors are noticeably low, and a strong effort should be made to improve them.

It appears that those members of the staff who would be likely to attend national mathematical meetings have adequate funds available for travel costs. Although the institutional contribution is satisfactory it should be noted that no members of the staff presently hold Federal research grants, from which their colleagues in other institutions can obtain additional travel funds. It is to be expected that as the size and quality of the program at Mines increases, Federal support will become available proportionately. This would provide summer support for some faculty members, travel and secretarial expenses, and a certain amount of financial support for graduate students. Such grants will become available, however, only to the extent that the faculty engages in research publication in recognized journals.

An additional source of income, both for the institution and for individual faculty members, might be realized through the offering of short courses during the summer or between semesters that would be of interest to mathematicians and engineers employed by industrial firms. The special strengths of the Department—operations research and linear analysis—are of great current interest to such individuals and their employers, and offerings of this kind would probably be warmly received.

**7. Summary and recommendations.** We find that the Mathematics Department at the Colorado School of Mines has been strongly improved in quality in the past few years and that correspondingly its contributions to the well-being of the school have increased markedly. We feel that a specialized doctoral program in mathematics, centering around operations research and linear analysis, will be a feasible undertaking with the staff that we foresee by next fall. We feel that the development of such a program will have a strongly positive effect on the Department, and indeed on the institution as a whole, that it is entirely consonant with the mission of the School of Mines, and that the training its graduates will receive will be of great benefit to themselves professionally and the mineral industry as a whole. We, therefore, recommend that the doctoral program be initiated as soon as is possible.

Thys B. Johnson  
William J. LeVeque  
Albert W. Musgrave

## Winners in 1970

1970 will be the year  
When mining will go boom,  
And new men will appear  
To dig and make mines zoom.

Boys from mining schools  
And men from eperwhere  
Will grab the reins of mining  
And win by "Do and Dare."

—Pearl Ance

## Computing Resources

THE primary computer of the Colorado School of Mines is a standard Computer Corporation IC4000 operated by the Computing Center for instruction, research, and administration. This computer is to be replaced by an IC7000 timesharing system in February 1970.

The IC4000 is a 36-bit word-oriented computer with 32K words of high-speed memory, 3 magnetic tape drives, magnetic disk storage, card reader, card punch, and line printer. Languages implemented on the IC4000 include FORTRAN IV, COBOL, and an Assembly Language. A unique design feature of the IC4000 is a microprogrammed inner computer which permits modification of the instruction set. Through changing the inner computer program or "firmware" the IC4000 can emulate an IBM7094 or IBM-7044, among others.

The IC7000 is fully program compatible with the IC4000 and in addition has two processors (central processor and input-output processor), separate communications processor, and a full conversational timesharing system with background batch processing. The initial IC7000 configuration will have 32K memory, 2 tapes, 2 disks, card reader, card punch, line printer, and the capability to serve 12 teletypewriters simultaneously. The system is expandable to include up to 256K words of memory, a second central processor, 120 teletypes served simultaneously, on-line graphics, and on-line data acquisition.

## Library Resources

COMPLETED in 1954, the Arthur Lakes Library is an attractive and commodious structure having three floors and five stack levels with a total of 39,872 square feet and a capacity of about 170,000 books. In addition to offices, shipping and receiving room, binding room, processing room, and various utility rooms, the library includes a general reading room, a United States Documents reading room, an audio-visual room, a projection room, a microfilm and slides room, a reference and index room, and a reading lounge. The second through fifth stack levels contain study carrels for the use of faculty and graduate students, with ten faculty studies available to faculty members doing extensive library research.

The last annual survey showed a total of 131,787 books and periodicals, and 498 microforms. Periodicals on mathematics numbered 38 and included major publications of the American Mathematical Society, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics. Guidelines suggested by the Committee on the Undergraduate Program in Mathematics have been followed with acquisitions exceeding their recommended basic list. In the last five years alone, 871 volumes have been added to the collection in the field of mathematics.

As a sponsoring member of the Bibliographic Center for Research, Rocky Mountain Region, the Mines Library has made the resources of libraries throughout the nation available to students and faculty for research. The Center files and maintains a union catalog of cards, coded for locations of books and journals to be found here and abroad. Located in the Denver Public Library, it includes the Library of Congress National Union Catalog and contains more than 15,000 volumes of valuable bibliographic source materials.

Items from any of our neighboring academic or government libraries have been made readily available through a cooperative courier service which runs twice a week from the libraries of Colorado State University to Colorado University at Boulder, the Colorado School of Mines, Denver Federal Center, and the Denver Public Library.



# Undergraduate Mathematics Program

By William R. Astle

Assistant Professor of Mathematics

THE undergraduate mathematics program at Mines is a carefully balanced mixture of applications and rigor. A frequently used approach is to examine a "real-world" problem, describe the problem using mathematical symbols and concepts, solve the mathematical problem, and interpret the solution in the "real-world" context. This "model building" approach to mathematics gives the students broad experience in applying mathematics and a thorough understanding of logic and rigor.

The lower division (freshman and sophomore) mathematics program consists of a combined course in analytic geometry and calculus (three semesters; twelve semester hours credit) and differential equations (one semester; three semester hours credit). Every Mines student must complete the analytic geometry and calculus sequence and approximately 80% take the differential equations course. Only 12% of the freshman class is deficient in algebra and/or trigonometry, and for these students a college algebra and trigo-

nometry course is offered. Honors sections are available for those who are especially talented and interested. All these courses include the traditional applications of differential and integral calculus to the engineering and physical sciences as well as an understanding of the fundamental concepts. The Mines sophomore has by far the best mathematical education of any comparable student at any other college or university in Colorado.

The upper division mathematics program consists of a highly diversified collection of courses and seminars, including; Advanced Engineering Mathematics; Numerical Analysis for Digital Computers; Statistical Analysis; Statistical Models in Engineering; Statistical Decision Theory for Business and Economics; Probability; Operations Research; Linear Algebra; Advanced Calculus; Complex Variables; Partial Differential Equations; Modern Algebra; Number Theory; Topology; and Real Analysis.

Courses offered in support of the mineral engineering options are carefully designed to acquaint the students with the traditional and contemporary uses of mathematics. These courses provide the mathematical tools necessary for solving engineering problems and the foundation for learning more advanced mathematical techniques. The recent addition of courses in statistical analysis, operations research and digital computing has made the most up to date techniques available to the Mines student.

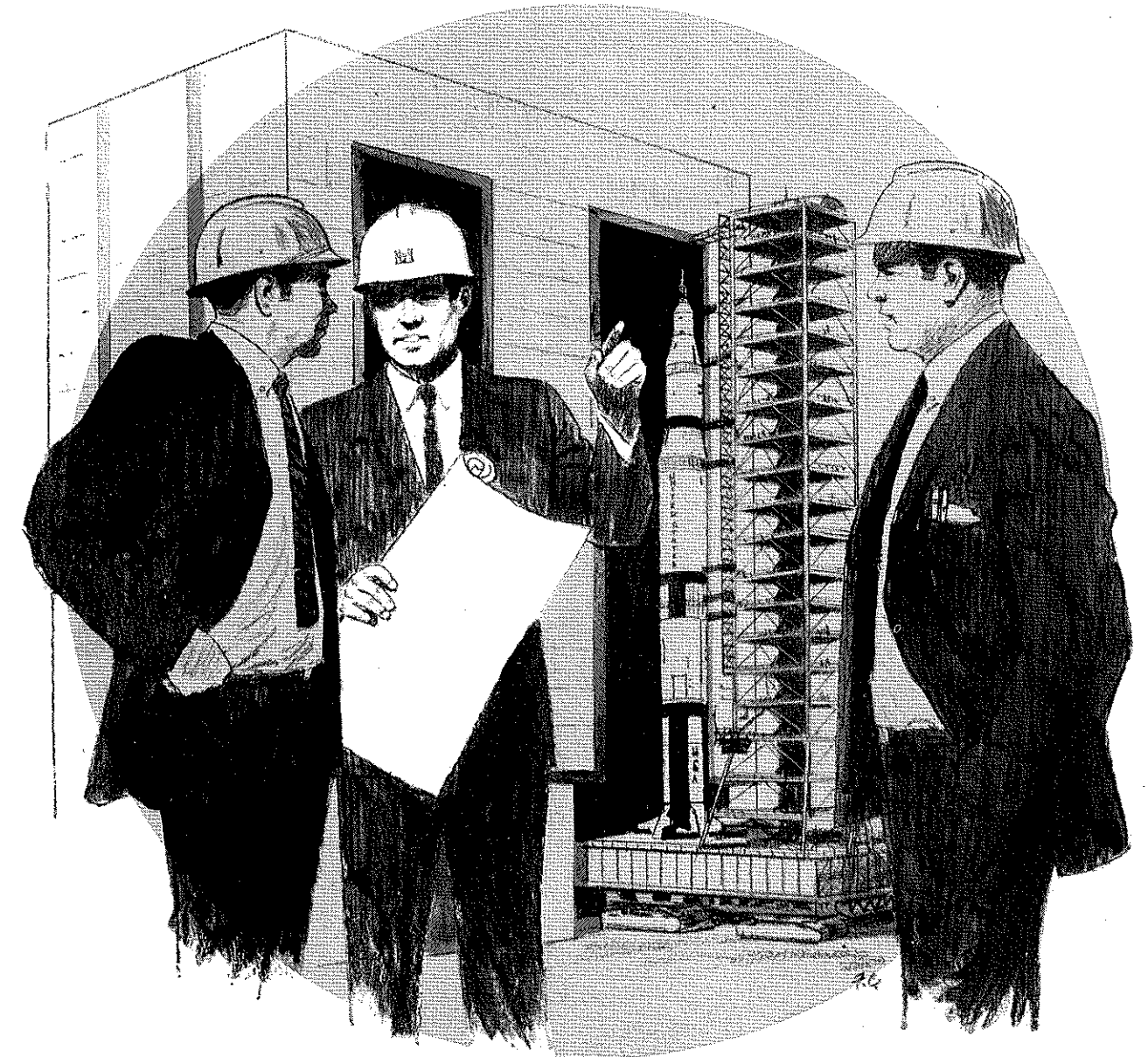
Mathematics majors, in addition to thirty-nine semesters hours of mathematics, must take a field course, a senior seminar, a minor (twelve semester hours) in a mineral engineering option and twelve semester hours of Basic Engineering. The field course is devoted to applications of mathematics in problems related to the mineral industries. The senior seminar provides the opportunity for the soon-to-be-graduated seniors, together with a faculty member, to study some area of mathematics of current interest. The technical electives and basic engineering courses expose a mathematics major to the real world of engineering problems and develop in him a facility for solving such problems. The Mines mathematics major is well prepared to enter industry or government or to enter graduate school in any area of the mathematical sciences. During his first year after graduation the Mines mathematics graduate currently earns an average of \$80 per month more than the national average for Mathematics majors.

The combination of a strong background in mathematics together with a facility for solving engineering problems seems to be in great demand. The program at Mines is helping meet that demand.

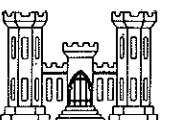
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electric power dams, flood control facilities, airports, roads, hospitals, family housing and special application manufacturing plants. Plus a host of stimulating research projects. □ The Corps is career headquarters for the engineer who wants to move in and do things, get involved, expand his horizons—starting right now. If that sounds like you, write to us today. We'll tell you all about the advantages of a civilian career with the Corps of Engineers.

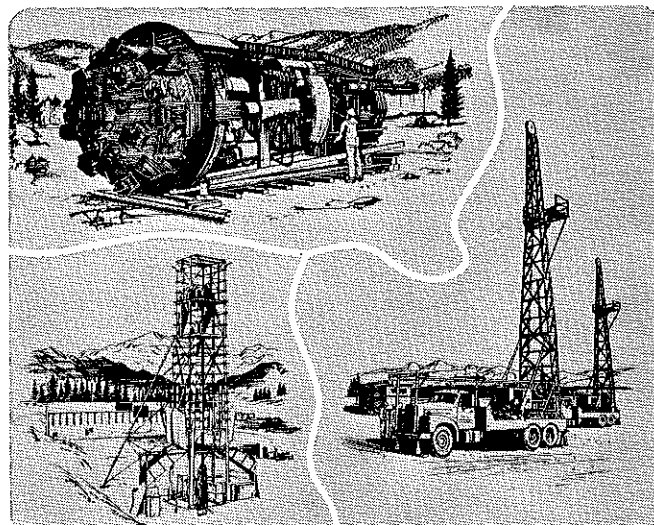
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# Introducing the Faculty Of the CSM Mathematics Dept.

**T**HE following Professors will be engaged in teaching graduate courses in the Department of Mathematics during the academic year 1969-70:

## Professors

Joseph R. Lee, Head of Department  
Austin R. Brown, Jr.  
Donald D. B. Marsh  
Walter W. Whitman

## Associate Professors

Ardel J. Boes  
Robert E. D. Woolsey

## Assistant Professors

William R. Astle  
John O. Kork  
Glenn E. Staats

The following Professors will teach upper division undergraduate courses; many of which are required of graduate students, during 1969-70:

## Associate Professors

Raymond R. Gutzman  
Robert B. Osborn

## Assistant Professors

Charles R. Baer  
Victor W. Bauman  
Don L. Bohmont  
Winton H. Laubach

**Joseph R. Lee**, Professor of Mathematics, Head of Department, received his Ph.D. (Mathematics) 1950, M.S. (Mathematics) 1946, and B. A. (Mathematics) 1944, all from Yale University.

Dr. Lee joined the faculty of the Colorado School of Mines as Professor of Mathematics and Head of the Department in September, 1964. His principal concern has been strengthening the undergraduate course selection and calibre of instruction while instituting a full-fledged graduate program both at the Master's and Ph.D. levels. In this endeavor he has increased the percentage of staff members holding the doctorate from eight per cent to 60 per cent in addition to substantially increasing the enrollment in Mathematics courses at all levels.

His previous teaching experience was obtained at Yale University, the University of Michigan, and the College of William and Mary. He also served in an administrative capacity at Yale where he was Assistant to the Dean for several years. During 1961-1962 Dr. Lee was an N.S.F. Fellow at the University of California at Berkeley.

He is a member of Phi Beta Kappa and Sigma Xi honor societies as well as an active member of the American Mathematical Society, the Mathematical Association of America, the Society for Industrial and Applied Mathematics, and the American Institute of Mining Engineers.

His principal research interest has been in Linear Operators e.g., contributions to "Semi-Groups" by Einar Hille and abstracts presented at Mathematics meetings. He has a text in preparation entitled "Linear Methods for Advanced Calculus."

**Austin R. Brown, Jr.**, Professor of Mathematics and Director of the Computing Center, holds Ph.D. (1952) and

M.A. (1950) degrees in Mathematics from Yale University and a B.A. (1949) degree in Math from Grinnell College.

Dr. Brown joined the faculty of the Colorado School of Mines as Associate Professor in the Department of Mathematics and Director of the Computing Center in August, 1965, and was promoted to Professor in 1967. His principal projects have been the establishment and subsequent development of the Computing Center and the introduction of graduate work in numerical analysis.

Previous teaching experience was gained as Adjunct Professor at Colorado College from 1962 to 1963, Associate Professor at Drury College from 1954 to 1956, and as Lecturer at the University of Delaware from 1952 to 1954.

Dr. Brown is a member of the honor societies Sigma Xi and Phi Beta Kappa, and a member of the Mathematical Association of America, Association for Computing Machinery, and the Solar Energy Society.

His experience in numerical analysis, digital computers, operations research, and war games was obtained by employment as follows: Mathematician in the Ballistic Research Laboratories at Aberdeen Proving Grounds from 1949 to 1953 and subsequently chief of computing methods section from 1953 to 1954; Chief of the ballistics computation branch of the Air Force Armament Center at Eglin Air Force Base from 1956 to 1958 and Chief of the computations branch of the Air Proving Ground Center in 1958; and Operations Analyst at the Headquarters of the Air Defense Command at Ent Air Force Base from 1958 to 1965.

While working for Ballistic Research Laboratories he represented the Army and the Air Force on the development of a new standard atmosphere for ballistics purposes (publication, "Toward a New Standard Ballistic Atmosphere"), developed methods for reduction of tracking camera data for the early high altitude rocket research program, and did some of the early software development for the ORDVAC computer.

Since leaving the employ of the Air Force he has done consulting for them in the areas of fighter interceptor effectiveness, missile kill probabilities, and air cargo terminal operations.

**Donald C. B. Marsh**, Professor of Mathematics, has the following degrees: Ph.D. (Mathematics) 1954 (University of Colorado), M.S. (Mathematics) 1948 (University of Colorado), B.S. (Mathematics) 1947 (University of Arizona).

Dr. Marsh joined the faculty of the Colorado School of Mines as an Instructor in the Department of Mathematics in September, 1955, and was promoted to Assistant Professor in 1958, to Associate Professor in 1963, and to Professor in 1966.

He has taught a wide range of courses, both undergraduate and graduate, with special emphasis on Modern Algebra and its applications. In this line he has been particularly active in the field of cryptography, developing courses, serving as Editor of the Foreign Cipher Department of the American Cryptogram Association's Journal and subsequently Vice President and President, and publishing solutions of ciphers and general research papers. He has also been one of the most active contributors to the Problems Section of the American Mathematical Monthly (published by the Mathematical Association of America), receiving solution credits in every issue for well over ten years.

Previous instructional activity includes Assistant Professor of Mathematics at the Texas Technological College in Lubbock, Texas, from 1954 to 1955, part-time Instructor at the University of Colorado from 1950 to 1951, and Instructor of Mathematics at the University of Arizona from 1948 to 1950.

Dr. Marsh has lectured at many professional meetings including the following: Society for Industrial and Applied Mathematics, Mathematical Association of America, the Colorado University Number Theory Conference, and Sigma Xi. He has also been active as a reviewer of texts and professional papers and as a translator thereof. He has also written numerous technical papers.

He is a member of Phi Beta Kappa, Sigma Xi, Pi Mu Epsilon (Mathematics honorary society), and Phi Lambda Upsilon (Chemistry honorary society).

**Walter W. Whitman**, Professor of Mathematics, has a Ph.D. (Mathematics) 1964 (Cornell University) and a B.Eng. Physics (5-year degree) 1959 (Cornell University).

Dr. Whitman joined the faculty of the Colorado School of Mines as Associate Professor in the Department of Mathematics in September, 1966, and was promoted to Professor in 1969. His primary concern has been to broaden and strengthen the course selection. He has developed courses in Partial Differential Equations, Mathematical Model Building, Methods of Applied Mathematics, Operations Research, Inventory Theory, Probability, Spectral Analysis, Industrial and Economic Time Series, and Statistics (for which extensive notes on practical problems were developed). He has been instrumental in developing the Operations Research program which sees its first degree graduate enrollment in 1969. He has supervised several M.S. and Ph.D. theses and has served on numerous graduate committees.

From 1964 to 1966 Dr. Whitman was Assistant Professor in the Statistics Department of the University of California at Berkeley.

His previous experience includes employment as Research Engineer in the Operations Research Department of Grumman Aircraft at Uniondale, N.Y.; Mathematician in Physics Group of the Aircraft Nuclear Propulsion Department of General Electric at Evendale, Ohio; Tech. Asst. in the Electrical Lab. of General Electric at Pittsfield, Mass.; and Tech. Asst. in the Lightning Arrester Advanced Product Engineering Group of General Electric at Pittsfield, Mass.

**Ardel J. Boes**, Associate Professor of Mathematics, earned Ph.D. (1966) and M.S. (1960) degrees in Mathematics from Purdue University and a B.A. (1959) degree from St. Ambrose College.

Dr. Boes joined the faculty of the Colorado School of Mines as an Assistant Professor in the Department of Mathematics in September, 1966, and was promoted to Associate Professor in 1969. He has considerably extended and expanded the course selection at the senior and graduate level in Analysis including additions in Elementary and Advanced Real Analysis, Real Variables, and Point Set Topology. These endeavors are supported by his research interests, which also include Measure Theory, and by his active participation for the past three years in the Colorado Conference on Collegiate Mathematics (panel member), the Rocky Mountain Section Meeting of the Mathematical Association of America (paper presented), and the annual meetings of the American Mathematical Society and the Mathematical Association of America.

His varied experience includes Research Fellow at Purdue University from 1964 to 1966, Instructor at Marycrest College from 1963 to 1964, Teaching Associate at Purdue University from 1962 to 1963, and Teaching Assistant at Purdue from 1959 to 1962.

He is a member of Sigma Xi honor society, and Delta Epsilon Sigma (National Catholic Honor Society).

**Robert E. D. Woolsey**, Associate Professor of Mathematics, Principal Scientist and Associate Director of Computing Center, has three degrees from the University of

Texas: Ph.D. (Operations Research) 1969 (requirements completed), M.S. (Mathematics) 1965, and B.S. (Mathematics) 1959.

Dr. Woolsey joined the faculty of the Colorado School of Mines as an Associate Professor in the Department of Mathematics in September, 1969. He has built a national reputation in Mathematical Programming with emphasis on Integer Programming and applications. He is the author of numerous papers in this general area and has written commercially successful programs and compilers for computers.

During his years in industry he has been employed by the General Electric Computer Division in Phoenix, Arizona, as a Consultant; by Sandia Corporation in Albuquerque, New Mexico, as a Staff Member in Software Development for Geophysics and in Operations Research, and later as a Consultant; by Control Data in Albuquerque, New Mexico, as a Senior Applications Analyst and Computer Software and Systems Developer; and by the U.S.A.F. Intelligence Center at Arlington Hall Station, Virginia, as a Supervisor of the Programming Branch. He is currently Assistant Director of the Computation Center for the College of Business Administration at the University of Texas while completing his Ph.D. requirements.

He has also had three years teaching experience as an Assistant Professor of Mathematics and Business Administration at the University of Albuquerque where he taught both undergraduate and graduate courses in Mathematics and Operations Research.

**William R. Astle**, Assistant Professor of Mathematics, has the following degrees: Ph.D. (Mathematical Statistics) 1969 (expected) (Colorado State University), A.M. (Mathematics) 1961 (University of Illinois), M.A. (Mathematics Education) 1959 (Columbia University Teachers College), and B.S. (Elementary Education) 1958 (S.U.N.Y. at New Paltz).

Dr. Astle joined the faculty of the Colorado School of Mines as an Assistant Professor in the Department of Mathematics in September, 1967. He has contributed greatly to the undergraduate and graduate courses in statistics which are assuming greater importance in the Mathematics curriculum. His general consulting and research background includes the following: Child Research Council at Colorado General Hospital; Marathon Oil (interpretation of well logs, modeling of geological structures, and evaluation of secondary recording techniques); Colorado School of Mines Research Foundation (evaluation of iron ore exploration data, calibration of magnetic logging instruments and evaluation of radon levels in uranium mines); Colorado State University and Colorado State College (evaluation of the effectiveness of video tape replay as an instructional aid); and current research in statistical estimation theory. He has a paper in the Arithmetic Teacher titled "The Mathematics Consultant."

Additional teaching experience in Mathematics was obtained at Western Illinois University as Assistant Professor from 1961 to 1963 and as a teacher in the South Huntington, New York, public schools from 1959 to 1960.

He is a member of the Mathematical Association of America, the Institute of Mathematical Statistics, and the American Statistical Association. He is also very active in the National Ski Patrol System, serving presently as Rocky Mountain Division Advisor for Testing and Training.

**John O. Kork**, Assistant Professor of Mathematics, received his Ph.D. (1969) in Mathematics from the University of Tennessee and M.S. (1963) and B.A. (1961) degrees in Mathematics from Colorado State University.

Doctor Kork joined the faculty of the Colorado School of Mines in September, 1969, as an Assistant Professor in the Department of Mathematics. He will support the department primarily in the areas of Probability and Statistics as well as applications in more general areas. His education is quite diversified, including an undergraduate minor in English and Philosophy and general mathematics at all levels. His Master's Thesis was on infinite products



of matrices, and his PhD. thesis is entitled "Relationships between Information Theory (Kullback-Liebler type), Sufficient Statistics, and Sequential Analysis."

Teaching experience was gained as Graduate Assistant at the University of Tennessee and at Colorado State University, and as Instructor in the Guided Missile Department at Fort Sill, Oklahoma. In addition, Dr. Kork has been employed as a Computer Programmer at the Colorado State University Hydraulics Laboratory. He has been a member and officer in many undergraduate and graduate honor societies.

**Glenn E. Staats**, Assistant Professor of Mathematics, earned three degrees from the University of Texas: Ph.D. (Operations Research) 1969 (Expected), M.S. (Mathematics) 1968, and B.A. (Mathematics) 1966.

Doctor Staats joined the faculty of the Colorado School of Mines as an Assistant Professor in the Department of Mathematics in September, 1969. His duties entail the developing and teaching of Operations Research courses at the undergraduate and graduate levels. A "nuts and bolts" mathematician, as he describes himself, he brings a substantial emphasis on the practical aspects of Operations Research.

His teaching experience has been obtained as both a Teaching Associate in the department of Mathematics at the University of Texas and as a Teaching Assistant in the Department of Mechanical Engineering.

Industrial experience has been divided between the Oil Well Division of U. S. Steel Corp., where he was a consultant, and the Bureau of Engineering Research at the University of Texas in the capacity of Research Assistant. His research activity thus far consists of "The Numerical Solution of Partial Differential Equations" and "An Approach to the Solution of Generalized Geometric Programming Problems" for Master's Thesis and PhD. Thesis respectively.

He is a member of Phi Beta Kappa honor society, and the Institute of Management Science and the Operations Research Society of America, professional societies.

**Raymond R. Gutzman**, Associate Professor of Mathematics, has a M.S. degree (Mathematics) 1946 (Iowa University) and an A.B. degree (Mathematics) 1941 (Fort Hays State College).

Professor Gutzman joined the faculty of the Colorado School of Mines as a Assistant Professor in the Department of Mathematics in September, 1949 and was promoted to Associate Professor in 1967. He has been particularly concerned with staying abreast of current advances in Mathematics, as evidenced by his continuing education: Massachusetts Institute of Technology (1942), University of Colorado Extension (1950 to 1951), Iowa University (1963 to 1964), and University of Colorado Denver Center (1968 to 1969).

Besides utilizing the above in the classroom, Professor Gutzman has teaching experience at Penn College (Instructor from 1946 to 1949) and at Iowa University (Teaching Assistant from 1945 to 1948).

Professionally he has done consulting work for Coors Porcelain in Golden, Colorado, and for the U. S. Navy, as well as working as a Research Physicist at the Naval Ordnance Laboratory in Washington.

His civic endeavors have extended to a Deaconship of the First Presbyterian Church from 1958 to 1960 and to Chairmanship of the Youth Budget Committee of the same from 1967 to the present.

**Robert B. Osborn**, Associate Professor of Mathematics, has a M.A. degree (Mathematics) 1936 (University of Missouri) and a A.B. degree (Mathematics) 1926 (William Jewell College).

Professor Osborn joined the faculty of the Colorado School of Mines as an Assistant Professor in the Department of Mathematics in October, 1946 and was promoted to Associate Professor in 1949. His interest in and dedication to undergraduate teaching is substantiated by his

long membership in educational associations: Mathematical Association of America (1942 to 1969), National Education Association (1926 to 1942), Montana Education Association (1926 to 1942) of which he was President in 1939 and Board Member from 1939 to 1942, and the Montana Hill County Teachers Association (1938-1939) of which he was also President.

Additional teaching experience in Mathematics was obtained at the General Motors Institute (1942 to 1946), Havre High School in Montana (1929 to 1942), and Bolivia High School in Missouri (1926 to 1929). This has been supplemented with additional graduate study at the University of Washington and the University of Colorado.

Professor Osborn has also been active in his community as a Member of the R1 School District Citizens Committee in Colorado three different times, and a Havre Lions Club member from 1929 to 1942, serving as president in 1936.

**Charles R. Baer**, Assistant Professor of Mathematics, has two degrees from the University of Colorado: M.S. (Mathematics) 1960, and B.A. (Physics) 1958.

Professor Baer joined the faculty of the Colorado School of Mines as an Assistant Professor in the Department of Mathematics in September, 1962. His principal concern has been the development of courses in numerical techniques and related computer studies. In keeping with this interest he has developed a unique double course in computer applications in the mineral industry, requiring original investigation with submission of a project report.

In projects for courses Professor Baer has utilized much of his consulting experience gained diversely at Stearns-Roger Corp., the National Center for Atmospheric Research, Martin-Marietta, Dow Chemical, and the University of Colorado Business School. Further endeavors have included the presentation of a paper at the Seventh Symposium on Operations Research in the Mineral Industries entitled "Errors in Computation." Currently, he has in preparation a textbook, "An Introduction to the Analysis of Numerical Methods."

Additional teaching experience was obtained as an Instructor in the University of Colorado Applied Mathematics Department from 1958 to 1962, and further computer experience while in Communications in the U. S. Navy from 1949 to 1953.

**Victor W. Bauman**, Assistant Professor of Mathematics, earned a M.S. degree (Mathematics) 1957 (University of Colorado) and a B.S. degree (Mathematics) 1935 (Dakota Wesleyan University).

Professor Bauman joined the faculty of the Colorado School of Mines as an Assistant Professor in the Department of Mathematics in October, 1946. His activities have been diverse, serving both as a teacher of Mathematics and as a leader in extracurricular campus activities. In the latter capacity he has served as the Faculty Sponsor of the Band and Chorus. To this endeavor he brings formal education in Music at Colorado State College (1938 and 1939), and twenty years experience as Director and officer of the Golden Methodist Church Choir.

His additional teaching experience was gained at the Cotopaxi High School in Colorado from 1939 to 1942 and at the DeSmet High School in South Dakota from 1935 to 1937. Further professional employment includes "Armed Guard" for the U. S. Navy from 1942 to 1946 and miner for Climax Molybdenum in Climax, Colorado from 1937 to 1938.

Professor Bauman is also active in community projects including membership on the Board of the Colorado Junior Soccer Association and coordinator for the Northern League from 1965 to 1968, presidency of the Golden Junior Soccer Association from 1965 to 1967, and Board membership for the Golden Symphony Orchestra.

**Don L. Bohmont**, Assistant Professor of Mathematics, has two degrees: a M.S. degree (Mathematics) 1961 (Colorado State University) and a B.S. degree (Mathematics) 1958 (University of Nebraska).

(Continued on Page 17)

# Air Pollution and Atomic Power

By C. K. Viland

The need for electrical power is increasing faster than the population explosion. Many people fear the construction of an atomic power plant in their neighborhood because of association with the atomic bomb. Actually, besides its inherent safety, a greater proportion of nuclear electrical power (using uranium or thorium) with respect to conventional steam plants (burning coal, gas or oil) in future growth will tend to alleviate air pollution. Nuclear plants are essentially free of emissions, where CO<sub>2</sub> and other impurities in the atmosphere from industry and from transportation have measurably increased in recent years. Many scientists are becoming alarmed about the environmental changes now taking place, and at a rapid rate. This article will provide another reference, and may serve a useful purpose in pollution control activities. The writer has condensed a great deal of material from numerous sources.

WITH some people reacting unfavorably to possible nuclear power plant construction in their neighborhood, some facts on the subject of atomic energy have been assembled; and are presented herein, primarily in the interest of better understanding of the subject, and of improving our environment, particularly with regard to air pollution.

We are living in an era of very rapid population growth, and also of much greater use of energy per capita—both of which factors contribute to pollution of our surround-

## Introducing the Faculty

(Continued from Page 16)

Professor Bohmont joined the faculty of the Colorado School of Mines as an Assistant Professor in the Department of Mathematics in September, 1966. He has been furthering departmental goals along the lines of Modern Algebra, especially in increasing the level of practical applications. To support his course development he has graduate study at the University of Wisconsin in addition to the above mentioned degrees, with a thesis in Algebraic Structures, and plans further graduate study at the University of Colorado.

The teaching experience of Professor Bohmont is quite varied: Instructor at the University of Wisconsin both at Madison and Sheboygan from 1965 to 1966, Instructor at the University of Vermont from 1961 to 1965, teacher at Longmont High School in Colorado from 1958 to 1959, and teacher at Lincoln High School in Nebraska from 1956 to 1958.

His civic interests are corroborated by his having held the position of Precinct Committeeman.

**Winton H. Laubach**, Assistant Professor of Mathematics, holds a M.A. degree (Mathematics) 1950 (Columbia University) and a B.S. degree (Education) 1943 (Bloomsburg State Teachers College).

Professor Laubach joined the faculty of the Colorado School of Mines as an Assistant Professor in the Department of Mathematics in September, 1953. As attested to by his first degree he has been principally concerned with the methods and techniques of teaching. His work along this line led him recently to the preparation of a paper for the Colorado Conference on Collegiate Mathematics.

His previous teaching experience in mathematics was gained as Instructor at Pennsylvania State College from 1948 to 1953. Instructor at Sampson College from 1946 to 1948, and teacher at New Milford High School in Pennsylvania from 1943 to 1945. Additional professional experience has been as consultant to the U. S. Bureau of Mines.

Professor Laubach has also for many years been an active church constituent, primarily as a member of the Methodist Choir in Golden.

ings. Pollution is now noticeable almost everywhere, particularly in and near metropolitan centers. Many cities are growing together and some areas are rapidly approaching the status of a megapolis.

An explanation of "atomic power" may be helpful in removing a few existing unfounded prejudices. Nuclear electric power plants are not similar to atomic bombs. In fact building more nuclear electric power plants (which are safe) should ultimately lead to more clean air to breathe; and they should to some extent alleviate water pollution. However, the latter is a separate problem, solution of which requires application of methods more generally understood.

Since (1) nuclear power plants are incapable of producing an explosion and radioactive "fallout," as with a bomb, because of certain principles which will be more fully explained; and (2) since the nuclear fuel—presently mostly "enriched" natural uranium containing slightly more uranium 235 than found in nature—is completely encapsulated by suitable metals or alloys thereof; and (3) the reactors themselves are enclosed, and heavily shielded to stop gamma rays—which are essentially X-rays—emissions to the air or to cooling water are negligible. When the nuclear fuel declines sufficiently in activity—usually after about two years or so—due to part of the fuel's radioactive decay into isotopes of other elements tending to interfere with and slow the reaction, the still encapsulated fuel is removed and transported to another plant where the elements are chemically separated. There reconstituted uranium fuel is placed into new tubular metal cladding for further use in power generation.

While nuclear electric power plants produce negligible air or water pollution, this is not the case with the conventional thermal electric power plants depending on ordinary fuels—natural gas, oil or coal. All of these produce carbon dioxide and products of incomplete combustion including smoke and some poisonous carbon monoxide. Besides this, oil and coal produce sulfur oxides to a greater or less extent, depending on source; and the degree of refining in the case of oil.

These air pollutants are beginning to reach such alarming proportions in some areas that regulations now provide that only natural gas or slightly desulfurized fuel oil may be used. Coal produces still another undesirable pollutant, ash. Fly-ash pollutes the air along with smoke from incomplete combustion and settles out over large areas. Recovered ash contains many undesirable elements including metals and compounds. When the ash is removed to disposal areas it tends to leach out by rainfall, adversely affecting ground waters.

Even more important, all three fuels—gas, oil and coal—when burned with air (about 21% oxygen and 79% nitrogen) produce, to a greater or lesser degree, some very undesirable oxides of nitrogen. These oxides remain one of the unsolved problems of "smog," little progress having been made in their elimination. Nitrogen dioxide

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and nitrous anhydride are reddish brown gases and are among the ingredients of smog.

Automotive equipment, whether burning gasoline or diesel fuel, are also major contributors of nitrogen oxides to the air. Under pressure by recent laws, automotive and aircraft engine manufacturers have made great strides in developing and introducing devices which reduce unburned hydrocarbons, and other products of incomplete combustion—smoke and carbon monoxide. Hydrocarbon evaporative losses have been or are being solved—both in the refinery, in transportation, and in automotive use. Improved refining methods have greatly improved quality of automotive fuels which now burn cleaner because of substantial removal of petroleum's sulfur and nitrogen compounds, also other impurities.

Nitrous oxide is particularly undesirable in the air as its chemical activity increases smog problems. It combines with ozone produced by the sun from the air's oxygen, making oxygen far more active, and also with hydrocarbons, particularly if they are of the "unsaturated" type.

All these smog elements, including smoke and many poisonous pollutants such as carbon monoxide and lead from gasoline are entrapped near the surface if wind fails to blow and/or a "lid" is formed by a temperature inversion (some air above ground at higher temperature than at ground level), which phenomenon is common in some areas, particularly along the California Coast. This problem is mentioned in some detail, since it is common to conventional thermal electric power generation, all industry in general, and to automotive and any other form of transportation involving fuel burned with air.

Geothermal electric power generation is not considered since it is inconsequential, presently developed only in several places—Sonoma County, Calif., Italy, and more recently in Iceland, New Zealand and Russia. Direct production of electricity from solar energy is also omitted from discussion, since practicable large scale methods have yet to be developed. Electric automobiles suitable for today's traffic are a long way off pending invention of an efficient light weight battery. Should they be developed many more electric power plants would be needed to recharge batteries.

Thus it is apparent that a greater proportion of nuclear electric power plants with respect to conventional thermal plants will be quite beneficial in reducing air pollutants. In fact, some scientists have gone so far as to recommend that all electric power, other than hydroelectric, be generated in nuclear plants.

Presented herewith are some facts pertaining to generation of electrical power by nuclear (atomic) energy:

## Past, Present and Forecasted Nuclear Power Operations

1. The September 1969 issue of "News from Jersey," sent to shareholders of Standard Oil Co. (New Jersey) contains the following paragraph: "PREPARING FOR THE NUCLEAR AGE—Although it as yet accounts for only a small proportion of the total supplies, nuclear energy is perhaps the fastest growing of all energy sources. In recent years it has assumed particular importance in the generation of electrical power. The first large commercial power plant was ordered in 1963; since then 21 nuclear power plants have been put into service and another 76 have been ordered and are slated to be completed by or before 1976."
2. "Chemical and Engineering News" for Sept. 15, 1969, contains an article on Page 21, which is quoted in part as follows: "Atomic Energy Commission's Robert L. Ferguson cited the projected growth of electrical generation capacity from 290,000 Mw. (Note: megawatts—one megawatt equals 1,000 kilowatts or one million watts) of today to 600,000 Mw. by 1980 and to 1.6 million by 2000. Nuclear electricity is only 1% of today's capacity but may be 25% by 1980 and 45% by 2000. This capacity will come from construction of plants whose lifetime is expected by A. E. C. to be 40 years."
3. A good proportion of the present and planned large nuclear power plants are in or near major metropolitan areas.

## About the Author

Clare Kenneth Viland received his Petroleum Engineering degree in 1929 from the Colorado School of Mines. For more than 34 years he was employed as a chemist, chemical engineer and in supervisory positions by Tidewater Oil Co. (now Getty Oil Co.) and its predecessors, Associated Oil Co. and Tidewater Associated Oil Co. For more than 15 years Mr. Viland was general supervisor and manager of Research and Development, Western Division, at its Avon Refinery near Martinez, Calif.

Recently retired Mr. Viland is active as a member of the Board of Directors, Bodega Bay Public Utilities District; a member of the Sonoma County Health Planning Assn., Subcommittee Four—Radiological Health, Occupational Health, Accident Prevention and Noise Control.

Mr. Viland has been granted 10 U. S. patents of which over half are being used commercially in oil refining. During World War II he received a U. S. Government Citation for his activities in maximizing production of aviation gasoline.

4. Prior to 1963 a substantial number of nuclear power reactors were in operation, mostly experimental. Pacific Gas and Electric Co. was granted A. E. C. License #1 for a nuclear electric power plant; and placed into service October, 1957, the 5,000 kilowatt semi-commercial Vallecitos plant at Pleasanton, Calif. It operated for a number of years with complete success and only recently was taken out of service.
5. Although Hahn and Strassman of Germany first produced fission of Uranium in 1939, the first atomic power reactor, or uranium pile as it was called, was erected and operated by the foreign-born scientist, Dr. Enrico Fermi, of Columbia University and collaborators on Dec. 2, 1942. It was located under the stands of Stagg Field at the University of Chicago.

The purpose was to obtain technical data needed for developing the atomic bomb, and done under war-time conditions. It was easily controllable and was finally allowed to reach a maximum output equivalent to only 200 watts; with no shielding it was felt unsafe to go higher because of radiation danger to personnel in and around the building. It was constructed of graphite bricks, a moderator used to slow down neutron emissions for their efficient use, with each alternate brick containing a lump of uranium or uranium oxide. A spherical shape for the pile was desired, and its size determined by theoretical considerations.

Channels into which cadmium strips could be raised or lowered were provided. Cadmium along with some other materials has the property of absorbing neutrons emitted by atoms of Uranium 235, needed to split other atoms of the same isotope or Uranium 238; and therefore can be used to stop or control such reaction. These control strips were kept lowered during construction but periodically raised to determine when the "chain" or self-sustaining reaction had started. The chain reaction started somewhat sooner than calculated so that the final shape of the pile as a cross between a sphere and a spheroid.

The nature of matter which includes atoms and subparticles thereof are discussed in an ensuing section.

6. The first atomic powered submarine, the USS "Nautilus" was launched in 1954. Today the United States, Russia and Great Britain operate fleets of these submarines. In addition the United States has built and operates an experimental merchant ship, and the large aircraft carrier USS "Enterprise."
7. Nearly all oil companies, who consider themselves primarily energy suppliers, are in or are entering the uranium mining and ore concentration field; and more recently have started to take over from, or to supplement the U. S. Government's activities in refining and reprocessing spent reactor fuel elements, and reconstitute uranium or plutonium for further use.
8. Thorium which is more plentiful than uranium can also be used as a nuclear fuel but at present offers no advantages.



9. The energy available from known minable uranium and thorium far exceeds that of the combined reserves of natural gas, petroleum, coal and oil shale.

#### Nature of Matter

All matter is made up (1) of elements—including hydrogen, the lightest, atomic weight 1, on through a total of 92 occurring in nature—to the heaviest, uranium, atomic weight 238; or (2) of compounds—which are chemical combinations of atoms, such as water which is two atoms of hydrogen and one of oxygen held together by a binding force.

Other elements beyond the 92 in nature are those man-made, in the laboratory; and in the case of plutonium, also in large plants (as well as recovery of some from spent uranium fuel.) There are now 100 elements—some already well known such as plutonium and californium.

A Russian scientist, Mendeleyev, in 1870 arranged the known elements into a pattern called the Periodic Table. This table arranged the elements—placed horizontally by atomic weight and vertically by similarity in chemical behavior. For example, copper, silver and gold exhibit similar chemical behavior, but have different atomic weights—29, 47 and 79. They appear in the same vertical column in the Mendeleyev Table, with the lightest on top. The table is a most useful tool to scientists. It helped in the discovery and explaining of more than one species of some elements, differing slightly in atomic weight—these are called isotopes of the element. There were gaps in the table, subsequently filled in by new discoveries, including the new man-made elements.

Up to the beginning of the present century it was thought that the atom was the smallest particle of matter, and was indivisible. It is now known that an atom is made up of three basic particles—protons, neutrons and electrons, and that the atom can be subdivided. There are also other particles of an atom, such as mesons, and the binding forces which are still being investigated.

Each atom consists of a tiny but relatively heavy core called the nucleus. It has a positive charge because it contains at least one proton, and may contain neutrons with no charge. This nucleus is surrounded by whirling negative electrically charged particles called electrons. Thus the atom might be compared to our solar system with the sun as the core or nucleus, and the planets including Earth as the electrons whirling around it in a predictable pattern.

#### Isotopes of Elements

As indicated above, the Periodic Table has been helpful in the discovery of the existence of different species of the same element; and why certain elements were not whole numbers. These isotopes of elements, each with a different atomic weight, have almost identical physical properties and chemical behavior. They vary in atomic weight because of the difference in number of neutrons in their nucleus (central core.) Of the presently known 100 elements, including those man-made, many have isotopes. Tin for example has 11, and there are three known hydrogen isotopes: ordinary hydrogen with atomic weight of 1; deuterium (heavy hydrogen) with atomic weight of 2; and tritium with atomic weight of 3. The first two hydrogen isotopes are stable and found in nature; and the third, tritium, is unstable (radioactive.) Most unstable isotopes are known as radioisotopes. These include most of the elements man-made in particle accelerators or nuclear reactors.

The heaviest element occurring in nature is uranium and all its isotopes are radioactive—hence the use of the Geiger counter in prospecting for deposits. In nature it has 3 isotopes, about 99.3% uranium 238, 0.7% uranium 235 and a trace of uranium 234. Hence uranium in its natural state does not have an atomic weight of exactly 238. Since hydrogen in nature has two stable isotopes—ordinary hydrogen and deuterium (heavy hydrogen, atomic weight 2)—hydrogen in nature has an atomic weight of 1.0080.

#### Radioactivity

Elements which spontaneously change or disintegrate into other elements are unstable and described as being "radioactive." The only natural elements which exhibit this property (with a few minor exceptions) are those of very high atomic weight or mass numbers—uranium, thorium, radium and actinium. Radon, the heaviest gas known, atomic weight 222, is radioactive and is found in nature always with radium but has a very short "half life." Because uranium decays to radium on its way to lead, Radon is found in underground (pitchblend ore) uranium mines. These heavy metals have very complex nuclear structure. All of these eventually change into lead in the process of becoming stable by particle loss through radiation. They may form intermediate elements, also unstable, during this decay. For instance, uranium in nature changes into elements like radium, radon and polonium before becoming lead.

The rate of radio-active decay is measured in terms of "half-lives." Half-life is the time for radioactivity to be reduced to one-half the original amount. These "half-lives" vary; for instance, that of uranium 238 is 4.51 billion years; of radium 226, 1620 years; or radon 222, 3.8 days; and of polonium 212, 3 ten-millionths of 1 second. Man-made elements are also radioactive and disintegrate and transmute into other elements at various rates, and have now been assigned their "half lives." That of plutonium 239 is 24,300 years.

A "radioactive" atom emits rays which are electrically charged particles, or may be electromagnetic waves with no mass; or may emit both. These emissions are known as alpha, beta and gamma rays. Alpha rays carry a positive charge, have an atomic weight of 4 and travel only short distances, in air an inch or so. They are easily stopped by any thin shield such as a sheet of paper. Beta rays are negatively charged electrons with extremely small mass. They travel only a few feet in air and are stopped by a thin metal shield or about an inch of wood. Alpha and beta rays can be dangerous, particularly if materials emitting them are ingested or inhaled. Gamma rays are not particles, but are shortwave electromagnetic emissions similar to well-known x-rays. They travel great distances and easily pass through most solid substances, requiring thick shields of lead, steel, concrete, earth or other material to stop them.

#### Fundamentals of Atomic Energy

##### 1. Basic Principles

Nuclear energy is everywhere in the universe around us. The sun pours out great quantities of atomic energy which comes to earth in the form of heat, light and other kinds of radiation. The sun's energy comes from fusion of light elements (hydrogen) to form heavier elements including helium with some overall loss in weight (mass) and a release of energy. Energy can also be created by fission of elements—breaking apart heavier atoms into lighter ones, such as the splitting of an atom of uranium. This also occurs with loss in total weight accompanied by a release of energy.

According to Einstein's law, one pound of any matter (hydrogen, uranium, etc.) is equal to over 11 billion kilowatts of energy. A substantial part of this is recoverable by presently known means—such as generating steam from the heat released, and converting the steam's energy by turbo-generators into electrical energy. Albert Einstein, in 1905, stated that mass and energy were equivalent according to the equation:

$$E \text{ (energy)} = m \text{ (mass)} \times c^2 \text{ (speed of light)}$$

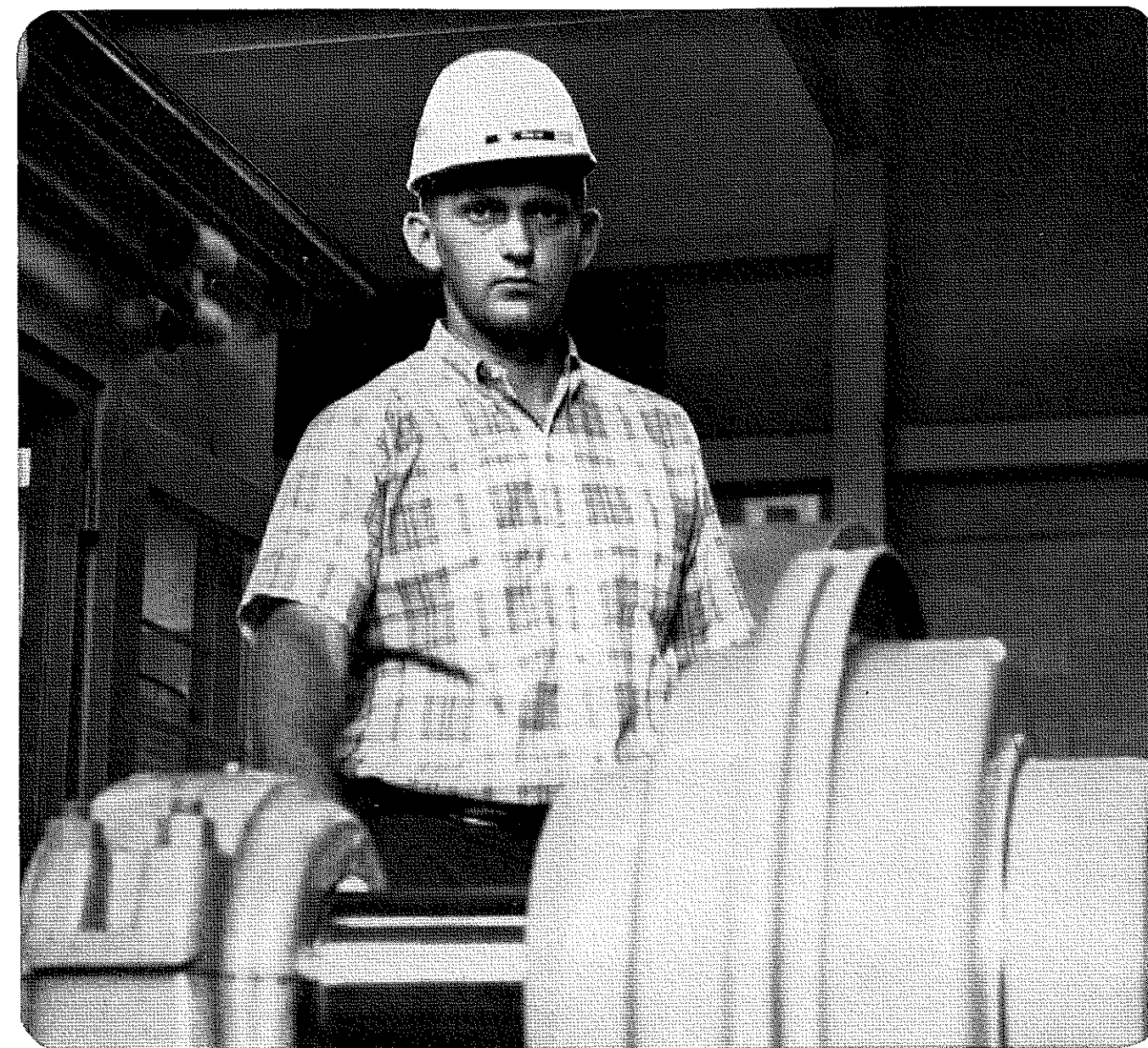
Thus, one pound (of anything) multiplied by 186,000 miles per second equals a number in mile-pounds per second equivalent to 11.4 billion kilowatts per hour of energy.

##### 2. Fission and Fusion

Splitting an atom is known as fission. Fission requires atoms of high molecular weight such as uranium. The splitting or fission is done by either high or low speed neutron particles.

(Continued on Page 22)

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(Continued from Page 20)

Under proper conditions atoms of the lighter elements can be made to fuse, thus forming heavier elements. To initiate fusion extremely high temperatures are required—in the order of millions of degrees. The sun in our solar system is an example of fusion, where hydrogen is the fuel, and is converted into helium and heavier elements.

Science has not yet learned to control the fusion process sufficiently other than for producing an explosion; i.e., in the hydrogen bomb. However, research work on fusion processes and potential methods of recovery of the enormous useful energy therefrom is continuing.

#### Difference Between Atomic Bombs and Atomic Energy for Power

##### A. The Bomb

1. When Dr. Fermi and his associates produced the first atomic chain reaction in uranium at the University of Chicago, this did not insure that atomic energy could be made effective as a bomb. To have an effective explosion it is necessary that the chain reaction build up extremely rapidly; otherwise only a small amount of nuclear energy will be utilized before the bomb flies apart, and reaction stops. It is also necessary that no premature explosion occurs. This "detonation" problem was one of the most difficult problems to be solved in the war-time race with Germany.

Fortunately this, as well as the other two major problems were solved; namely, (1) the difficult separation of uranium 235 from its isotope uranium 238 with nearly the same unit weight but also both having the same chemical behaviour, and (2) large-scale production of the new, hitherto unknown element plutonium 239. Chemical difference between it and its parent metal uranium 238, however, made separation relatively easy.

Plutonium and other transuranic elements were discovered and first made in the laboratory by Dr. Seaborg and others in 1940 at the University of California (Berkeley). U. of C. scientists were especially prominent in

producing the first successful bomb—Lawrence, Oppenheimer, Teller and others; as well as many from other U. S. universities, from industry and from government agencies. To mention a few typical well-known names—Drs. Compton, Urey, Conant, Bush, Murphree and General Groves. While European scientists were most prominent in early research work on atomic energy, a number of these emigrated to the United States immediately after the war started in 1939—Einstein, Fermi, Neils Bohr, Wigner, Szilard—are a few of these.

It has been noted Germany was aware of uranium's potential, and was working on the atomic bomb. For example, they were frantically trying to make large quantities of heavy water (containing deuterium instead of ordinary hydrogen), an excellent moderator, in Norway after their invasion—pure water and hydroelectric power being plentiful there.

2. Although details of the bomb are a military secret, some facts have become well known. A chain or self-sustaining reaction is needed. A bomb must consist of a number of pieces of fairly pure uranium 235 or of plutonium 239 capable of producing neutrons. Each part must be below the "critical size" either by reason of weight or shape. To produce detonation, these parts must be brought together extremely rapidly. In an ordinary atomic bomb the parts are properly assembled and then brought together at high velocity; this "firing" of the bomb raises the temperature to millions of degrees. After this condition occurs vaporization and expansion causes the uncontrolled reaction to be no longer possible, and therefore stops before all fissionable material can be utilized. Hence the difficulty in producing a relatively high efficiency bomb. By 1945, the World War II type bombs had been developed largely under the direction of Oppenheimer. The first test bomb was set off in New Mexico July 16, and the first military bomb dropped over Hiroshima Aug. 6, 1945.

3. In the case of the hydrogen bomb the mechanism of causing explosion is even more complex. Since millions of degrees are required to initiate a fusion reaction, firing may be done with a small conventional atomic bomb. The first large hydrogen bomb was tested at Eniwetok Atoll in 1951. Dr. Teller was largely responsible for developing the hydrogen bomb.

##### B. Nuclear Power Reactors

Power generation requires "slow" neutrons, so that with present knowledge the neutron-producing uranium 235 is efficiently utilized. Therefore, a suitable moderator to slow down the normally fast neutrons is essential. This moderator (usually carbon) surrounds the nuclear fuel capsules or rods. The fuel is usually "enriched uranium"—i. e., normally 2–3% uranium 235 mixed with natural uranium. This fuel is encased, commonly in tubular form with a suitable encapsulating metal such as aluminum alloy or stainless steel. To keep the reactor temperature within the limits of materials of construction, the heat must be removed by a suitable coolant—ordinary boiler water is commonly converted into steam by the reactor. The steam is used to turn turbines generating electricity, then condensed in heat exchangers for re-use. Output of power by the reactor is controlled by inserting or withdrawing the control rods (to absorb neutrons as desired.) These are commonly made of cadmium, boron carbide or other suitable materials. This movement, of course, is easily adaptable to fully automatic control.

With sufficiently high steam pressure and temperature, high thermal efficiencies are possible—in the order of 35–40% as compared to 20–30% in the internal combustion engines using gasoline or diesel fuel.

The encapsulated nuclear fuel, after it becomes spent or undesirably inactive in producing heat, contains a substantial amount of a number of fission products, a small amount of uranium 236, and a substantial quantity of plutonium 239 produced—all of which must be separated from the remaining uranium 235 and 238. This is done in a separate plant located elsewhere as will be discussed below.

For safety reasons the reactor itself is usually contained in a gas-tight vessel; or in some cases in an entire gas-tight housing.

##### Health Hazards of Radiation

In small amounts, radiation is a phenomenon of nature to which every living creature is subjected: cosmic rays from the sun strike the earth everywhere and some elements in the earth's crust like uranium or radium emit radiation. However, in large amounts, radiation is injurious to all living things.

Therefore, all personnel working in radioactive areas, whether in the laboratory or in plants, are required to wear film badges. These are examined periodically—weekly, or more frequently if necessary, to determine radiation received. Standards are presently set by the Atomic Energy Commission, and while these or medical standards may be changed from time to time, the standard program is: 0.3 roentgen in any week, adding up to at most 15 roentgens per year. This includes a safety factor which experts believe will not cause any tissue damage if continued for a lifetime.

A roentgen is a measurement of radioactivity named in honor of the discoverer of X-rays (Roentgen of Germany in 1895. A roentgen is the quantity of X- or gamma radiation needed to penetrate one cubic centimeter of air at standard pressure and temperature.) The medical profession often uses the word "rad," or roentgen equivalent, physical.

Radiation problems to workers are solved by proper use of shielding, observing proper distances, and time of exposure. Radioisotopes can be handled safely by anyone with proper training, facilities and instrumentation.

In the case of power reactors as previously stated, normally no radiation escapes. However, normal sampling, testing, changing of fuel rods, etc. involves some exposure and if considered necessary, protective clothing and masks may be required. This is in addition to normal measurement of any radiation by instruments, alarms, and on film badges. The few accidents which have occurred to date were all in experimental reactors. If for some reasons all controls should fail, including human; and excessive temperatures result, followed by melting of the metal encapsulating the fuel elements, reaction will finally stop, but when cool the resultant mess must be cleaned up. In the June 1955 conferences mentioned in the acknowledgment paragraph below, one such case had occurred in an experimental reactor in Canada using plutonium as fuel. Elaborate precautions were taken during decontamination and when a worker had received his maximum radiation for the week, which may have in some cases occurred in a short time, he was taken off the job for the balance of the week.

It should be mentioned that experiments have been made in which "runaway" conditions were deliberately imposed upon nuclear reactors. In 1953 and 1954 a series of tests were made at the Idaho Reactor Testing Station. In one test, power output was allowed to rise to well over a million kilowatts in a tenth of a second, and resulted in the destruction of the reactor core and some associated equipment. The conditions imposed in this test were much more severe than in any reasonable conceivable accident.

##### Public Reaction

Radiation's danger is properly feared, but the wrong common sources are suspected. While some people react unfavorably to nuclear power plant construction, they fail to recognize even more lethal sources—excessive X-ray diagnostic examinations, some types of electrical switches used in industry, color TV sets in the home, radar ranges for cooking and even the sun's rays, especially at high altitudes.

A good deal of information on this subject is contained in the June 1969 "Science and Technology" in an article entitled "Tainted Radiation" starting on Page 46 by Dr. Karl Z. Morgan, director of the Health Physics Division at the Oak Ridge National Laboratory since 1943. He has been awarded a Gold Medal by Sweden's Royal Academy of Science.

His article states "more radiation is thrown up into our skies in one year's burning of coal (as radon) than is released from an atomic thermal reactor operated for 50 years. Atomic bomb fallout containing radioactive iodine (and other materials) can be particularly harmful to humans and animal life. As stated before, such fallout normally cannot occur with atomic reactors." Dr. Morgan also asserts that in a commercial power reactor elaborate precautions are taken to minimize any type of accident. Even assuming human failure, always possible, with these safety devices "the possibility of a so-called maximum credible accident is exceedingly small." His article states there have been two experimental reactors involved in fatal accidents—one person was killed in an accident near Belgrade, Yugoslavia, in October 1958, and three persons died at the Idaho Falls, Idaho, experimental reactor in January 1961. He also points out that risks of accident in an experimental reactor are many orders of magnitude greater than in large power reactors.

##### Valuable By-Products of Reactors

In condensing the steam, heat exchangers are used. By installing more elaborate cooling equipment most of this waste heat, normally dissipated into cooling waters of rivers or the ocean, brackish or even ordinary sea water can be distilled into high-purity potable water. Less heat is lost in cooling. This water can advantageously be used to augment our dwindling water supplies. Even with the best treatment plants, many cities use highly polluted river water—and finished product to the consumer is certainly of marginal quality.

In very large installations of nuclear power plants near oceans, even the by-product brine may contain valuable and potentially economically recoverable materials such as, for example, magnesium, of which sea water is presently the main source of supply. With the recovered potable water and/or other sea water products bearing part of the operating costs, nuclear-produced electricity becomes cheaper.

In the entirely separate centrally-located nuclear fuel reprocessing plants, useful radioactive isotopes are recovered which are finding increasing use in research, medicine and industry. For example, cobalt 60 has replaced to a large extent radium and X-rays in cancer treatment and in preservation of food such as dog food containing meat. Iodine 131 with short half-life can be used as a tracer to locate difficult-to-find tumors by injecting the body with it. Cities can similarly locate water or sewer line leaks with short-life tracers. Oil companies may use iron 59 to measure engine wear and thereby improve lubricating oils; or with small amounts of any of several radioactive tracers can accurately determine the interface when two different products are being pumped in slugs through a pipeline. Other industrial and research uses are too numerous to mention.

##### Reactors of the Future

A large variety of experimental reactors have been built and tested. Dr. Morgan in his article states, "In the years immediately ahead, breeder reactors making more plutonium 239 and/or uranium 233 than the U 235 they burn will replace burner-reactors now operating. The next round of power reactors will be fast neutron breeders (0.5–2 Mev.) also producing more plutonium 239 from uranium 238 than the uranium 235 they consume. These reactors will be followed 10 to 15 years later by thermal breeders that produce uranium 233 from thorium 232 and operate in the thermal or low energy (slow) neutron region."

##### Acknowledgment

In addition to the above current references, the author wishes particularly to acknowledge valuable information on peaceful use of the atom obtained during the Atomic Energy Course for Management presented by the National Industrial Conference Board at Montauk Manor, Montauk Point, N.Y., in June 1955, which course included a visit to Brookhaven National Laboratory's experimental reactor on Long Island and also to information presented by Dr. H. D. Smyth in his book "Atomic Energy for Military Purposes," issued by Princeton University Press.

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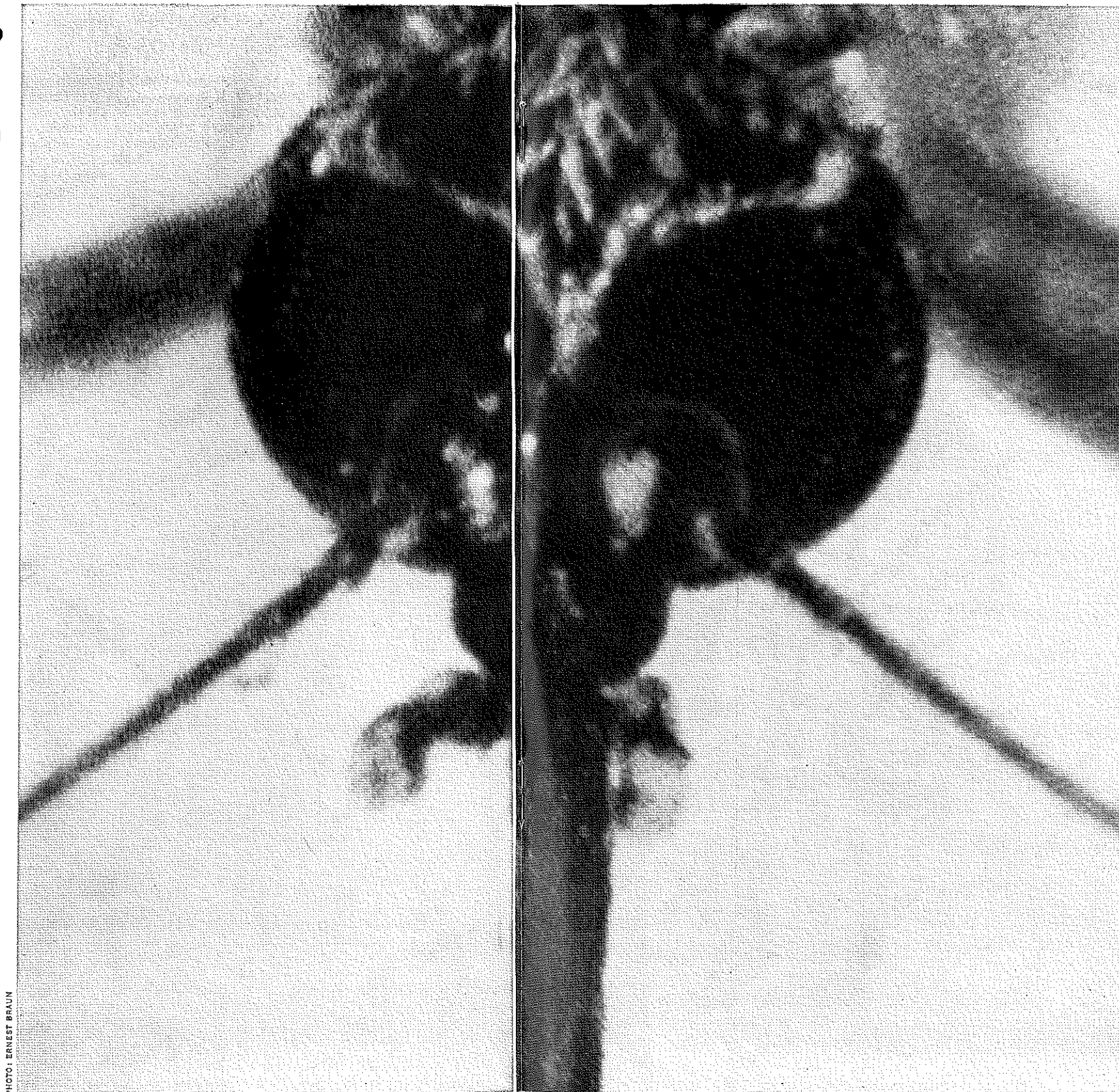


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*The Violent 60's*—After reading the splurge of horrible happenings that have plagued the past decade, I wonder how any of us survived. From my own experiences it cannot have been quite as bad as portrayed by the press and television. Some good things must have occurred, for the year 1969 did not produce the riots and bloodshed predicted for 1969. Seemingly our prophets are always either too right or too wrong. The Middle Way, which has a tendency to follow, just does not satisfy the seer who sees colors in black or white and never in shades of gray.

The student protests have apparently lost their impact because the mass of students (the squares or semi-squares) are simply fed up with the diet of constant agitation.

Based upon my own experiences during World War II, even fear loses its edge of terror and becomes acceptable as part of the facts of life.

*The Happy 70's*—Magically the decade will have no problems since all were left behind with the violent 60's. Peace will settle over the world and the peace demonstrators must find something to protest, and, of course, there will be plenty—pollution, overcrowding, civil-rights and the hippies. Really nothing will have changed but the year. Hope ever arises and the next sunrise will reveal the paradise that we long for but have never found.

*L'Envoi*—The belligerent young and the uncommitted continue the war against the establishment, seemingly unaware of the fact that those who started the agitation and demonstrations in 1967 are all ready out of the picture.

The environment which youth is trying to create is the one in which they will spend most of their lives. At my age, I can ignore them and the environment and I won't be here to put up with their "creation."

—Wendell W. Fertig

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## Meeting—Board of Directors Colorado School of Mines Alumni Foundation

November 6, 1969

**P**RESIDENT Johnson called the meeting to order at 7:40 p.m. Those present were: Robert Johnson, president; Harrison Hays, secretary; Robert Magnie, treasurer; John D. Vincent, director; Allen McGlone, chairman, High School-College Relations; Warren Prosser, chairman, Entertainment Committee; William V. Burger, alumni staff; Wendell W. Fertig, executive secretary.

The minutes of the meeting of Oct. 15, 1969, were read and approved.

The financial report for October, 1969, will be presented at the next meeting.

### OLD BUSINESS

a). A good attendance on Parent-Student Day was reported despite the bad weather. About 200 were present mainly from areas outside the City of Denver. The new procedure for introducing guests was reported to be successful. The Admissions Office has expressed pleasure concerning the excellent manner in which the program worked in cooperation with the Administration.

A motion was made and approved expressing appreciation to Al McGlone for managing the successful activity.

b). Bob Johnson reported good progress being made in arranging for a general reunion of the classes of 1952, and 1959 at the Holiday Inn West. The night before Homecoming. The Class of 1954 had their own reunion dinner the same evening at the Holiday Inn.

c). Colonel Fertig reported a reasonable return of ballots which were mailed about October 20.

d). A good attendance at the Mines breakfasts in Salt Lake City and San Francisco was reported—84 at the Ramada Inn in Salt Lake City and 77 at the Sir Francis Drake in San Francisco.

### NEW BUSINESS

a). A Prudential Insurance Company retirement plan for key employees was approved at an annual cost of \$500.

b). Approval was given for the sale of 150 shares of Liberty Loan stock and reinvestment of the proceeds in American Export and Tenneco convertible debentures. Colonel Fertig was commended for the way in which he is managing the Trust Fund.

c). Magazine — Dean Burger reported that advertising revenues were ahead of a year ago by some \$2,400. He also reported that the corporate image type of advertisements have increased due to delivering the magazine to all juniors and seniors.

d). The next meeting will be held on December 11, 1969. The Annual

Meeting is scheduled for January 23, 1970. The location will be announced later.

The meeting was adjourned at 9:10 p.m.

### AERIAL TRAMWAYS

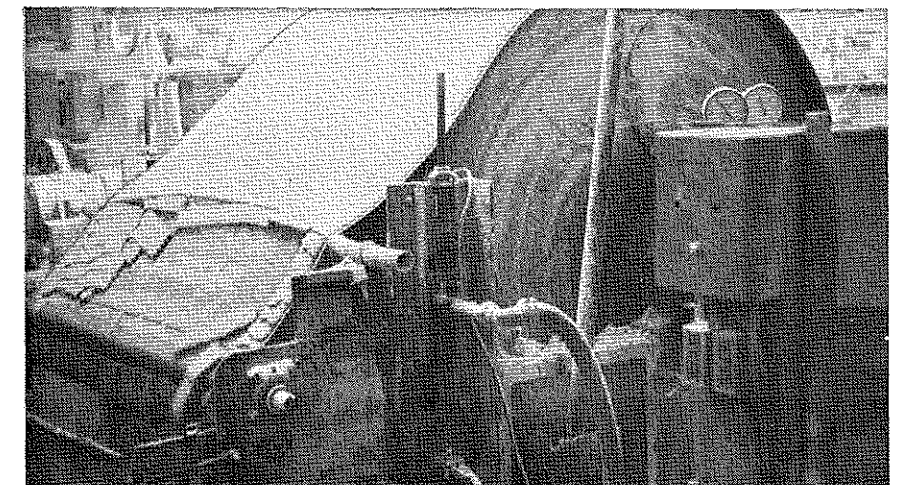
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## From the Executive Secretary's Desk



Col. Fertig

**Election Results**—Committee headed by Dr. Walter Dumke, M.Sc., 1929, Honorary CSM member alumni 1969, will meet on January 15, to count the ballots and present the results to the director of the alumni association, that same evening the board of directors at CSM alumni foundation will meet to receive the report of this committee and certify the results.

The new officers will be installed on Friday evening, Jan. 23, 1970 at the annual meeting to be held at the Lakewood Country Club. The Hospitality hour at 6:30 with the dinner served at 7:30. The club is being rebuilt and entrance should be made through the swimming pool entrance to the rest of the main building. Facilities are intact and I am sure that this meeting would be enjoyed by all who attend. A separate notice is being sent to the individual alumni so reservations can be made.

**Financial Condition**—It is impossible to put in detail the financial condition of the foundation at this early date since all reports from the bank and the trust fund have not been received (this is written Dec. 29, 1969). From a cursory survey for the period our income from the trust fund will be some 60 per cent higher than last year while advertising revenue has increased by some 20 per cent. This increase, of course, has been offset in part by the increased expenses of printing and operation.

**Christmas Greetings** — Many Christmas cards were received from the alumni and these will be noted in a later issue of the magazine. It is impossible to reply individually to each of you

but we do want you to know how much we appreciate your good wishes.

**The New Year 1970**—As my firm belief we will enjoy another prosperous year and this will certainly come true if we retain the support of the individual alumni as we have in the past. To each of you we wish to extend our heartiest best wishes for your success in 1970 as well as in future years.

**Convention Meetings** — The Annual Mines Breakfast during Colorado Mining Convention will be held at 7:30, Saturday morning, Feb. 14, 1970 at the Denver Hilton Hotel. Tickets may be purchased at the Registration Desk.

### Joe Fusselman, '42

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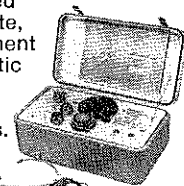
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## Personnel Placement

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

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

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

Client's Code Number	Degree	Age	Marital Status	No. of Children	Preferred Fields of Work	Locality Preferred	Languages Spoken
MN 12	Mining	30	M	2	Project Mgmt./Opns. Mgmt.	West U.S.	English/Spanish
MN 16	Mining	28	M	2	Underground or Open Pit Mine, Operation or Engineering	Open	English/Spanish
MN 18	Mining	44	M	2	Mining-Metals Mill	Colorado	English
MN 19	Mining	34	M	2	Mining Engineer	Western U.S.	English
MN 25	Mining	28	M	0	Mine Engr./Submarine Mining	Southeast U.S./Alaska	English
MN 26	Mining	23	M	0	Engr. Management	Open	English
MN 27	Mining	26	M	0	Mining Engr. Management	Open	English
MN 28	Mining	39	M	2	Mining Engineering	West U.S.	Spanish/Portuguese
MT 41	Metallurgy	29	M	2	Metallurgical Engineering Management	U. S.	English
MT 42	Metallurgy	25	S	0	Sales or Technical Representative	Open	English
MT 43	Metallurgy	28	M	2	Metallurgical Engr./Nuclear Fuel Rod Mfg.	U. S. except N.E.	English
MT 44	Metallurgy	28	M	2	Mechanical Metallurgy	Open	English
GE 26	Geology	44	M	3	Petr. Geology	Foreign	English French
GE 27	Geology	45	M	4	Petroleum Expl.	Western U.S. Pacific/Asian Pacific	English
GE 28	Geology	28	S	0	Engr. Geol. or Petr. Petroleum Exploration	Western U.S. Alaska	English
GE 29					Mining Geology	Western U. S.	English
GE 31							
GP 15	Geophysics	49	M	3	Petroleum Expl.	Rocky Mountains	English
GP 17	Geophysics	34	M	1	Geophysics	Colorado	English
GP 18	Geophysics	23	S	0	No Mgmt. Trainee	Rky. Mtn.	English
PE 10	Pet. Engrng.	48	M	2	General Management/Administrative or Financial	Open	English French (slightly)
PE 11	Pet. Engrng.	26	S	0	Pet. or Sales Engineering	Denver	English
PE 12	Petroleum	27	M	2	Reservoir Engr.	Foreign or Rky. Mtns.	English
PE 15	Petroleum	24	S	0	Reservoir Engr.	Rocky Mtn. Region	English
PH 02	Physics	23	S	0	Engineering Physics	Rocky Mtn. Region	English

## Address Changes

### 1900-1919

C. E. Dyer, '10, R.R. #2, Box B5, Durango, Colo. 81301.  
Arthur C. Bigley, '13, c/o George Gluck, Ramsey, Mont. 59748

### 1920-1939

F. H. Storms, '24, Apartado 61, 692, Caracas, D. F. Venezuela, S. A.  
Donald M. Davis, '25, 1906 Bolsover, Houston, Tex. 77005  
J. Ross Hartley, '27, 10705 Emerald Dr., Sun City, Ariz. 85351  
T. A. Manhart, '30, 608 National Bank of Tulsa Bldg., Tulsa, Okla. 74103  
James C. Wilkerson, '31, 9618 Bontwell, San Antonio, Tex. 78230  
Clifford R. Horn, '33, 1143 North Jordon, Liberal, Kan. 67901  
Clifton W. Livingston, '33, 624 Panorama Dr., Grand Junction, Colo. 81501  
Earl L. H. Sackett, '33, 2220 E. 4800 South, Apt. 85, Salt Lake City, Utah 84117  
Paul G. Sharp, '33, P. O. Box 908, Big Springs, Tex. 79720  
Arthur E. Falvey, '34, 468 North Main St., Buffalo, Wyo. 82834  
Philip A. Pelton, '35, Pelton & Smith Co., Inc., 334 West 17th South, Salt Lake City, Utah 84115  
W. C. Grove, '36, Apartado Postal 1595, Guadalupe, Jalisco, Mexico  
Hugh E. Templeton, '36, The Lummus Company Far East Ltd. (18 Fl.) 2 Ice House St., St. George's Bldg. Hong Kong B.C.C.  
W. Bruce Barbour, '37, 1309 Bank of the Southwest Bldg., Houston, Tex. 77002  
Eugene D. Bishopp, '37, 963-19th St., Boulder, Colo. 80302  
Richard S. Russ, '37, P. O. Box 113, Benton, Ariz. 72015  
Charles D. Saus, '37, Huertas 11, San Miguel de Allende, Gto., Mexico  
George M. Chapman, '38, 5492 Brae Burn Pl., Buena Park, Calif. 90620  
Thomas C. Baker, '39, 400 E. Randolph St., Chicago, Ill. 60601  
Paul B. Davis, '39, 1020 Columbia Ave., P. O. Box 67, Del Norte, Colo. 81132

### 1940-1959

Wm. R. Lewis, '40, 14 Cornelia Dr., Greenwich, Conn. 06830  
W. Everett Sherbondy, '40, 455 Garrison St., Denver, Colo. 80226  
Richard E. Buell, '41, c/o Caltex Services, Ltd., 29/30 Old Burlington St., London, W. 1 England  
Ray F. Keller, '41, Mandrel Industries, Inc., P. O. Box 36306, Houston, Tex. 77036  
W. R. Schiele, '41, Ave. Juarez 117, Mexico 1, D.F., Mexico  
Edward A. Dolega, '42, 247 Green Acres Road, Tonawanda, N.Y. 14151  
Lt. Col. Rone B. Tempest, '42, 110 Estates Dr., Apt. B, Roseville, Calif. 95678  
Robert R. Davis, '47, 10 Kensington Dr., Lincolnshire, Deerfield, Ill. 60015  
William H. Erickson, '47, 440 Capitol Life Center, Denver, Colo. 80203  
Bernard J. Ferris, '47, c/o Shell Development Co., P. O. Box 481, Houston, Tex. 77001  
Gilbert D. Borthick, Jr., '48, 1833-13th Ave. Greeley, Colo. 80631  
Ralph D. Eakin, '48, Caravel Apts., 701 Pacific Marina, Alameda, Calif. 94501  
Curtis L. Horn, '48, 5531 Falls Road, Dallas, Tex. 75229  
Robert S. Warfield, '48, Route 1, Box 1430, Juneau, Alaska 99801  
Lee M. Yarberry, '48, 804 Van Buren St., Pueblo, Colo. 81005  
Russell C. Cutter, '49, 969 Petroleum Club Bldg., Denver, Colo. 80202  
Garth B. Harlan, '49, 2317 B St., Washougal, Wash. 98671

Charles R. Johnson, Jr., '49, P. O. Box 88, Manitou Springs, Colo. 80829  
David B. Schulz, '49, 3909 Sherwood, #16, Houston, Tex. 77018  
David E. Perrinan, '49, NYS Conservation Department, Albany, N.Y. 12201  
Brian R. Hill, '50, 2887 Worden St., San Diego, Calif. 92110  
Pierrepoint A. Meyer, Jr., '50, University Club Bldg., Union Pacific RR, 136 E.S. Temple, Suite 1610, Salt Lake City, Utah 84111  
Howard W. Miller, '50, 8 Chisolm Trail, Greenville, S.C. 29607  
Frank J. Murphy, '50, 1247 Briar Forest, Houston, Tex. 77042  
Mark K. Shipman, '50, 528-23rd, Grand Junction, Colo. 81501  
Frederick T. Inouye, '51, 124 Columbia Heights, #409, Brooklyn, N.Y. 11201  
Willie T. Kinoshita, '51, 792 Matadero Ave., Palo Alto, Calif. 94306  
Wesley H. Parker, '51, P. O. Box 762, Eagle Mountain, Calif. 92241  
J. Douglas Streit, '51, Suite 1000, 360 Bay St., Toronto 105, Ontario, Canada  
Aziz A. Alwattari, '52, 1 The Hermitage, Grange Road, Barnes, London S.W. 13, England  
Carl D. Baer, '52, 318 Summerhill, Salley's Alley, Kentview, Johannesburg, Rep. S. Africa  
Arthur J. Graves, '52, 4865 Raritan St., Denver, Colo. 80221  
Joe T. Taylor, '52, No. 7 Barra Brui Crescent, St. Ives, N.S.W. 2075 Australia  
Kurt A. Wittges, Jr., '52, 4113 Fitzpatrick Dr., Colorado Springs, Colo. 80909  
Gerrett H. Bryant, '53, 2811 East Williamette Lane, Littleton, Colo. 80120  
John P. Holland, '53, 14919 Bramblewood, Houston, Tex. 77024  
Richard R. Storm, '53, C-111 Petroleum Center, San Antonio, Tex. 78209  
Eric Newman, '54, 5810 W. 38th Ave., Denver, Colo. 80212  
Frank F. Ruskey, '54, 500 W. Mauzanita, Sierra Madre, Calif. 91024  
R. Douglas Sears, '54, 1212-8th Ave., Greeley, Colo. 80631  
Aldon H. Strobeck, '54, 34 Freitas Dr., Moraga, Calif. 94556  
Robert G. Martin, '55, 44 Lytleton Road, Hampstead Garden Suburb, London, N. 2., England  
Richard L. Stallings, '55, Box C 1580 GPO, Perth, West Australia 6001, Australia  
E. Dean B. Laudeman, '55, 1948 Sage Dr., Golden, Colo. 80401  
David P. Biedget, '56, 7102 Siesta Dr., Missoula, Mont. 59801  
John A. Gazewood, '56, 720 Winding Way, Bartlesville, Okla. 74003  
Franklin L. King, '56, 14 Windsor Road, Massena, N.Y. 13662  
C. David Mann, '56, 718 Iroquois Road, Sullivan, Mo. 63080  
Dr. Joseph L. Teeters, '56, P. O. Box 151, Eau Claire, Wis. 54701  
Louis M. Bonnefond, '57, c/o Battelle Memorial Institute, 4000 N.E. 41st St., Seattle, Wash. 98105  
Delbert F. Tolen, '57, Route #4, Box 423-B, Bakersfield, Calif. 93307  
Tod F. Barton, '58, 260 Island Ave., Apt. 2, Reno, Nev. 89501  
Harvey P. O'Brien, '58, R.R. #4, Box 117, Newport, Wash. 99156  
Donald Shaw, '58, 6090 Sunset Lane, Indianapolis, Ind. 46208  
Robert F. Zimmerman, '58, 1375 So. Benton, Denver, Colo. 80226  
Ronald P. Barr, '59, R. R. 1, Morris, Ill. 60450  
Russell E. Blom, '59, 1886 S. Saulsbury Ct., Denver, Colo. 80226  
Fred A. Kumpf, '59, c/o Robert G. Martin, Phillips Petroleum Co., London, England  
Francis H. Merelli, '59, 1201 Manor Dr., Casper, Wyo. 82601

### 1960-1969

William A. Anderson, '60, 513 Vista Verde, Bakersfield, Calif. 93309

## Class Notes

### 1950

Keith Comstock, Met.E. 1950 and M.Sc. 1958, has completed 20 years service with the Ordinance Corp. of the United States Army and has retired to accept a position with General Motors. His address remains the same at 26529 Marilyn, Warren, Mich. 48089.

Bond Taber, Geol.E. 1950, is in Angola, Africa, on a geological project. He's been there since March 1969 and his mail is being forwarded by his mother, Mrs. Leslie R. Taber. That address is 232 North Maple Avenue, Bridgewood, New Jersey.

### 1952

Robert E. Johnson, P.E. 1952, vice president of Plains Exploration, president of the CSM Alumni for the year 1969, and a member of the Board of Directors of the CSM Foundation, Inc., was elected mayor of Arvada, Colo., in November 1969. Bob tells me that Arvada is the fastest growing city in the United States.

### 1953

Richard E. Oppel, G.E. 1951 and M.Sc. 1953, who has been working as a geologist for Texas Gulf Sulphur in Houston, has been transferred by his company to a subsidiary, Total-Texas Gulf, EP Box 3392, Dakar, Senegal. I doubt that we have reported that Dick was married about a year ago, and I wish to apologize for this oversight.

### 1957

Ferdinand F. Zdenek, Geol.E. 1957, writes: "My wife and I have returned to the States by way of long tour of Europe. We're settled in St. Paul, Minn., where I am under training as an application engineer in V. A. P. Johnson Division, manufacturers of the finest in well screens and metal industrial screens." His address is 1360 Terrace Drive 309, St. Paul, Minn. 55113.

### 1963

R. Ricardo Cabrera, E.M., M.Sc. 1963, who has been carried as address unknown in 1969 directory of Mines Men, has been located. Dr. Fogarty, president of Texas Gulf Sulphur, was kind enough to advise us that Mr. Cabrera is working for an affiliate of Texas Gulf Sulphur Co. Mr. Cabrera's address is Cia. Exploradora del Istomo, S.A. Zaragoza No. 700, Coatzacoalcos, Ver., Mexico.

Graham "Wix" Howard, Met.E. 1963, after receiving his MBA degree from Stanford University on June 15, accepted employment with the FMC Corp. He is at present staff assistant to the division manager, Chiksan Division for FMC Corp. The Howards' home address is: 313 El Encino, Diamond Bar, Calif. 91766.

## Letters

Nov. 14, 1969

Dear Wendell:

Effective Nov. 1, 1969, I have been transferred from Tokyo, Japan to Hong Kong. My new title in Hong Kong is Managing Director of The Lummus Co., Far East Ltd. In this position I will be covering the Australasia area for sales and service for The Lummus Company. This includes everything from Korea through Australia and New Zealand and everything east of India and west of Hawaii. My new address in Hong Kong will be: The Lummus Co., Far East Ltd., 18th Fl. St. George's Building, 2 Ice House Street, Hong Kong.

Please arrange to change my address for the Mines magazines and other correspondence and publications which you send out. Also please change the listing in the next Mines Directory.

Sincerely yours,  
The Lummus Co., Far East Ltd.  
Hugh E. Templeton, P.E. '36  
Managing Director

### 1966

Gerald E. Heyman, Met.E. 1966, who was with the Exploration-Geophysics Dept. of Continental Oil Co., has been transferred to the Research and Development Dept., Exploration-Research Division, Continental Oil Co. His address is 1020 North Oak, Ponca City, Okla. 74601.

### 1968

John W. Walker, P.E. 1968, has completed officer's training and has been commissioned a second lieutenant in the Corps of Engineers. At the present time John is assigned as a platoon leader of the first and second pipeline platoons, 158th Quartermaster Company (Petroleum Depot) attached to the 5th Engineer Battalion. John is stationed at Fort Leonard Wood, where his address is Lt. John W. Walker, Jr. 464747608, 158 QM Company, 5th Engineer Battalion, Fort Leonard Wood, Mo. 65437. Congratulations!

H. K. VAN POOLLEN, '50, '55

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# Catalogs and Trade Publications

## SELECTING AGGREGATE SCREENS (458)

A new six-page brochure from Cambridge Wire Cloth Co., Cambridge, Md. 21613, offers engineers a comprehensive guide to the correct selection and use of aggregate screens. Sections of the bulletin are devoted to detailing screen fabrication, construction and ordering information. The selection of mesh or opening for a particular application is simplified by tables presented in the brochure. The specifications listed in the tables are typical for aggregate screens used in a wide variety of production operations. All data listed in the tables is in accordance with A.S.T.M. specifications. To select the right wire cloth specification from the table, all that is needed is to establish the size of opening required and choose from the grade indicated. Since aggregate screen construction is important not only to proper operation but also to service life, the brochure devotes another section to metal, crimp, and weave selection. The use of Cambriloy, Super Cambriloy, Stainless Steel, and other metals for screening is explained in detail. Various crimping and weaving techniques as well as available screen edge constructions are also illustrated. Circle 458 on Reader Service Card.

## SWITCHRACKS (459)

A new booklet on custom-built Switchracks—electric motor control and distribution centers—is now available. The 12-page brochure contains descriptions of Switchracks designed for all NEMA classifications including hazardous locations and corrosive atmosphere. Explosion-proof, water-tight, dust-tight and oil immersed models are shown. Typical specifications and code requirements are listed in addition to information on individual components and space requirements. Nelson Electric Div. of Sola Basic Industries, P. O. Box 726, Tulsa, Okla. 74101. Circle 459 on Reader Service Card.

## MICRO ANALYTICAL INSTRUMENT (460)

A new eight-page, two color technical brochure describes the operating characteristics, analysis capabilities and theory of operation IMMA—the Ion Microprobe Mass Analyzer. Available from Applied Research Laboratories, Sunland, Calif. 91066, the new brochure is amply illustrated, and explains how IMMA combines the features of an electron microprobe and a mass spectrometer, to analyze positive or negative primary and secondary ions and measure isotopes of all elements or the periodic table with point analysis and depth analysis. Circle 460 on Reader Service Card.

## INDUSTRIAL EQUIPMENT (461)

New annual edition of Roberts "Equipment Bargains" contains 52 pages of wholesale buys on light and heavy-duty industrial equipment. Roberts' line includes: variable-speed transmissions; Generators; hydraulic equipment; motors; winches; hoists; pumps; solenoids; speed reducers; hydraulic power units, much more . . . illustrated in color and fully described for direct purchase at savings to the user. All equipment sold on unconditional 1-year guarantee. Special editorial features in the catalog are: "Choosing and installing a generator" and "Hydraulic principles and applications complete with formulas." Roberts Electric Co., 849 W. Grand Ave., Chicago, Ill. 60622. Circle 461 on Reader Service Card.

## PORTABLE GANTRY CRANES (462)

A new two-page bulletin covering new portable gantry crane models is now available. The catalog sheet gives comprehensive technical information on the 1-ton and 2-ton models, including dimensional data, specifications, etc., as well as picturing some other Round materials handling devices. Copies of Bulletin PGC-100 are available on request by circling No. 462 on reader service card. (David Round & Son, Inc., 32405 Aurora Rd., Solon, Ohio 44139.)

## SONARGAGE (463)

A new sonar-type instrument that measures the level of bulk materials and slurries is described in new literature from C. W. Stevens, Inc., P. O. Box 619, Kennett Square, Pa. 19348. Designated as Bulletin 3000, the four-page piece outlines the operating principles of SONARGAGE plus its applications and basic components. Circle 463 on Reader Service Card.

## AIR POWER COMPRESSORS (464)

A new 4-color, 16-page catalog, Form 3525-A illustrates and describes Ingersoll-Rand's line of big capacity packaged air plants in the 2600 to 6400 acfm capacity range. These air plants are completely factory assembled and factory tested at rated speed. They can be shipped fully assembled as one package and installed in less space and in less time than any comparable units. The catalog describes and illustrates in

## Send Us Your Bulletins

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detail the construction features and ease of installation of this class of air compressor. Complete specifications, physical information as well as related accessory equipment is also described. (Ingersoll-Rand Co., Air Power Compressor Div., P. O. Box 552, Corning, N. Y. 14830, Dept. ELH). Circle 464 on Reader Service Card.

## EXPANSION JOINTS (465)

Of special interest to engineers, piping system designers, contractors, builders and plant maintenance personnel, is Uniroyal, Inc.'s new Rubber Expansion and Vibration Joint catalog and fact book. Over 30 diagrams and charts in this 24-page color brochure, aid in the proper selection of joints for air, gas, water, pressure and vacuum lines. Also covered in detail is the selection and application of expansion joints. (Uniroyal, Inc., 1230 Avenue of Americas, New York, N. Y. 10020.) Circle 465 on Reader Service Card.

## MARKETING MANAGEMENT (466)

"Multiplying Management Effectiveness through Professional Counsel in Marketing Management" is the title of a 16-page brochure available from Drake Sheahan/Stewart Dougall, Inc. Included in the brochure is a useful checklist of 18 major areas of marketing with 99 subfunctions where, according to the firm, marketing problems—and opportunities—most frequently arise. The firm has completed over 2,000 consulting engagements in marketing and physical distribution. (Drake Sheahan/Stewart Dougall, Inc., 330 Madison Ave., New York, N. Y. 10017.) Circle 466 on Reader Service Card.

## POWER SHOVELS (467)

A 20-page, illustrated brochure describing the parts and service program offered by Marion Power Shovel Co., Inc., 617 W. Center St., Marion, Ohio 43302, is now available. The booklet points out how Marion uses automated equipment in each phase of parts control—manufacture, storage, inventory and shipment. Also included are instructions on how to order parts and obtain technical assistance from Marion field representatives. Circle 467 on Reader Service Card.

## CAR PULLERS (468)

Webster Car Pullers Catalog No. 141 not only has detailed information on the entire range of this firm's car pullers but also everything needed for sketching shipping-receiving layouts and describing conditions prior to receiving free proposals for car puller installations. (Webster Mfg. Inc., Tiffin, Ohio 44883). Circle 468 on Reader Service Card.

## PULVERIZING MACHINERY (469)

Bulletin 571-B, describing Mikro Products for industrial dust and air pollution control, particle size reduction and separation, has been released by Pulverizing Machinery, Division of the Slick Corp., Summit, N. J. 07901. The well-illustrated, general line catalog lists performance, design and specification data on its dry filter dust collectors, gas scrubbers, electrostatic precipitators and cyclones for air pollution control, dust and fume collection. Included is Pulverizing Machinery's complete line of grinding mills, separators and related process equipment for particle reduction. Circle 469 on Reader Service Card.

## EPOXY ADHESIVES (470)

A new 12-page brochure on Sika Chemical's line of 100%-solids epoxy-based adhesives is now available. The piece details the properties of the company's five structural adhesives, provides a guide for their use and describes the surface preparation necessary prior to their application. (Sika Chemical, P. O. Box 297, Lyndhurst, N. J. 07071). Circle No. 470 on Reader Service Card.

## WEIGHING SYSTEMS (471)

An 8-page, 2-color brochure (Bulletin 41) describes Ohaus balances and weighing systems. Several new products are described, including: a % Moisture System, a Counting System for small parts of high value and a series of over-under scales for the quality control function. Balances described include 10 mg laboratory units; 20 kg heavy duty models; and top loaders with optically projected readouts. (Ohaus Scale Corp., 29 Hanover Rd., Florham Park, N. J. 07932). Circle 471 on Reader Service Card.

## MOISTURE GAUGE (472)

Moisture content is an important economic factor in the processing of many products of the mining, mineral and primary metal industries. Microwave moisture analyzers such as the new Model 633B are the most reliable means of bringing moisture determinations out of the laboratory and directly onto the production line, where measurements are obtained continuously at process speeds. Moisture can be gauged in solids, granules, slurries and other product forms. (Microwave Instruments Co., 3111 2nd Ave., Corona Del Mar, Calif. 92625). Circle 472 on Reader Service Card.

## SEISMIC COVERAGE (473)

Geophysical Service Inc., Box 5621, MS 938, Dallas, Tex. 75222, is offering a new 26-page brochure, "Non-Exclusive Seismic Coverage Available From GSI." The publication serves as index to GSI marine seismic data recorded off the U. S. East Coast, Louisiana, Texas, Southern California, and Argentina and land data from the Anadarko Basin of Oklahoma, Southwestern New Mexico, the Central Basin Platform of New Mexico, and the San Joaquin Valley of California. Circle 473 on Reader Service Card.

## HEAVY-DUTY SLURRY PUMP (474)

Pumping abrasive slurries such as cement, sand, coal and ore tailings require a heavy-duty pump designed specifically for the purpose. Such a pump is the Type RX Slurry Pump illustrated and described in a new four-page brochure (Bulletin 185) from Morris Machine Works, Baldwinville, N. Y. 13027. Available in sizes from 2-to-8 inch discharge, the RX pump features bolted clamp construction and back suction design of liquid end for easy access to wear parts without disturbing either suction or discharge connections. Replaceable liners on both sides of the impeller, and wear adjustment increases the life of major pump components and provide for maintenance of pump efficiency over the life of the wear parts. Circle 474 on Reader Service Card.

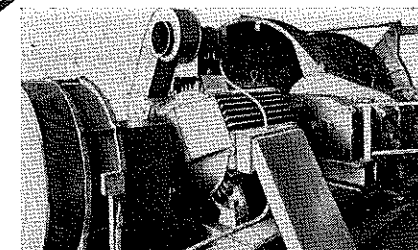
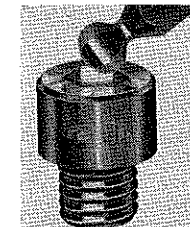
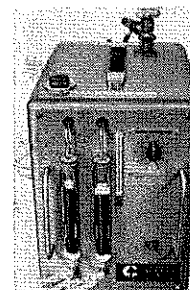
## ULTRAFILTRATION (475)

"Ultrafiltration for industry with the Dorr-Oliver IOPOR system" (Bulletin No. 10-1), a 10-page booklet, defines and illustrates the complete range of Dorr-Oliver IOPOR ultrafiltration equipment and systems for industrial plant applications. The new IOPOR system described in the bulletin is a modular concept for pressures as low as 30 to 50 psi, with membranes in a variety of organic polymers that provide a broad spectrum of separations in the 2,000 to 2,000,000 molecular weight range. Circle 475 on Reader Service Card.

## MINING TRANSPORTS (476)

The 915 LHD, the low headroom model in Elmco's (Box 300, Salt Lake City, Utah 84110) line of big capacity, load-haul-dump mining transports, is described and illustrated in a 12-page bulletin (L-1277). Complete technical information on the design and operation is given. Circle 476 on Reader Service Card.

# With the Manufacturers

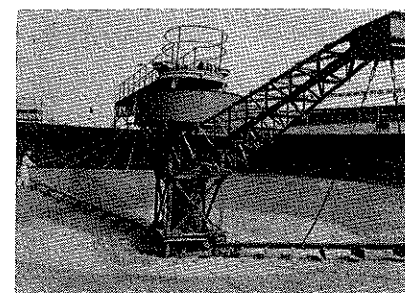


## Calibration System (327)

A new calibration system from Calibrated Instruments, Inc., 17 W. 60th St., New York, N.Y. 10023, delivers 0 to 2000 ppm sulphur dioxide in ten steps for accurate calibration of stack gas analyzers. Self-contained, portable and including a small 100 per cent sulphur dioxide cylinder, the Stack Gas Calibration operates from 110 vac to deliver increments of 200 ppm SO<sub>2</sub> and provide ten calibration points for stack gas SO<sub>2</sub> analyses. Circle 327 on Reader Service Card.

## Multi-Purpose L-Square (328)

The Fairgate 911 L-Square instantly gives height, width and squareness and serves as a cutting rule, triangle and proportion scale. It is precision-calibrated on both sides for inches up to 1/32", inches in 10ths, 12ths, picas, half picas, 6, 8, 10, and 12 point, agate, elite and pica typewriter spacing. The proportion scale gives size of enlargements and reductions up to 32" long, simply and quickly. Made of hard tempered non-glare aluminum, the Fairgate 911 L-Square is a unique tool for every drafting room and art department. (Fairgate Rule Co., Inc., Cold Spring, N.Y. 10516.) Circle 328 on Reader Service Card.



## CableTorq Thickener (329)

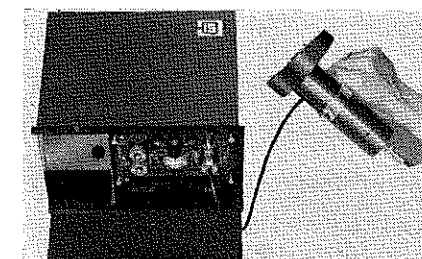
CableTorq, Dorr-Oliver's new low-operating-cost Thickener, transmits torque via cables from the drive trusses above the mud or solution level to the rake arms. Special hinges permit rake arms to automatically lift and lower when heavy loads occur in mud zone. (Dorr-Oliver, Stamford, Conn. 06904.) Circle 329 on Reader Service Card.

## Ballpoint Driver (330)

The ballpoint driver makes it possible to tighten socket screws at any angle in hard to reach places. Ideal for assembly operations. Made of high quality heat treated steel, it is available in different sizes from .028 up to 3/8 inch. (Bondhus Tool Co., Monticello, Minn. 55362.) Circle 330 on Reader Service Card.

## Mine Roof Strengtheners (332)

Reflecting a national concern with safety in the nation's coal mines, American Cyanamid Co., Wayne, N.J., is marketing two products designed to strengthen mine roofs. Cyanamid's Engineering Chemicals Section is offering the industry Roc-Loc® "A" anchorage resin and Reflect-o-Seal spray sealant. Circle 332 on Reader Service Card.



## Portable Analyzer (333)

Columbia Scientific Industries, Box 6190, Austin, Tex. 78702, announced the release of a portable X-ray instrument for quantitative elemental analysis. The instrument, called the Model 700 XRF Analyzer, uses a small radioisotope X-ray source which causes atoms of the element of interest to emit their own X-rays. The X-rays thus emitted are counted and read out on a lighted digital display. Counts displayed are then referred to a calibration curve to obtain per cent concentration by weight of the element. Circle 334 on Reader Service Card.

## Slope Hoist Drive System (336)

Harnischfeger's Electrical Products Division, Milwaukee, Wis. 53246, announces a new slope hoist drive system for the mining industry. The new AC static stepless Magnetorque drive has the performance of an adjustable voltage MG set drive at approximately the cost of a simple wound rotor motor drive. Controlled rates of acceleration and deceleration, automatic landing and programming control variations are available with this control. Circle 336 on Reader Service Card.

## Cutting Tool (334)

Collins Machinery Corp., 955 Monterey Pass Rd., Monterey Park, Calif., has developed and is marketing a new tool that prepares piping for mechanical couplings. It simultaneously cuts and grooves pipe. The tool employs a Collins threading machine, either a Model 44A (range 1"-4") or a 66A for pipe from 2 1/2" to 6" in diameter. The new (patent pending) tool is called a "grooving head." The groove is machined to the exact depth required (without a gauge) while the pipe is also being separated. Circle 335 on Reader Service Card.

## Mine Hoisting System (335)

Card Corp., Denver, Colo., is introducing a mine hoisting system that "feels like a passenger elevator" while satisfying the operating and economic requirements of most underground mines. The Card Hydrostatic hoist uses a closed hydraulic system to give the gradual starts and stops plus high maximum speeds usually found only in very costly passenger service elevators. A simplified electronic control and signal system gives precise operation without a man at the hoist controls. The hoist system is ideal for inclines or vertical shafts, meeting all mine safety codes, including the proposed U. S. Federal code. Circle 335 on Reader Service Card.

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## Plant News

### Lewis to New CF&F Sales Post

Warren P. Lewis, 42, has been appointed assistant manager-Rolled Steel Products Sales for CF&I Steel Corp. Formerly a sales representative for CF&I's Chicago District, Lewis will make his headquarters in Denver. In his new duties, he will be involved with such products as structural shapes, reinforcing bars, cutting edges, grinding balls and rods, light rails, and rock bolts.

### Wood Now Special Products Manager of Dresser's Mining Equipment Division

John A. Wood has been named manager of Special Products in the Mining Operations of Dresser Oilfield and Mining Equipment Division of Dresser Industries, Inc. of Dallas.

Wood will be responsible for market studies which will lead Dresser OME into new mining equipment product lines. He was formerly vice president of Vulcan Denver Corp. and product manager with Joy Manufacturing Co.

He brings a great deal of experience in mining equipment and operations to Dresser OME. Wood holds a B.S. in Mining from the University of Illinois and M.S. in mining from the University of Tennessee.

### New Developments in Ceramics Boost Expenditures for Materials To Half Billion Dollar Mark

Advancing technology is creating new markets for chemicals and minerals in ceramics. Expenditures for raw materials by the U.S. ceramic industry will exceed \$500 million for the first time in 1969, according to advance estimates for an industry survey by C. H. Kline & Co.

Once confined largely to brick, window and container glass, and tableware, the ceramic industry now produces such technical products as laser glasses, ferrites, piezoelectrics, armor and superrefractories. New production methods such as isostatic pressing and float glass production have been introduced. New applications are being developed for existing products such as glass fiber for tires and flame-safe materials, glass for self-destructing containers and resin-bonded enamel frit for coil coating steel.

These and other new developments are not only rapidly increasing the already large market for ceramic raw materials but are causing major changes within it. Materials of greater and greater purity are being used. Often ultrahigh purity is required, and synthetic chemicals are replacing natural minerals in many applications. The industry is adopting more stringent specifications for materials, greater control of materials handling and blending, and wider use of pre-batching.

### Amens Named Chief Engineer At Card Corp. in Denver

HAROLD C. AMENS has accepted the position of chief engineer with Card Corp., Denver, manufacturers of mine haulage and materials handling equipment.

Amens, a registered professional engineer, has had a wide-ranging career including assignments with Stearns-Roger, the Martin Co., U.S. Smelting & Refining and Joshua Handy Iron Works. His career has also included 14 years as a college engineering professor at the universities of Utah, Nevada and Santa Clara.

With Card, Amens will work with the company's entire line of systems for the mining and construction industries. These include mucking, conveying, track haulage, shaft hoisting and shaft raising systems, all designed for increased efficiency with a minimum of operating personnel.

### Two New Appointments Made By McPhar Geophysics, Inc.

ANTHONY M. HAUCK has been appointed chief geophysicist and Emil L. Winniski, manager of Operations, McPhar Geophysics, Inc., Tucson, Ariz.

Mr. Hauck received an A. B. from Dartmouth College in 1952, the degree of Geophysical Engineer from the Colorado School of Mines in 1958, and a Master's degree in geophysics from M.I.T. in 1960. His thesis research dealt with deep resistivity measurements in Massachusetts.

From 1960-1962, Mr. Hauck was employed by the Western Electric Co. as an engineer on the Nike-Zeus ABM project. In 1962, he joined Phelps Dodge Corp. as research geophysicist in the corporation's mineral exploration program.

A native of Canada, Mr. Winniski was graduated from the Ryerson Institute of Technology as an engineering technician in electronics in 1956. Following graduation, he was employed by Lane Wells, an oil geophysical service company of Houston, Texas, using gamma ray and neutron logging instruments in Edmonton, Alberta. Returning to Toronto, he worked briefly for Decca Navigating Co. of London, England. In 1957, he was employed by McPhar Geophysics, Ltd., of Toronto.

During the past 12 years with McPhar, Mr. Winniski has acquired extensive experience in electromagnetic and induced polarization methods as applied to mining geophysical exploration. He began his career with McPhar as an electronics technician, working on the design and development of electromagnetic systems. Mr. Winniski established McPhar's Tucson office in 1967 and has been responsible for the technical training, supervision, and deployment of the McPhar Crews in the United States.



Petrie



Jordan

### P. B. Petrie and Bruce Jordan Join Denver Equipment

TWO experienced sales engineers—P. B. "Pete" Petrie and Bruce Jordan—are recent additions to the Sales Department at Denver Equipment Division, Joy Manufacturing Co. Both will be working out of the Denver, Colo. office.

Before coming to DENVER, Mr. Petrie was employed as a sales engineer for Joy Air Power Division in California. Since 1951 he has been associated with sales of mining and milling equipment, mostly in the Rocky Mountain Region. He attended Weber College, Ogden, Utah, and the Colorado School of Mines, Golden, Colo. Petrie's assignment will include work in the International Sales and domestic field work for the Vulcan-Denver Division.

Mr. Jordan has been assigned to DENVER's Pump Division. He has 18 years of pump engineering and sales experience with two of the nation's largest pump manufacturers. Mr. Jordan attended Texas Military College, Kaufman, Tex., and Pasadena City College, Pasadena, Calif. During World War II he served with the U.S. Marine Corps Reserve in the Pacific Theater of Operations.

### New Dow Plant in Tucson

Dow Chemical Co. has constructed a plant near Tucson, Ariz., to manufacture blasting agents for the mining industry. Located at Sahuarite, 20 miles south of Tucson, the plant was scheduled for completion Jan. 1, 1970, and should be supplying Dow blasting agents to mines in Arizona and New Mexico shortly thereafter.

### Lewis General Sales Manager For Allis-Chalmers Division

Appointment of Julian B. Lewis as general sales manager for Allis-Chalmers Cement and Mining Systems Division has been announced by F. E. Briber, Jr., manager of marketing for the division.

Mr. Lewis joined Allis-Chalmers in 1953 and has held a series of sales positions, most recently that of project sales manager for cement and chemical industries. He will be located at division headquarters in West Allis, Wis. Mr. Lewis was graduated as a chemical engineer from Cooper Union College, New York.

## Alumni Headliners



Nelson



Touslee

### T. W. Nelson Elected to Board Of Mobil Oil Corporation

THEODORE W. NELSON, P.E. 1934, 827 Highland Ave., Westfield, N.J., was elected to the board of directors of Mobil Oil Corp. on Jan. 1, 1970. He also is an executive vice president and a member of the corporation's executive committee.

Mr. Nelson is now a vice president of the corporation and president of Mobil Chemical Co., an operating division.

A native of Missoula, Mont., Mr. Nelson received a Petroleum Engineering degree from the Colorado School of Mines in 1934 and joined Mobil the same year at its Augusta, Kan., refinery.

Three years later he moved to the company's research laboratories in Paulsboro, N.J., where he helped develop the Houdry and Thermoform catalytic cracking process for improving the yield of high octane gasoline.

In 1946 Mr. Nelson became director of Mobil's field research laboratories in Dallas, working primarily in exploration and producing research. In 1953 he was named director of the research and development laboratories in Paulsboro.

He became manager of production in the corporate exploration and producing department in 1961. The following year he was elected a senior vice president of the corporation, responsible for coordinating worldwide exploration and producing operations. Mr. Nelson has been president of Mobil Chemical Co. since 1967.

In 1964 Mr. Nelson received a medal from the Colorado School of Mines for distinguished achievement in mineral engineering. During 1966 and 1967, he served the U.S. Government on a part-time basis as Alternate Deputy National Administrator for the Emergency Petroleum and Gas Administration.

Mr. Nelson is a director of the Society of Petroleum Engineers of the American Institute of Mining, Metallurgical and Petroleum Engineers. He is also a director of the Colorado School of Mines Research Institute.

Mr. and Mrs. Nelson, the former Elizabeth Wiley of Wichita, have four children.

### Lt. Touslee Wins Pilot Wings

2nd Lt. RANDALL D. TOUSLEE, P.R.E. 1968, son of Mrs. V. E. Touslee of Greeley, Colo., has been awarded U.S. Air Force silver pilot wings upon graduation at Williams AFB, Ariz.

Lieutenant Touslee is being assigned to Bien Hoa AB, Vietnam, for flying duty with the 504th Tactical Air Support Group, a unit of the Pacific Air Forces, headquarters for air operations in Southeast Asia, the Far East and Pacific area.

He is a 1963 graduate of Greeley Central High School, and attended Colorado School of Mines, receiving his P.R.E. degree in 1968.

He was commissioned in 1968 upon completion of Officers Training School at Lackland AFB, Tex.

### Lovett Named Corporate Director Executive Staffing for Motorola

NORMAN V. LOVETT, P.E. 1942, has been named corporate director of executive staffing for Motorola Inc., according to Kenneth M. Piper, human relations vice president.

"Mr. Lovett will work closely with corporate officers to identify their present and future managerial needs and will conduct searches for suitable candidates to fill these needs. Following the corporate policy of promotion from within whenever practical, he will seek out managers who are ready for promotional opportunities," Piper said.

For the past three years Lovett served as manager of management consulting services for Ernst & Ernst, an international public accounting and management consulting firm. Prior to that he held various personnel and industrial relations positions with several notable companies.

Lovett graduated from the Colorado School of Mines in 1942 and attended Denver University for graduate work in business administration.

He and his wife Esther will take up residence in Arlington Heights, Ill.

## 50 Years Ago

From the files of *The New Mexican* for November 10, 1919.

Denver, Nov. 10

Governor Shoup will use troops to suppress fighting between the students of the University of Denver and the Colorado School of Mines, if necessary, the governor said today in a proclamation issued from the executive office.

Trouble between the schools broke out on Nov. 6, when it is alleged men from the School of Mines exploded dynamite on the campus of the University of Denver.

### David C. Jonson Joins Midwest Oil Corporation

DAVID C. JONSON, Geol. E. 1951, has been appointed to the position of assistant manager, Minerals Exploration, for Midwest Oil Corp., Denver, Colo.

Mr. Jonson joins Midwest after 13 years with Climax Molybdenum Co., a division of American Metal Climax, Inc. (AMAX), where he served as Resident Geologist at the Climax mine and most recently as Project Manager—Exploration on the Hudson Bay Mountain molybdenum project, Smithers, British Columbia. He was graduated from the Colorado School of Mines in 1951 with a Geological Engineering degree; in 1955, he received a master's degree in Geology from Mines.

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# From the Local Sections

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

SECTION	PRESIDENT	VICE-PRESIDENT	SECRETARY-TREASURER	TIME AND PLACE OF MEETING
Alabama Birmingham	J. E. Brown, '47 600 18th St.		Wm. Haynes, '54	On call of the president.
Arizona Arizona	Guerdon E. Jackson, '52	William E. Saegart, '53	James D. Sell, '55 2762 W. Holladay St. Tucson, Ariz. 85706	Annual Meeting, Dec. 7, 1970, Western Motel, Tucson.
California Bay Cities	Carl Foget, '61	Dave Strandburg, '61	Tom Aude, '62 54 Woodford Drive Moraga, Calif. 94556	Meetings held on call of the Secretary.
Santa Clara Valley Sacramento	Gail Penfield, '56		Stanley Y. Ogawa, '53	
San Joaquin Valley	R. A. Ganong, '47		F. B. Sweeney, '57 6619 Auburn Blvd., Citrus Heights	
Southern California	Dick Richards, '62		B. A. Ellison, '61	
Colorado Denver	Earl Ostling, '54	Allen McGlone, '54	Neal Schmale, '68, Sec.	
Four Corners	See N.M. for officers		Ted Seep, '68 2790 S. Steele St., Denver	Luncheon meeting held third Tuesday of each month, Denver Press Club, 1330 Glenarm Pl.
Grand Junction	Arch F. Boyd, '26	Robert H. Sayre, '34	Robert F. Barney, '35	
District of Columbia Washington	A. A. Wyner, '25	Louis DeGoes, '41	Charles T. Baroch, '23 2001 N. Daniel St. Arlington, Va.	Regular meeting at noon, second Tuesday of each month at the Shrine Temple, 1315 K St. N.W.
Illinois Great Lakes	C. R. Fitch, '49 7915 Exchange Ave. Chicago 17, Ill.		James Daniels, '51 307 Schweitzer Bldg., Wichita, Kans. AM 5-0614.	Meetings called by secretary. Contact secretary for date of next meeting.
Kansas Wichita	Francis Page, '39		Joseph L. DuBois, '50 Mobil Oil Corp., 1111 Gravier New Orleans, La. 70112	Regular luncheon meetings — last Wednesday of the odd-numbered month except July.
Louisiana New Orleans	John Petrocco, '50	Chas. D. Tyler, '53	Stephen D. Chesebro, '64 P. O. Box 51345 Lafayette, La. 70501.	Regular luncheon meetings at Lafayette Petroleum Club on fourth Thursday of each month.
Lafayette	John J. Wallace, '51	Edward J. Gibbon, '68		
Minnesota Iron Ore Range	Paul Shanklin, '49		James H. Bright, '52 575 E. 2nd St. Reno, Nev. 89502	Meetings held four times per year at call of the Secretary.
Missouri St. Louis	H. A. Dumont, '29 227 Crane St. Edwardsville, Ill.			
Montana Butte	John M. Suttie, '42 Continental Dr. Butte			
Nevada Northern Nevada	Paul V. Fillo, '40	H. R. Fitzpatrick, '36		
New Mexico Carlsbad	John Magraw, '53			
Four Corners	Bill Cutler, '48		Lou Amick, '50.	Special meeting at the call of the president.
New York New York	Robt. B. Kennedy, '33	Board of Governors: Ralph Hennebach, '41 C. D. Michaelson, '32 C. Bellm, '34 R. B. Kennedy, '38	E. T. Benson, '33 1175 Broadway, New York, N. Y.	Meetings on call every month or six weeks from September to May, usually at Uptown Mining Club, 49th and Park Ave.
Ohio Central Ohio			Raymond M. Schatz, '35 Battelle Memorial Institute Columbus	
Cleveland	Bob Garrett, '45	Carl Nowak, '62	Richard Pitney, '60	Meetings held on call of president.
Oklahoma Bartlesville	G. T. McIntyre, '39	Bill Fredrick, '56	Charles Strong, '58 Box 336, Bartlesville, Okla.	Regular meetings held every Tuesday at noon, YWCA, 411 S. Johnston St. After September, group will meet every Friday.
Oklahoma City	Ed Johnson, '49 844 First Nat'l Bldg.			Regular meeting held at call of the president.
Tulsa	Todd C. Storer, '47		Jerry McLeod, '57 1708 East 60th Pl. Tulsa, Okla. 74105	Meetings held at call of the president.
Oregon Lower Columbia River Bas'n	Michael DiLembo, '53	D. H. Griswold, '30	Wendell Cloepfil, '62	On call of the president.
Pennsylvania Eastern Pennsylvania	Samuel Hochberger, '48	Arthur Most, Jr., '38 1345 Woodland Cr., Bethlehem		
Pennsylvania-Ohio	Vincent G. Gloia, '56		David P. Rühl, '58 Dravo Corp., Pittsburgh and Terrace Rd., Carnegie, Pa. 15106	Meetings held first Wednesday of each month (noon), Cafe "B," Golden Triangle YMCA, 4th and Wood Sts., Pittsburgh.
Texas Coastal Bend	Robert B. Owen, '51	Ray Gouett, '52	Charles R. Russell, '54 Petroleum Tower Corpus Christi, Texas	Luncheon Meeting — First Wednesday of each month at the Petroleum Club.
El Paso	Peter A. DeSantis, '51	William F. Dukes, '50	L. G. Truby, '48 4320 O'Keefe Dr. El Paso, Texas 79902	Meetings held on last Wednesdays of January, March and May. Special meetings on call.
Houston	John A. Jameson, '50	Ronald E. Diederich, '57	James K. Applegate, '66 Marathon Oil Co. 2300 W. Loop, South	Luncheon meetings held at 12 noon on first Thursday of each month at White Horse Cellar, 1211 Fannin St.
Permian Basin	Jim Morris, '38	Robt. H. Mallett Jr., '55	Harry B. Hinkle, '59 4604 Pasadena, Midland, Tex. 79702	Meetings held in Jan., Mar., May, Sept., and Dec.
Dallas-Ft. Worth	Wallace Tucker, '49	Frank A. Ausanka, '42	Peter H. McQueen, '50 2129 Hildring Dr. West Ft. Worth, Texas	Meeting held on call of president.

## 71 CSM Alumni, Wives, Guests Attend Dec. 1 Luncheon Meeting

An excellent group of 79 Alumni, wives, and guests attended the luncheon meeting at the Westerner Hotel during the Arizona Section AIME meeting held on Dec. 1. The group included Alumni from Colorado, Utah, California, and throughout Arizona.

A special group of Alumni honored during the luncheon included Percy I. Jones, 1908, Harlow D. Phelps, 1910, Clare L. French, 1913, and Frank M. Stephens, 1913.

The social gathering and renewal of friendship from past years was highlighted with reminiscences by Mr. Stephens and concluded by a short business meeting and the election of officers for the 1970 term. Those elected are: Guerdon E. Jackson, E.M. 1913, president; William E. Saegart, Geoph. E. 1953, vice president; and James D. Sell, Geol. E. 1955, secretary-treasurer.

The next annual luncheon meeting will be held on Monday, Dec. 7, 1970, at the Westerner Hotel, Tucson, during the Arizona AIME Section meeting. The Annual Spring Picnic of the Section is our next scheduled activity.

—James D. Sell, '55

## Elmer R. Wilfley, '14

Wilfley Centrifugal Pumps

Denver, Colorado

## Alumni Breakfast on Feb. 14

The CSM Alumni Breakfast will be held at 7:30 Saturday morning, Feb. 14, in the Denver Hilton Hotel, where the 73rd National Western Mining Conference and Exhibition is being held Feb. 13-14.

Tickets to the Alumni Breakfast may be purchased at the registration desk.

## Six Alumni Become Life Members

The following Miners have become Life Members during the past few weeks. They are: Frank M. Stephens, E. M. 1913; Carl A. Blaurock, E. M. 1916; Lawrence E. Smith, E. Met. 1931; J. L. Fusselman, P. E. 1942; Rod A. Thomas, P. E. 1952; James F. Orofino, Geol. E. 1957.

## El Paso Alumni Section Meeting Oct. 29 at Ft. Bliss

El Paso Alumni Section held a meeting Wednesday, Oct. 29, at the Fort Bliss Officers' Club. The following members were present: Glenn Allen, '29; John Church, '50; William G. Cutler, '48; Peter A. DeSantis, '51; C. Francis Jordan, '23; Harold W. McCullough, '27; John Skokowski, '50; Lee C. Travis, '48; Lester G. Truby, '48.

It was decided that El Paso Section would continue to plan its regular meetings for the last Wednesday in January, March and May for 1970. Any special meetings would then be held on call. W. G. Cutler has been transferred by the El Paso Gas Co. from Farmington, N. M. to El Paso, Tex.

—L. G. Truby, '48

## Mines Breakfast in Spokane During Anniversary Convention

The following Alumni attended the Mines Breakfast held in conjunction with the 75th Anniversary Convention of the Northwest Mining Association Dec. 5-6 in Spokane, Wash.:

John L. Holt, '58, Benson, Ariz.; John G. Roylance, Jr., '56, Spokane, Wash.; David R. Cole '52, Lakewood, Colo.; D. G. McIntosh '66, Vancouver, B. C. Can.; John A. Bowsher '34-40, Butte, Mont.; Malcolm C. Brown '37,

Kellogg, Idaho; George O. Argall, Jr. '35, San Francisco, Calif.; Joseph W. Reese '60, Wallace, Idaho; Kenneth P. Beech '61, Tacoma, Wash.; Charles L. Clugston '65, Spokane, Wash.; Peter L. Siems '67, Moscow, Idaho; Luther S. Helms '41, Salt Lake City, Utah; Norman W. Burmiester '61, Vancouver, B. C. Can.; Eugene H. Skinner '60, Spokane, Wash.; John L. Neff '53, Spokane, Wash.; C. E. Gregory Fac., Moscow, Idaho.

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

# In Memoriam



## G. Morton Kintz

**G**EORGE MORTON KINTZ, E.M. 1920, who before his retirement was recognized by the U.S. Department of Interior for his outstanding accomplishments in the field of safety in the mineral industry, died Oct. 5, 1969 at his home in Dallas, Texas 75225 (4133 Purdue St.).

The citation for distinguished service was awarded Mr. Kintz at the Thirteenth Honor Awards Convocation in Washington, D.C. on May 27, 1954. Signed by Secretary of the Interior Douglas McKay, it read as follows:

"After serving in the General Land Office from 1923 to 1927, Mr. Kintz entered the Bureau of Mines in April, 1927 as a mining engineer and was assigned to first-aid and safety work. For the past 15 years he has been supervisor of the Dallas Safety Division Office, and upon regionalization of the Bureau of Mines became the first Chief of the Accident Prevention and Health Division, Region VI. In this position he supervises the coal mine inspection activities and accident-prevention and health programs in mineral and related industries in six states.

"Mr. Kintz pioneered development of a safety program designed to meet the specific needs of the petroleum industry. Realizing the advantages of visual education, he developed a series of demonstrations of fire and safety hazards which has received international acclaim. He has participated in the rescue work following more than a dozen mine disasters.

"During World War II, his technical lecture-demonstrations were requested by many defense groups. He has written many technical papers concerning the general field of mine safety and accident prevention. Many people in this country and abroad have written him for information on the hazards of handling flammable and toxic substances and approved techniques for extinguishing fires, and copies of his lectures.

"In recognition of his outstanding ability for developing methods to gain acceptance and practice of the fundamentals of safety in industry, the

highest honor of the Department of the Interior, its Distinguished Service Award, is conferred upon Mr. Kintz."

In addition to the U.S. Government award, Mr. Kintz received the Texas Safety Assn. Distinguished Service Award and a Certificate of Appreciation from the State of Oklahoma. He was vice-president of the American Association of Safety Engineers and president of the Dallas branch. He wrote a paper for the meeting in Delhi of Economic Aid to Asia and the Far East, and when it met in 1962 in Iran, he went to give a lecture-demonstration.

In a recent letter, Mrs. Kintz writes: "Morton was a Beta at Mines for 50 years, and it is my understanding that this June would have been his 50th reunion at the annual alumni banquet. How he would have enjoyed it!"

In addition to his wife Jane N. Kintz, Mr. Kintz is survived by a daughter, Mrs. Walter C. Barnhardt, 442 Furr Dr., San Antonio, Tex. 78201.

## P. Jay Lonergan

**P.** JAY LONERGAN, E. M. 1905, who until his retirement was a supervising engineer, Reconstruction Finance Corporation, Defense Plant Division, died Oct. 16, 1969 at his home — 1230 Monitos, Wenatchee, Wash. 98801.

Born Jan. 1, 1881 in Boulder, Colo., Mr. Lonergan attended private schools in Colorado Springs and Manual Training High School in Denver. After graduating from the Colorado School of Mines in 1905 with an E.M. degree, he spent several years working as an engineer in Colorado, Nevada, California and Wyoming.

From 1911 to 1917 he was professor of Mining and Ore Dressing at the Imperial University, Peking, China. Returning to the United States, Mr. Lonergan was superintendent, Iron Mountain Alloy Co., Utah from 1917 to 1919. From 1920 to 1931 he was chief engineer and general superintendent, Royal Development Co., Leavenworth, Wash.

For about 10 years he was employed by the State Highway Department, Seattle, Washington. During World War II and thereafter, Mr. Lonergan was a supervising engineer with the RFC, Defense Plant Division.

## G. C. Weaver, '26

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## William Horblit

**W**ILLIAM HORBLIT, P.E. 1946 and D.Sc. 1951, died July 11, 1969 at his home in Sunnyvale, Calif. 94087 (710 Remington Dr.).

Born April 12, 1919 in Denver, Colo., Dr. Horblit was graduated from East Denver High School and received his Petroleum Engineering degree in 1946 from the Colorado School of Mines. He also studied chemical engineering at the University of Denver and in 1951 he earned a D.Sc. degree from the Colorado School of Mines.

During World War II, Dr. Horblit served as a colonel with the Eighth Air Force, USAF. From 1946 to 1947 he was employed by Humble Oil & Refining Co. and for a year he taught chemistry, physics and management at Bethany College, Lindsborg, Kans. For a number of years he was president and owner of Horblit & Company, Denver, Colo. From 1967 until his death, Dr. Horblit was department chief, Process and Instrumentation, H. K. Ferguson Co., San Francisco, Calif.

## Eugene E. Dawson, '38

American Independent Oil Co.  
Kuwait, Arabian Gulf

## John F. Mann, Jr., '43

Consulting Geologist  
and Hydrologist  
945 Reposado Drive La Habra, Calif.

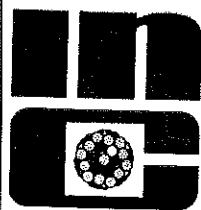
## Clyde E. Osborn, '33

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## Annual Meeting Installation of Officers

Friday, January 23, 1970

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6:30 P.M.

Miners and Their Wives

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## Book Reviews

### 1969 AIME Proceedings Of Council of Economics

The American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) has announced publication of the 1969 Proceedings of its Council of Economics. The 360-page volume contains all the technical papers presented by the Council during AIME's 1969 Annual Meeting held last February in Washington, D.C.

The 1969 Council of Economics Proceedings Volume contains 21 technical papers. It is divided into the following five general sections: The impact of Mineral on Underdeveloped Economics, The Impact of Environmental Regulations on Industry, Mineral Reserves for the Future, Technological Innovation and Mineral Demand, and Application of Economics to the Mineral Industry.

Included in the volume are the following major papers: "The Role of Foreign Investors in International Mineral Development," Mark E. Emerson and Julian O. Cumberland, Newmont Mining Corporation; "Financing Mineral Development in Underdeveloped Economics," Frank H. Skelding, Public Land Law Review Commission; "The Impact of Surface Mining Regulation on the Coal Industry—The Case of Kentucky," David B. Brooks, U.S. Bureau of Mines; "Oil Shale as a Potential Source of Liquid Fuels," Sidney Katell, U.S. Bureau of Mines; and "Demand Economics for Space-Age Metals," F. H. Buttner and R. J. Runck, Battelle Memorial Institute.

Copies of the 1969 Proceedings of the Council of Economics of AIME can be obtained by writing AIME, Book Department, 345 E. 47th St., New York, N.Y. 10017. The cost to AIME members is \$7.50; non-members pay \$10.00.

### Metal Belt Institute Publishes Glossary

The Metal Belt Institute, 441 Lexington Ave., New York, N.Y., composed of manufacturers of wire mesh conveyor belts, announces the publication of a "Glossary of Terms and Definitions" applicable to products of the industry. This publication has received the approval of the United States of America Standards Institute as a United States Standard, No. MH13, 1-1969, and is available from the Institute offices at \$1.00 per copy.

### Subsurface Disposal Of Industrial Wastes

Published and distributed by the Interstate Oil Compact Commission, P. O. Box 53127, Oklahoma City, Okla. 73105, this study was conducted by the Research Committee of the Interstate Oil Compact Commission and resulting booklet is considered to be the most up-to-date and definitive publication in this field.

The content should be of great interest to public groups interested in understanding the problems involved in disposal of industrial wastes by underground injection as well as those government agencies charged with preservation of pure water resources. Those interested in this report should write directly to the Interstate Oil Compact Commission at the address given above.

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### Technological Data On Soviet Union, China

Where can the researcher go when he wants the latest technological data about the Soviet Union or mainland China?

He can consult the new edition of the RMP (Research and Microfilm Publications) **Catalogue of Scholarly Book Translation Series and Backfiles** published this month by CCM Information Corporation, the information sciences subsidiary of Crowell Collier and Macmillan, Inc.

The new RMP **Catalogue** lists more than 700 books covering such subjects as Soviet cybernetics, math and earth sciences; Chinese economic distribution, demography and legal system; and aspects of life in Eastern Europe, Asia and Africa.

The books, which range in cost from \$7.50 to several hundred dollars, are available in hard or soft cover editions.

The **Catalogue** itself is arranged by subject, providing an easy outline of material available in any field. In addition to country headings, material is broken down into fields of interest such as neurology or pesticides. Among the more diverse titles are the **Moscow Oblast Guide Book**, a complete guide to the city's historical, architectural and cultural attractions; the **Atheist's Handbook**, a point-by-point analysis of the world's major religions; and the **Ulan Bator Telephone Directory**, which due to the way telephones are distributed in the Mongolian capital is a comprehensive listing of its Communist Party members.

In developing the **Catalogue**, CCM Information Corporation microfilmed and indexed all materials translated by the U. S. Joint Publications Research Service, thus providing researchers and scholars with the only index to these foreign translations.

Carefully planned to meet researchers' needs, the **Catalogue** provides a wide assortment of specialists' libraries which combine titles by geographic location such as **Southeast Asia** as well as functions such as **Physical Geography**.

CCM Information, through Research and Microfilm Publications, already publishes a monthly bibliographic index to all J.P.R.S. translations organized by geographic area, and a quarterly index to scientific, technological and medical translations.

### Trashless Dam

The Oroville Dam in California, highest in the United States, uses a specially engineered trashrack system to prevent logs and debris from entering its powerplant turbines. Designed entirely from more than 700,000 pounds of nickel stainless steel, the trashracks stretch over 70,000 square feet.

## Technical Societies

### 52nd Annual ASM Meet Features Important Role Of Small Parts Today

Cleveland—in the heart of the nation's biggest metalworking market—will host the American Society for Metals 1970 Materials Engineering Congress and Exposition, Oct. 19-22, 1970.

An important new feature of this 52nd annual event is an in-depth conference which will spotlight "The Big Part Played by Small Parts and Components Today." This four-day conference will present industry experts reporting on practical applications of materials in castings, forgings, stampings, tubing, powder metal parts along with plastics vs. metals in component parts. Case studies of part failures, incorrect design, wrong materials, poor assembly methods, improper surface protection, poor heat treating control, and inadequate inspection, will be featured.

In the processing and fabricating area, cleaning, finishing, joining, testing and a two-day in-depth heat treating conference will be featured.

Last held in Cleveland in 1967, the event was attended by 20,000 engineers, and metalworking executives from around the world. It is expected to attract a like number in 1970.

More than 400 international companies are expected to exhibit in excess of \$11 million in materials and processing equipment in the Convention Center. Visitors will have a chance to see the latest equipment and developments that make new techniques possible, graphically displayed—many in actual operation—by exhibitors that covers the entire field of materials, design, welding, fabricating, finishing, and testing.

In addition to the full schedule of technical sessions sponsored by ASM, the Metallurgical Society of AIME, the American Society for Nondestructive Testing, and many other leading metalworking technical societies and associations will participate in presenting several hundred papers and panels.

Two annual features — the Materials Application Center and ASM Metallographic Exhibit — will be presented at the exposition. The Materials Application Center offers visitors and opportunity to inspect examples of improvements and innovations in materials and processes, while the Metallographic Exhibit includes hundreds of exceptional metallographs.

What's so new about finding marriage partners with a computer? In times past, a girl always had a calculator called mother.

## Second Inter-American Conference On Materials Technology in Mexico City

**S**PEAKERS from the United States, Canada, Latin America, Europe and the Middle East will participate in the II Inter-American Conference on Materials Technology to be held in Mexico City Aug. 24-27. According to R. D. Wylie, director of the department of materials engineering at Southwest Research Institute and general chairman of the conference, the meeting will bring together specialist in the fields of materials research, development and education to explore common problems and mutual goals in the field of materials technology and education in the Western Hemisphere.

The conference is sponsored by more than 40 professional and technical organizations throughout the Americas. The Organization of American States, The Ford Foundation, the Colegio de Ingenieros Mecanicos y Electricistas of Mexico, and Southwest Research Institute of San Antonio are underwriting sponsors of the meeting.

A highlight of the conference will be an international exposition of equipment, books and facilities for materials engineers and educators.

The technological program will concentrate on materials processing for metals and nonmetals. The educational program will be concerned with the present state and future developments of materials education. Emphasis will be placed on all academic levels from technical to post-doctorate, as well as to problems of continuing education.

C. E. Lautzenheiser of Southwest Research Institute is chairman of the technical program committee. W. R. Upthegrove, chairman of the department of mechanical engineering at the

University of Texas, Austin, is chairman of the educational program committee.

For additional information, contact David Black, Symposium Coordinator, Southwest Research Institute, Post Office Drawer 28510, San Antonio, Texas 78228.

### 99th AIME Meeting Feb. 15-19 in Denver

**T**HE "Mile High" City, the Colorado Section and the Denver Petroleum Section will host AIME's 99th Annual Meeting, Feb. 15-19, and as the Institute celebrates its 99th birthday, Colorado will celebrate Minerals Industry Week, Feb. 12-19.

The program will include nine All-Institute sessions, with the Society of Mining Engineers scheduling 38 sessions. The Metallurgical Society plans 33 sessions and the Society of Petroleum Engineers plans two. At AIME's 99th Annual Meeting, over 50 technical papers will be presented, representing some of the latest research and developments in the mining, metallurgical, and petroleum fields.

The modern Denver-Hilton will be headquarters for the meeting, with All-Institut and SME-AIME sessions located there. Both TMS-AIME and WAAIME will be located in the elegant Brown Palace Hotel, with some TMS-AIME session also scheduled in the Cosmopolitan Hotel directly across the street. SPE-AIME will headquarter at the Denver-Hilton, but SPE-AIME sessions will be held in the nearby Downtowner Hotel.

In addition, the 6th Annual Hydrocarbons Symposium, co-sponsored by AIME, the Colorado School of Mines Research Foundation, and the Colorado School of Mines, will be held in the Denver Hilton, Feb. 18-19, in conjunction with AIME's Annual Meeting.

Martha was very ill and feeling that her time on earth was quite limited, she said to her husband, "If I should die and you should marry again, promise me one thing; that you'll never let your second wife wear my clothes."

"Of course I won't," replied her husband indignantly. "Besides, they wouldn't fit her."

\* \* \*

"If you die on our elevators," the sign said, "be sure to push the UP button."

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# News of the Mineral Industries

## Uranium Industry Plans 110 Million Feet of Drilling

A total of nearly 110,000,000 feet of surface exploration and development drilling during calendar years 1969 through 1972 is planned by the domestic uranium industry, according to a survey conducted by the Atomic Energy Commission's Grand Junction, Colo., office.

The total cost of this drilling program by private industry is estimated at \$178,000,000, which includes related technical and administrative costs but excludes the cost of property acquisition and exploration rights.

The 109,600,000 feet of drilling planned by the industry in 1969 through 1972 compares with an industry estimate of 98,850,000 feet for the four years 1968 through 1971 as reported to the AEC in the summer of 1968.

The new estimate is based on replies from 54 companies which supplied the footage and cost data. In addition, there were 12 other companies whose drilling plans were not yet sufficiently firm to permit estimates.

Of the drilling planned for the four years, exploration drilling footage is estimated at 70,200,000, and development drilling at 39,400,000.

Industry's plans for calendar 1969 call for a total of 29,400,000 feet of drilling, as compared with a record 23,800,000 feet drilled in 1968. According to the AEC, the average drilling depth increased from 362 feet in 1967 to 410 feet in 1968.

## AEC Distributes Film Of Nuclear Energy in Space

Three motion pictures dealing with applications of nuclear energy in space have been made available recently for public showing through the Atomic Energy Commission's free-loan film libraries. The films are also available for purchase.

The color films are:  
"The Weather Eye," 13 minutes, produced by the AEC.

"The Atom and the Man on the Moon," 13 minutes, produced by the General Electric Company for the AEC.

"Nuclear Propulsion in Space," 20½ minutes, produced by the National Aeronautics and Space Administration for NASA and the AEC.

Queries on sale or loan may be directed to the appropriate field film library or to the Chief, Audio-Visual Branch, Division of Public Information, U. S. Atomic Energy Commission, Washington, D. C. 20545.

## Manganese Ore Pellet Plant Contract Awarded to McKee

A contract for construction of the world's first plant for the production of manganese ore pellets has been awarded to Arthur G. McKee & Co. by Industria e Comercio de Minerios S.A. (ICOMI) of Brazil, in which Bethlehem Steel Corp. holds a 49% interest.

The new plant will be located in Santana in the territory of Amapa, Brazil. The contract is valued at about \$5,000,000 and calls for the engineering, purchase of materials, and supervision of construction of a facility for roasting, concentrating and pelletizing the fines of manganese ore.

Work on the plant is scheduled to start immediately and it will be completed in approximately two years. It will produce 235,000 tons annually of pellets for use as feed stock in the production of ferro-manganese.

## Nuclear Power Plant Of the Future Built By General Electric

THE nuclear power plant of the future is represented by this General Electric-designed fast breeder reactor system, the only one of its kind to use plutonium-uranium oxide fuel. The reactor heats sodium which in turn heats water to produce steam. The steam eventually will be used in such plants to turn a turbine-generator to produce electricity.

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Chief advantage of the breeder reactor system is that it will produce more fuel than it burns, thus helping to conserve the natural resources of the world.

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## Campus Headlines

## Mather Given Recognition

JEAN PAUL MATHER, professor of Mineral Economics and head of the CSM Mineral Economics Department, has been awarded recognition in the 1970 National Register of Prominent Americans.

Mather came to Mines after serving as president of the University of Massachusetts and president of the University City Science Center in Philadelphia.

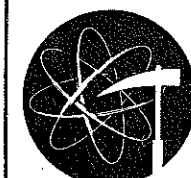
One of the nation's top economists, Mather is a native of Del Norte, Colo., receiving his first teaching and administrative experience at Colorado School of Mines.

From 1938 to 1943, he served as administrative assistant to the vice president of Mines and as assistant registrar and business manager in addition to his teaching duties.

Following service in the U.S. Navy in World War II, Mather returned to teach at the University of Denver, later teaching at Princeton University and functioning as a visiting professor at the University of Maryland.

Professor Mather, 54, came to Colorado School of Mines this fall to head the newly formed Mineral Economics Department. Dr. Orlo E. Childs, Mines president, said the new department was created as part of the school's effort to prepare its mineral engineers for industrial management. During the spring of 1969 the Colorado Commission on Higher Education had approved Mines to offer a master's degree in mineral economics.

Mather attended the University of Colorado for three years before receiving his bachelor's degree from the University of Denver in 1937. He received master's degrees from DU and Princeton University, and has received seven honorary doctorate degrees.

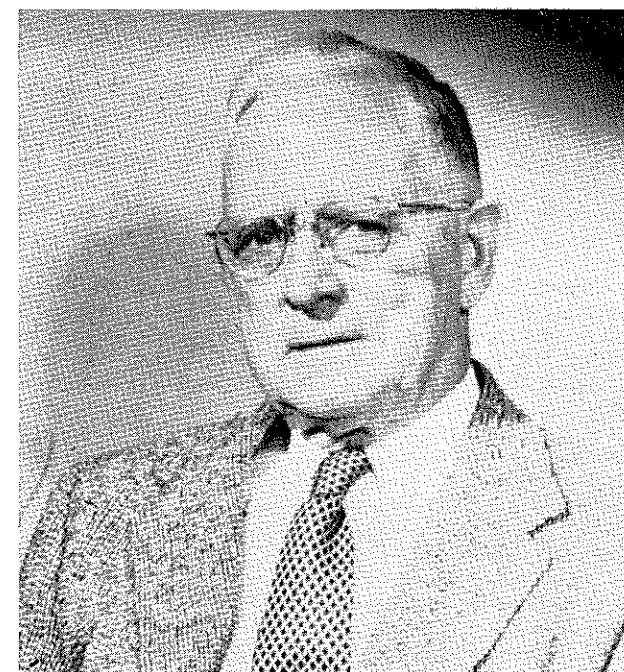


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## Dr. J. Harlan Johnson Given CEC's Gold Medal Award

DR. J. HARLAN JOHNSON, Colorado School of Mines professor emeritus of Geology, was awarded the Gold Medal of the Colorado Engineering Council at its 50th Christmas Reunion Saturday, Dec. 6, 1969, at the University Club of Denver.

Johnson was the 12th person to receive the award in its 39-year history.

Dr. Johnson was on the Colorado School of Mines faculty from 1920 until he retired in 1957.

He was instrumental in establishing the geological engineering curriculum at Mines, and 600 to 700 geological engineering students were graduated from Mines during years he was on the faculty.

Born in 1892 in Philadelphia, Johnson received a master's degree in geology at Mines in 1923 and a doctor's degree in geology and biology from the University of Colorado in 1936.

He has been active in many scientific societies and served as president of the Rocky Mountain Association of Geologists 1930-31.

Since 1930 he has been engaged in research on organic limestones and has pioneered the study of rock-building algae in North America.

The Colorado Engineering Council has 36 member organizations in the fields of architecture, engineering and science.

## Sgt. Maj. Gallegos Retires From Army

SERGEANT MAJOR ANDREW M. GALLEGOS retired Dec. 1, 1969, after more than 22 years of service in the U.S. Army. Sergeant Gallegos had been with the Colorado School of Mines ROTC Detachment since June 1968. He is married with three sons and lives at 11251 W. 60th Ave., Arvada.

Sgt. Maj. Gallegos was born in Denver on Feb. 13, 1930. He completed high school in Los Angeles, Calif. and entered the service on Feb. 14, 1947 at Fort MacArthur, Calif. He completed basic training at Fort Ord, Calif. and attended the Engineer School at Fort Belvoir, Va. in General Drafting (1947), Surveying (1954) and Construction Foreman (1956).

Since his retirement from the Army, Sgt. Maj. Gallegos has been employed by Moore and Combs Engineering Co. of Denver.

## Winter Concert

The Colorado School of Mines Concert Band and chorus under the direction of Byron Darnell again presented their special winter concert on Dec. 11 in Guggenheim auditorium.

This year the Christmas music of England, Italy, Germany, and Russia was featured. In addition to the band and chorus presentations, a woodwind quartet and male singing quartet presented short Christmas favorites during the evening program.



# Veterans Chapter Organized on CSM Campus

**R**ECENTLY a Veterans Chapter has formed on the campus of Colorado School of Mines. The Chapter is an organization primarily dedicated to improving understanding of our American Democracy. In particular the organization will help with the observance of events of national, community, and school interest.

The Veterans Chapter and the College Republicans recently sponsored an observance of Veterans Day on the campus. The ceremony began at the Golden City Hall where Mayor Goudge of the City of Golden issued a proclamation. Then the procession consisting of students, citizens, veterans, ROTC Color Guard and CSM Band marched through Golden to the steps of Guggenheim Hall. At Guggenheim, Dr. Brom of Denver University delivered the keynote address entitled "Our Fateful Challenges." The slogan adopted for student attendance at the program was "Cut Lunch — Not Class."

Members of the Veterans Chapter and the College Republicans also published a special supplement to the Ore-digger commemorating Veterans Day. The supplement was four pages long and dealt with the history of Veterans Day, contained letters written by Vet-

erans concerning the world situation, and described the Veterans Day ceremony. The supplement was financed by contributions from individual alumni.

Membership in the Chapter is limited to students holding an honorable discharge or separation from the Armed Services of the United States, who are on active duty with those forces, or who have served or are serving in a reserve component. This definition of membership also includes Advanced ROTC Cadets.

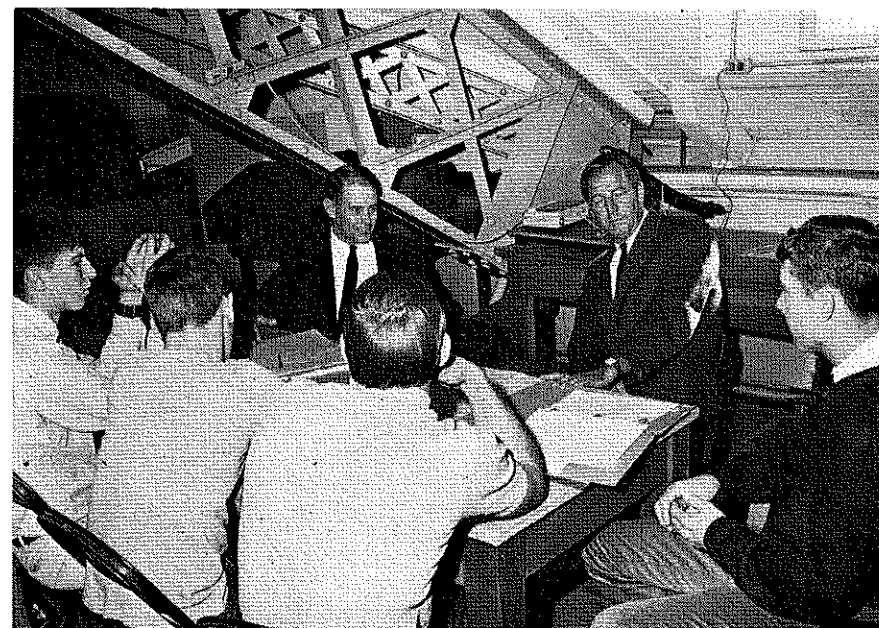
On Nov. 7th the Chapter held its first organizational meeting and

elected the following officers: President, James V. Taranik; Vice President, Truman King; Secretary, Keith Linck; and Treasurer, Andrew M. Taylor.

According to Jim Taranik, a Ph.D. candidate in Geology, the constitution does not limit membership to any political group. Rather, the organization is non-partisan and welcomes members from all sides of the political scene. The Chapter is dedicated to promoting patriotism, advanced responsibility, developing integrity, and further respect for freedom and the democratic way of life.



WILLIAM E. GORHAM, JR., area manager of the Baroid Division of the National Lead Co., presents a \$1,000 cash gift to Dr. Ramon E. Bisque, head of the Chemistry Department at Colorado School of Mines. This cash gift will be used in support of the graduate Chemlaunch program initiated this fall after a 400% increase in graduate enrollment occurred within the Chemistry Department.



BASIC ENGINEERING STUDENTS discuss their group project with visiting engineer Laurance E. Ferreira of Coors Porcelain Co. (left) and Professor Robert Taylor of CSM's Basic Engineering Department.



## Maynard Slaughter Joins Faculty

**D**R. MAYNARD SLAUGHTER has joined the faculty of the Colorado School of Mines as a Professor of Chemistry.

He earned his B.S. at the Ohio University, his M.S. at the University of Missouri and his Ph.D. at the University of Pittsburgh.

He is a member of the American Crystallographic Association, the Mineralogical Society of America and the Mineral Society of London.

Dr. Slaughter is the author and co-author of numerous publications.

## Dr. Keller Named to Safety Committee

**G**EORGE V. KELLER has been appointed a member of the National Academy of Engineering Committee on Mine Rescue and Survival Techniques. Dr. Keller is professor of Geophysics at Colorado School of Mines.

The primary concern of the committee will be to improve mine workers' prospects of survival and rescue following mine disasters. The study will also investigate technological advances in such fields as space exploration, deep submergence, and civil defense that can lead to improvements in mine rescue techniques and procedures. Chairman of the committee is Walter R. Hibbard, Jr.,

# CSM Chemlaunch Program

**T**HE CSM Department of Chemistry has initiated a program of participation for mineral orientated groups that wish to provide assistance for the expansion of geochemical and pollution-control research.

Historically the chemistry department has had a very limited graduate research involvement program with an average of five advanced degree candidates in residence each year for the preceding past five years. This fall the graduate student enrollment in chemistry has quadrupled, saturating the present physical facilities of the department.

The CHEMLAUNCH program has followed, with funds received to be used to catalyze the expansion of the graduate research studies and facilities. Further expansion will involve space in the Graduate Research Center and the new Graduate and Professional Center now under construction.

"The response thus far has been gratifying and encouraging," states Dr. Ramon E. Bisque, head of the

Chemistry Department. "We have had thirteen positive responses to date with about half of the participants offering cash support with the remainder offering equipment or cost sharing. One group, the Ministry of Mines of Venezuela have expressed interest in the geochemical research emphasis and will participate by direct support of graduate students who enter into the program. Without this type of support and encouragement from industry, we would be seriously hobbled in our expansive efforts," Dr. Bisque stated.

The industrial participants will be announced in MINES Magazine and a list will be posted in Coolbaugh Hall as a reminder of the timely generosity of these groups.

## CSM Receives Grant From Gulf Oil Corp.

**O**RLO E. CHILDS, CSM president, recently received a \$2,000 departmental assistant grant from the Gulf Oil Corp. educational assistant program.

This grant has been authorized for the Chemistry Department at Mines, to be used at the departments own discretion during the school year.

Walter M. Garvey, district sales manager of Gulf, and F. S. Mooney, staff engineer for Gulf Mineral Resources Co., presented the grant on campus to President Childs.



DR. ORLO E. CHILDS, (right), Colorado School of Mines President, recently accepted a \$9,000 grant from the Atlantic Richfield Foundation to be distributed to four departments on the Mines campus. Presentation of the check was made by Glenn Simpson, manager of Atlantic Richfield's Rocky Mountain District.

## Visiting Engineers Program

**T**HE CSM Basic Engineering Department has introduced a new program involving visiting engineers from industry and government with the intent of their evaluation of student work emphasized beyond the existing faculty staff.

Freshmen in basic engineering have previously been involved with engineering drawing with little emphasis on creative and design abilities until their sophomore year.

Within this new program, students are given design problems associated with geology, mining and petroleum application. Groups of students are assigned projects where individual emphasis and group discussion are involved, with the end result being in direct association with the visiting engineers for technical consulting and evaluation.

Engineers presently participating in the project are: Richard D. Gauthier of Dow Chemical Co.; Leland Logue, retired from Denver Equipment Co.; and Laurence E. Ferreira of Coors Porcelain Co. Additional engineers with varying backgrounds rather than similar areas of specialization will be invited to participate, therefore, broadening the student's concept of the engineering profession.

The participating engineers are also involved in an evaluation questionnaire once the students have presented their topics. Areas of comment will include student performance, strong and weak points of the new program, interest and importance of team projects, and the final rating of the student teams.

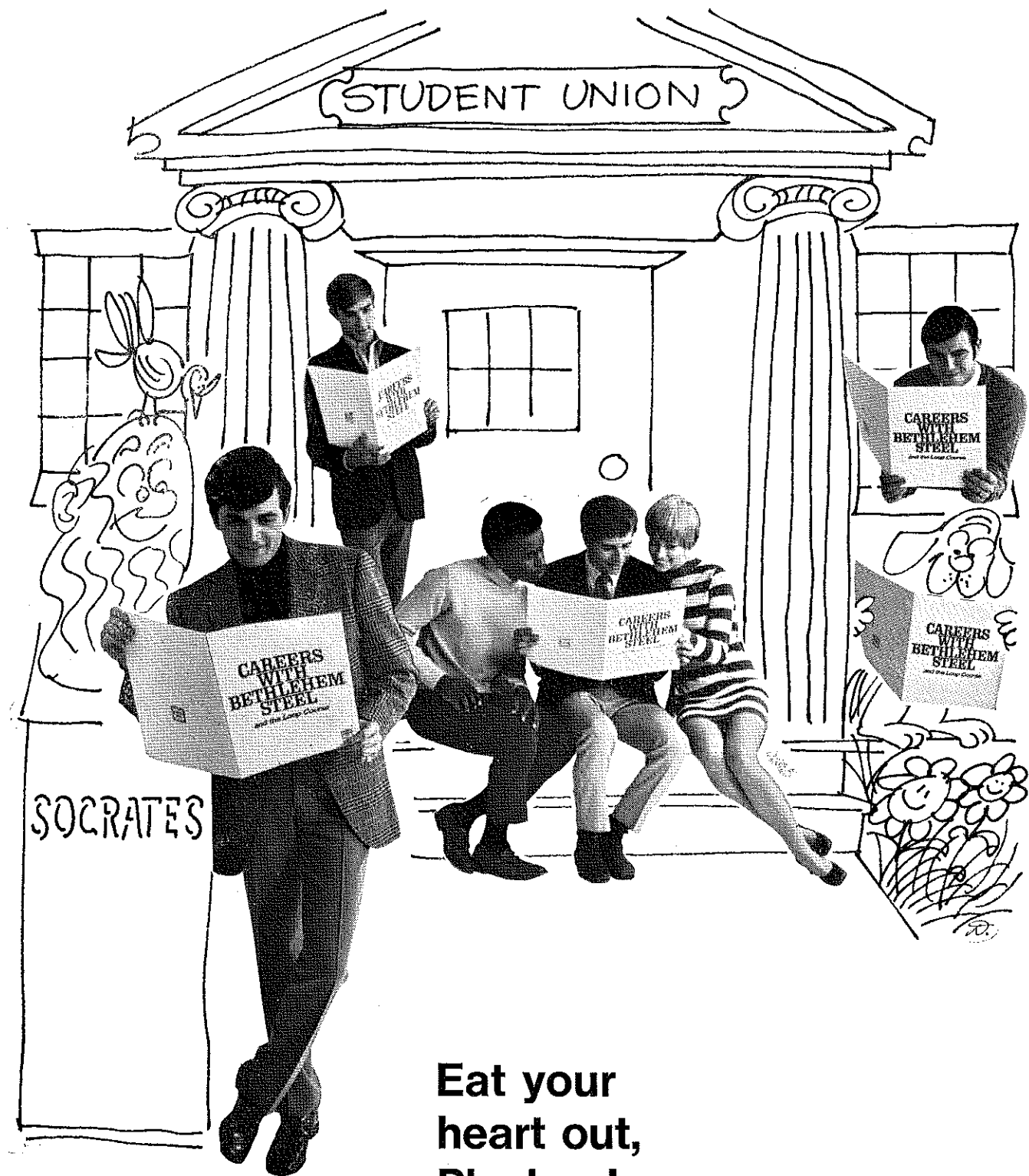
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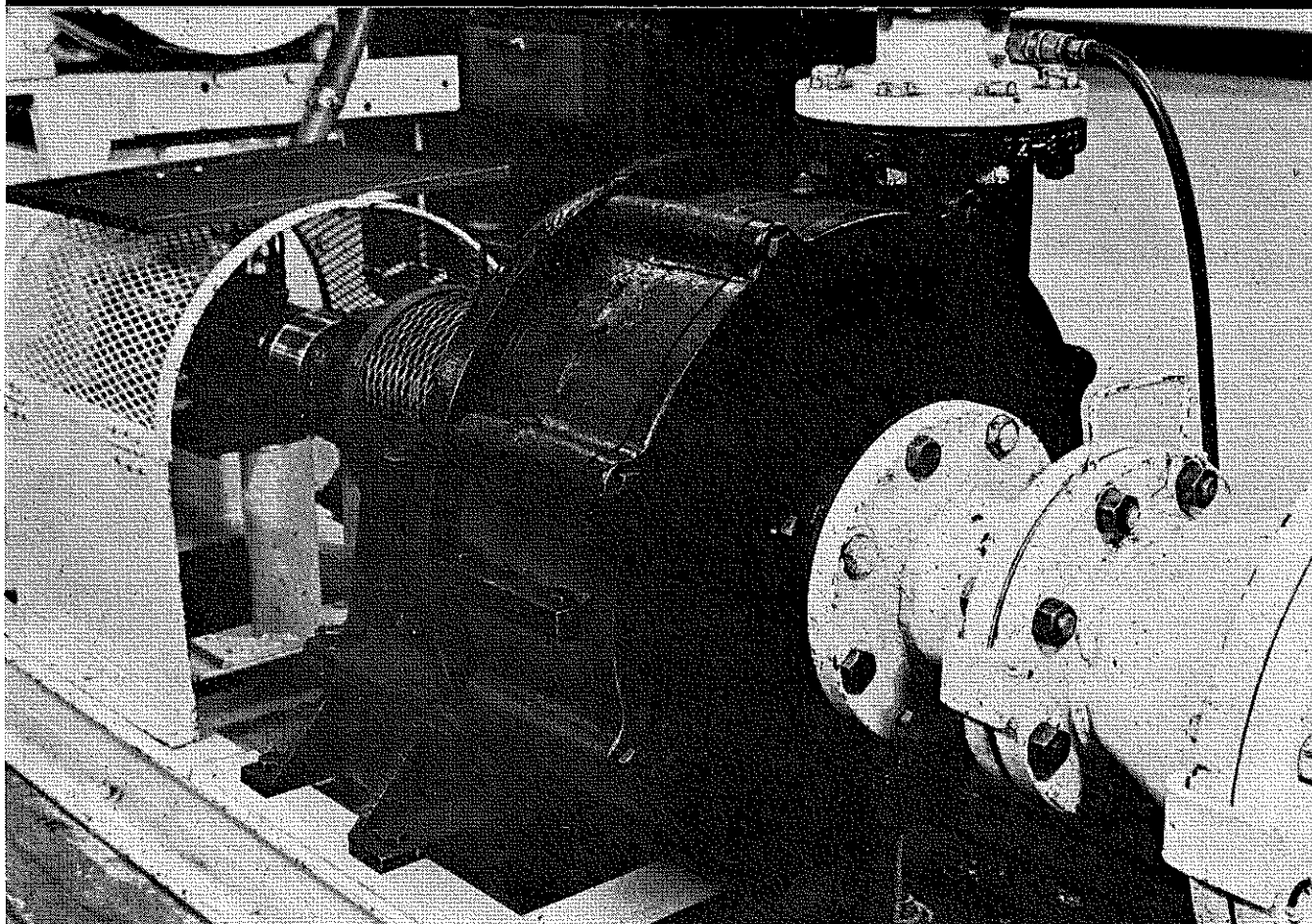


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