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Mathematics at Mines, 1970

IN June, 1946, the Colorado School of Mines awarded to two students the degree of Bachelor of Science in Mathematics. The first student to receive the degree was authorized by the Board of Trustees. In 1959 the college awarded the degree of Master of Science degree in Mathematics and one M.D. inter-disciplinary degree in Mathematics and Mining. In the intervening years the completion of the mathematics facility has changed to keep pace with the new demands on it. Where there had been only one professor holding the M.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 so pervasive in our in-dustrialized society that the concept of what is applied mathematics has had drastic revisions. This has been accomplished by Dr. Henry G. Pollak, director of the Mathematics and Mechanics Research Center of Bell Telephone Laboratories, as he was discussing elementary in Education of Mathematics: "The first fact to remember is that calculus, differential equations, partial differential equations, and some further successively more difficult kinds are applied mathematics, and that every science is pure and irrelevant to applications. It is amazing how true this has become, in recent years, particularly with the rise of combinatorial mathematics and probability. Mathematics has become so important to the scientist that the scientist cannot think logically without mathematics." The mathematics curriculum at Mines, while still requiring three semesters of calculus of every student, has been developed to provide the student with additional advanced courses in statistics, probability, linear algebra, operations research, and modern analysis, in some cases of the broad areas of study. In fact, operations research and linear analysis have become so important to the mining 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 refinement of applications. In the traditional areas, but rather an expansion of applications in new areas. That these areas are of vital importance to the mining industry can be questioned. The attention paid to graduate study and research has not resulted in neglect of the undergraduate program. In fact, the recognition by the journal of the Mathematics at Mines is as high as ever.

ARE YOU A BECHTEL ENGINEER?

Graduates with a first degree in Mathematics have 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 students in Mathematics are attending first-rate graduate schools in all parts of the country and are distinguishing themselves and their schools, as mathematics courses (more hours than are required by some other schools) are well taken at Mines.

The undergraduate curriculum includes a full fee (of most colleges) and traditional humanities and basic science courses. In addition to 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 to contribute to mineral technology. He knows the problems of the mining engineer and, although not ready for top posts in Research and Development with the first degree, can relay those problems and assist in their solutions. We are confident that these 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 initiated a Visiting Committee to meet on the Mines campus in October, 1953, to review the progress of the Mathematics Department and make recommendations for its further direction. The committee, composed of representatives of mathematics departments and mathematics education, included the following:

Dr. Thos B. Johnson, Mines Systems Officer
U.S. Bureau of Mines, Denver
Dr. William P. LeVan, Chairman
Department of Mathematics
University of California, Berkeley
Dr. Albert W. Manzur, Geophysicist
Mako Oil Company, Dallas

The Mathematics Department has received valuable advice from the committee and will benefit from their dedicated efforts. It seems proper to include here excerpts from the Report of 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 MINE'S!
Mathematics for Miners

By A. W. Schlechten

Vice President for Academic Affairs

MATHEMATICS 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 is quite obvious that the increasing complexity of technology requires a greater understanding of mathematics on the part of engineers.

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 current status of the industry, the professors at Colorado School of Mines are continuously developing 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

THE growing need for more powerful mathematicians 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 in mathematics.

These two fields are in increasing demand by the mineral industry. Operations Research is important to management in development of new methods of exploration, excavation, and commercial processing. Linear Algebra represents the theoretical framework of modern research in many fields of mathematics. 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 technology. Thus students will be expected to demonstrate knowledge in one or more fields while pursuing an advanced degree in mathematics.

The Mines graduate already has at least 13 hours of study in his mineral-resource specialty, and an opportunity for further study in mathematics is needed.

At its meeting on Dec. 12, 1969, the Colorado School of Mines Mathematics Department requested the approval of the Board of Trustees to offer a Ph.D. degree with specialization in operations research and linear algebra. The proposal is designed to recognize the increasing importance of operations research and linear algebra in mineral engineering.

The Ph.D. program would be open to students who have already completed the M.S. degree in mathematics or related fields and who have demonstrated a substantial background in mathematics. The program would be designed to provide advanced training in the areas of operations research and linear algebra, and to prepare students for careers in government, industry, or academic institutions.

We believe that Mathematics, and especially the two major fields we are proposing, will play an increasingly important role in the future.

The combination of Mathematics and Operations Research at the Ph.D. level is at the cutting edge of modern research and application. The proposed program would provide a unique opportunity for students to gain a deep understanding of the mathematical foundations of operations research and to apply these concepts to real-world problems in the mineral industry.

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This program would be designed to provide comprehensive training in mathematics and operations research, with a focus on the application of these concepts to problems in the mineral industry. The program would be flexible and customizable to accommodate the diverse interests and career goals of its students.

We believe that Mathematics, and especially the two major fields we are proposing, will play an increasingly important role in the future.
have been increasing both in number of books and number of periodicals.

The Mathematics Department is increasing its staff by one man for the 1960-61 session and feels that an additional man will be justified before the program reaches a level of about 30 students as explained in the feasibility study. In some areas the additional staff pays for itself, and there is a kind of "multiplier effect" through the use of graduate students as teaching assistants. Thus, the 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 about 90 percent of 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 for the Mathematics Department if the proposed program is approved.

We at present have 100 students in the freshman math courses, Math 101, 111, 112 in the Fall semester. Assuming a total of 500 students for the sake of argument, these 500 could be taught under the present system in sections of 40 students each by five equivalent of five instructors. (At the undergraduate level the teaching load is three courses, 5 x 3 x 4 = 60.) Three of these 500 students could also be taught by having them take two hours in a lecture class of 100 students taught by a senior professor, and two hours in a recitation class of 20 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 x 2 x 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 one man 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 35 students would be 12 per semester. Additional plans for visiting lecturers and elective courses in other departments will enrich the program with little additional cost.

It should be 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 with out regard to the expansion by the Mathematics Department into a Ph.D. 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 and Professional Center will help alleviate the situation somewhat, as the large lecture halls will be used for Ph.D. 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.

To other schools in Colorado at present offers work in Operations Research leading to a degree, with the exception of the Air Force Academy, and there is only the B.S. degree. We list below institutions in the United States offering the Operations Research degree, and in another list, institutions with a Ph.D. program in Operations Research. The symbols correspond to the list below.

1. 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 Ph.D. degree unless otherwise indicated.

It can be seen that opportunities for Operations Research are scarce in this part of the country, and the creation of a Mathematics Department in this area is indeed a rarity. We have already commented on the small staffs of O.R. men employed by Mobil and Kruskell. Other industrial companies (American Metal Climax, for example) are forced to contract with contract work for their O.R. needs.

The Ph.D. 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 Ph.D. degrees granted by the Colorado School of Mines, as listed in the catalog, will apply.

The President of the Colorado School of Mines has appointed a visiting committee for the Department of Mathematics consisting of the following:

- Dr. M. L. With the new computer and space needs of the department, the new graduate programs will be able to expand with little additional cost. The goal is to create a Ph.D. program that is competitive with other institutions in the United States.

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C. Newton Page, '42
Consulting Geophysicist
Box 5572, Midland, Tex.
Telephone Mutual 4-4862

Alber C. Harding, '37
Partner, Black Hills Bunkr Co.
Casper, Wyoming
Box 1, Mills, Wyoming

JANUARY, 1970-THE MINES MAGAZINE

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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.

2. Relationship with other units. The study began with a visit by LeVeque and a mathematics professor from Colorado State University, and to the Mathematics Department of Colorado University. It was found that all three units were entirely agreeable to having a doctoral program at Mines, that there would be no overlap of function with programs already being carried on at this institution, and that there would be no 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 university-oriented departments at Mines, namely Geophysical, Mechanical and Petroleum Engineering, as well as representatives from the Department of Mining Engineering. The visit was arranged through the Department of Mathematics and was designed to afford the Committee an opportunity to judge whether the Mathematics Department has improved remarkably within the past few years, and that the Department has been most cooperative and successful in performing program work necessary to their survival. This part of the program is the institution of a master's degree program, and uniformly felt that the Department has provided a great program of wider benefits to both the Mathematics Department and to the students in the field of application.

In short, the Committee found strong support within the institution, and the visitation stated positively to the institution, to the establishment of a doctoral program in mathematics at Mines.

3. Curriculum. The Committee feels that the present U.S. and M.S. programs in mathematics are well-established and that the goals and objectives and the Mathematics Department have no minimum of the institution. Although Department members are fairly stable and are being satisfactorily required for the doctorate, the Committee did examine two versions of core curriculums, which would closely approximate minimum goals for the doctorate. It was observed that the schools having the training indicated would be well satisfied in Mathematics, although in a rather narrow fashion. We did feel that more courses in sciences and Liberal Arts were needed to support such a program, and that the schools having the training indicated would be well satisfied in Mathematics, although in a rather narrow fashion. We did feel that more courses in sciences and Liberal Arts were needed to support such a program.

4. Physical facilities. The Mathematics Library seems to be adequate and will continue to be adequate. Although no new research projects or large research program as well as more work in classical analysis — transforms, distribution theory, etc. — is to be installed will be entirely adequate to the needs of the program.

5. Financial support of the staff. The Mathematics Department has a number of positions, mostly in teaching, that are comparable with national figures. This is less satisfying than it might be, but there is a marked improvement in its relatively low status in recent years. The provision for experimental research and projects is not yet highly attractive to mathematicians, and it will probably prove to be necessary to go somewhat above the usual level to attract your own people. The problem also involves the availability of a sufficient number of students to achieve a balance between teaching and research.

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The Department is approximately one and a half times the size of the Department of Mathematics at Mines. It is not clear that this would be a significant benefit to the student in the field of application.

7. The Department presently has one unfilled position, and anticipates two requirements at the end of the present academic year. If these 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 in the nature of the situation; it has been impossible to attract really high level mathematicians to Colorado State University, and offers for the Mathematics Department have been extremely strong 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 little experience in the direction of doctoral students, although some of the mathematics doctoral committee at other institutions or have collaborated in the direction of inter-disciplinary doctoral courses at Mines. The Department gives highest priority in its hiring plans, to obtain two additional specialists in research and general application. 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 this would be fully justified in principle, but not necessarily in practice, if in the state of the art of the subject, even without any increase in enrollment. The Department has an extremely flexible, but a few titles, and that typically at least once per annum, the faculty members of the Department can be fully more be used as consultants in graduate, for example, for the School of Mines Research Institute.

8. Physical facilities. The Mathematics Library seems to be adequate and will continue to be adequate. Although no new research projects or large research program as well as more work in classical analysis — transforms, distribution theory, etc. — is to be installed will be entirely adequate to the needs of the program. Nevertheless, the possibility of increasing the number of publications is a matter of concern. The suggestion that the program be increased in size is not yet realized. The mathematics Department is presently housed in a small building which is not adequate for the size of the current program and the need of training is still optimal for Ph.D.'s in Mathematics, which must be prepared to arrive at individual programs, but entire
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Samuel Mullen
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Oakland, Calif. 94611

The Mines Magazine • January, 1970
Introducing the Faculty of the CMMathematics Dept.

The 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. Marsh
Allan W. Whitney

Associate Professors

Arich J. Rose
Robert E. Woolsey

Assistant Professors

William G. Brown
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:

Professors

Raymond R. Cottum
Robert R. Redin

M.A. (Mathematics) 1964, all from Yale University.

Dr. Lee joined the faculty of the Colorado School of Mines in 1964 as Associate Professor of Mathematics and Head of the Department in September, 1964. His principal concern has been strengthening the undergraduate course selection and computer science curriculum and the integration of "general education" courses at all levels. In addition to teaching the enrollment in Mathematics courses at all levels, he has served as Chairman of the Department of Mathematics at Yale University, and in December 1969, he was elected as a member of the Board of Trustees at the University of California at Berkeley.

His previous teaching experience includes employment as Research Engineer in the Operations Research Department of Draper Laboratory at Cambridge, Massachusetts. He received his Ph.D. in Mathematics from Brown University in 1965 and has been employed by the U.S. Army at the Research and Development Laboratory in Massapequa, New York, where he is currently Assistant Director of Operations Research at the National Bureau of Standards.

Dr. Lee received his Ph.D. in Mathematics from the University of California at Berkeley in 1965 and has been employed as a Research Associate at the University of California at Berkeley since 1965.

The following professors have been appointed to the faculty of the Colorado School of Mines as Assistants in the Department of Mathematics, 1969-70, and have been promoted to the rank of Assistant Professor in 1969:

Donald R. Marsh, Professor of Mathematics, has the following degrees: Ph.D. (Mathematics) 1956 (University of Colorado), M.S. (Mathematics) 1954 (University of Colorado), and B.S. (Mathematics) 1950 (University of Colorado).

Dr. Marsh joined the faculty of the Colorado School of Mines as an Assistant Professor of Mathematics in 1969 and was promoted to the rank of Assistant Professor in 1969.

The following professors have been elected to the grade of Assistant Professor at the University of California at Berkeley, effective September 1, 1969:

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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 creation of a new type of power plant in their neighborhoods because of the association of such plants with air and water pollution. But a more serious danger, 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 lead to alleviation of air pollution. Nuclear plants are essential to meet the growing demand for electrical energy, and their safety is measurable increased in recent years. Many scientists are becoming alarmed about the environmental changes now taking place in our country and have written a useful guide to pollution control activities. The writer has condensed a great deal of material from numerous sources.

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, 1936. He has been teaching at the university since then, both in mathematics and physics. His courses have included a broad range of topics, from calculus to quantum mechanics. Bohmont's research interests have centered around the application of mathematics to physics problems. He has published several papers on quantum mechanics and quantum field theory.

Widham St. Saad, Assistant Professor of Mathematics, earned his degree from the University of Texas in 1965 and his Ph.D. from the University of California in 1969. He has been a member of the Mathematics Department at the University of Texas and has also taught at the University of California. His research interests include partial differential equations and the theory of distributed parameter systems.

Charles R. Raier, Assistant Professor of Mathematics, has a degree from the University of Colorado (1958) and his Ph.D. from the University of California (1965). Raier has been teaching at the University of Colorado since 1965, where he has taught courses in mathematics and computer science. His research interests include combinatorics and computer science applications.

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and nitrogen oxides 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, and dioxides of carbon. Hydrocarbon evaporative losses have been or are being solved—both in the refueling and in the vehicular use. Improved refining methods have greatly improved quality of automotive gasoline. The amount of pollution 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 smoke from the air with oxygen, making oxygen far more active, and also with hydrocarbons, particularly if they are of the "unburned" type. All these smog elements, including smoke and many poisonous pollutants such as carbon monoxide and lead from gasoline are expelled near the surface if wind falls to low or falls to "zero level" formed at a temperature inversion (some air above ground at higher temperature than at ground level), which phenomenon is common in some areas, particularly 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 invariable, presently developed only in several places—Geysers, California, Italy, and more recently in Iceland, New Zealand and Russia. Direct generation of electricity from solar energy is also omitted, by 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 a good high-voltage battery. Should they be developed, many more electric power plants would be needed to recharge batteries.

Thus it is apparent that a great 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 here are some facts pertaining to generation of electricity by nuclear (atomic) energy:

1. The September 1959 issue of "News from Jersey," and to shareholders of Standard Oil Co. (New Jersey) contains the following paragraph: PREPARING FOR THE NUCLEAR AGE—Although it was first accounts for only a small proportion of the total supplies, nuclear energy is expected to be 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 1952; since then 21 nuclear power plants have been put into service and another 35 have been ordered and are under construction.

2. "Chemical and Engineering News" for Sept. 15, 1959, contains an article on Page 31, which is quoted in part as follows: Atomic Energy Commission's Robert L. Fargason cited the projected growth of electrical generation capacity from 200,000 Kw. (N.W. megawatts one megawatt equals 1,000 kilowatts or one million watts) of 1958 to 200 million Kw. by 1968 and to 1.6 million by 2006. Nuclear electricity is only 1% of today's capacity but may be 25% by 1975 and 45% by 1992. This capacity will come from construction of plants whose lifetime is expected by A. R. 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.

WHAT THE AUTHOR

Clare Kenneth Wilcox received his B.S. in Engineering degree in 1929 from the Colorado School of Mines. For more than 25 years he has worked a chemical engineer in the petroleum and forest industries. Mr. Wilcox is presently a consultant and is connected with the development of a new type of dietary supplement for the prevention of heart disease.

Recently retired Mr. Wilcox is active as a member of the Board of Trustees, Balance by Richfield, a national council of the American Council on Education Prevention funds and Noise Control.

Mr. Wilcox has been granted 10 U.S. patents, of which over half are being used commercially in the field. During World War II, Mr. Wilcox had a medical career in the U.S. Navy and for his activities in mammalogy production of animal welfare.
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 of (1) elements—including hydrogen, the lightest, atomic weight 1; carbon, atomic weight 12; nitrogen, atomic weight 14; oxygen, atomic weight 16; (2) compounds—such as carbon dioxide, water, sugar, starch, etc.; or (3) 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 118 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 some 100 elements—some already well known such as plutonium and californium.

A Russian scientist, Mendeleev, in 1869 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—39, 47 and 79. They appear in the same vertical column in the Mendeleev Table, with the lightest on top. The table is a most useful tool to scientists. It helped in the discovery and explanation of more than one species of some elements, differing slightly in atomic weight—those 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 contains 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 electricity 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 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 and chemical behavior. They vary in atomic weight because of the different number of neutrons in their nucleus (central core). Of the presently known 100 elements, including these man-made, many have isotopes. The example being hydrogen, there are three known hydrogen isotopes: ordinary hydrogen with atomic weight of 1; deuterium, with atomic weight of 2; and tritium with atomic weight of 3. The first two hydrogen isotopes are stable; but the third, tritium, is unstable (radioactive). Most unstable isotopes are called radionucleides. These include most of the elements man-made in particle accelerators or nuclear reactions.

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 5 isotopes, about 99.3% uranium 238, 0.7% uranium 235, and 0.0052% uranium 234. Hence uranium in its natural state does not have an atomic weight of exactly 238. All hydrogen in nature has two stable isotopes—ordinary hydrogen, atomic weight 1, and deuterium (heavy hydrogen), atomic weight 2; hydrogen in nature has an atomic weight of 1.008.

Radioactivity

Elements which spontaneously change or disintegrate into other elements are unstable and are 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. Radio, the heaviest gas known, atomic weight 226, 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, radium is found in underground (pitchblende ore) uranium mines. These heavy metals have very complex nuclear structures. All of these eventually change into lead in the process of becoming stable by particle loss through radiation. They then 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 4.5 billion years; of radium 226, 1820 years; and radon 222, 3.8 days; and of polonium 210, 3.2 seconds. 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 pluto 319 in 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 object such as a sheet of paper. Beta rays are negatively charged and extremely small. They travel only a few feet in air and are stopped by a film metal seal or about an inch of wood. Alpha and beta rays can be dangerous, particularly if materials emitting such are exposed to inhabitants. Gamma rays are not particles, but are short wave electromagnetic emissions similar to well-known x-rays. They travel great distances and easily pass through most solid substances, requiring their shield of lead, steel, concrete, earth or other material to stop them.

Fundamentals of Atomic Energy

1. Basic Principle

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 light, heat and other forms of radiation. The sun's energy comes from fission of light elements (hydrogen) into heavier elements including helium with some overall less weight in mass (mass) and a release of energy. Energy can also be created by fusion of elements—breaking apart heavier elements into lighter ones, such as the splitting of an atom of uranium. This also occurs with less 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 11 billion kilowatts of energy (known as known as mass-energy—measured by the release of energy from the breakdown of material). Current estimates indicate about 15 billion kilowatts of energy can be generated from each pound of uranium.

2. Fission and Fusion

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

(Continued on Page 22)

ST. JOE
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ST. JOE THE MINES MAGAZINE • JANUARY, 1970

Terry Gooding, Kentucky '65, met the challenge in mining at St. Joe
For the safety reasons the reactor itself is usually con- 

Under proper conditions conditions of the higher elements 

to make it fissionable. In fact, if energy is 

in the order of millions of degrees. The sun in our solar 

nuclear energy is an example of a technique where hydrogen is con- 

in the fission process sufficiently other than for producing an 

; in other words, it is needed in the fusion processes and potential methods of recovery of 

the enormous nuclear energy therefore is continuing. 

Differences Between Atomic Bombs and Atomic Energy for 

The Captain R. B. Merifin and his associates produced the 

the first atomic chain reaction in uranium at the University of 

Chemical differences in fissionable material, 

uranium 238, however, made separation relatively easy. 

Photons and electrons in fission are produced in 

In the case of the hydrogen bomb the mechanism of 

of the hydrogen bomb than for the atomic bomb. 

Nuclear Power Reactors 

Power generation requires "slow" neutrons, so that 

of the usual separation efficiency is used. This 

surrounds the nuclear fuel capsules or fuel 

i.e., normally 3-5%. This material is then 

groundwater 

environmental studies 

mineral resource development 

engineering geology 

in producing the first successful bomb—Lawrence, Oppen- 

heimer, Teller and others; as well as many from other 

U. S. universities, from industry and from government 

agencies. To make the breeder reactors require in the 

Dr. Compton, Trey, Conant, Bush, Murphey and Gen- 

eral Groves. With the development of the reactor came 

in early research work on atomic energy, a number of 

of course, neutrons from the first fission and as a result the 

the war started in 1939—Einstein, Fermi, Nella Bohr, 

Weisskopf, Salzberg, and others, to mention a few. 

It has been noted Germany was aware of uranium's 

potential, and was working on the atomic bomb. For 

produced in large quantities of heavy water containing deuterium instead 

could not be produced, inasmuch as the fission process requires 

they are of several types: Formerly the term "atomic 

of the earth's crust like uranium or radium or 

volcanic rocks, radium deposits in hot springs, radon gas in 

injury to all living things. Therefore, all personnel working in radioactive areas, 

whether in the laboratory or in plants, are required to wear 

These badges are examined periodically— 

standards are if necessary amended. If the standards may be changed from time to time, 

the practice is to set standards for certain radioisotopes by a given date, 

in which the standard may be varied as required. 

The 1950's represent an important turning point in the history of nuclear 

the discovery of X-rays (Roentgen of Ger- 

many in 1895). A roentgen is the quantity of X- or gamma 

in order to produce a unidirectional beam of 

at standard pressure and temperature. 

the medical profession. 

in the fission process to work, even if continued for a 

in the case of power reactors as previously stated, 

commonly known as atomic fission, consists of 

the first fission products, radon, radium, and 

and the first military bomb dropped over Hiroshima Aug. 

of the case of the hydrogen bomb the mechanism of 

its possible to produce a unidimensional beam of 

are covered which are finding increasing use in 

medicine and industry. At some point, coal is 

placed to a large extent radium and X-rays in cancer 

in living organisms as food and air. Photons from 

covered containing actual radioactive material, such as 

radioactive materials, as, and on film badges. The few accidents which have occurred to 

and the complete family of products will finally stop, 

but when the resultant neutrons are added together, 

in the acknowledgment 

of course there are exceptions, he was taken off for the job 

that should be mentioned that experiments have been made with 

and as was shown above, this is in fact the case. 

as they are commonly used. This method of 

is applied to the use of radioactive materials for 

by the body. Cities can similarly locate water 

power or power lines by using short-life tracers. 

some companies may use 60 to measure engine wear 

and thereby improve lubrication oil; or with small amounts 

of any of several radioactive isotopes can accurately determine the 

interface when two different products are being present in ships and other vessels. Other industrial 

and research uses are too numerous to mention. 

Reactor safety 

A large variety of experimental reactors have been 

in this period of time, some 20 years, the United States 

years immediately ahead, breeder reactor making more 

and uranium 235 than the U-238 they burn with 

power reactor will be fast neutron breeders 

also from uranium 238 than the uranium 235 they consume, 

the output of the breeder reactors gives rise to thermal neutrons. 

these reactors are considered primarily "fast" breeders that produce uranium 233 from thorium 232 and operate on the 

the thermal or low energy (slow) neutron region. 

Acknowledgments 

in the above current references, the author wishes particularly to acknowledge valuable information 

on pulse pile reactors, the Atomic Energy 

Course for Management presented by the National 

are on Long Island and also to information presented by Dr. 

for Military Pur- 

sued by Princeton University Press. 

the Mines Magazine • January, 1970 

23
Ever Hear a Mosquito Cough?

Thanks to more effective bug sprays, mosquitoes all over the United States are coughing their last—in public places, fraternity houses, swamp land.

Ten thousand other pesky and destructive pests are also being wiped out.

And the thing that's knocking them dead is a chemical agent derived from the fragile Pyrethrum daisy found on the equatorial plains of Ecuador and Africa.

The extracts are pyrethrins. With these we make Pyrenox®, now found in nearly every major brand of aerosol. Pyrenox is one of more than 100 chemicals manufactured by FMC Corporation.

Thanks to Pyrenox, you can give your room a spritz at exam time. And put all the mosquitoes out of their misery, without putting you out of yours.

You might gather from all this that we're a chemical company.

Well, yes and no.

As one of the nation's top 70 corporations, we're one of the largest manufacturers of chemicals in the U.S.

But we also make synthetic fibers, power shovels, harvesting machines, marine vessels, food processing equipment, lawnmowers, fire engines, ... altogether over 10,000 different products vital to our way of life.

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The Way I See It

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 on portrayed by the press and television. Some good things must have occurred, for 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 man who sees colors in black or white and never in shades of gray.

The student protesters 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 breast loss its edge of terror and becomes acceptable as part of the facts of life.

The Hippy 70's — Magically the decade will have no problems since all are 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 of pollutants, overcrowding, civil-rights and the hippies. Really nothing will have changed but the hop. Hope ever arises and the most desperate will reveal the paradox that we long for but have never found.

L'Envoi — The intelligent 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.

This 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 the same and the environment and I won't be here to put up with their "creation."

—Wendell W. Fertig

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425 E. Las Flores Dr., Altadena, Calif.
Syccoma 4-1793

Edward J. Johnson, '49
Petroleum Geology
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Write for rates.
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ABC "TAKES THE CAKE" at Minerva Co. Fluorspar Mine

The Minerva Co., Division of Minerva Oil Co., relies upon ABC Filter Fabric to handle a dense, thick filter cake build-up which results from the Fluorspar beneficiation process used at their Cave-in-Rock, Illinois, deep mining operation. Like other mineral mining and processing firms, they depend upon ABC for the finest in filter media — supplied to meet their requirements. Write today for complete information.

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where the sun shines the year round.
Ski, swim, horseback ride, cook-outs in rear
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AMERICAN BRATTICE CLOTH CORP.
Kings Highway, Warsaw, Indiana 46580

The President called the meeting to order and the following was approved:

Those present were: Robert Johnson, president; Harrison Hayes, secretary; Robert Nance, treasurer; John D. Vancleet, director; Allen McGlone, chairman; Hugh School-Colleges Relations; Warren Prouse, chairman, entertainment Committee; William V. Burger, alumni staff; Wendell W. Ferig, executive secretary.

The minutes of the meeting of Oct. 15, 1969, were read and approved. The financial report for October, 1969, was 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 mostly from areas outside the City of Denver. The new procedure for introductions guests was reported to be successful. The Admissions Office has expressed pleasure concerning the excellent manner in which the guests worked in cooperation with the Administration.

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c. The minutes of the meeting of Oct. 15, 1969, were read and approved. The financial report for October, 1969, was presented at the next meeting.

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 500 shares of Liberty Loan stock and retirement of the proceeds in American Export and Nicaragua convertible debentures. Colonel Perto was commanded for the way in which he is managing the Trust Funds.

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

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.

Meeting was adjourned at 9:10 p.m.
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Magnetic Susceptibility Bridge
Rapidly constructed and simple to operate, this portable instrument offers a unique opportunity to measure magnetic susceptibilities from 2 x 10^-6 to 100,000 X 10^-6 c.g.s. of volume susceptibility, and will accept samples as chips, fragments, powders, or whole cores. Ideal for planning magnetic surveys, it provides initial information enough to select the required instrumentation, sensitivity ranges, and station spacing—thus eliminating a considerable amount of wasted motion, time, and money.

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CHRISTMAS GREETINGS  Many Christmas cards were received from the alumni and those 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 first term 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 heartfelt 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.

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 Geologic Engineering, Geophysical Engineering, Metallurgical Engineering, Mining Engineering, Petroleum Engineering, Petroleum Geophysical 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.
SELECTING AGGREGATE SURFACES
A new bulletin from the U.S. Department of Agriculture provides information on methods of selecting surface aggregates for a wide variety of uses. The bulletin emphasizes that the selection of the right aggregate surface requires an understanding of the design, function, and environment in which it will be used. The bulletin covers topics such as the properties of different types of aggregate surfaces, their cost, and installation procedures. It is available from the USDA, Washington, D.C. 20250.

Catalogs and Trade Publications

Send Us Your Bulletins
Send us your publications to "The MINES Magazine," 1100 Colorado Blvd., Denver, Colo. 80206.

With the Manufacturers

Harrower-Electric's Electrical Products Division, Milwaukee, Wis. SD96, announces a new slope drive system, the "Ballpoint Drive." The new AC static steplers Magnetic Drive System is designed for a self-contained, adjustable voltage MG set drive at specified load conditions. The worm-wound motor drive. Controlled rates of acceleration and deceleration, automatic landing and program control variations are available with this control. Circle 236 on Reader Service Card.

Slope Hoist Drive System (336)

Collins Machinery Corp., 956 Mentor Ave., Mentor Park, Calif., has developed and is marketing a new tool that prepares pipes for mechanical couplings. It simultaneously cuts and grooves the pipe. The tool employs a Collins threading machine, either a Model 46A (range 1"-4") or a 46A for pipe from 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 being operated. Circle 235 on Reader Service Card.

Ballpoint Driver (330)

Mines 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 Ceramics Section is working the industry to develop a "C" arm, a stainless steel, high-temperature spray sealant. Circle 232 on Reader Service Card.

Mines Hoisting System (335)

Card Corp., Deerfield, Ill., is introducing a mine hoisting system that features "hoist operational data" while satisfying the operating and economic requirements of most underground mines. The Card Hydrostatic hoist uses a closed hydraulic system and makes the greatest steps plus high maximum speeds usually found only in very costly passenger service elevators. A simplified electronic control and signaling system is activated without a man at the hoist controls. The hoist is ideal for inclined or vertical shafts, meeting all mine safety codes, including the proposed U.S. Federal Code. Circle 235 on Reader Service Card.

Ballpoint Drive System (336)

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Collins Machinery Corp., 956 Mentor Ave., Mentor Park, Calif., has developed and is marketing a new tool that prepares pipes for mechanical couplings. It simultaneously cuts and grooves the pipe. The tool employs a Collins threading machine, either a Model 46A (range 1"-4") or a 46A for pipe from 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 being operated. Circle 235 on Reader Service Card.

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SECTION

From the Local Sections

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Antilles

Boise

California

Canton

Columbia, S.C.

Fargo

Fort Worth

Great Lakes

Guatemala

Hartford

Indiana

Iowa

Kansas City

Los Angeles

New Orleans

North Carolina

Oakland

Ohio

Ohio

Ohio City

Omaha

Ohio River Valley

Pittsburgh

Pennsylvania

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South Carolina

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Tennessee

Texas

Tulsa

Virginia

West Virginia

Maxwell, Ala.

Mapos

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New York

Oklahoma

Oklahoma City

Texas

Tulsa

Tulsa, Okla.

Dakota

Texas

TEXAS

Texas

Texas

Texas

Texas

Texas

Alabama

Arizona

Arkansas

California

Colorado

Connecticut

Delaware

Florida

Georgia

Hawaii

Iowa

Kansas

Kentucky

Louisiana

Maine

Maryland

Massachusetts

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In Memoriam

G. Morton Kintz

GOOD MORTON KINTZ, E.M., in 1930, 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. 3, 1969 at his home in Dallas, Texas 75225 (4120 Purdy St.).

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

"After serving in the General Land Office from 1920 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, and upon reorganization of the Bureau of Mines became the Chief of the Accident Prevention and Health Division, Region VI. In this position he supervised the mine inspection activities and accident prevention and health programs in the 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 covering the general field of mine safety and accident prevention. Many people in this country and abroad have written to him for information on the hazards of handling flammable and toxic substances and approved techniques for extinguishing fires, and disposing of their leathers.

"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 State Award, 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 1965 in Japan, he went to give a lecture-demonstration.

In a recent letter, Mrs. Kintz writes: "Morton was a Beta at Mines for 56 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 Kintz, Mr. Kintz is survived by a daughter, Mrs. Walter C. Barahard, 442 Furr Dr., San Antonio, Texas 78201.

Eugene E. Dawson, '38

AMERICAN INDEPENDENT OIL CO.
Kuwait, Arabian Gulf

John F. Mann, Jr., '43

Consulting Geologist
Hydrologist
945 Reservoir Drive, Lake Tapps, Calif.

Clyde E. Osborn, '33

Professional Soils, Metallurgical Eng., Cole, and P.I. Registration
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Denver, Colo. 80203

G. C. Weaver, '26

FOTASCH

Robert B. Sipperley, '43

Oil, Gas, and Metallurgical Engineer
Gulf Oil Co., Refining Division
P. O. Box 808, Houston, Texas 77001

G. C. Weaver, '26

FOTASCH

CONSULTANT
P. O. BOX 1014
CARLSBAD, NEW MEXICO

Metal Belt Institute Publishes Glossary

The Metal Belt Institute, 41 Lexington Ave., New York, N.Y., compo-
mised of manufacturers of wire mesh, conveyor belts, announces the publica-
tion of "Glossary of Terms as Defined" 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. 21H, 1-1960, 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 1321, Oklahoma City, Okla. This study was conducted by the Research Committee of the Interstate Oil Compact Commissions and resulting booklet is considered to be the most up-to-date and best infall 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.

Technical Societies

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

Cleveland—in the heart of the nation's largest metropolis, ASM will host the American Society for Metals' Twenty-Fifth Annual Congress and Exhibition, Oct. 18-22, 1969.

An important feature of this 52nd annual event is in-depth coverage of the "Big Part Played by Small Parts and Components of Metal." The conference will present industry experts reporting on the applications of small parts in castings, forgings, stampings, tubing, powder metal parts along with plastics vs. metals in component parts. Case studies of part failures, incorrect design, poor assembly methods or improper surfacing techniques, component failure, control, and inadequate inspection, will be featured.

In the processing and fabricating area, small parts will be discussed during a two-day in-depth joint meeting conference will be featured.

Last held in Cleveland in 1967, the event was attended by 20,000 engineers, engineers and educators and is expected to attract the same number of people from around the world. It is expected to present over 300 technical papers.

More than 900 international companies are expected to exhibit in excess of $1 million worth of new and improving equipment in the Convention Center. Of this, a choice equipment of the most recent technical developments and improvements will be presented, graphically displayed—many in actual operation—by exhibitors who comprise the equipment manufacturers.

In addition to the full schedule of technical papers and exhibits, the Technical Societies of AIME, the Metallurgical Society of AIME, the American Society for Nondestructive Testing, Metalworking technical societies and associations will present several hundred papers and sessions.

Two annual features—the Materials Application Conference and METALLOGRAPHY—will be presented at the exposition. The Materials Application Conference offers visitors and opportunities to inspect examples of new technologies and innovations in materials and processes. The METALLOGRAPHY symposium includes hundreds of exceptional metallographs.

What's new about finding nailing material, the interdependence of materials, technologies, facilities, and measurements in silicon device technology? It's all discussed in this symposium.

Second Inter-American Conference

On Materials Technology in Mexico City

SPEAKERS from the United States, Canada, Latin America, Europe and the Middle East will be featured in the Second Inter-American Conference on Materials Technology to be held in Mexico City Aug. 24-27. According to Dr. R. D. Wyke, director of the material engineering at Southwest Research Institute and general chairman of the conference, the meeting will bring together specialists in the field of materials technology, 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 35 technical and professional conferences (throughout the Americas. The Organizing Committee is made up of the Mexican Institute of Metals, The Pontifical Catholic University, the College of Mining Engineers and Electricians of Mexico, and Southwestern Research Institute of San Antonio. The conference program will be under the sponsorship of the organizers.

A highlight of the conference will be an international exhibit of equipment, books for metallurgists, engineers and educators. The technical program will concentrate on materials processing for metals and ceramics. The exhibit program will be held at the conference site at the Hotel which is being constructed for the Conference.

The Symposia on Silicon Device Processing Date 2-3

A Symposium on Silicon Devices Processing will be held at the National Bureau of Standards (U.S. Department of Commerce), Path, Md. on June 1, 2-3, 1970. Joining the conference in the same area in sponsoring this event is Committee F-4 on Materials for Electronic Devices and Microelectronics of the American Society for Testing and Materials.

The symposium's purpose is to bring together people involved in silicon device technology to discuss in detail the present day's techniques for processing and characterizing semiconductor materials.

The theme of the symposium is "Fundamental Electronic Properties of Intrinsic Silicon Devices".
News of the Mineral Industries

Uranium Industry Plans 110 Million Feet of Drilling

A total of nearly 110,600,000 feet of surface exploration and development drilling for uranium, mainly in 1969 and 1972, is planned by the domestic uranium industry, according to details released recently by the Atomic Energy Commission (AEC), Washington, D.C.

The total cost of this drilling program by the industry is estimated at $75,000,000, which includes extended technical and administrative costs but excludes the cost of property acquisition and exploration rights.

The 110,600,000 feet of drilling planned by the industry in 1969 and 1972 compares with an industry estimate of 80,000,000 feet for the four years 1969 through 1971 as represented to the AEC by the industry in November of 1969.

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

Of the drilling planned for the four years, exploration drilling footage is estimated at 70,000,000 feet, and development drilling at 30,600,000 feet.

Industry plans call for a total of 25,700,000 feet of drilling, as compared with a recent estimate of 22,800,000 feet drilled in 1968.

According to the AEC, the average drilling footage planned for the four years is 302,000 feet in 1969, 510,000 feet in 1969.

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 library. The films are also available for purchase.

The films are:
1. "The Snow Eye," 13 minutes, produced by the AEC.
3. "Quark on a sail or stem may be directed to the appropriate field staff for additional release.

Hazen Research, Inc.

Manganese Ore Pellet 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. Inc., Cleveland, Ohio, by the Electric Authores E (EOM) of Brazil, in which Bethlehem Steel Corp. holds a 6% interest.

The new plant will be located in Santos in the territory of Amapa, Brazil. The contract is valued at about $5,000,000 and calls for the engineering, construction, and supervision of construction of a facility for rolling, 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 29,000 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 being represented by this General Electric-designed fast breeder reactor system, the only one of its kind to use pressurized-moderated oxide fuel. The reactor houses sodium which in turn heats water to produce steam. The steam eventually will be used in such industrial processes as producing aluminum.

The fuel and coolant system is based on sodium-23-oxygen, a fast reactor fuel and coolant combination that promises to be less expensive and more efficient than other fast reactor systems.

Now made in the West — to serve you better:

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Mather Given Recognition

Jearl Paul Mather, professor of Mineral Economics and head of the Columbia University Mineral Economics Department, was named an honorary member of the 1970 National Register of Prominent Aluminumists.

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

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

From 1958 to 1965, he served as administrative assistant to the vice president of Mines and as assistant campus and business manager in addition to his teaching duties.

Following service in the U.S. Navy in World War II, Mather returned to teaching at Colorado School of Mines, later teaching at Princeton University and finishing 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. He is also a member of the AEC's Technical Advisory Committee, the department's advisory board.

Mather attended the University of Colorado for three years before receiving his bachelor's degree from the University of Denver in 1951. He received master's degrees from DU and Princeton University, and has received seven honorary doctored degrees.

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 120th person to receive the award in its 30-year history.

Born in 1892 in Philadelphia, Johnson received a master's degree in geology at Mines in 1915 and a doctor's degree in geology and biology from the University of Colorado in 1918.

He has been active in many scientific societies and served as president of the Rocky Mountain Association of Geologists in 1929.

Since 1919 he has been engaged in research on organic landlives and has pioneered the study of rock-building algae in North America.

The Colorado Engineering Council has 26 member organizations in the fields of architecture, engineering and science.

Winter Concert

The Colorado School of Mines Concert Band and chorus under the direction of Byron Darsell again presented their special winter concert on Dec. 11, 1969 in the student union.

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

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Veterans Chapter Organized on CSM Campus

Recently a Veterans Chapter has formed on the campus of Colorado State University. The Vet- Chan is an organization primarily dedicated to improving understanding of the American Democracy. In particular, the organization will help with the observance of events of national community and school interest.

The first meeting of the Vets on the campus was held at noon in the library in the Johnson Science Building on October 4th. The meeting was attended by Vets, students, members of the faculty, and alumni.

The Vets on the campus are planning to meet on a regular basis and to become involved in various activities that will help to promote understanding of the American Democracy.

Maynard Slaughter Joins Faculty

Maynard Slaughter has accepted the position of the Colorado School of Mines as a Professor of Chemistry. He will begin his duties in January of 1979.

Dr. Kelliher Named to Science Committee

G. B. Kelliher, vice president for research and development, Owens-Corning Fiberglas Corporation, and former director of the Bureau of Mines, has been named a member of the Science Committee.

Visiting Engineers Program

The CSM Basic Engineering Department has introduced a new program involving visiting engineers from industry and government with the intent to help build an awareness of the work emphasized beyond the existing faculty.

Fresman in basic engineering have previously been involved with engineering drawing with limited emphasis on design and the students have been unable to participate in the program due to their schedule. The new program, sponsored by the visiting engineers, offers an opportunity for students to participate in the design process and to develop their skills.

The program is open to all students who are interested in engineering and are willing to participate. Students interested in participating should contact the engineering department for more information.

CSM Chemlauna Program

The CSM Department of Chemistry has initiated a program of participation in mineral oriented groups that wish to provide assistance for the organization of geological and pollution control research.

Historically the chemistry department has had a history of conducting research in the field of pollution control. The new program will involve the participation of graduate students in research in the field.

CSM Receives Grant From Gulf Oil Corp.

ORLO 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 department's discretion during the 1978-79 academic year.

Dr. Kelliher has been named a member of the Science Committee and is a recognized expert in the field of electrical methods of prospecting.

The program is open to all students who are interested in the field of engineering and are willing to participate. Students interested in participating should contact the engineering department for more information.

Just off the "Strip" in Las Vegas

NEVADA

55 NORTHERN AIR-CONDITIONED ROOMS AND SUITES (SOME KITCHENETTED WITH STOVETOP, HOT WATER) IN ROOMS ELECTRIC HOT TUBS. LARGE SWIMMING POOL AND PATIO. COFFEE SHIP IN LOUNGE. "STRIP" & ENTERTAINMENT AREA MAIL ONLY 15 MINUTES FROM DOWNTOWN. CALL TOLL FREE: 760-5541-1977

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

JANUARY, 1979—THE MINES MAGAZINE

The Mines Magazine • January, 1979
Eat your heart out, Playboy!

Even sans full-color centerfold, our perky publication has plenty of SA—Senior Appeal. Remember the swelling title, "Careers with Bethlehem Steel and the Loop Course." Pick up a copy at your placement office, or write: Manager of Personnel, Bethlehem Steel Corporation, P.O. Box 1806, Bethlehem, PA 18016.

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JANUARY, 1976—THE MINES MAGAZINE
Critical Service—always a major pump problem
We met the challenge over 30 years ago with a truly reliable plastic-lined pump.

NOW KYNAR®. Wilfley engineers haven’t been resting on their laurels. They continually adapt to the needs of industry by designing and developing new pumps, by using new materials of construction to meet the increasing, ever-changing demands for dependable, low-cost operation.

The new Kynar-lined addition to our other plastic pumps provides an answer to many of today’s, critical service problems.

Kynar is a new fluoroplastic which has unusual strength characteristics and excellent corrosion resistance. Impact and abrasion resistance is quite exceptional. Wilfley fully armored, Kynar-Lined Acid Pumps are manufactured in two sizes. The smaller has a 2" intake x 1½" discharge with capacities up to 120 GPM and discharge pressure up to 100 feet of head. The larger pump has a 5" intake x 4" discharge, developing up to 130 feet of head with capacities up to 600 GPM.

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