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These safety features are especially important when holes must be preloaded and allowed to stand before being fired.

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Blasters and operators choose Primacord for all types of open pit and construction projects and for many underground operations, too. For complete information, consult your explosives supplier—or write.
What Is the Best Education For Mining Engineers?

There has been a great deal of change in the mineral industry in recent years, and even more can readily be seen for the years immediately ahead. Rising levels of demand, exhaustions of the higher-grade ores, and increasing restraints on mining activities as the result of widespread interest in environment control all combine to make the task of the mining engineer in the years ahead more difficult.

To meet these challenges the highest quality of mining engineering education is needed, on both the undergraduate and graduate levels. Constant efforts are being made within Mines to ensure that our curricula are pertinent with respect to the needs of the mining industry. All levels of education are emphasized, what new material introduced, and what emphasis be?

Pertinent research strengthens a school's educational program on all levels, as well as providing useful data for students and industry. It will be interesting to find out the differences between the professional engineering approach and the business administration approach to graduate work. What areas of graduate-level training should be emphasized, what new material introduced, and what previous material is no longer so pertinent?

Areas of graduate-level training should be provided? What will be the difference between the professional engineering approach and the business administration approach to graduate work? Where should we emphasize the emphasis be?

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Since he graduated from the University of Missouri at Columbia in 1964, Dan Schmidt has been Plant Engineer at St. Joe's ultra-modern Fletcher mine in Southeast Missouri. He's Piant Engineer at St. Joe's ultra-modern Fletcher mine in Southeast Missouri.

Dan Schmidt, Missouri '64, met the challenge in mining at St. Joe.
Mining and agriculture are the two basic industries which modern civilization is based and as such are among man's oldest pursuits. When man picked up his first stone to throw at a small animal he became not only a hunter, but a miner. Flint tools associated with paleolithic man, and said to be 490,000 years old, have been discovered. Since man has been more or less continuously involved in the process of obtaining useful materials from the earth's crust—an endeavor which we refer to as mining.

The first mining to obtain materials for these tools was obviously confined to primitive surface excavations. However, by about 2500 B.C. copper and gold were being intensively mined, and by the first century A.D. mining had become an important industry to the Romans. The first mining to obtain materials for these tools was undoubtedly place even greater demands on our mineral resources.

Until the present time, the rate at which minerals are consumed during the first two-thirds of this century than throughout all previous history of mankind. Yet if the consumption of the world doubles by the year 2000, as has been predicted, and if per capita consumption of mineral resources remains at the present level, the rate at which we extract materials from the earth's crust must double during the next 30 years. An increase in per capita consumption, as predicted for much of the world, will undoubtedly place even greater demands on our mineral resources.

However, before discussing mining of the future, let's take a brief backward glance. There is probably no better way to do this than by reviewing the first major treatise on the art of mining—Agricola's "De Re Metallica." This treatise, published in 1556, was a compendium of books on the various phases of mining. As such, it represents a statement on the state of the art, at that time, and provides a logical place to launch a discussion of mining research.

Agricola's stated purpose in writing his books was to immortalize in writing the whole length and breadth, and we might add depth, of a complex and already ancient art. He concludes at least a partial failure in his task because he omitted all things which he had not himself seen. However, Agricola has handed down to us a detailed description of mining and metallurgy as it was then practiced. He has also included numerous drawings of the tools which were employed in the 16th Century Saxony. Among the twelve books which comprise "De Re Metallica" are included books on the digging of ore, the surveyor's art, miner's tools and machines, methods for delimiting veins, and assaying of ores, and so forth.

Agricola broke the art of mining into a series of operations which could be more easily understood and therefore improved. Obviously he understood the interrelationships and interdependence of the various sciences upon which the miner depends.

In Agricola's time the basic operations included breaking the rock, loading it, hauling it out of the mine, and transporting it to a processing point. He also recognized the importance of ground support, ventilation, mine drainage, safety, and miner's diseases. These operations and problems are still basic to the mining industry.

The earliest known methods of ore breakage were primitive indeed. Materials which Agricola described as soft ores were broken by pick. Harder ores were broken by iron tools described as wedges, iron blocks, iron plates, buckets or baskets were used to haul ore out of shafts in conjunction with a windlass whereas wheelbarrows, either by hand, or by shovel. The latter were used to haul ore out of shafts in conjunction with a windlass whereas wheelbarrows were used to haul ore out of tunnels. A variety of methods were used to transport the ore to a processing point. The method chosen depended on distance, terrain, season, and other factors. Ore was removed from steep mountainous in cascades dragged by men, in small sacks carried by dogs, in pack saddles on horses or mules, and occasionally on hand and wheelbarrows when mountainsides were covered with snow. The latter was described by Agricola as providing some pretty wild

The best engineers are far from happy with the world the way it is. The way it is, kids choke on polluted air. Streets are jammed by cars with no place to go. Lakes and rivers are a common dumping ground for debris of all kinds.

But that's not the way it has to be. Air pollution can be controlled. Better transportation systems can be devised. There can be an almost unlimited supply of clean water.

The key is technology. Technology and the engineers who can make it work.

"When there are no roads, engineers build them," says John F. Kennedy. And General Electric is already working on these problems. And on other problems that need to be solved. Disease, hunger in the world, crime in the streets. General Electric engineers don't look for overnight solutions. Because there aren't any. But with their training and with their imagination, they're making steady progress.

Maybe you'd like to help. Are you the kind of engineer who can grow in his job to make major contributions? The kind of engineer who can look beyond his immediate horizons? Who can look at what's wrong with the world and see ways to correct it?

If you are, General Electric needs you.
In situ studies of rock and related stresses have resulted in several significant developments in mining. The understanding of stresses around underground openings led to the development of a series of standards for the ideal opening. Among these was the appreciation that the rock immediately adjacent to the opening must be left relatively undisturbed, and sacrificing the short-term effort to satisfy this requirement led to a considerable research effort in the field of blasting. As a result of this effort was the development of the presplitting and smooth-wall blasting techniques which are widely used today. These techniques rely on a series of closely spaced holes which are loaded with small quantities of decoupled explosives. The action of the explosives is confined to the vicinity of the drill holes and damage to the adjacent rock is minimized.

Both the general public and the mining industry stand to benefit from these and other anticipated improvements in tunneling technology. A very substantial portion of the need for rapid underground excavation, during the next twenty years will, of course, be related to mining.

The one extraction processes themselves may be the subject of systems engineering. The design of a mine is based upon many factors such as the size and geometry of the orebody, depth of burial, and so forth. At the present time we are witnessing an incredible growth in the size of surface mining machines. A 10-cubic-yard shovel is presently operating in one coal mine and a 250-cubic-yard dragline is being operated at another. These machines have allowed the mining by surface methods of material which previously would have been attainable only from underground openings.

Yet another extractive system is currently being applied to a potash deposit in Canada where development of conventional underground potash mines is difficult because of shaft-milling problems in the Balmersmore Formation. As an alternative to conventional mining methods, one company has undertaken solution mining of potash. Water is pumped down more than 5,000 feet into the potash beds where it dissolves the sodium and potassium salts. The brines are then pumped to the surface where they are collected and pumped to the refinery.

A final and increasingly important system in the world we live in is the mining industry itself. Of course, every industry is exploitive in nature, and, unfortunately, theories of conservation of resources were viewed by the industry in the past with less than enthusiasm. Our increasing population is exerting an ever-increasing pressure on available land space, and in recent years organized conservation groups have created powerful lobbies in Washington. Mine managers are now faced with a rising tide of public opinion which is demanding an end to the despoiling of the land. These men who rejected ideas of resource conservation are being replaced by men who are now fighting for their companies' existence against a tide of resource preservation.

When most people speak of conservation, they mean something entirely different. Simply stated, conservation of resources means that the extractive process of mining must not be allowed to destroy all other resources such as water, agriculture, or esthetics. Much of the public demand today seems to be for the preservation of resources which means that they will not be removed from the ground or changed in any way.

The long-term effects of mining on our environment probably offer one of the most fruitful areas for mining research. The demand for new materials precludes the elimination of mining from our list of active pursuits. The only alternative, then, is to adopt mining to our environment. Those aspects of the industry which are harmful must be eliminated, those areas which need redevelopment must be re-examined.

In conclusion, mining research is a much-needed and fast-growing sector of the mining industry. Men and women with creative ability, imagination, and technical competence are needed to develop the mining art into a true science. The mining industry is entering into a renaissance as demands for its materials increase daily.
Yieldable Rock Bolts for Shock Loading
And Grouted Bolts
For Faster Rock Stabilization

By W. D. Ortlepp and John J. Reed

Yieldable Rockbolts

In order to overcome these limitations in conventional rockbolts, a simple yielding device has recently been developed. Ortlepp (1969), Fig. 1. This consists of a smooth-bored die of a diameter slightly larger than the rockbolt stud but appreciably smaller than the crest diameter of the thread rolled on the stud. The stud passes freely through a conventional expanding shell anchor, then through the die, before terminating in several inches of rolled thread. The large diameter of the thread secures the stud in the anchor until the imposed load exceeds a critical value. When this happens, the thread becomes deformed and is forced back into the thread groove, permitting the bolt to move steadily through the die and anchor. By suitable choice of dimensions of the die, the load at which movement commences can be arranged to be slightly less than that which would result in plastic yield of the bolt itself. Available testing machines provided a range of displacement velocities from about one inch per minute to about two feet per second, and within this range the yield load appears to be independent of yield rate. For nominally constant die dimensions the variability in yield load was found to be about 9 per cent. Yielding rockbolts have been developed in the U. S. in prototype form, using a tube drawing or enlarging mechanism instead of the wire drawing scheme described above. They would be more expensive and complicated to manufacture, and have not been field tested.

Test Procedure

It was decided to test the yielding bolts vs. conventional bolts in a suitable drift test, using controlled peripheral blasting to cause large and high-velocity displacements believed to be characteristic of rock bursts. Site: At a depth of 9,600 feet, the development of a main fan installation was in progress in quartzite which, although somewhat argillaceous, was not prominently bedded. As a result of complete and extensive mining of the thin section of ore 60 feet above, the field stresses were low. Moreover, there was no indication that the over-mining had induced any fracturing in the rock surrounding the fan chambers.

A 9 feet high by 10 feet wide heading, which would finally form a 12 feet high by 19 feet wide wider chamber, was advanced 25 feet from the main fan chamber. Decoupled charges were used in the peripheral holes to minimize blast damage of the wall rock.

Method: Two parallel, horizontal wires were stretched between survey points to form a guide from which identical rows of rockbolt holes were drilled at 23/4 foot intervals along the heading. The distances from the guide wires to the ends of the rockbolts were measured with an accuracy of about one-half inch. To minimize end-effects, radial "pre-split" blasts were effected 18 feet along the tunnel and near its end. This enabled two tests to be carried out as indicated in Figs. 2 and 3.

In each test conventional rockbolts and yielding rockbolts were symmetrically opposed about the center-line of the heading. All the rockbolts were 1/4-inch diameter, high-tensile steel studs with spring-loaded, self-locking anchors, tensioned against a double layer of 8-gauge linked wire mesh of 3-foot mesh. Conventional rockbolts were effectively four feet long in the first test section and five feet long in the second section, with an additional 9 inches or 12 inches of yielding thread provided for the yielding bolts, in each case, respectively. Using the guide wires as a base, 24 peripheral holes, 19 feet long and uniformly spaced about 17 inches apart, were drilled parallel to the axis of the tunnel about 2 feet from its surface.
The simultaneous detonation of decoupled explosive charges in these peripheral holes provided the desired impulse loading to the tunnel wall.

Results: First Test
Four rows of rockbolts consisting of four feet long were anchored with two-component expanding shells of malleable iron which effectively provided only line-contact with the sides of the holes. Each row consisted of six conventional bolts on one side of the heading and six yielding bolts with 9 inches of yielding thread on the other side. The appearance of the mesh, the irregularities in the walls of the heading and the detonating-cord connection of the blast-holes are shown in Fig. 4.

The explosive charge consisted of 22 inch cartridges of 46 per cent dynamic uniformly spaced to fill 15 per cent of the volume of each hole.

The energy of the blast was sufficient to split and eject the rock and destroy all the bolts and mesh, leaving a clean "post-split" surface—Fig. 5.

The majority of the bolts—37 of a total of 48—had failed as a result of ineffective anchorage. A close examination suggested that the metal along the line-contact between anchor and rock was so highly stressed that it sheared and was rapidly shaved away.

Four of the conventional bolts were partly, but not completely dislodged and, in two of these, the ddomed plates had failed.

In seven instances, all 9 inches of thread on the yielding bolts had been forced through the dies, leaving anchors and dies still locked in their respective holes.

Second Test
An improved type of anchor, with three expanding segments, was used in the first five rows of rockbolts, viz., rows 6 and 8, in the second test, Fig. 3. As before, one side of the tunnel was bolted with conventional rockbolts, nominally 6 feet long, while the equivalent yielding bolts, with 12 inches of yielding thread, were symmetrically opposed on the other side.

The spacing of the 46 per cent dynamite cartridges in the blast holes was increased to the extent that the explosives occupied only 8 per cent of the volume of each hole.

After detonation, this amount of explosive was found to have been sufficient to completely split and fragment the conventionally bolted rock-wall, Fig. 6. Of the 18 bolts equipped with two-component anchors, 2 failed in tension and 8 were completely dislodged, while the rock had broken away around the remaining 8 bolts.

Tensile failure occurred in 8 of the 12 bolts equipped with the three-segment anchors, 2 were completely dislodged, and the rock had broken away around the remaining 8 bolts.

A visible split developed between the peripheral holes on the side which was bolted with yielding bolts, but no bolt failed, the mesh remained completely intact, and no rock was dislodged except at the crown of the tunnel adjacent to the conventionally bolted side, Fig. 7. Some fracturing of the painted rock surface was visible behind the wire mesh and measurable displacement, relative to the guide-wires, was observed at the ends of 12 of the 30 bolts.

A typical profile is shown in Fig. 8.

Energy Considerations
The analysis of the stability of the fractured walls of a tunnel at depth, anticipated that the most important requirement of support would be the ability to yield while maintaining undiminished resistance. Although no refined measurements were made, the visual evidence conclusively showed that yielding rockbolt support was much more effective than conventional bolting, in preventing damage due to impulse loading. In this respect, the analysis appears to be substantiated by the experimental results.

However, the results would be of little more than academic interest if the experimental situation bore no resemblance to any failure that might occur in practice.

Unfortunately very little is known about the mechanism of rockburst damage in tunnels. It is conceivable that damage could result in two distinctly different ways.

Firstly, the passage of a shock wave arising from some large energy release, originating at some distance, could accelerate and eject already fractured and partially detached slabs of rock. Seismic measurements have shown that energy releases of as much as 10^9 ft.-lbs. are not uncommon in South African gold mines. A tunnel 366 feet away from such an event would experience a shock wave intensity of the order of 10^-9 ft.-lbs. per square foot of surface area. The velocity of propagation of the shock wave (Continued on Page 16)
bolts even assuming that each possessed an impact of one-half inch, would be such that only 0.5 per cent more explosive would be required than that which exists. Only about 5,000 ft.-lbs. per foot of tunnel or about 5 x 10^3 ft.-lbs./sq. ft. per square foot of surface.—Cook (1960).

The strain-wave energy associated with the second form of rockburst damage would occur, and is largely simultaneous with excavation; and block and fragmental relaxation and readjustment, which involves dilation of the move and cracks within it. This latter action takes time, but under critical conditions, if uninhibited, will result in collapse of the rock mass. The sooner and more positively this block action takes place, the better. For a cylindrically shaped rock and 19,000 feet per second in solid rock, the strain-wave energy would vary between about 11,000 feet per second in fractured rock and 19,000 feet per second in solid rock. Moving Rock Mass

The added stress in the bolt will be

\[ \sigma = \frac{E}{120} \]

and be equal to:

\[ \text{Strain E} = \frac{0.1''}{120''} = 8.33 \times 10^{-3} \text{ psi} \]

Substitution of values for Strain E into the above equation gives the following equations:

\[ \text{Stress} = \frac{220}{120} = 1.8 \text{ psi} \]

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Since the added stress in the bolt was not only small, but also distributed over a large area, it is obvious that much more of the strain was actually in the explosive than in the rock. However, it is generally accepted that the strain-wave energy is equal to one pound of explosive per square foot of tunnel.

(Continued from Page 14)

Yieldable Rock Bolts for Shock Loading

A fully grouted rock bolt placed and grouted immediately after an excavation; and block and fragmental relaxation and readjustment, which involves dilation of the move and cracks within it. This latter action takes time, but under critical conditions, if uninhibited, will result in collapse of the rock mass. The sooner and more positively this block action takes place, the better. For a cylindrically shaped rock and 19,000 feet per second in solid rock, the strain-wave energy would vary between about 11,000 feet per second in fractured rock and 19,000 feet per second in solid rock. Moving Rock Mass

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(Continued from Page 14)
Some Impressions of Rock Cutting in South Africa

By William Hustrulid

It is not possible to mine only the gold-bearing portion of the reef because of the minimum space requirements for men and machinery. The minimum stoping widths of about 40 in. presently being used, have been developed on the basis of many years of experience. This means that at least an equal amount of barren rock must be mined, transported, hoisted, and milled for every ton of gold-bearing material. As depths increase, the costs associated with this waste rock can make mining of all but the richest material uneconomical.

At the Doornfontein gold mine (1) in which the rock cutting experiments are being performed by the MRL, the average stoping width is 40 in. Drilling and blasting is presently being used as the standard mining method in panels 150 ft in length. Hand held 3/8 in. percussion machines are used to drill the required holes (42 in. in length, having diameters of 30 to 35 mm or 36 to 40 mm). The average burden per hole is 16 inches. The larger holes (36 to 40 mm) are loaded with 40 percent by 1 in. diameter dynamite whereas the smaller are loaded with 50 percent x 1 in. dynamite. Fuses and igniter cord are used to achieve sequential firing.

Rock support in the stope is by 2 ft. by 2 ft. solid or spaced mat-packs at 15 ft. centers on dip and strike. Faces are cleaned with 30 h.p. scraper winches. The average face advance for this mine is 15 ft. per month. It is obvious that any reduction in amount of material which must be mined, hoisted and milled will be directly reflected in the cost to produce an ounce of gold. Rock cutting as depicted in Figures 1 to 3 is a method which substantially reduces the effective stoping width. The basic set-up as shown in Figure 1-A consists of the cutting machine, hydraulic props for temporary support and a chute for removal of waste material. At the gold bearing reef, at the great depth (3,000,000 ft) at which mining is presently being done, the stresses in the rock at the working face are extremely high. The cutting machine has been designed to cut slots above and below the reef, thereby removing the high vertical stresses and creating free faces to which the remaining material may be broken. The gold reef, because of the high stresses, tends to slab off between the slots. (Continued on page 20)

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SPECIALISTS IN THE IN SITU MEASUREMENTS OF SOIL AND ROCK BEHAVIOR

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

MARCH, 1970 • THE MINES MAGAZINE

Working for us is no bed of roses!

It's a tough, demanding job from the very beginning. Practically the very day you join Western Electric you start giving you real responsibilities. You'll have your own decisions to make. Your own problems to solve.

In return we offer the chance to do thinking that may make your head spin but will certainly make it grow; the satisfaction of real achievements personally achieved; and the knowledge you're contributing something tangible to the world's largest and most advanced communications network.

Oh yes. One parting thought. If you're tempted by what does look like a bed of roses, remember: roses have thorns.
(Continued from Page 18)

As man goes deeper to extract from diamond cores drilled in highly stressed ground. After the slots have been cut, the machine is moved to a new panel using a winch. The gold bearing material is hand scooped and placed in the chute for transport to the haulage level. At this stage in the process, only a 10 to 20 in. width of material (the valuable material) has been mined. Holes are now drilled along the upper and lower edges of the stope and the waste rock broken to the free surfaces using one of several methods (explosives, wedges and feathers, impact driven wedges, or combustion breakers). Because of the additional free surfaces produced by cutting, this material is easily broken leaving the roof in much better condition than with presently used methods. The waste rock broken from above and below the slot is then packed into the back area away from the face (Figures 1 and 2). This eliminates the need for the timber or concrete packs presently used. Assuming some method other than explosives can be employed to break the waste rock, this mining system would be continuous. The effective stopping width is equal to the width of reef which was cut and removed from the mine.

According to Cook et al. (3), some advantages expected of rock-cutting over the methods presently used are summarized below.

1. Less material is mined, handled, hoisted, and milled.
2. A smaller capital investment is required for the same production.
3. Better strata control results in reduced likelihood of rock falls and rock bursts.
4. Wooden or concrete permanent support in stopes is unnecessary.
5. Thermal control and ventilation are improved since the worked out area is filled with waste rock.
6. Continuous mining is possible.
7. The hanging wall is left in a better condition and stopping width control is improved.

At the present stage of development, however, the cost of rock-cutting is approximately 3 times that of conventional methods (3). This is due to mechanical breakdowns of the cutter, blade failures, and rather large times required to move the cutter to a new position. The first and third are engineering problems on which significant progress has been made during the past year by the MRL. Makers of tungsten carbide are presently working on carbide cutter improvements. It is not surprising that some cutter trouble occurs since the comparative strength of the quartzites in which the gold is found varies from about 20,000 to 200,000 psi.

Figures 4 through 6 show the cutter in operation in a stop in the Doornfontein gold mine, approximately 8000 ft. below surface. This particular cutter is designed to give 1 ft. of free advance per shift with a panel length of 10 ft. Figure A shows the prototype machine set up in a narrow stope. The condition of the roof is very much better than in adjacent areas mined using ordinary methods. Often the footwall contains the more shaley quantities which are easier to cut than the hanging wall. In this case it may be only necessary to cut one slot below the gold bearing reef, (see Figures 5 and 4), thereby relieving the high vertical stress across the face and producing an additional free surface. A row of holes would then be drilled above the reef and non-explosive means used to break out the remaining material. The process could then be continued as described earlier. In Figure A, the holes drilled at the head and tail of the slot allowing the cutter to begin and end at a free surface are visible. These are easily drilled using a hand held percussion machine.

Conclusion

As man goes deeper to extract from the earth, materials which are needed to maintain our present way of life. It is obvious that new, or at least clever adaptations of present mining methods, must be introduced. In South African gold mines which are operated in a stope in the Doornfontein Gold Mine, South Africa.

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presently at depths greater than 12,000 ft, below surface, new methods must be introduced if all the rich-out gold is to be economically mined. The rock-cutting method being developed by the Mining Research Laboratory of the South African Chamber of Mines holds great promise in reducing the cost of gold mining at great depths. We in the mining industry should watch these developments with great interest.

Acknowledgements

The author wishes to thank the South African Chamber of Mines for making this visit possible. Special thanks must go to N. G. W. Cook, N. C. Joughin, and G. A. Wiebols of the Mining Research Laboratory. A Friend of the Author.

Bibliography

Dr. Orlo E. Childs Announces Resignation As President of Colorado School of Mines

Although I am no longer a student of the school, I did attend the University of Colorado in the 1920s, and I, together with my grandchildren, who is a freshman at Mines, left for the school in 1962 to supervise the new program.

We arrived on the campus by 10 a.m. on Sunday, Feb. 3, and drove to the Port of Entry at the end of the day. We stayed in the new Camino Real Hotel, which has 25 or more rooms.

With the December 1969 edition of the Mines Magazine, we celebrated the 25th anniversary of the Colorado School of Mines. The magazine contains more than 30 pages of articles and photographs that describe the school's history and current activities.

The volume includes articles about the school's first 25 years, including its founding, growth, and the people who have contributed to its success. It also features stories about the school's programs, faculty, and students.

The magazine is a valuable resource for anyone interested in the history and development of the Colorado School of Mines. It is available for free online and can be downloaded from the school's website.

You can also purchase a hardcopy of the magazine at the school's bookstore or by contacting the Mines Magazine office at (303) 279-2111.

Dr. Orlo E. Childs

President of the Colorado School of Mines
Gisler, internationally known metallurgist and former manager of Benco's Western Continental Sales, has been promoted to manager of Domestic Sales, Joy Manufacturing Co., Denver Equipment Company's Denver Equipment Division. The announcement was made by President James E. Quinn.

Mr. Gisler's headquarters will remain in Denver. The company's Eastern, Central and Western Sales areas have been consolidated under the Domestic Sales Manager who has responsibility for all branch offices.

With Bachelor of Science and Master of Science degrees in Metallurgy from the University of Idaho and the University of Utah, Mr. Gisler joined Denver Equipment Company's Cee Two Division in 1957. He served for many years as chief metallurgist prior to his appointment as manager of the Eastern Sales Division.

Power Generating Facility To Be Located Near Fairbanks

Alcoa of Alaska, a majority-owned subsidiary of Earth Resources Co., has authorized the awarding of a contract for final design and engineering and site selection studies for its proposed refinery-electric power generating facility to be located near Fairbanks. The facility is to be built and operated by Energy Co. and is expected to be in operation by 1972. It will coincide with the completion of the Trans-Alaskan Pipe Line System.

Timken's Rock Bit Operations Moved to Colorado Springs

As part of an expansion and consolidation program, the Timken Roller Bearing Co. will move its rock bit forging operations from Wooster, Ohio, to Colorado Springs. Currently, 800,000 rock bits are forged at Wooster, then shipped to Colorado Springs for finishing. A building will be constructed at the Pikes Peak Street location to house the forging equipment. The present rock bit manufacturing building will be enlarged.

The Timken Roller Bearing Co., a subsidiary of The Timken Co., is the nation's largest producer of rolling bearings.

Promoted to Manager Of Deco's Domestic Sales

Henry J. Gisler, internationally known metallurgist and former manager of Benco's Eastern Sales Division, has been promoted to manager, Domestic Sales Division, Joy Manufacturing Co., Denver Equipment Company's Domestic Sales Division. The announcement was made by President James E. Quinn.

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Gisler Promoted to Manager

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30

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Alumni Headliners

Klingmueller's Fellowship

Klingmueller was in charge of all open pit operations for Phelps Dodge Corp. at Bisbee. He has been mine superintendent of underground mining operations of the Safeway parking lot when our old mining area was closed. He has received an M.S. in Geological Engineering from the University of Arizona from which he expects to receive his Ph. D. in the fall of 1970.

In a recent letter to Colonel Perlitt, Lester states that "the research I am engaged in deals with the mineralization associated with the diapiric structures in the Northern Flinders Ranges in South Australia. Actually that part of Australia is subject to the Southwest, except that the 'gum tree' (Eucalyptus) takes the place of thousands of various eucalyptus. . . Although you may not recognize me in the picture above, you may recall giving a couple of bearded seniors a push on the Shoulder parking lot over a few years ago. And old and tired truck would not start."
Oredigger vs. Mines Magazine

Editorials

As It Looks to Me

The Chicago Seven are destined to be the news in a manner completely beyond the understanding and ability of most of us to comprehend. It is a case that could have resulted in the coverage of little more than a few pages in the news, but for the fact that the defendants actually fought back at the lawyers, whose defense lawyers and the defendants' followers, they were appalled when the Judge refused to dismiss the charges against the defendants.

The current climate in our country is not one in which we can afford to be complacent and apathetic. Wendell W. Fertig

Technical Societies

Offshore Meeting
Schedules Discussion Of Recent Oil Spill

The costs of the recent oil spill in the Gulf of Mexico, caused by the blowout of the Deepwater Horizon rig, are immense. The spill came as a result of a well that was being drilled by the Transocean Deepwater Horizon rig, which the company had been trying to control for over two days. The spill has affected a large area of the ocean, and the cleanup efforts are still underway.

Dobbins ReectedPresident of AMC

Cris Dobbins, president and chair- man of Ideal Basic Industries Inc., has been named president of the American Mined Industry Foundation (AMIF), a leading industry group. Dobbins, who has served as the president of the National Mining Association (NMA) for the past three years, will take office on May 1, 2013.

AIME's 99th Annual Meeting Held Feb. 5-19 in Denver

The American Institute of Mining, Metallurgical and Petroleum Engineers held its 99th Annual Meeting at the Denver Convention Center. According to the Annual Meeting Committee Chairman, Earl E. Stoltz, over 4,000 engineers, scientists, educators and executives working in the mining, metallurgy and petroleum industries attended the event. The meeting featured keynotes, technical presentations, student activities and a variety of other educational activities.

The five faculty sponsors of the Undergraduate Student Paper Contest, who accepted $86 for his chapter.

The Mining Convention

These planning to attend the Western Mining Convention, June 25-28, in Denver, should make their room reservations prior to June 1. Such reservations are given that rooms will be available if requested prior to that date.

Editor, Oredigger:

Enclosed is $5.00 for a one-year subscription to the Oredigger. You've certainly come along way since we put out the paper, I think. The word 'freedom of speech' is often used in our school or at the Oredigger. It seems to be a common phrase. The Oredigger has used frequently; yet none filed the tenets of the legal system. In support of your followers, they were appalled when the Judge refused to dismiss the charges against the defendants.

Wendell W. Fertig

Your Truly,
Jack Riske, '50 CSM

February 18, 1970
Mr. Jock R. Linsky
310 South Beach Avenue
Old Greenwich, Conn. 06870

Dear Jack:

Your letter, which was printed in the Oredigger of February 17 was read with considerable interest. It is certainly your privilege to print or expand on the two publications and to criticize the Oredigger. Your letter is your file and during the time you were out of school we have never had a word of criticism from you concerning the contents of the magazine.

Your letter said "— the magazine is losing more and more donations and renewals by the alumni." I do not know where you obtained this information, but it is seriously in error. For that reason, I am writing to offer you the correct data.

1. Compared to 1966 the donations received during the year 1969 were increased by almost 25%.

2. The average monthly print order for the MINES Magazine has increased from 600 in 1965 to 900 in 1969. The first two issues in 1970 have averaged $1.21.

I am taking the liberty of reprinting your letter within the next issue of the magazine with the exception of your signature and address.

Sincerely yours,
Wendell W. Fertig
Publisher, Mines Magazine

Feb. 22, 1970

February 28, 1970

Wendell W. Fertig
Publisher, Mines Magazine

The Mines Map: Golden, Colorado

The legal system of the United States has the same effect on our country as the legal system of any other country of our time. If the discontents are to be handled, the legal system of the United States must be examined. The present climate in our country is not one in which we can afford to be complacent and apathetic.

Wendell W. Fertig
James E. Brown

James E. Brown, E.M., 1847, assistant manager, First Deposit Refining Co., died Nov. 19, 1909, in a Birmingham, Ala., hospital. He was a charter member of the CSM Alumni Assn., and served for several years as president of Birmingham Section. In 1896 he was finalist for the Birmingham Engineering Scholarship of the Year.

Born in 1841 in Bluefield, W. Va., Brown received his R.E. degree in 1847 from the Colorado School of Mines, where he was a member of the Sigma Scalland and Mu, Gamma Epsilon, and Beta Theta Pi fraternities. He was awarded a research fellowship at the University of Washington, obtaining his Master of Science degree in Mining Engineering.

After graduating from Mines, he worked for four years as a mining engineer with the Carlin Corp. For four and a half years he was superintendent of the Deerfield Mine, Pocatillo Mining Co. In 1868 Mr. Brown became manager of Coal Operations, Southern Electric Generating Co., and seven years later, April 1, 1868, he joined Southern Services as assistant manager of the Fuel Department. He was a registered Professional Engineer in the states of West Virginia and Alabama.

During World War II Mr. Brown was a captain in the Marine Corps and participated in the campaigns in Guadalcanal, Okinawa and Iwo Jima. He was awarded the Silver Star with citation to his wife and son, Nicholas, are two other children living in Port Angeles, Wash.; and a son, Robert, of Wallace, Idaho.

Survivors include his wife, Ann Lackford Brown; two sons, James Brown, III, and Donald Brown; all of Birmingham, and a sister, Mrs. James West, Brookfield, Mass., where he was buried.

Robert D. Stouder

Robert D. Stouder

Robert D. Stouder, E.M., Class of 1918, passed away Oct. 24, 1968, in Springfield, N. J. Services were held at St. John's Cathedral in Denver with interment at the Mountain View Cemetery. Mr. Stouder was a long-time employee of American Smelting & Refining Co. and held many positions of responsibility with the company.

Born in Denver in 1890, Mr. Stouder attended Wheat Ridge High School and then was employed by American Smelting & Refining Co. on the location of the Colorado Platiou, as general manager of the smelter.

In 1966 he joined Hidden Spider Mine Co., later to become a part of Atlas Minerals, operating in the Big Indian Mining District near Moab, Utah. Mr. Stouder was a superintendant of mines at the time of his death.

Mr. Stouder assisted in the development of the Southeastern Utah Mining Division of AIME and served a term as chairman. He was present in civic affairs, he was a member of the American Legion, was a member of the Colorado School of Mines Alumni Assn., and served as Ancestral Pioneer from 1945 until his retirement on Jan. 1, 1968.

Mr. Stouder was a member of the Two Mountains Chamber of Commerce, Presbyterian Church, Kiwanis Club, American Legion, Elk's Lodge, Red Cross, and the Colorado School of Mines Alumni Assn.

Survivors include his widow, Ella; his sons, Dale R., Dallas, Texas; and Donald A., Dallas, Texas (also a graduate of Mines, E.M. 1931); Whitfield, Cal.; sister, Edith J. Miller, Oklahoma City, Okla.; and three grandchildren.

Roland T. Litheredge

Roland T. Litheredge, E.M.

Olofund T. Litheredge, E.M., 1892, a member of the CSM Alumni Assn., died known for the past several years, died in February, 1968, at his home in Madison, Wis.

James A. Masten

Charles A. Masten

Charles A. Masten, a retired civil engineer for the U.S. Bureau of Reclamation, died Feb. 15 in St. Anthony Hospital.

Born June 7, 1889, in Denver, Mr. Masten attended Denver public schools, and the Colorado School of Mines. He worked on the design of many irrigation dams built between 1902 and 1939, including Hoover, Eisenhower and Grand Coulee.

Survivors include his widow, G. Church; a son, Charles W., Boulder; a daughter, Mrs. Zoe A. Leporean, Phoenix, Ariz.; and five grandchildren.

Adam Thomas

Adam Thomas

Adam Thomas, of Climax, Colo., was killed unexpectedly of a heart attack at 3 o'clock a.m. on February 17, at his home in downtown. The funeral service was held in the Memorial of the Bethel Baptist Church, at 11 a.m. on Feb. 21, at his former home in Alabama, during which time, including Hoover, Eisenhower and Grand Coulee.

Survivors include his widow, G. Church; a son, Charles W., Boulder; a daughter, Mrs. Zoe A. Leporean, Phoenix, Ariz.; and five grandchildren.

Robert A. Martin

Robert A. Martin

Robert A. Martin, president and chairman of the Copper Development Association, was killed Sept. 2, 1969, in a traffic accident near Spokane, Wash.

Mr. Martin was president of the Copper Development Association, and chairman of the Copper Electric Products Manufacturers Assn., and served in various official capacities over a 13-year period, advancing to assistant project engineer for the contractor's nearest 24-man. He was a captain in the Marine Corps, including one year in Korea. He later graduated with a Master of Science degree in Civil Engineering from the University of Washington.

Mr. Martin came to Spokane in September, 1966, to succeed his father as chairman of the Copper Development Co. It was not until April, 1969, that Mr. Martin was appointed chairman of the Copper Development Co. At that time, he was serving as a consultant to the company.

Mr. Martin assisted in the development of the Southeastern Utah Mining Division of AIME and served a term as chairman. He was present in civic affairs, he was a member of the American Legion, was a member of the Colorado School of Mines Alumni Assn., and served as Ancestral Pioneer from 1945 until his retirement on Jan. 1, 1968.

Mr. Stouder was a member of the Two Mountains Chamber of Commerce, Presbyterian Church, Kiwanis Club, American Legion, Elk's Lodge, Red Cross, and the Colorado School of Mines Alumni Assn.

Survivors include his widow, Ella; his sons, Dale R., Dallas, Texas; and Donald A., Dallas, Texas (also a graduate of Mines, E.M. 1931); Whitfield, Cal.; sister, Edith J. Miller, Oklahoma City, Okla.; and three grandchildren.

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**Campus Headlines**

**Environmental Committee**

A "Committee on Environmental Factors in Mineral Engineering" has been formed at the Colorado School of Mines, announced by Dr. Frank S. Mathews of the Physics Department.

The original membership of the committee, composed of faculty, administration, and a representative of the student body, was appointed by Dr. Albert W. Schlechten, vice president for Academic Affairs.

One of the chief aims of the committee will be to broaden its scope to include all faculty and students who are interested in environmental problems.

The committee will have subcommittees for specific purposes, such as encouraging research, organizing curricular and general information effects such as seminars and conferences.

Attention will be given to efforts already underway on the CSM campus.

An example of the problem of tailings and mine dump material in Clear Creek, which has been a source for some time, is the subject of a study by Dr. Paul G. Breed of the Metallurgy Department, with the help of several graduate students.

Some encouraging results have been produced so far. Material from the tailings and mine dump material in Clear Creek has been found to be suitable for road base material.

Dr. Gore had been an assistant professor of Economics at Mines from 1952 to 1955. During this time, he was associated with the Rocky Mountain Athletic Conference and the Colorado State College system.

Dr. Gore had an interest in the economic aspects of the environment and was a member of the American Economic Association, the Western Economic Conference, and the Rocky Mountain Economic Conference.

Dr. Gore was active in the development of environmental policies and was involved in the planning of the Environmental Protection Agency.

Dr. Gore also served as a consultant to the United States Senate Committee on Environment and Public Works, and was a member of the Board of Directors of the Rocky Mountain Institute.

Dr. Gore was known for his work in the field of environmental economics, and his contributions to the field have been widely recognized.

Upon his death, a memorial service was held at the University of Colorado.

**McMechen at Mines**

**As Assistant Manager Buildings, Grounds**

**Edward R. McMechen**

is a Colorado architect, who has been appointed assistant manager—Buildings and Grounds, Colorado School of Mines.

Dr. McMechen comes to Mines after being employed in the physical plant department at the University of Denver.

After attending Colorado State College, he has been active in the field of architectural design.

Active in the Elks National Foundation for the State of Colorado, McMechen is also a member of the alumni association.

Dr. McMechen will be responsible for the maintenance and repair of the campus buildings and grounds.

**Miners Professor Found Dead in Car**

Dr. Jack F. Gore, associate professor of Economics at the Colorado School of Mines, was found dead February 7 near Meeker Lodge, 36 miles northwest of Boulder, in his car.

Dr. Gore had been an assistant professor of Economics at Mines from 1952 to 1955. During this time, he was associated with the Rocky Mountain Athletic Conference and the Colorado State College system.

Dr. Gore had an interest in the economic aspects of the environment and was a member of the American Economic Association, the Western Economic Conference, and the Rocky Mountain Economic Conference.

Dr. Gore also served as a consultant to the United States Senate Committee on Environment and Public Works, and was a member of the Board of Directors of the Rocky Mountain Institute.

Dr. Gore was known for his work in the field of environmental economics, and his contributions to the field have been widely recognized.

Upon his death, a memorial service was held at the University of Colorado.

**Ph.D. Program in Mathematics**

The Colorado School of Mines has gained approval to offer the degree of Doctor of Philosophy in the Mathematics Department.

The program is under the direction of Dr. Albert C. Harding, 37, Professor of Mathematics, who has been a member of the Mines faculty since 1962.

The program includes the study of advanced topics in mathematics, including algebra, analysis, topology, and geometry.

The program is designed to prepare students for careers in academia, industry, or government, and to provide them with the knowledge and skills necessary to pursue advanced research in mathematics.

**Oil Shale and Hydrocarbons Symposiums**

The Sixth Oil Shale Symposium was held in conjunction with the Hydrocarbons Symposium in the fall of 1969 at the Colorado School of Mines. The symposiums were sponsored by the U.S. Department of the Interior and the American Institute of Mining, Metallurgical, and Petroleum Engineers.

The symposiums were aimed at bringing together experts in the fields of oil shale and hydrocarbons to discuss the latest developments and future prospects in these areas.

The symposiums included lectures, panel discussions, and poster sessions, and were attended by over 2000 participants.

Dr. James H. Gary, head of the Department of Computer Science, said, "The long-range plans of the Colorado School of Mines include a continued expansion of our computer facilities and the development of new courses in computer science."
From the Local Sections

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

**Section**
- Alaska
- Arizona
- Nevada
- Montana
- Minnesota
- District of Columbia
- California
- Alabama
- Oregon
- Illinois
- Delaware
- Colorado
- New Mexico
- Kansas
- Oklahoma
- Louisiana
- Missouri
- Nebraska
- Nevada
- Maryland
- Washington
- District of Columbia
- Pennsylvania
- New York
- Ohio
- Georgia
- New Mexico
- Oregon
- Texas
- Illinois
- Indiana
- Missouri
- Ohio
- New York
- Pennsylvania
- Tennessee
- Virginia
- Wisconsin
- Michigan
- Missouri
- Oklahoma
- Pennsylvania
- Rhode Island
- South Carolina

**President**
- None

**Vice-President**
- None

**Secretary-Treasurer**
- None

**Meetings**
- Monthly
- On call of the president

**Time and Place of Meeting**
- On call of the president

**Life Members of CSM Alumni**
- Neil MacNeill, 74
- M. D. Riddle, 83
- E. S. Gough, 86
- E. A. Wyner, 25
- C. R. Fivech, 49
- A, A. Wyner, 25
- William H. Angier, 51
- W. B. McNeely, 51
- Robert F. Duncan, 51
- J. A. Jameson, 50
- John Magraw, 53
- Wallace Tucker, 48
- Bill Cutler, 48
- Charles R. Reeves, 58
- Charles F. Barich, 55
- J. E. Magraw, 59


**CSM Alumni Section in Calgary Will Host Luncheon June 23**

On Tuesday, June 23, during the A.A.P.G. Annual Meeting, a CSM Alumni Section luncheon will be held at the Petroleum Club from 12:30 to 1:30 p.m. Tickets will be available at the registration desk for $5. However, if an alumni misses the opportunity to pick up a ticket, a call to 207-4350 in Calgary will provide a reservation.

R. C. Suggs is President of the CSM Alumni Chapter in Calgary.
**Technical Career Index**

A new study, detailing the current salaries, benefits and personnel policies of nearly 500 major American companies, has been published under the title *Technical Career Index*. This report also contains a candid description of current on-campus recruiting procedures and provides advice to the new college graduate on company evaluation and selection.

The *Technical Career Index* was compiled by Professor James L. Lubin, director of Placement at Newark College of Engineering. Professor Lubin is also the author of the recent Lubin Report, a graphically-presented statistical summary of the salaries, benefits and personnel policies of major American employers.

Both the *Technical Career Index* and the Lubin Report are published by Pedrie Publishing Co., Box 393, Bernardsville, N. J. 07924.

**MGS Publications**

Four new publications are now available from the Minnesota Geological Survey at the University of Minnesota.

1. "The Cryptic limestone Breccia from the Middle Ordovician Deborah Shale, Minnesota," a booklet by Objects L. Karklins, sells for $1.


4. "The fourth publication, a map of the Barrera Quadrangle, St. Louis County, Minnesota, by W. L. Griffin, is $1.00.

These publications can be obtained by sending a check or money order to Minnesota Geological Survey, University of Minnesota, Minneapolis, Minn. 55455.

**Energy's Tomorrow**


Here is a worthwhile collection of eight major addresses given in a symposium on the outlook for energy during the 53rd Annual Meeting of the American Association of Petroleum Geologists in Oklahoma City, April 22, 1968.

Widely known authorities provide separate presentations on petroleum, natural gas, coal, oil shale, tar sands and other bituminous, nuclear sources, geothermal energy; and a commentary on insecticide coin-petition.

**Science Thesaurus**

Vital to the development of information systems for professional and scholarly research, a new computer-based thesaurus series will begin publication this month. It was announced by OCM Information Corp., a subsidiary of Crowell-Collier and Macmillan, Inc.

The first thesaurus to be issued will be the Engineering Index Thesaurus compiled by Engineering Index, Inc., a major indexing service sponsored by professional engineering societies.

The new series has been established to increase the availability of the many new thesauri being developed for computer-based information systems. The thesaurus series is under the direction of Dr. Maurice F. Tushar and Dr. Theodore C. Haas of the School of Library Services at Columbia University where both have been active in subject analysis and applying computer techniques to Library and information sciences.

**Technical Career Index**


Edited by Alfred Weiss, the book presents a comprehensive and authoritative look at the whole spectrum of computer applications in the mineral industry. Mr. Weiss is director of the Scientific and Engineering Computer Center of the Metal Mining Division of Kennecott Copper Corp. in Salt Lake City. He was assisted by scores of international science and engineering leaders in presenting this outstanding work.

The 324-page hard cover book, with illustrations, indexes, and glossary, is a perceptive guide to the salient activities of the mineral industry in the use of digital computers. It affords a keen insight into techniques, such as "Rigging," popular abroad but not here.

In addition to providing answers to hundreds of questions in the mineral industry, the book offers a means of reviewing the state of the art after ten years of gaining an understanding of digital computing. The scope of the volume is international.

The list price for *A Decade of Digital Computing in the Mineral Industry* is $22. It is available to AIME members for $15. Orders should be sent to AIME, 345 East 47th St., New York, N. Y. 10017.

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