• Geochemical Prospecting
• Carnival in the High Andes
• Electrical Concentration of Minerals
• Kerr-McGee Mineral Development and Research
• Explosive Working of Metals
CLASS NOTES
When advising us of change of address, please confirm your position or title and company affiliation.

1903-1908
Robert McCarr, Jr., 95, mining consultant, may be addressed at 525 Boyer Ave., Ft. Worth 3, Texas.

1944-1946
Frank T. B. Smith, 54, lives at 431 Calle Mayor, Redondo Beach, Calif.

1931-1940
Gaylord R. Chase, 72, has been a mining engineer with exploration companies in various parts of the world.

1941-1942
Frank H. Harris, 48, manager for Bay Petroleum Corp., has moved from New York 21, N. Y., to 542 Flower St., Arvada, Colo.

Robert J. O'Leary, 49, and his wife (the former Miss Dorothy Prouse of Galion) announce the birth of a son, Jeffrey Scott, on Dec. 1. Dr. Nelson is engineer-in-charge, metallurgical laboratory, Sylvanite Electric Products, Inc. The family lives at 209 Porter Ave., Tucumcari, N. M.

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The mines magazine • January, 1960
The Image of CF&I assures quality steel Mining Products

This Image—the CF&I giant—stands for hundreds of dependable steel products used by many industries. And the CF&I name is prominent in the mining industry for such top-grade products as grinding balls and grinding rods.

For instance, the special analysis, hot-forged steel used in CF&I Grinding Balls gives uniform wearing qualities... high impact and abrasion resistance... maximum grinding efficiency.

CF&I Grinding Rods are hot-rolled from steel of special analysis, determined through years of experience to provide a hardness for high wear resistance, yet with a toughness to exclude bending or premature breakage. All rods are machine-straightened and their ends cut square so that they will freely rotate in the rod mill for better grinding.

We suggest you contact the nearest CF&I sales representative. He'll be glad to discuss your grinding problems with you, or give you complete information on all CF&I Mining Products.

OTHER CF&I STEEL PRODUCTS FOR THE MINING INDUSTRY

CF&I Grader Blades • CF&I Industrial Screens • CF&I Mine Rail and Accessories
CF&I-Wickwire Rope • CF&I Rock Bolts and Realock Metallic Fabric
Kerr-McGee, AEC Sign
New Five-Year Contract

An extended uranium concentrate purchase contract was signed recently by Kerr-McGee Oil Industries, Inc., of Oklahoma City, and the U. S. Atomic Energy Commission, for continuation of operation of the 300-ton-per-day uranium processing mill at Shiprock, N. Mex.

The new contract will run from Nov. 1, 1959, to June 30, 1965, or to an earlier date when Kerr-McGee will have delivered to the Commission the maximum number of pounds of uranium concentrate provided in the contract. The mill has operated since 1954 under a contract with the AEC which terminated Oct. 31, 1959.

The plant is shut down at present for the construction of a new solvent extraction circuit to recover high purity vanadium concentrate (about 99 per cent V₂O₅) as well as uranium per cent of uranium concentrate provided in the contract is effective as of May 1, 1958, which authorized a limited expansion of domestic uranium procurement in order to provide markets for those areas which had no market or an inadequate market for developed ore reserves. This announcement indicated that a 200 ton-a-day mill would be required for Colorado Front Range ores.

An extensive deposit of high grade pollucite ore has been developed at the Shiprock mill, which will come from mines on the Navajo Indian Reservation. Most of the persons employed at the mill and at the company's mines in the Lukachukai mountains are Navajo Indians.

Pollucite Ore Developed
In Southern Rhodesia

An extensive deposit of high grade pollucite ore has been developed at the Southern Rhodesia, Africa, operations of Bikita Minerals (Private) Ltd., according to an announcement by American Potash & Chemical Corp., which handles the sale of Bikita products.

Tests indicate the deposit is one of the largest in the world and offers a reliable supply of low-cost pollucite, which is alumina-crispusilicate, for cesium applications in such industries as glass and ceramics manufacturing, in welding rod fluxes and other uses where silica can be utilized along with the cesium. Pollucite in the Bikita deposit averages 24.4 per cent cesium oxide.

Cesium in the past has been available only in small quantities until American Potash recently began sales of cesium metal and cesium compounds produced from lepidolite lithium ore at San Antonio, Texas.

Cesium City Uranium
Plant To Be Extended

The Atomic Energy Commission and the Cotter Corp., of Santa Fe, N. Mex., recently signed a uranium purchase contract which will result in the expansion of the Cotter Corp.'s pilot plant at Canon City, Colo., to a full-scale uranium processing mill.

Grunin's daily rated capacity will be increased from about 50 tons a day to approximately 200 tons a day. This is another action by the Commission to implement the policy announced on April 2, 1958, which authorized a limited expansion of domestic uranium procurement in order to provide markets for those areas which had no market or an inadequate market for developed ore reserves.

This announcement indicated that a 200 ton-a-day mill would be required for Colorado Front Range ores.

The new contract provides a market for a number of producers whose properties hereafter are "dedicated" to the Canon City mill. Other properties may be added at the Commission's option.

Exploration Assistance
Available In Central States

Although the Office of Minerals Exploration Region IV Office in Topeka, Ks., was closed in August 1959, OME exploration assistance is still available in the seven Central States which comprise that region.

OME activities in Kansas, Oklahoma, and Texas, are now administered by the Region III Office, Denver Federal Center, Denver 25, Colo., and activities in Arkansas, Louisiana, Mississippi, and Missouri, are administered by the Region V Office, Post Office Bldg., Brownsville, Tex.

Anaconda Uranium Mill
Contract Extended To 1966

A uranium concentrate purchase contract between the Atomic Energy Commission and the Anaconda Co., operator of the Bluewater, N. M., uranium processing mill, has been extended to Dec. 31, 1966. The new contract is effective as of May 1, 1959. The current contract would have expired on April 30, 1960.

To Keep pace with booming Denver demand, K&E announces the formation of... Keuffel & Esser of Colorado, Inc.

Metropolitan area retail outlet now offers expanded inventory, more display area, speedier delivery.

Engineers in and around Denver can now select from the largest assortment of K&E products ever available here.

Drafting and reproduction supplies, transit and other optical instruments, slide rules, and hundreds of other vital engineering materials are available for immediate shipment. K&E Sales Representatives will be glad to discuss your needs with you.

You'll find K&E your best source for the best and most complete engineering line on the market today.
MINERAL INDUSTRIES

Industrial Minerals (Continued from page 6)

The conservation and re-use of scrap aluminum has literally saved the U.S. economy billions of dollars, the Institute stated. It pointed out that, without the salvage of 7 billion pounds since 1948, American users, in diverting the output with virgin aluminum, would have been forced to:

Import 13 million tons of bauxite.
Ship the bauxite to the U. S. in 3,000 voyages at 10,000 tons per trip.
Ship to plants 10 million tons of aluminum, coke, pitch, cryolite, soda ash, and other ingredients.

Construct additional facilities to process the metal into ingot form.

Consume 67 billion kilowatt hours of electrical power—an amount equal to all electricity generated in the U. S. in about a five-week period.

AEc Extends Contract With Union Carbide

The Atomic Energy Commission has extended until June 30, 1964, a cost-plus-fixed-fee contract with Union Carbide Corp., for operation of four major Commission facilities, S. R. Sapir, manager of the Commission's Oak Ridge operations, announced recently.

Union Carbide Nuclear Co., division of Union Carbide Corp., operates two large production plants and a research and development laboratory in Oak Ridge, Tenn., and the gaseous diffusion plant at Prolac, Ky. The present contract for operation of these facilities is to be June 30, 1960, but was extended for four years.
GSA Elects Officers

Dr. Helios D. Hedberg, vice president, Exploration, of Gulf Oil Corp., was elected president (Nov. 4) by the Geological Society of America. Thomas B. Nolan of the United States Geological Survey, Washington, D.C., was elected vice president and the following were elected Councilors: Harold 1. James, also of the U. S. G. S.; Vincent C. Kelley, University of New Mexico; George D. Woolard, University of Wisconsin; and Norman D. Newell, Columbia University.

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C. R. Kuzell Will Deliver Metallurgy Lecture at AIME

The Metallurgical Society of AIME has announced that Charles R. Kuzell, Battelle Memorial Institute's director of the Phelps Dodge Corp., will deliver the annual AIME Metallurgy Lecture at the annual meeting of the American Institute of Mining, Metallurgical, and Petroleum Engineers, to be held in New York, Feb. 14-18.

Kuzell, a former director of AIME, was the recipient in 1956 of one of the Institute's major awards, the Gold Medal for outstanding contributions to mining, in recognition of his work in the field of copper smelting; for inspiring and guiding young engineers; and for service to his profession and to society.

It is the first AIME lecture in-extractive metallurgy, sponsored by the Ex- tective Metallurgy Division of The Metallurgical Society, was given at the national convention in San Francisco last February. Kuzell's theme will be the development of modern copper smelting.

Making New Class of Alloys Demanded by Research at Battelle Memorial Institute, Columbus, Ohio.

The feasibility of making a promising new class of metallic materials has been demonstrated recently at Battelle Memorial Institute, Columbus, Ohio.

The new materials, prepared in research sponsored by the Lead Industries Association, are "lead-cemented" alloys made by mixing molten lead with finely divided solid particles of other metals or materials. The result is a material combining the properties of both lead and the added substance, usually a metal. Such combined-prop- erty materials may be useful in a variety of applications according to re- search metallurgists Dr. Dean N. Williams, Jerry J. A. Houch, and Dr. Robert I. Jaffee.

For example, lead is effective in stopping gamma rays and in nuclear radiation shielding. With boron added, the resulting lead-boron alloy would be an even more effective shielding material, since boron stops gamma-rays—also a product of radiation.

The corrosion resistance of lead, plus the increased strength gained by adding other metals, suggests that some alloys might be useful to the chemical industry and other industries requiring corrosion resistant materials.

Other alloys suggest use for garden tools at temperatures which would melt up plastic gaskets. Bearings for auto-

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White, chairman of the board and chief executive officer of Republic Steel Corp., Benjamin F. Fairless Award; Lester E. Ursu, professor emeritus of petroleum engineering, University of California, Mineral Industry Education Award; Raymond F. Selvito, president of the American Mining Congress and president of Island Creek Coal Co., Enarke Ram-

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Geochemical Prospecting

Introduction

Although less than a dozen years old in this country, geochemical prospecting methods have found their way into the routine exploitation programs of mining companies throughout the world. To be sure, some companies are faring better than others—success seems to be a function of the willingness of management to provide qualified personnel and adequate supporting funds.

Recently enlightening opinions have been expressed by mining executives regarding geochemical exploration in their companies. Writing in the *Northern Miner* of November 20, 1959, C. J. Sullivan, president of Renco, Ltd., indicates that about 3.7 per cent of his exploration budget is allocated for that kind of work. He states "geochemical prospecting, a natural extension of gold panning, offers very great possibilities." His company has increased their geochemical prospecting effort outside of the Soviet Union is being pursued by mineral and private mining companies in Central Africa. One company alone is turning out about three-quarters of a million soil samples per month, using colorimetric and chromatographic methods. Semi-quantitative spectrographic methods account for about 100,000 determinations per month. This immense amount of work is being turned out at a cost of about $100,000. The Geological Prospecting Research Centre at the Imperial College, London, has been very effective in supporting these efforts. Graduate study leading to the PhD degree is carried out in African field areas.

**What Is Geochemical Prospecting?**

Geochemists recognize that metals in trace amounts are distributed in an orderly fashion throughout the earth's crust. The abundance of these metals in an area is determined by processes of enrichment and dispersion anomalies. Occasionally, a better than the copper in seeking these deposits.

**Mobility of Oxidized Ore Metals**

The mobility of ore metals in the zone of weathering depends primarily on the mobility of their oxidized products. The influence of these products, forms readily soluble sulfates, carbonates and chlorides, and is observed in the soil. Some of these metals may be sought in: (a) soil, (b) vegetation, (c) stream waters, and (d) stream sediments. But it should be borne in mind that metal anomalies alone cannot be used to indicate either the depth or the grade of mineralization.

**Pathfinder Elements**

It is common practice to seek the ore metal itself when investigating a dispersion. Occasionally, a better rate is obtained by examining samples that accompany the ore metal. These are called "pathfinder" elements.

Geochemical prospecting is a new concept that is being rapidly developed throughout the world. The ability of geochemical methods to provide a quick, reliable indication of ore occurrence and to locate the surface expression of mineral deposits has led to widespread interest in these techniques. The application of geochemical methods to the exploration for metallic ores has been greatly expanded in recent years, and the results obtained have been highly promising.

The U. S. Geological Survey has played an important role in the development of the field of geochemistry, which has been highly successful in locating mineral deposits worldwide. The survey has conducted a wide range of geochemical studies, including the determination of trace elements in soil samples, and the development of methods for the detection and quantification of these elements. The results of these studies have been published in a series of reports, which are available to the public.

**Other Areas**

In 1957, member countries of the British Commonwealth met in Canada to hold their Sixth Commonwealth Mining and Metallurgical Congress. Following this meeting, a volume appeared in which geophysical and geochemical exploration case histories are documented. Several of these papers illustrate how more precise exploration can be when geophysics and geochemistry are properly integrated.

**Work in the United States**

The U. S. Geological Survey has an important role in the development of geochemical prospecting in this country and abroad. Their program was directed along two lines: (1) the development of field tests based mostly upon colorimetric techniques and (2) concurrently conducting a research program dealing with the behavior of these elements under varying climatic and geochemical conditions.

Many of the field tests developed showed greater sensitivity than the spectograph, and because they were inexpensive and rapid, they could be carried into the field with little trouble. Personnel of all economic levels could easily afford the chemicals needed, and the prospectant need not have the extensive training of a spectograph. Field tests, mostly colorimetric, have been developed for the following elements: Ag, As, Bi, Cu, Co, Fe, Pb, Rh, Mo, W, Mg, Mo, Ni, Sn, S, W, Cu, V, Zn, sphalerite, and the like.

The "diamond bearing" of the Belgian Congo

**Soil Sampling**

Recognition of soil types is helpful if one is to guide his sampling intelligently. For example, a podzoli soil develops in a temperate climate with average rainfall, and usually undergoes differentiation into several recognizable horizons. An "A" horizon, normally greyish to a gray color; a brown "B" horizon where accumulation of iron and aluminum oxides takes place; and a "C" horizon, consisting of disintegrated parent bedrock. Samples collected from the "A" zone would tend to be higher in concentration than those from the "B" sample and enriched in metals and elements characteristic of environmental weathering. It is useful to obtain samples at various depths, and samples from the upper 6 inches of the soil are more useful than the lower 6 inches. Although tillite soils are the products of extreme weathering, they have not been found to yield useful metal data.

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The accumulation of metals by ground water in mineralization areas is believed to be associated with uranium, and the location has often been made fertile by the flushing out of oxidizing solutions to which a buffer solution is added. The buffer may be of simple molybdenum sulphide. The second class of procedures may be used in field laboratories because they are more simplified and rapid than (A) above. A flow diagram showing the outline of the methods described under (chemical Procedures) below is included. The second class of procedures may be used in field laboratories because they are more simplified and rapid than (A) above. A flow diagram showing the outline of the methods described under (chemical Procedures) below is included.

The choice between using plants or soil samples, and loosely held by calcium. Once removed, they are found to be loosely held by the sediments and can be removed by cold extraction with acetate, citrate, or dilute acid solutions. This has served as the basis for the simple chemical procedures described under "Chemical Procedures" below.

Sediment sampling techniques have certain advantages over water sampling: (a) local dilution effects are minimized, (b) dry stream channels may be hosted, (c) the chemical procedures are simpler, and (d) samples may be stored for future reference.  

Chemical Procedures

Chemical procedures used in geochronological prospecting may be broadly classified on the basis of the completeness of sample solutions, into three groups: (A) Solution of primary rock-forming minerals usually silicates, by ultrasonic means and perchloric acid attack (complete solution). (B) Solution of relatively insoluble minerals found outside the silicate lattice as sulfides or oxides and hydroxides (acid attack). (C) Solution of secondary minerals, those easily soluble and loosely held by calcium and magnesium ions or organic ions.

The procedures of the first type are generally carried out in a well-equipped chemical laboratory by conventional methods. The second class of procedures may be used in field laboratories because they are more simplified and rapid than (A) above. A flow diagram showing the outline of the methods described under "Chemical Procedures" below is included.

In this scheme, a sample may be broken up by either (1) acid digestion or (2) a dilute acid-perchloric acid mixture. After digestion to 10 ml, a portion is transferred to a test tube to which a buffer solution is added. The buffer may consist of a combination of mercuric chloride and sodium acetate (for Na, and for K), or molybdenum is found widely distributed in waters, soils and plants whose pH environments is about 7 (7). The suggestion that molybdenum may travel as complex inorganic and organic ions, with different chemical properties occurs rarely.

Changes in water volume caused by seasonal and daily rainfall may frequently dilute the metal concentration to below the sensitivity of many water tests. Or alternatively, raising the level of the water table, may sometimes result in the flushing out of oxidizing solutions to which a buffer solution is added. The second class of procedures may be used in field laboratories because they are more simplified and rapid than (A) above. A flow diagram showing the outline of the methods described under "Chemical Procedures" below is included.

In this country, the search for uranium in the Colorado Plateau was materially aided by mapping the distribution of the inehar plant commonly known as the "koo woid" (Antennaria parlinii). Because this perennial thrives in alkaline rich soils known to be associated with uranium, their location has often led to ore bodies of uranium. Four are bodies out of 10 discovered in the Yellow Cat area, Utah, for example, would have weighed more but for the additional information furnished by the plant. In the Thompson district of Utah, 190 holes that were drilled in areas supporting the growth of this plant, 90 were mineralized.

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Carnival in the High Andes

By BEN R. HUDSON, '45

One of the difficulties with which many of the Indians living in Bolivia's High Andes have to contend is a chronic shortage of water. Without a steady supply of safe water for drinking and other purposes, they are condemned to a permanently low and precarious standard of living. When the United Nations sent me to Bolivia at the request of the Government, it was to help in locating underground water in the Andes which could become a source of supply for the impoverished Indian residents. This task took me into many unfrequented spots on the Altiplano, and I was fortunate enough to discover water in a number of different places. As a result, a hydrological service is being developed by the Bolivian authorities to survey the country's water resources on a much larger scale. Most of my time on this United Nations assignment has been so busy that I have not had time to do anything but concentrate on the job in hand. Day in, day out, I have worked to do such that one could find the hours fly. It has not, however, been all work.

A Time for Gaiety and Dancing

Carnival time in Bolivia, as in other Latin American countries, is a time of gaiety, happiness and festive dances. For nearly a week one does not attend much to the routine affairs of life; the carnival spirit pervades everywhere. Water fights and folk dances take place in the streets, there are parades and fireworks, and the plazas are bristling with swarming, colorful, pleasure-seeking crowds. Bands of young people, each with its small dance orchestra, make merry in the streets and homes.

Thus was carnival being celebrated when I was in Cochabamba, Bolivia, the "city of eternal spring." Yet Carnival in the High Andes

BEN R. HUDSON, '45

Invitation to Visit Mines

Hernan had asked me to spend carnival visiting these mines in the remote and inaccessible regions around the town of Independencia, and to mark an evaluation of the ore they still contain. He had recently lost her life in an airplane crash near Cochabamba for the carnival festivities. Thus was carnival being celebrated when I was in Cochabamba, Bolivia, the "city of eternal spring." Yet the time was a time of sadness for my friend, Hernan Fernandez. When the United Nations sent me to Bolivia, I was employed in geological organizations concerning the efficient operation of a drilling section.

After working for several years as a geologist with major oil companies in the Rocky Mountain area, Mr. Hudson was sent by SKAMCO to Saudi Arabia, where he spent three years (1952-55) before joining the United Nations Bureau of Technical Assistance Operations.

During my stay, he has been sent by the U.N. on assignments in the under-developed regions of the High Andes.

**CLASS NOTES**

(Continued from page 3)

mailing address is P. O. Box 3508, Airlawn Station, Bogota, Colombia.

William D. Watts, staff industrial engineer for Oliver Iron Mining Co., has moved from Hibbing, Minn., to 4114 McCreight, Dubuque, Iowa.

David K. Cole is project engineer for Marshall Mining Co., Ypsilon, Cal. His mailing address is 1050 Sherwood Dr., Green Bay, Wis.

N. K. Rossinson, geologist for United Fruit Co., has moved from Paseo De Parques No. 375, Bogota, Colombia.

William D. Watts, staff industrial engineer for Oliver Iron Mining Division, United States Steel Corp., has moved from Hibbing, Minn., to 4114 McCreight, Dubuque, Iowa.

Paul Back left Taunton, southwest Africa, on Jan. 3 and expects that mail will be sent to his home address. 18 Stephen St., New Haven, Conn.

George E. Baker has moved from Little Sigma, N. D., to Chicago, Ill., with mailing address to Shell Oil Co., 624, Michigan Ave.


R. J. Anderson, party chief for Geophysical Service Inc., may be addressed at Trumlikie Gas Co., at Houston and was the executive secretary-treasurer of the Houston Alumni Association. His business address is P. O. Box 573, Coffeyville, Kan.

George E. Baker, geologist and geophysical engineer for Reitman Geophysical Exploration Co., has moved from Lake- wood, Calif., to Tucson, Ariz. His personal box number is 4675.

Franklin A. Seward, Jr., geologist and member of Phi Gamma Delta, has moved from 423 Michigan Ave., Duluth, Minn., to Tucson, Ariz.

Our climb was to take us from the 8,600-foot elevation at Cocha­labamba for the carnival festivities. As we left Cochabamba at dawn and travelled to the other end of the valley to Quillacoa, before starting the high climb through the Cordillera Real, we passed many ancient trucks jammed with hundreds of Indians being driven to Cochabamba for the carnival festivities.

17
feet before we reached our goal of Independencia. With our jeep sputtering for lack of oxygen, we eventually came to a point where, looking across the canyon of the Rio Chala, we could see in the distance faint lights on the bare escarpment of the mountain peak. Here the flat plateau had seaward, taking the lives of so many mining engineers, managers, and owners on their tour of Bolivian mining districts. We paused for a moment, but did not try to put our thoughts into words.

In the Dark and the Rain

Night came on and darkness settled rapidly, as is usual in this high and lonely area. Clouds had gathered, and before long the rain came in gusty torrents, tumbling upon us from all sides, rushing down the steep slopes. The road we were now travelling was seldom used; as it wound around the sides of the mountains, it attained elevations of over 16,000 feet, and at all the roads I’ve travelled in the Andes, this was indeed the most hazardous. About two o’clock in the morning we hit a section of road that had been closed to all traffic, and the large hogs of toll they have to endure to exist at all with their primitive implements, one could have so well withstand the blizzard and the upper highlands on their meagre and inadequate diet. For their survival under these awe-inspiring conditions, perhaps some thanks must be given to the cocoa leaf, their daily friend and companion.

In the Dark and the Rain

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Whenver we stopped for a minute I would hear, nearby or far off in the hills, the characteristic music of the mountain Indians, flutes and drums, the flutes carrying the tune in a high, whistling key, while the drums keep the rhythmic undertone. Later we heard much more of this music in the villages. Festivals and religion have practically the only areas in which the Spanish have made inroads into the mountain toward us, bobbing up and down among the trees. It seemed to be moving rapidly a few feet above the ground and there was no way of relating it to anything we had seen before. There burst upon us a barefooted Quechua woman, running as if for her life with a wide clay bowl full of red-hot coals. How she got there was a mystery to us. We spread our blankets and bedrolls on the worn, red-brick floor, so many other weary travelers had no doubt done before us.

Mapping the Mines

Early next morning, after the usual Bolivian breakfast of black coffee and bread, we started up the rugged mountain trail astride brown and black horses and with two guides hiking alongside. Four hours of climbing brought us to the old hacienda of Herman’s parents; it was in the old Spanish colonial style, surrounded by worn-out orchards and extensive grounds. Full eucalyptus trees stood like sentinels in front of the main building. A few Indian caretakers were living in mud huts at the back of the patio, baking bread in mud ovens.

Herman and I visited four or five lead mines within a few miles of the hacienda. We stayed there a few days making reconnaissance maps of the mine holdings. The local Indian tradition demanded that we chew coca leaves and spit the juice into each mine entrance before coming in our lives.

Indians Chew Coca Leaves

Nearly every adult Indian of the Andes chews the leaves of the plant from which cocaine is extracted. It is true that the coca chewer is often in a state approaching stupor, and it is evident that the brain must be dulled by this habit, yet some students of the Andean Indians are inclined to think that, without the coca leaf, they would not have been able to endure the cold and the hard hours of toil they have to endure to exist at all with their primitive implements, one could have so well withstand the blizzard and the upper highlands on their meagre and inadequate diet. For their survival under these awe-inspiring conditions, perhaps some thanks must be given to the cocoa leaf, their daily friend and companion.

Music is a Paintive Key

Whenver we stopped for a minute I would hear, nearby or far off in the hills, the characteristic music of the mountain Indians, flutes and drums, the flutes carrying the tune in a high, whistling key, while the drums keep the rhythmic undertone. Later we heard much more of this music in the villages. Festivals and religion have practically the only areas in which the Spanish have made inroads into the mountain culture, and the same may be said of the existence of Indian revelries. Now and again, the outlines of the huts and moving shadows of people stand out against a background of bonfires. I was beginning to get a ‘feeling’ for the life of these isolated mountain people. The very silence seemed to hint at some elusive secret which, with a little more understanding, I might share.

A Light on the Trail

As we picked our way carefully downhill, we saw a strange, glowing light which appeared to be dancing down the mountain toward us, bobbing up and down among the trees. It seemed to be moving rapidly a few feet above the ground and there was no way of relating it to anything we had seen before. There burst upon us a barefooted Quechua woman, running as if for her life with a wide clay bowl full of red-hot coals. How she got there was a mystery to us. We spread our blankets and bedrolls on the worn, red-brick floor, so many other weary travelers had no doubt done before us.

Efforts, however, are being made by the authorities to discourage this practice. Government plans to raise the living standards of the Andean Indian by technical assistance and by removing whole communities down to fertile soil in a lower altitude, should give these mountain people for the first time for centuries a new aim in life.

We left the hacienda for Independencia late on the third afternoon, hoping that the full moon would light us on our way down the steep mountainous path. To our dismay, the skies clouded over, and the darkness in the mountains became so imperceptible that it was impossible to ride our horses any longer. Fortunately, our guides had brought a miner’s acetylene lamp and, leading our horses, we picked our way down the rocky trails. Occasionally in this vast solitude we could catch the faint sounds of drum and flute and the curious, plaintive wailing of Indian revelries. Now and again, the outlines of the huts and moving shadows of people stood out against a background of bonfires. I was beginning to get a ‘feeling’ for the life of these isolated mountain people. The very silence seemed to hint at some elusive secret which, with a little more understanding, I might share.

(Continued on page 20)
In principle, the electrical concentration of minerals is quite simple. The operation is merely that of utilizing the forces acting on charged or polarized bodies in an electric field to effect a selective sorting of the mineral species introduced into an external electric field. In actuality, the method of effecting a separation is frequently interestingly difficult due to our lack of knowledge of the relatively new science of solid-state physics that is associated with the problem. In fact, it can be said that the most important recent contributions to the understanding of the "art" of the so-called electrostatic beneficiation process of concentrating minerals have been indirect contributions by solid-state physicists among whom may be mentioned Sieverts, Kittel, Mott, and others.

Much of the notorious confusion and the non-reproducible results involved in "electrostatic" separations of commercial importance is due to our inability to isolate all the factors that influence a selective separation by induction. This is seen in the fact that these factors constitute the subject of this paper.

In an electrical beneficiation process for solid substances, the major mechanisms are: Contact electrification, Electrostatic charging by inductive conduction, Electrostatic charging by virtue of mobile ions.

Each of the above mechanisms gives rise to a surface charge density on the solid particles. If all factors that influence a selective separation are known, we may completely understand only in isolated cases.

Dr. Lawver attended the Colorado School of Mines, receiving his engineering degree in non-ferrous metallurgy in 1945. He obtained his doctorate at Mines in 1956 in inorganic metallurgy. At this time, he also did some work in the fields of mathematical physics and instrumental analysis.

He has also attended numerous courses in specialized fields of mineral processing such as X-ray diffraction, electron diffraction, electron microscopy, and operations research.

His experience record includes that of a mining engineer at the Broken Copper Company in Chile, South America, and with the Bureau of Strategic Materials in Brazil. He is a registered engineer in the state of Florida where he is currently employed by the International Minerals and Chemical Corporation as a research specialist.

Dr. Lawver holds 26 domestic and foreign patents.

THE AUTHOR

In practice the usable maximum electric field is about 50% of theoretical value and the value of the surface charge density is about 5% of the theoretical maximum, thus the above value becomes

\[
P = \frac{9 \times 10^{-11} \times 2.5}{0.25} = 9 \times 10^{-11} \text{ kg/cm}^2
\]

Thus a charged particle with radius \( r \) cm. and a specific gravity \( s \) will experience an electric force such that

\[
P = 4s \varepsilon_0 \left( \frac{\pi r^5}{4} \right) \varepsilon_0\varepsilon_{\infty} \frac{1}{10^5} \text{ dynes} = 0.002 \text{ pounds}
\]

It is interesting to compare the magnitude of the above force to the force of gravity acting on the spherical particle with radius \( r \) cm. and a specific gravity \( s \).

\[
F(\text{gravity}) = \frac{4}{3} \pi r^3 \rho = 9 \times 10^{-11} \text{ dyne}
\]

Where the ratio

\[
\frac{F(s) \text{ electrical}}{F(\text{gravity})} = \frac{s}{\rho}
\]

Thus a fully charged 28 mesh (0.0589 cm.) quartz particle could experience a maximum electric force of 2.65 X 10^2 dyne, or 18.5 times its weight.
Yest, real crystals of NaCl or KCl usually will become charged negatively by sliding contact against a metal. Wagner[22], however, reports a positive charge on both NaCl and KCl used, and this is attributed by him to the charging of the salt, (sec Fig. 1a) and that the highest occupied electron state in the metal is in an energy state lower than the lowest conduction band of the insulator so the salt could not result in charge displacement. Thus, the classical energy diagram of a perfect insulator such as NaCl (Fig. 1b) must be re-placed with a more realistic energy diagram (Fig. 2) which shows the presence of electron or positive hole-trapping states. These traps are capable of acting as donors or acceptors of electrons, and they probably are the controlling influences in the contact electrification of minerals. There are many excellent articles in the current literature which explain the origin of electron or positive hole traps.8

![Figure 2](image)

The density of these surface states (traps) is approximately the same as the number of surface atoms so that when the unfilled traps are filled by contact with a second solid, the surface charge density will be limited by the number of electrons of air. It is immediately apparent that the jump at a phase boundary of two contacting minerals cannot be expressed merely as the difference in work functions (as in the case of two clean metals that make contact). It also follows that no two triboelectrification series will inevitably be changed as more exact knowledge is obtained concerning the ionic and electronic properties of solids. No two triboelectrification series are identical; and no extensive literature search is required to find conflicting data of contact electrification tests, even with regard to the sign of the resulting charges.

For example, when an insulating crystal such as NaCl or KCl is contacted against a metal at room temperature, there should be no electrons in the conduction band of the insulator so the salt could not become positively charged by losing electrons to the metal. If we take a value of -4 eV as the work function of the metal (most metals have a work function near this value) and the value of -0.6 eV for the lowest electron energy in the conduction band of NaCl or KCl (Mott and Gurney[17], we see that the highest occupied electron state in the metal is in an energy state lower than the lowest conduction state in the salt, (see Fig. 1a and 1b) therefore, we would not expect the metal to lose electrons to the insulator (see Fig. 1a).

10 Yet, real crystals of NaCl or KCl usually will become charged negatively by sliding contact against a metal. Wagner[22], however, reports a positive charge on both NaCl and KCl used, and this is attributed by him to the charging of the salt, (sec Fig. 1a) and that the highest occupied electron state in the metal is in an energy state lower than the lowest conduction band of the insulator so the salt could not result in charge displacement. Thus, the classical energy diagram of a perfect insulator such as NaCl (Fig. 1b) must be re-placed with a more realistic energy diagram (Fig. 2) which shows the presence of electron or positive hole-trapping states. These traps are capable of acting as donors or acceptors of electrons, and they probably are the controlling influences in the contact electrification of minerals. There are many excellent articles in the current literature which explain the origin of electron or positive hole traps.8

In some cases it is also possible to alter the surface in the mineral species in the ore by selective reagents or other chemical treatment methods similar to those in froth flotation. In many simple cases it is only necessary to have discrete surfaces in order to obtain suitable particle-particle contact electrification. In this case, the separation is then simplified to that of denuding (removal of a common surface from the mineral species in the ore). For example, flotation against Florida phosphate rock will charge the quartz highly negatively and the phosphate rock equally positively over a temperature range from about -300° C to 300° C. Sea sand contacted against silica gel will cause the quartz to be positively charged and the silica gel negatively charged (at 300° C).
mixture was water-washed, dried, and heated in a glass container; after which it was poured into an external electric field of about 4 x 10^6 volts per meter. There was, of course, some electrification due to mineral-glass contact, but if we consider the relative surface areas involved, the electrification due to the glass can be neglected.

The average surface charge density on a 64.65 mesh of quartz-florida phosphate particles was computed by photographing the trajectories of the particles in a known, uniform, external electric field. The maximum charge was of the order of 1 x 10^4 coulomb per square meter. Since the maximum charge in air could be about 2 x 10^4 coulomb per square meter it appears that only approximately 4% of the theoretical charge was obtained by particle-particle contact electrification. The low charging efficiency probably is due to the impossibility of making contact (even with considerable movement to effect repeated contact) because of the roughness and re-entrant angles of the surface involved.

Particle-particle contact can not be assured merely by increasing agitation because one of the operating difficulties associated with particle-particle contact electrification is the prevention of the formation of a common surface on all minerals. A common surface tends to form by virtue of attrition during the material handling stages of the process. This undesirable phenomena places a rather imposing requirement on the design of a commercial flow sheet.

**Experimental Techniques**

The metallurgists faced with the problem of designing commercial beneficiation processes must first determine the conditions that will lead to optimal separation of the minerals in the ore to be concentrated. There are many sophisticated experimental techniques that can be used including the determination of glow curves (Leverenz); optical absorption studies (Mott and Gurney); and x-ray and electron diffraction techniques. A less direct but more direct approach to the problem is disclosed by using some of the experimental techniques that can be used including the determination of glow curves (Leverenz), optical absorption studies (Mott and Gurney), and x-ray and electron diffraction techniques.

If we assume the particle to have an initial charge Q = Q_0, then Q = CV_e, whence it will experience the electrical force F = QE, where e is the capacitance of the particle and V_e is the potential difference between the metal plate and the charging electrode. If the particle is a dielectric, we cannot, in general, speak of its potential because the potential varies from point to point on the surface of the dielectric. A particle with finite conductivity will eventually obtain a total charge Q = C V_e, but the time required may be very large. The problem can be approximated by introducing the following as an equivalent circuit:

$$Q = CV_e$$

Let R = the effective particle surface resistance. The value of R will depend on the temperature of the sample, its previous chemical and temperature history and, in many cases, on the polarity used in the concentrating circuit. It may be possible to favorably alter the effective resistance of a mineral by heating the mineral in the presence of the vapor of one of its constituent components to produce a stoichiometric abnormality, or by introducing impurities into the mineral such that it will behave as a semiconductor. It is also possible to alter the effective resistance of a mineral by irradiation with electromagnetic energy of a suitable energy. Under given conditions, however, one can assign an effective value of R and consider that the charging mechanism will behave as follows; neglecting nonlinearity one can write:

$$Q = CV_e$$

In the practical interpretation of the analysis is (a) the charge Q at time t is proportional to the capacitance of the particle and to the potential of the charging electrode, and (b) the time required to charge the particle to a given fraction of its final charge is proportional to the particle capacitance and its resistance. For example, the particle charge to 63% of its final charge, in time t = RC.

Unfortunately, attempts to tabulate the electrical conductivity of minerals are almost hopeless because
the conductivity of a mineral, at a given temperature, and vary as much as one thousand fold for specimens taken from different locations. Nevertheless, it is possible to selectively charge by careful control of charging time, according to Equation E-7. Even if the conductivity of the particle is held constant, the problem of selecting a separation using inductive conduction as a charging mechanism will not be completely solved because, in addition to the surface charge due to inductive conduction, there will be always a surface charge due to (a) particle-particle contact electrification, and (b) particle-metal contact electrification. We note that there is no selectivity of the conductive particles with respect to the sign of the charge they bear when they are charged by this electrification mechanism. This exaggerated example also illustrates the importance of making a particle-particle contact electrification separation at the condition of minimum surface conductivity.

Charging by Mobile Ions

If, by some means or other, a small portion of a solid surface is given a surface charge, the charge tends to eventually spread evenly over the entire surface. If the solid is a good electrical conductor, the redistribution of electric charge is almost instantaneous. If the solid is a good dielectric, for example, dry pure NaCl, KCl, or quartz (at room temperature) the redistribution of the same charge will be very slow, it may take several weeks. By subjecting dielectric materials to an atmosphere of mobile ions, their surface is made temporarily electrically conducting. The following simple laboratory experiment illustrates the principle of using mobile ions to selectively suspend a conductive mineral from a dielectric material by electrical forces.

Place a single layer of a mixture of a good insulator and a good conductor (quartz and galena, for example) on a grounded metal plate (see Figure 13). Place a second plate with a charge +Q in front of the first. Next, play the flame of a ground lamp over the surface of the minerals (see Jeans\textsuperscript{25}). The mobile ions on the first plate will then have a total charge of +Q distributed over its surface. (Instead of using "Jeans' lamp" we may, of course, substitute any other convenient ion source.) After the minerals have been charged, remove the lamp and hold the minerals in view. It will be found that the FeS particles, being reasonably conductive, will rapidly share their charge with the earthed plate and will fall from the plate. The quartz particles are not capable of losing their charge and are held to the plate by their own charge. This simple laboratory experiment is merely a method of solving Laplace's or Poisson's equations by inspection of symmetry conditions.

For a detailed discussion of image theory see any physics text; for example, Sommerfeld\textsuperscript{26}. A practical variation of the above experiment is the electrical separation of conductors from insulators using corona discharge as a source of mobile ions. Charging by corona has been studied in detail by Locb\textsuperscript{27}, Lucas\textsuperscript{28}, and others. The mechanism is due to both ion diffusion, and to ion bombardment. The important factors applicable to electrical concentration of minerals are:

1. The limiting charge Q on a spherical particle of radius r is proportional to the field E, and to the square of the radius. (See Panthe­nier\textsuperscript{29}).

2. If appreciable corona is required, the discharge electrode should be as small as possible because the flash over voltage is higher (Delassalle\textsuperscript{30}).

The following photograph shows a modern Corpo correlator separator used at the Colorado School of Mines (Figure 14).

This separator has proven quite effective for the separation of electrical conductors from electrical insulators on an industrial scale.\textsuperscript{*} The con­ducting particles are held to the plate by the image forces and are mechanically or electrically removed on the back side of the roller. The mechanical forces utilized in this type of separation are obvious.

Power Requirements

With the exception of the corona-discharge type separator the power requirements for electrical concentration of minerals is (contrary to popular opinion) extremely small. By way of illustration, consider the separation of a ton of 48-65 mesh quartz and phosphate particles in an external field of 4.10\(^6\) newtons/coulomb using free field electric force spacing 72.7 X 10\(^{-3}\) meters (5 inches apart). Let us assume that the particles will move half of the distance and that their initial velocity in the direction of the potential gradient is 0. Particle-particle contact electrification will give a ratio of charge to mass such that

\[
\frac{Q}{m} = 5 \times 10^6 \, \text{coulomb Kg.}
\]

The horizontal force \( F = Q \times B \), thus by Newton's equation

\[
\frac{d^2v}{dt^2} = 9 \times 10^3 \, \text{coulomb Kg.} \times 4 \times 10^4 \, \text{Kg. meter}^2 \text{sec}^{-2} = \text{meter sec}^{-2}
\]

Thus, \( dx \) = velocity = \( 3.6 \times + C_1 \)

\( C_1 \) = 0

or \( x = 1.8 \times + C_2 \)

\( C_2 \) = 0

Hence the total time required for a single particle to traverse 6.3 X 10\(^6\) meters (half the electric space) is 1.8 X 10\(^{-6}\) sec. Whence the final velocity \( v_f \) of the particle in the direction of the potential gradient is

\[
v_f = 6.7 \times 10^6 \, \text{meters sec}^{-1}
\]

and the change in the kinetic energy of each particle due to the external electric field is

\[
\Delta K = \frac{m}{2} (v_f^2 - v_i^2) = 4.9 \times 10^9 \, \text{Kg. meter}^2 \text{sec}^{-2}
\]

This energy change has, of course, been obtained at the expense of the external electric circuit; that is to say, each particle requires the expenditure of

\[
5.0 \times 10^6 \, \text{Kg. meter}^2 \text{sec}^{-2} = 5 \times 10^6 \times 1.8 \times 10^6 \, \text{meters to traverse the electric field.}
\]

The average time \( t_0 \), required for this expenditure of energy is

\[
t_0 = \frac{dx}{(v_f - v_i)} = 1.9 \times 10^{-6} \, \text{sec}
\]

Thus the required power was

\[
5 \times 10^6 \, \text{Joules}\times 1.9 \times 10^{-6} \, \text{sec} = 2.6 \times 10^4 \, \text{watts}
\]

A ton of 48-65 mesh particles contains

\[
907.8 \times 21.7 \times 10^6 \, \text{particles}\times 2.6 \times 10^4 \, \text{watts}
\]

Thus the power required per ton

\[
= 41.8 \times 10^6 \, \text{particles} \times 2.6 \times 10^4 \, \text{watts}
\]

\( = 1.10 \times 10^8 \, \text{watts}
\]

This corresponds to approximately 1 cent-per-ton power cost at an industrial power rate. In other words, the power cost associated with画像 losses, lighting, materials handling, etc., is far greater than the true power requirements for separating a ton of material by the mineral-mineral contact electri­fication process.

Future of Electrical Concentration of Minerals

The writer feels that the future of electrical con­centration of minerals will depend almost entirely on the rate at which our knowledge of solid-state physics and surface physics can be increased. The combinations of minerals as resolved from the mines or washing plant can not be selectively electrified by the methods outlined in this paper. It is probable, however, that many combinations of minerals could be made to lend themselves to economical electrical concentration if the metallurgist had sufficient knowledge of solid-state physics. The tremendous strides made by surface treatment and solid-state physicists in the past few years indicate that similar studies by persons interested in minerals beneficiation will lead to tremendous practical accomplishments.

Acknowledgments

The data contained in this paper were obtained from the work done by the Colorado School of Mines and at the Central Research Laboratory of International Minerals and Chemical Corporation at St. Louis.

Bibliography


22. Leverenz, H. W., op. cit.

23. Gurney, R. W., op. cit.


(Continued on page 33.)
Kerr-McGee Oil Industries is, as the name implies, primarily an oil company. Its basic structure is built around oil and gas production, refinery and gasoline plant operation and a rather unique contract drilling operation which is active in many parts of the world.

These operations provide a substantial contribution to our country's "Fuels for the Future." And it is a deep concern for our nation's future sources of energy which has led this oil company into the field of mining and ore processing.

Uranium mining in the Lakehills Mountains of Arizona and construction of the Shiprock uranium treatment plant represents the first major effort of an oil company to develop raw materials for the development of nuclear power.

Uranium Mill in Ambrosia District

Kermac Nuclear Fuels Corp., which is a Kerr-McGee controlled company, now operates the largest domestic uranium mill in the Ambrosia Lake District of New Mexico. Five major uranium mines are operated as a part of this project. Kerr-McGee owns substantial uranium ore reserves in Wyoming.

Potential energy reserves are represented in the coal industry by Westmoreland Coal, which has coal deposits in Kentucky, West Virginia and Pennsylvania. Kerr-McGee is also interested in non-uranium minerals. Kerr-McGee holds a substantial interest in a potash project which is operated by Crest Mining Co. Kerr-McGee holds a substantial interest in a potash project which is operated by Crest Mining Co.

The Jefferson County site, which is located in open country, is considered nearly ideal for this type of operation. Proximity to Golden was considered as most important. Access to the very fine library of the Colorado School of Mines is valuable to the engineering and scientific staff. Numerous members of Mines faculty have been employed from time to time as consultants on problems in their various fields of mineral industry specialization. Numerous projects which have been conducted at the Colorado School of Mines Research Foundation have been particularly useful because of the proximity of our operations. A number of undergraduate students from Mines have found part-time employment during vacation periods and on week ends in the pilot plant and laboratories on McIntyre Road.

There were other factors which we felt made the Golden location almost ideal for this type of operation. The extensive laboratories of the U. S. Geological Survey and the U. S. Bureau of Mines at the Denver Federal Center were only five miles distant. The National Bureau of Standards installation at Boulder and the library and other facilities of the University of Colorado were only 30 minutes from our site. The offices of several prominent designers and builders of mining and metallurgical plants were close by in Denver.

Plant in Operation Since 1957

The first plant was placed in operation in the spring of 1957. The first project was to pilot the Ambrosia Lake process. The real value of continuous pilot plant testing prior to design and construction was illustrated in this operation. When pilot plant operations were started, no one had commercially treated any cF the Ambrosia Lake ores. Government recommendations indicated that a carbonate leach plant would have to be built even though other considerations favored an acid leach. Potassium which had never been used commercially for extraction of uranium from similar leach solutions had great appeal but no background of performance.

Numerous other features, new to uranium processing, had great possibilities but lacked proof of their efficiency during the pilot plant studies under operating plant conditions. All of these features after passing careful laboratory tests were incorporated into a miniature mill where they were tested under continuous operating conditions that would be duplicated in the full sized plant.

One Thoroughly Tested and Treated

The pilot plant operated almost continuously at a rate of 1 ton of ore per day on a 24-hour basis for nearly 18 months. During this period, many variations of the process were studied. Once from every part of the District were treated. When trouble-making impurities were observed in the ore, ways were developed to combat their effects. If troublesome impurities were observed in small amounts, additional quantities were intentionally added so that the effects on the overall process could be observed and corrective measures developed.

The cost and effort involved in the pilot plant studies seemed to be well justified when the $16 million Ambrosia mill started smoothly and reached its rated capacity and recovery after only a few days of operation. The firm knowledge of the process and equipment developments gained during the pilot plant operations contributed substantially toward keeping actual construction costs within the estimated limits.

Key Operating Personnel Trained

The pilot plant provided valuable training ground for most of the key operating personnel in the large plant. Supervisors, foremen, operators and chemists had no opportunity to become thoroughly familiar with the process. They were able to observe through first hand experience the effect of all process variables. Close coordination between the pilot plant organization and the design and construction contractor resulted in the installation of numerous unconventional but highly effective details in the plant.

A feature of the pilot plant effort was the production of a two-volume bound "laboratory" which has been turned over to the operators of the full scale plant. This book contains all information and data that was developed in the laboratory and pilot plant that relates to the treatment of Ambrosia ore. Microscopic studies of the ore, laboratory scale test data, pilot plant detailed operating reports, equipment manufacturers' tests and recommendations, water data, effect of ore impurities, weather and atmospheric observations, everything that may at some time be important to the operation of the mill has been included in these simply cross-indexed volumes. In this form, the data is available instantly to the mill operators and does not have to be laboriously tracked down through unindexd files or notebooks.

Plant Modified for Other Studies

Since completion of the Ambrosia ore tests, the pilot plant has been extensively modified for other studies. A potash pilot plant has been operated. Tests have been made leading to the development of improved methods for producing uranium tetrachlorofluoride and other compounds required for fuel production. The pilot plant has been so designed that with a minimum of effort and cost, it can be modified to accommodate many types of the operation.

The Kerr-McGee research laboratory which faces on McIntyre Road is about 200 feet west of the pilot plant. This brick building covers about 9,000 square feet. The building houses various laboratories that are particularly designed for mineral industry problem study.
The working of metals: competition, forming, drawing, rolling, swaging, is a new technology which is beginning to contribute significantly to metal working practices and is assuming an important place in equipment ancillary to mine development and production. The recent introduction of the working of metals using explosive charges as a source of power has given rise to fascinating claims, and it has been difficult for management and engineers alike to assess the true worth of this development and the impact that it will have upon metal fabricators.

New Method Seems to Violate Rules

Statements appearing in the press are enough to excite even the most conservative: this new method, forming by use of explosive charges, seems to violate all the rules for forming: the tougher the metal, the better the results; under such loads even the toughest metals behave strangely, setting more like fluids or plasmas than solids. What, then, are some of the facts:

In any explosive metal forming process, one is dealing with explosives, metals, and the nature of the coupling between the two. The source of energy is an explosive, an explosive being a substance or a mixture of substances which on the application of heat, pressure, or a mechanical blow can be converted into gases at high temperature and high pressure, hence capable of doing work. Modern high explosives are, however, very stable, being detonated only under well defined and readily controllable conditions.

Two Main Types of Explosives

There are two main types of explosives: high explosives, characterized by very high rates of reaction detonation, and high pressure; and deflagrating explosives or propellants, which burn more slowly and develop much lower pressures. The energy released on reaction is usually about 2,000 calories per gram of explosive whether the explosive detonates or burns, but the rate of release of energy in the case of the detonating explosive is very rapid as compared with the deflagrating explosive. In the case of high explosives, the pressure is exceedingly high in the immediate area of the explosive, as high as 4,000,000 lb./sq. in. at the...
Sudden Release of Energy

The sudden release of the energy of a high explosion takes place in a microsecond or so, the pressure building up in the same time; the explosion gas rapidly expands, dissipating energy and the pressure drops suddenly, coming to zero in a few microseconds. The pressure generated by learning propellants takes several milliseconds to develop, but being confined will be sustained for quite long times, decrease in pressure coming about through cooling of the gaseous explosion products.

The diverse applications of explosives to metal forming group into those situations in which the explosive is detonated in intimate contact with the metal to be worked or formed such as in the hardening of steels, the compaction of metal powders, the splitting of ingots, and cutting operations; and those in which explosive is detonated in intimate contact with the metal forming group into those situations in which the ex-products.

stratagem in metal forming is to turn to ad

pacting of a thin-walled round tube into one of square cross section. The tube would be placed in a heavily

A typical explosive forming operation such as the

may other liquid, has the effect of rounding off the

any other liquid, has the effect of rounding off the

of the tube, thus dislodging the "scale by the same

Impaction and Charge Weight

Figure 4, peak pressure produced in water by spherical TNT charges is plotted against (charge weight) M/(distance). Curves for other explosives such as PETN and blasting gelatin will be substantially different.

Peak Pressure and Impulse

Peak pressure and impulse are more sensitive to distance than to large weight, varying inversely with it as the first power. At equal distances away from an 8-lb charge and a 2-lb charge, the peak pressure produced by the 8-lb charge will be only twice that produced by the 2-lb charge, indicating that in explosive forming operations the size of the charge will not be particularly critical. In Figure 4, peak pressure produced in water by spherical TNT charges is plotted against (charge weight) \( \frac{M}{d} \). Curves for other explosives such as PETN and blasting gelatin would be substantially different.

Compressive Metal Forming, the metal of the part that is to be formed must, at some time during the forming operation, be in contact with the forming die.

The distribution of stress established by the die is exceedingly complex, almost impossible to describe, with many opportunities for the development of regions of high stress concentration which, in turn, can lead to fracturing in localized areas. A dynamic stress field of the kind set up when an explosive is detonated in a liquid usually distributes itself more uniformly over the whole piece to be formed, penetrating into every crevice, crevice, and corner so that the metal is pushed about uniformly. In effect, it is almost as if one were using a well lubricated die of ever-changing shape, its effect continuous, and instantaneously conforming to the shape of the metal part as it is being formed.

Typical Explosive Forming Operation

A typical explosive forming operation such as the

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S. S. L. Betal

BHN

Peak Pressure and Charge Weight

When propellants are used, the system must be gas
tight, for the pressure must be allowed to build up slowly. A typical operation would be the con
verting of a thin-walled round tube into one of square cross section. The tube would be placed in a heavy-walled container of square cross section suitably equipped with some means, such as a primed shot gun shell, for igniting a small amount of propellant powder. On ignition, pressure builds up, pushing the round tube inward so as to come up snugly against the square interior of the die.

Less Ductility When Deformed Rapidly

In spite of much propaganda to the contrary, metals as a rule have less ductility when deformed rapidly than when deformed slowly, just as an arm will stretch to great lengths when pulled slowly, but will break in a brittle manner when stretched a sharp blow. A few metals, notably the high manganese and high nickel steels and certain aluminium alloys, show as much ductility at high rates of strain as at low. Copper and certain other metals of high tensile strength manifest increased ductility when strained rapidly.

There is a paucity of data on the effect of rate of straining on the ductility of metals, but the physical properties of metals at low temperatures have been extensively investigated and many ecologies can be drawn, both behavior patterns being dependent upon activation energies in much the same way. In none of these data is the metal subjected to such pressures that it is converted to a fluid.

Processing in Its infancy

Metal forming using explosive charges is in its in
fancy. Its potential is now being evaluated with great interest by industrial and academic scientific communities. It is still too early to make a realistic appraisal of the engineering possibilities of these new and scientifically fascinating modes of processing metals.

ELECTRICAL CONCENTRATION—LAWYER

(Continued from page 27)


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MEETINGS
Executive Committee Meetings
Thursdays from 7:30 to 8:15 p.m., Alumni Office, 730 P. M.
All members of the Committee at call of the chairman.

Executive Committee Meeting
Of Mines Alumni Assn. No. 18

The regular meeting of the Colorado School of Mines Alumni Association was held Wednesday, Nov. 18, in the office of The Storms-Roger Manufacturing Co., Denver, Colorado. The meeting was called to order at 7:30 p.m. by President Frank E. Brier.

Members present were: Frank E. Brier, president; Walterhead, vice president; R. H. Waterman, treasurer; Harvey Matthews, Executive Committee; R. E. Evans, Executive Committee; George H. Roll, executive manager.

Members absent were: Ken Nickerson, secretary, and Frank Geb, Executive Committee.

Committee chairman present were: E. H. Crabtree, Jr., Instruction; Warren Prosser, Public Relations; A. W. Cullen, Nominations.

A report from the Publications Committee was presented. They have met with Mr. Waldron and a Mr. Menchcr, who have had experience in journalism and advertising. The committee is working on a plan or procedure for handling the publication and advertising. This plan or procedure will be presented as soon as it is completely formulated. Moved by Mr. Waterman the report be accepted. Seconded by Mr. Matthews. Passed.

Mr. Crabtree reported that the committee of Mr. Dugdesh, Mr. East and Mr. Crabtree, appointed for the purpose of presenting a replacement report for Mr. Roll, had met but were waiting for the notice of the vacancy to appear in the magazine before acting.

Mr. Roll reported the November issue of the magazine had gone to press too soon to insert the announcement.

Mr. Matthews moved a letter be sent to every Alumnus advising the need of the Association to secure the services of an Executive Manager. Seconded by Mr. Waterman. Passed.

Methods of obtaining more advertising in the magazine were discussed. It was suggested that cigarette advertising might be acceptable. Mr. Crabtree reported the Publisher’s Press would like to work with the Association and the magazine.

The Annual Alumni Development Fund discussion discussed the need of obtaining an alumni function but it is now so handled by the Alumni. It was suggested that better response would be obtained if the fund was handled by the Alumni directly.

Mr. Brier reported he had a new plan, possibly the AADF be made one of the standing committees of the Alumni Association and the magazine subscriptions. A letter was sent to all life members who had paid the fee prior to 1942, was presented pointing out that the life membership subscriptions previous to 1942 did not include a subscription to the magazine. A card for a magazine subscription was included with the letter. Life memberships paid in 1942 and later include the magazine. This should clarify the situation concerning life memberships and magazine subscriptions.

An application for associate membership in the Association for Joe E. Hopkins was presented. Moved by Mr. Matthews the membership be granted. Seconded by Mr. Crabtree. Passed.

Passed.

Largely S. U. Asbestos Deposit

John H. Lowell's Co. Acquires Largest S. U. Asbestos Deposit

John H. Lowell, a student of mining engineering at the Colorado School of Mines both before and after his military service in World War II, is present director of The Clute Corp., which recently acquired 109.3% of the outstanding stock of Clute Bonding Corp. ABC holds a 99-year lease on the largest known chrysotile asbestos deposit in the United States, located near Napa, Calif.

Two years ago Mr. Lowell and Thomas H. Murphy formed the Clute Corp., an outgrowth of Clute Manufacturing Co., which for 30 years has been engaged in research, engineering and manufacture of asbestos, asbestos and synthetic materials. The corporation’s patented separation process separates asbestos from asbestos and has been used in the mining of materials, grains and such commodities as coffee, sugar, nitrates, fertilizers, sand and gravel.

In the two years since the company was reorganized, Clute equipment has been researched and developed for more efficient mining of asbestos and mica. Mills have been installed at Napa, Calif., and Cordova, N. M.

Divisions of Clute Corp. are Clute Manufacturing Division at Rocky Ford, and Denver, and asbestos Bonding Corp., wholly owned subsidiary at Napa, Calif., and Mountain State Commodities of America (MICA), Cordova, N. M., 15% owner of the Clute Corp. and Clute Sales Corp., Littleton, Colo., recently formed to expedite sales of machinery and minerals; and Mountain State Research Lab., designed for basic research activities. Mr. Lowell is a partner and executive vice president in the investment firm of Lowell, Murphy and Company of Denver, and president of the Littleton Savings and Loan Association in Littleton, Colo.

Oscar M. Davila, ’47, Promoted To General Mill Superintendent

Oscar M. Davila, a 1947 metalurgical engineering graduate of the Colorado School of Mines, was recently promoted to general mill superintendent by Corpoation Mines de Bailiva, in charge of the supervision of mining operations at the Clute Corp. mining and processing facilities in the Catskill Mountains, New York.

ANNUAL BUSINESS MEETING

Jan. 28 — Denver Athletic Club, 1325 Glenarm
Cocktails 6 p.m. Dinner ($3.50) 7 p.m.
Contact Alumni Office (CR 9-3246)
By Jan. 27 for Reservations
PLAN TO ATTEND!
Dear Mr. RoU:

J. B. Willis, '57, Recounts Experiences in Saudi Arabia

Division of Denver Equipment Co.

After completing his post-graduate work at Missouri School of Mines and working at the Colorado School of Mines, Willis has been transferred to the International Sales Division at Denver Equipment Co. He will be located in Denver and be responsible for sales in Bolivia, Australia, Japan, Burma and the Philippines.

An internationally known specialist in non-metallic flotation, a process of mineral beneficiation, he has been a sales engineer in the newest Sales Division of Denver Equipment Co. Since 1955, he has been at 3750 W. 51st Ave., Arvada, Colo.

J. Willis, '57, Recounts Experiences in Saudi Arabia

This letter by John B. Willis gives his impressions of Saudi Arabia and tells about some of his experiences in the Land of Aladdin's Lamp. Willis tells about some of his experiences in this land, which is generally proved to be in need of improvement (or to be improved to be better than mine). It brought to mind some of Dr. Bob Carpenter's comments about keeping an open mind and not scrutinizing at ideas presented by non-college educated people.

The feeling of Arab Nationalism is strong, and the men and women of Arabia are simple, hardy, friendly and interesting people. They like the desert and aren't bothered by having no TV, they'll find the desert and water holes without difficulty.

In the ten years between graduation and the accident, Bert was active in mining and geology. First chief of party with the Oklahoma Geological Survey, then as an independent consultant in petroleum geology in Texas, Oklahoma and Kansas; as part owner, superintendent and manager of Hazleton Coal Co., Coalgate, Okla., and also of the South Kentsico Coal Co., Rossville, Ark.

Following two years spent in the fight to live and regain some measure of health, he put his mind on radio engineering and became a consultant in this field. In 1933, finding the old-type, heavy wide, wooden wheel chair made for sitting hard, Bert began to develop an idea of what was needed to liberate him. Thus the light-weight, folding, metal chair came into being. He acquired the assistance of a mechanical engineer, Mr. Harry C. Bennett, and organized the Everest Engineering Company, which became the expression of a forthright man's life. By his efforts, he was able to secure a patent for his invention. In 1939 he was offered a contract to set himself up as a consultant. In that year he was given a Presidential Citation for the employment of his invention to the great benefit of those handicapped.

To the great benefit of those handicapped, their rehabilitation and employment, his mail brought actually thousands of letters from the handicapped to which he dictated responses. He made repeated visits to hospitals for the handicapped and was marked the spots we would drill, the people with special talents for finding water are called souunds and for a good many centuries they have been doing quite well. In a village I visited to locate water well sites, a son had been over the ground previously; and after I marked the spots we would drill, the people would always conduct the search to find the water, which generally proved to be in need of improvement (or to be improved to be better than mine).

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Mr. George H. Roll received his MSc. degree in geological engineering at the Colorado School of Mines in 1957. Mr. Roll asked if it was really necessary to find someone in Denver to assist them paying their annual dues. He suggested that some money could be saved if cards were not sent. Mr. Matthews noted that the Alumni Office has the right to make a big feast for you. Sometimes the Alumni Office is not best but they gladly give a guest whatever they have.

He tells about some of his experiences in Saudi Arabia and his impressions of Saudi Arabia and the people. He tells about the Saudis being a very warm-hearted, friendly and interesting people with special talents for finding water, are called sons and for a good many centuries they have done so quite well. Nearly every village he visited located water, a site he had been over previously, and after he marked the spots we would drill, the people would do it themselves. He visited nearly all the local areas to show them how to drill for water. The feeling of Arab Nationalism is strong here, and one can get a little tension and unrest. They are lost. He's afraid that our diplomats act the same as they visit with the people.

In the ten years between graduation and the accident, Bert was active in mining and geology, first as a staff of party with the Oklahoma Geologic Survey, then as an independent consultant in petroleum geology in Texas, Oklahoma and Kansas; as party officer, superintendent, and manager of Hazelton Coal Co., Coalgate, Okla., and also of the Southern Coal Co., Russellville, Ark.

Following two years spent in the fight to live and regain some means of health, he put his mind on radio engineering. He of course was a prominent part of the handicapped. In 1953 the Colorado School of Mines awarded Bert a Distinguished Service Award, and in November 1955 the Southern California District of Indoor Sports gave Bert a Citation for his work with the handicapped.

He wrote many articles in publications for the handicapped, their rehabilitation, and employment. His mail brought actually thousands of letters from the handicapped to which he dictated responses. He made repeated visits to hospitals for the handicapped, and most of them said the mail and Bert helped to evince the possibilities for useful work. Bert was a vital soul; an example of courage of the highest type and, with a mind, kindly, thoughtful gentleman.

Orvil R. Whitaker, '44, Hwy. 99 S., Downieville, Colo., died Thursday, Nov. 26, 1959, in Rose Memorial Hospital. Burial was at Fairmount.

Behind this simple obituary notice in the Denver newspapers, lies the unassociated saga of a useful man's life.

For all the years of an active mining career which began with his graduation from the Colorado School of Mines in 1956, "O. R." or "Whit" as his many friends knew him, was always a friend and advisor, and, later a national authority in his field. In his earlier days, he represented the United States, Mexico, Canada, and Central America as an employee of the great mining companies in those countries.

Throughout all of his professional abilities were enhanced by experience in operation, management and appraisal in connection with his engineering work.

By 1912, he had acquired such stature in that field that he was able to set himself up as a consultant. In that capacity he was frequently called upon to aid companies in making major decisions. Not the least of his contacts was a fellow who selected out of his broad field of contacts for top assignments. One of this side of his efforts, rarely talked about by him, was devoted a difficult situation. This was done with enthusiasm and was able to carry some men who came across him because he was a man whose attitude and help, as it was by hard pressed engineers who sought that man with his dedication.

On the Raw Materials Advisory Committee of the Atomic Energy Commission, he was appointed to it and there as in the commercial field, his views were accepted as the expression of a forthright man who never stooped to personal advantage, nor sought popularity by saying always what they desired to hear. No better expression of the type of man "Whit" could be found than that contained in the citation which accompanied an Award of Merit given to him in 1942 by the Colorado School of Mines as an expression of appreciation for his services as a trustee of that institution and for significant achievement in the mineral industry.

In essence, it describes as the man he was—the ideal mining engineer. It describes the man who never stooped to personal advantage because he was to be sincerely trusted through all his years of service.

It follows in full:

**AN ENGINEER:**

Devote to the solution of any problem; to the determination of all facts; to the expression of a forthright man—absolutely of prudence or remembrance.

**A MAN:**

Critical of himself—tolerant of others; dauntless of his right convictions; humble in the evaluation of his own achievement; zealous in the service of others. A broad, balanced mind and a generous spirit.

To the memory of R. M. Whitaker, two sons, O. R. Whitaker, and Mrs. O. R. Whitaker, a daughter, Mary W. Parsons; two brothers, Dr. Milton C. Whitaker of Downieville and Harry R. Whitaker; and four grandchildren.

Harold E. Harrison, '33, has just sent us a notice of the death of Col. Harry E. Harrison, of Miami Beach, Fla., on June 22, 1958. Mr. Harrison adds that although "Letty" did not graduate from our campus she was here in college.
Major Changes in Curricula

An intensive integrated science program is a major change in the Colorado School of Mines curriculum, announced by Dr. John W. Vanderwilt, Mines president.

The curricular changes—first in several years—were unveiled at the School’s monthly faculty meeting in December. The class changes resulted from a study of the present curricula by the School’s faculty, administration and board of trustees.

Major changes occurred in the supporting departments of mathematics, chemistry and physics. Also added were the numbers of credit hours necessary for professional degrees in the six degree-granting departments at Mines. All changes become effective next fall.

Expanding Areas of Engineering

In commenting on the new requirements for a Mines degree, Dr. Trom- man H. Kuhn, dean of faculty, said: ""These changes have been made to insure greater depth education for the vastly expanding areas of mineral engineering. Since the minor fields open each year, we are attempting to better acquaint our students with basic, interrelated sciences—integrated manure."

In addition to the science changes, the School also added six more hours of humanities— including courses in electronics, economics and psychology—as requirements for each student. They will be required to take three of these humanities courses in either the freshman or sophomore year (making the lower division humanities requirement 15 semester hours) and the remaining three in the junior or senior years.

The School’s Board of Trustees approved the change, and resolution stating, "We do not believe a student load of 60 hours a week is excessive, nor do we believe a Mines student now carries 20 credit hours each semester (making the normal college student 13 actual hours of lecture and laboratory work each week). We urge the School to keep the work at a 30 semester hour level a week at home preparing for the School’s work."\n
Intensive Science Programs

Physics, mathematics and chemistry departments have tightened integrated restricted instruction in the sciences program several years ago. The faculty believes that, through integration of course material, students with minimal mathematical background subjects to more difficult areas will result in greater retention of course material and ability to apply principles of science to their particular concentration courses.

In mathematics, all Mines students will be required to take at least 14 semester hours during their two first years. The four-semester math program combines elements of trigonometry, calculus, analytical geometry and differential equations. Previously the students had been required to take 20 semester hours of math in their first two years, but the courses were given as closely integrated. The integration will also allow brighter students to proceed at a faster rate and enter more difficult classes earlier.

Nearly 50 per cent of the Mines students continue math studies in their junior and senior years—most of them taking courses in advanced calculus, statistics and numerical analysis.

Emphasis on Modern Physics

In physics, the changes are made to increase attention in modern physics. Previously required to take 10 semester hours in the first two years, Mines students will now be required to take 12 hours—with the majority of the increase devoted to modern physics. The integrated course for freshmen and sophomores includes elements of mechanics, wave motion, wave equations, heat, electronics, optics and nuclear physics.

Freshman and sophomore chemistry students will take two less semester hours in their first two years—a reduction to 16 from 18—but the emphasis on chemical principles has been increased. The chemistry classes will now be known as the four-semester program in Principles of Chemistry. The new program will combine elements of classes in chemistry, physics, inorganic and organic structures, chemical equilibria, chemical kinetics and advanced atomic and nuclear structures.

Hours Necessary to Graduate

Also changed in the new curricula are the number and hours necessary for graduation. Formerly the School required undergraduate students to take from 144 semester hours to 153 hours (in metallurgy) for the first degree. Now the requirement has been reduced to 120 semester hours from 153 to 15 hours (in metallurgy) for the first degree. Nearly the required courses will vary from mining and geology with metallurgy to 158 to metallurgy’s 152. in all, all undergraduate will now be required to take from 13 to 15 semester hours of summer session courses and field work.

This year 1900 students are enrolled at Mines, and 10 per cent of whom are graduate students.

Captain James L. Sutton, assistant professor at Mines, was recently presented with the Army Commendation Medal for meritorious service by PMST Lt. Col. Bruce D. Jones at a formation of the CSM ROTC cadet program. Captain Sutton, assigned to Mines from Green, was responsible for the end of one of the eastern stations of the Distant Early Warning (DEW) Radar Line. He effectively coordinated the efforts of civilian contractors, Navy, Air Force, Coast Guard and Army transportation units to complete the job well ahead of schedule, despite the hazardous and unusual working conditions existing north of the Arctic Circle.

Mines Equipment for Experimental Mine

Nearly $40,000 worth of mining equipment has been given to the Colorado School of Mines for use in the School’s experimental mine at Idaho Springs, Colo.

The equipment—which previously had been used in the U.S. Bureau of Mines exploration work—has been moved to the School and will be installed in the Edgar Mine in the near future.

The mining equipment came from a list of excess equipment and non-expensive property which the U.S. Department of Interior offered to the Mineral Engineering College. Included are eight drilling drills, 19 jackhammer drills, various mine development equipment and various mining, mules and drill steel.

The cost of the equipment to the Bureau of Mines is listed as slightly over $8,000, but the same equipment purchased new on the commercial market would cost at least five times that amount. The new additions of machinery bring the total amount of equipment in the Edgar Mine to $170,000.

The mining equipment is used to teach practical mining techniques and safety geared to the future mining engineers. The mines is also used as a tourist attraction during the vacation months. Mines students have taken guided tours of the former gold, silver and lead mine.

ROTC Rifle Team Moves to New Gym

The Colorado School of Mines ROTC rifle team has moved into its up-to-date range in the new gymnasium. Dr. John W. Vanderwilt, president of Mines, fixed off the first two shots for an eight and a nine to inaugurate the new school facility.

Face for many years with sub-standard safety, Mines rifle team will have home shoulder-to-shoulder matches for the first time this year. M/Sgt. William King, coach of last year’s Colorado-Wyoming Small Bore Rifle champs, hopes to continue improvement in the Miners on the new range.

Students will be allowed to practice firing at distances varying from 25 feet to 1000 inches.

Colorado School ROTC Graduates Rank Among Nation’s Best

The Mines School of Engineering ROTC Cadets, having graduated, rank among the nation’s best. The Schools ROTC program, under the direction of Capt. Belvoir, Va., that 51 per cent of the Miners attending the school were commissioned in the ROTC in 1949. Mines was ranked in the upper one-third of their class. 235 Engineer ROTC units in the nation were actively engaged in ROTC in 1949. Texas was able to outline the Mines ROTC program for the first time in the upper one-third of the class.

During the fiscal year of record, Mines sent 41 students through the eight-week basic officers’ course in a program which included a rapid method of mineral separation and modern equipment and techniques. The remaining $500 will go to buy new books and strain gauge meters from the University of Denver (Boulder). The equipment will be used both in class and research.

Moves to New Gym

The School of Mines Engineer ROTC is to be housed among the nation’s best. The School’s ROTC program, under the direction of Capt. Belvoir, Va., that 51 per cent of the Miners attending the school were commissioned in the ROTC in 1949. Mines was ranked in the upper one-third of their class. 235 Engineer ROTC units in the nation were actively engaged in ROTC in 1949. Texas was able to outline the Mines ROTC program for the first time in the upper one-third of the class.

For Geology and Mining

A $2,230 grant to the Colorado School of Mines Foundation, Inc., will be used to purchase needed equipment for the School’s mining and geology department. The grant was made by George M. Morehouse of Grand Junction, Colo.

Morehouse, a 1949 mining engineering graduate of the School, is a consulting engineer and geologist with offices in Grand Junction. He also received a master of science degree in geological engineering in 1950 from Mines.

The majority of the recent grant will be used to purchase a $1,730 Prance Separators for the School’s new four faculty mineral department. This equipment allows a rapid method of mineral separation and modern equipment and techniques. The remaining $500 will go to buy new books and strain gauge meters from the University of Denver (Boulder). The equipment will be used both in class and research.

24-Game Basketball Schedule Announced by Broncette

A 26-game basketball schedule has been announced for the 1959-60 season. The schedule includes 100 games, distributed among the following departments: basketball, geology, geophysics, civil engineering, mining engineering, petroleum engineering, geology and petrology.

Mines will play 18 Rocky Mountain Faculty Athletic Conference games, and split its entire schedule with 10 home games and 16 on the road. Jimmy Darby, former AUA and professional player and coach, will enter his sixth year as head basketball coach.

The schedule of games will be played in the:

Jan. 16—Colorado State College, Greeley
Jan. 19—Colorado State College, Greeley
Jan. 23—Western State College, Lakewood
Jan. 26—Western State College, Lakewood
Jan. 29—Western State College, Lakewood
Feb. 1—Colorado State College, Greeley
Feb. 2—Colorado State College, Greeley
Feb. 5—Colorado State College, Greeley
Feb. 8—Colorado State College, Greeley
Feb. 13—Colorado State College, Greeley
Feb. 14—Colorado State College, Greeley
Feb. 18—Colorado State College, Greeley
Feb. 20—Colorado State College, Greeley
Mar. 1—Colorado State College, Greeley
Mar. 5—Colorado State College, Greeley
Mar. 8—Colorado State College, Greeley
Mar. 12—Colorado State College, Greeley
Mar. 15—Colorado State College, Greeley
Mar. 18—Colorado State College, Greeley
Mar. 20—Colorado State College, Greeley
Mar. 22—Colorado State College, Greeley
Mar. 25—Colorado State College, Greeley
Mar. 29—Colorado State College, Greeley
Mar. 31—Colorado State College, Greeley

The Miners will have a basketball "home court" advantage in a dozen games this season. Work has been completed on the new Mines $1 million gymnasium, which contains a basketball arena. The arena can seat 1500 spectators for intercollegiate or high school basketball games. The Miners are able to play on a portable floor which can be used in the Joe Steibaker Fieldhouse's clay surface.
From the Local Sections

Minutes of Section Meetings should be in the Alumni Office by the 15th of the Month preceding Publication.

ALABAMA

Birmingham Section
Pres.: Paul Shankley, '44
V. Pres.: John King, Jr., '51
Treas.: Frank V. Fahrenholz, '45
Sec-Treas.: Norwood Mathis, '56

ARIZONA

North Phoenix Section
Pres.: Herbert D. Torpey, '51
V. Pres.: James B. Pendergast, '51
Treas.: Robert Shepard, '52
Sec-Treas.: Arnold Zimmo, '51

MISOURI

St. Louis Section
Pres.: Hal H. Sackett, '51
V. Pres.: R. W. Griffin, '52
Treas.: W. T. Cook, '52
Sec-Treas.: A. L. B. Rice, '52
621 Union Ave, Belleville, IL

MONTANA

Montana Section
Pres.: John Sutin, '42
V. Pres.: John Lavin, '44
Sec-Treas.: Wm. Catt, '44
12 W. Silver St, Butte

NEW MEXICO

Four Corners Section
Pres.: Dick Reynolds, '51
V. Pres.: Tony Ring, '51
Sec-Treas.: Tom Allen, '41
P.O. Box 951, Gallup

NEW YORK

New York Section
Pres.: John Proctor, '42
V. Pres.: John Lavin, '44
Sec-Treas.: Wm. Catt, '44
223 W. 44th St, New York City, N.Y.

OHIO

Central Ohio Section
Pres.: Bob Fleck, '43
V. Pres.: Frank Steffek, '43
Sec-Treas.: Kenneth Meenagh, Jr., '41
4515 South High St, Columbus

WASHINGON

Puget Sound Northwest Section
Pres.: Wm. Deshler, '41
V. Pres.: Wm. H. Smiley, '42
Sec-Treas.: Kenneth Meenagh, Jr., '41
2150 South High St, Columbus

OKLAHOMA

Bartlesville Section
Pres.: R. C. Ludington, Jr.
V. Pres.: G. T. Braden, '43
Treas.: Bob White, '41
4234 North 1st St, Bartlesville

Oklahoma City Section
Pres.: R. R. Kerr, '43
V. Pres.: Clayton Kerr, '43
Meetings the 1st and 2nd Tuesday of each month at the Oklahoma Club

Tulsa Section
Pres.: Parks Huntington, '26
V. Pres.: Jesse T. King, Jr., '29
Treas.: Jim Newell, '52
Sec-Treas.: Jim Newell, '52

PENNSYLVANIA

Eastern Pennsylvania Section
Pres.: Samuel V. Miller, '42
V. Pres.: Robert E. Stiles, '42
Treas.: W. E. L. Brown, '42
Sec-Treas.: Harold F. Sibley, '42
Pennsylvania-Ohio Section
Pres.: W. A. Austin, Jr., '29
V. Pres.: I. M.揮o, '30
Sec-Treas.: George Schuetz, '32
733 Thomas Blvd, Philadelphia
Meetings upon call of the secretary

TEXAS

Houston Section
Pres.: Paul Hines, '44
V. Pres.: John C. Caspuch, '44
Sec.: J. C. Purcell, '42
4322 Minnewa St, Bellaire

North Central Section
Pres.: Howard Hiren, '44
V. Pres.: Willoughby, '44
Treas.: P. W. Finch, '44
5806 Ave A, Dallas
Sec-Treas.: J. Gifford, '43
Sec-Treas.: J. T. Johnson, '40
5000 Penrod

Permian Basin Section
Pres.: Van Houston, '44
V. Pres.: Hal Bal вне, '44
Treas.: W. E. L. Brown, '42
Sec-Treas.: J. L. Moore, '40
Permian Basin Business Meeting

CAMPUS HEADLINES

KANSAS

Kansas Section
Pres.: J. M. Biegel, '39
V. Pres.: E. R. Miller, '40
Treas.: G. L. Gray, '43
Sec-Treas.: J. E. B. Miller, '43

LOUISIANA

New Orleans Section
Pres.: R. W. Biegel, '25
V. Pres.: Vinyu V. Fuentes, '25
Treas.: J. W. Parier, '25
Sec-Treas.: Shell Oil Co, Box 191, New Orleans

MINNESOTA

Iron Range Section
Pres.: Paul Shankley, '44
V. Pres.: Louis Keller, '43
Sec-Treas.: James B. Jarrel, '43
15 Garden Dr, Minneapolis, Minn.
Treas.: Gordon Gipson, '43
Robert Shipley, '53

MONTANA

Montana Section
Pres.: John Sutin, '42
V. Pres.: John Lavin, '44
Sec-Treas.: Wm. Catt, '44
12 W. Silver St, Butte

UTAH

Four Corners Section
See New Mexico for officers

COLORADO

Denver Section
Pres.: Ed. Hacker, '41
V. Pres.: John Proctor, '42
Treas.: Douglas Rogers, '43
Sec-Treas.: John Hedges, '43

Four Corners Section
See New Mexico for officers

GRAND JUNCTION

Pres.: John Emerson, '31
V. Pres.: Elmo Johnson, '32
Treas.: John Hedges, '43
Sec-Treas.: Joe Hopkins, Ex-77
1231 W. 4th Ave, Grand Junction

DISTRICT OF COLUMBIA

Washington, D. C. Section
Pres.: W. G. Vicari, '41
V. Pres.: W. A. Austin, Jr., '29
Treas.: P. Avelino Suarez
Aptdo 889

WASHINGTON

Pacific Northwest Section
Pres.: Wm. Deshler, '41
V. Pres.: Wm. H. Smiley, '42
Sec-Treas.: Kenneth Meenagh, Jr., '41
2150 South High St, Columbus

WEST VIRGINIA

WV. State Section
Pres.: R. F. Ziemer, '41
V. Pres.: W. L. Price, '41
Treas.: G. L. Gray, '43
1160 6th St, SW, Charleston

LOCAL SECTIONS OUTSIDE U. S. A.

CALIFORNIA

Caracas Section
Pres.: William A. Austin, Jr., '27
V. Pres.: F. E. Johnson, '52
Sec-Treas.: Bob Ohanian
Caracas Section held an informal
dinner meeting at the Caravan Mess Hall on Saturday, Jan. 23, with Alan and Dorothy Simpson as host and hostess. John Biegel, Jr., secretary.

Houston Section
The Houston section held its monthly luncheon on Friday, Nov. 13 at the Houston Club. This meeting had been delayed to accommodate Minerals who might be attending the geologists and geophysicists conven­ tion. Several were atached, who were particularly pleased to meet an old friend, Chuck Thurber, '59.
Bob Turley, '52, reported briefly on some of the subjects of interest which were discussed at the conver­ sation.

John Biegel, '59, talked briefly about the luncheon to the Houston section, which was held on Nov. 29. At this meeting we hope to bring together some of the novice students who live in Houston and prospective students who may be considering en­ rolling at Mines. John is planning to communicate with the registrants with the objective of publicizing this luncheon.

Minerals attending the Nov. 13th luncheon were:


VENEZUELA

Caracas Section
Pres.: William A. Austin, Jr., '27
V. Pres.: F. E. Johnson, '52
Sec-Treas.: Bob Ohanian
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Minerals attending the Nov. 13th luncheon were:

The machinery for ASEA's giant mine hoist is designed for 12,000 h.p. and a driving speed of 15 meters, or 42 feet, per second at a depth of 3,000 feet. The machinery is designed for an ultimate depth of 5,000 feet, if that shall be reached. The capacity of the driving mechanism is 92,000 kilogram (203,000 pounds) per minute for hoisting and 134,000 kilogram (294,000 pounds) per minute for winding wires.

The hoist drum weighs 49 tons, and its two skips weigh 40 tons each. For supporting the drum outside of the construction hall, it was necessary to build a new traversing gear. In spite of new and improved methods, the total capacity of the ball mill is only 14 tons, as its capacity was distributed over eight wires, as against a maximum of two wires in other large-size driving hoists.

The driving speed is 33 feet per second at a depth of 3,000 feet. The motor effect is 9,000 h.p., derived from four separate units which are connected to the driving wires by means of two double-reduction gearing units. The motors are connected to the hoist drum by hammer gear. However, the mechanical equipment is designed for an ultimate depth of 3,000 feet, which will mean an increase in the driving speed from 33 feet per second at 140 or 42 feet, per second, at a

**PLANT NEWS**

**BOOK REVIEWS**

**Bibliography of Stable Isotopes**

Reviewed by Leonard G. Lucas, Departement de Physique, Universite de Montreal, Montreal, Quebec, Canada.

The compilation of this bibliography by G. C. Hockey and H. F. Steckel is a monumental and important work in the rapidly growing field of isotopic studies. The publication of this book is the result of a collaborative effort by a team of specialists in the field of isotopes.

The book is divided into seven sections, each covering a different aspect of isotopic studies. The first section is an introduction to isotopic studies, followed by sections on the preparation of isotopes, the measurement of isotopes, the application of isotopes in various fields, and the bibliography of stable isotopes. The final section is a collection of abstracts of recent publications in the field of isotopes.

The bibliography of stable isotopes is a comprehensive and up-to-date resource for anyone interested in the field of isotopes. It is a valuable tool for researchers, students, and professionals in the field of isotopes.

**Survey of Gold Sources**

They have been described by many investigators in recent years, and most recent Colorado School of Mines, is written by Donald W. Be- ll. The survey of gold sources is the result of extensive research and analysis of data available in the literature.

The book is divided into three main sections: the geology of gold sources, the mineralogy of gold ores, and the methods of gold extraction. The first section deals with the geology of gold sources, and includes discussions of the formation of gold sources, the types of gold sources, and the distribution of gold sources. The second section deals with the mineralogy of gold ores, and includes discussions of the mineralogical properties of gold ores, the identification of gold ores, and the classification of gold ores. The final section deals with the methods of gold extraction, and includes discussions of the extraction of gold from ores, the processing of gold, and the recovery of gold from tailings.

The book is a valuable resource for anyone interested in the field of gold sources. It is a comprehensive and up-to-date resource for researchers, students, and professionals in the field of gold sources.
Hemlock Extinct in Canada

A gap in the historical record of the 1915-1920 helium project in Canada has been filled by JohnSETTHY, professor of geology at the University of Toronto, Toronto, Canada, who has studied the records and compiled a report on the project.

The Canadian government's interest in helium began in 1915, when it was decided to explore for the gas in the region of the Klondike gold rush. The objective was to use helium as a lifting gas for balloons and other applications in scientific research. The project was undertaken by the Geological Survey of Canada, and involved the participation of several universities, including the University of Toronto.

JohnSETTHY's study of the records reveals that the project was highly successful in its initial stages, with significant helium production from several locations, including the Llanos oil field in Sherman County, Kansas. However, the project faced significant challenges in the later years due to the cost of production and the changing priorities of the government.

In 1920, the government decided to cease production of helium and to focus on other projects. This decision was based on the认为 the cost of production was too high and the technological advances were not sufficient to make the project economically viable.

JohnSETTHY's report provides a detailed account of the project, including the technical challenges faced, the economic considerations, and the political decisions that led to its eventual termination. The report is a valuable resource for understanding the history of helium production in Canada and its role in the development of the country's scientific and technological capabilities.
showing the sources of the geologic data included in the map. Dr. J. D. Parrish, curator of the Arizona Museum of Natural History, has identified the map as "designed to serve many useful purposes, not only for the mineral expert, but also for the public as a whole."

The geologic map, as well as the other six maps already issued, may be obtained from the office of the Director, Arizona Bureau of Mines, The University of Arizona, Tucson, at 75 cents a copy.

Dale L. Pinkerton was recently transferred to Denver office of Ingersoll-Rand as mining and construction representative in the Colorado and northern New Mexico area. For the past 26 years Dale has been with the New York headquarters office of Ingersoll-Rand as sales engineer in the rock drill division. Mr. Pinkerton, a native of Wyoming, is a graduate of the University of Wyoming in geology.

Douglas P. Hildenbrandt has moved from Bannock, Idaho, to Vernal, Utah. His P. O. Box is 355 Dukes, Richland, Calif.

Darwin H. Rush is project manager for Creole Petroleum Corp. He lives at Apt. 5, 1155, Vinal Ave, Oakland 4, Calif.

William T. Elwell has moved from El Dorado, Calif., and now lives at 1423 Stout St., Denver 2, Colo.

The Department of Mines and Technical Surveys, Mineral Resources Division, Ottawa, Canada, offers Mineral Information Bulletins for $1.50 each. These bulletins provide a detailed study of the production, trade and development of the various mineral industries in Canada during 1958. Maps showing the distribution and production of the various minerals combined with production, consumption and trade in iron ore are included. The text is supported by tables and graphs dealing with production, consumption, and trade in iron ore.

PLANT NEWS

(Continued from page 42)

he became president and a director of Three-Diamonds Inc., during World War II, Mr. Hitch served as a civilian technical advisor in China for the U. S. Government. Mr. Boling joined the company in 1941 following eight years with the United States Chemical Co.

The American Society for Metals magazine continued its monthly reports of new mineral producers. It has been the practice of the magazine to publish a list of new mineral companies each month.

ADVERTISERS' LISTINGS

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