• Improved Ore Milling Practice
• Operation Mohole
• Geology in Development of Mining
• Nation's 'Mines-Above-Ground'
• Research Man and His Environment
• 'Spring Water,' Ceramics, Aluminum Cans


**CLASS NOTES**

When advising us of change of address please confirm your present title or company affiliation.

1822-1930

Frank E. Lewis, '01, wishes that for the next four months he will be receiving mail at 11503 S. Sth Ave., Chicago 23, Ill. 

Alfred R. Fricke, '17, gives his mailing address as 61 History Hill, Fall River, Mass. 

Robert F. Biddle, '22, has moved from Miami to 1200 Wolseley Ave., Miami, Florida.

Louis C. Firestone, '21, manager of Peter Lumber Co., lives at 459 S. 9th Ave., Royersford, Pa.

Joseph A. Rosnicke, '22, formerly with Hidast Gas Mining and Refining Co. at Pilt Farm, Manila, Philippines, has retired and is now living at 373 Center Ave., Saint Albans, Fla.

Flehugh B. Jones, '26, chemist for the Food and Drug Administration, gives his address as 226 Park Ave., Freeport, N.Y.

Francisco J. Iniquin, '26, may be addressed at 501 30th St., San Francisco, Calif.

Harold B. Frenson, '26, supervising safety engineer for the U. S. Bureau of Mines, receives mail at 410 Hammsbury Blvd., Fort Worth 5, Texas.

Gordon C. MacFarland, '26, has moved from Oklahoma City to 7411 E. St. Rd. 99, Cicero, Ohio.

Robert L. Boyle, '29, chief assayman, receives mail c/o S.A.O.R., El Paso, Texas.

W. F. McNelly, '29, safety director for Northern Uranium Mines Ltd., lives at 2312 S. Wabash Ave., Chicago 16, Ill.

Harry J. Wolf, '30, consulting engineer to Ocean Mines Ltd., operating silver mining properties in British Columbia, and to Northern Development Corp., developing extensive gold and platinum places near Sarnia, South America, recently has been elected a Director of the Standard of New York Corp., with mineral interests in Brazil.

1931-40

John R. Aho, '31, district industrial engineer for Oliver Iron Mining Division, has moved from Eveleth, Minn., to 707 E. 30th St., Fort Worth, Tex.

John W. Cooley, '32, chief engineer for Oliver Iron Mining Division, has been transferred from Sumatra, Indonesia, to 12597 Cedar Rd., Cleveland Heights 37, Ohio.

Dr. R. T. Rayfield, '32, project engineer for Hanford Steel Co., lives at 12951 Donner Rd., Cleveland Heights 37, Ohio.

L. E. Miller, '32, assistant sales manager for Engineering Company, lives at 313 Canandaigua Ave., Sea Girt, N.J.

Walter O. Luehn, '32, has moved from 298 Mississauga Ave., Elliott Lake, Ont., to 3538 West 32nd Ave., Vancouver 23, B.C.

Juan J. Liu, '32, consulting engineer for Engineering Co., lives at 2414 W. 22nd St., Los Angeles 21, Calif.

D. L. Bayley, '37, project engineer for Hanford Steel Co., lives at 12597 Cedar Rd., Cleveland Heights 38, Ohio.

Conrad G. Ottey, '37, assistant manager of engineering at Arizona State University, lives at 313 Canandaigua Ave., Sea Girt, N.J.

Victor R. Gieger, '37, has moved from 419 West 32nd St., Los Angeles, Calif., to 26 West 42nd St., New York 36, N.Y.

John R. Wagner, '37, is receiving mail c/o Pacific Merchandising Corp., 951 Dawson St., Vancouver 5, B.C., and Philadelphia 37, Pa.

Edward B. Dye, '37, manager of the central industrial division of Deere-Oliver, Inc., has been transferred from Dallas to Chicago. His new address is c/o Deere-Oliver Inc., 411 Merchandise Mart, Chicago 34, III.

1941-45

Sercivito Agustin, '39, lives at 44, Calana, Quezon City, Philippines.

Atanasio D. Chalipo, '39, picks up his mail c/o T. M. Consolito, Inc., 201 W. 4th, Manila, Philippines.

Rolando L. Espinos, '39, has moved from La Castellana, Philippines, to Bantay, Ilocos, Philippines.

Emiliano T. Pica, '40, lives at 193 1st St., Tagbilaran, Philippines.

J. M. Rago, '40, assistant sales manager for The R. L. Boyce Co., has moved from Chicago to 404 N. Warren Rd., St. Louis, Mo.

Marilmai Imai, Jr., '40, has changed his mailing address from Titegang, Com- munes, Philippines, to San Luis Terraza Blvd., Manila, Philippines.

Jose C. Guevarra, '40, receives mail at 115 5th, Hiliden, Manila, Philippines.

David Snita, '40, may be addressed c/o Northern Mines, Inc., Isaac Peral, Esq., 1322 California St., San Francisco 9, Calif.

Eugenio S. Navial, '40, lives at 1314 1st Ave., Manila, Philippines.

Manuel C. Jarivalla, '40, has moved from Davao City, Panay, Philippines, to Baguio City, Philippines, where he may be addressed c/o Filipo Mines, Baguio City, Philippines.

Jose L. Ilandana, '40, receives mail c/o Commercial Credit Co., Natividad, Manila, Philippines.

Rolando J. Galhano, '40, is addressed at 401 Quintinshill Blvd., Manila, Philippines.


John R. Wagner, '40, is receiving mail c/o Pacific Merchandising Corp., 951 Dawson St., Vancouver 5, B.C., and Philadelphia 37, Pa.

Patterson Bldg., Denver, Colo.

Richard F. Miller, '43, is employed by National Photo Product Corp., 234 West 35th St., New York 1, N.Y.

Frank E. Lewis, '43, is employed by Union Carbide & Carbon Corp., N.Y.

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THE MINES MAGAZINE • FEBRUARY, 1960

Don't gamble on your mining investment! BE SURE you are RIGHT! Reaching into a lost world

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Massive creatures once sloshed through endless swamps, feeding on huge ferns, luxuriant rushes and strange pulp-like trees. After ruling for 100 million years, the giant animals and plants vanished forever beneath the surface with violent upheavals in the earth's crust. Over a long period, they gradually turned into coal. Today, Union Carbide converts that stored resource into a modern miracle—the widely-used plastic called polyethylene.

Millions of feet of tough, transparent polyethylene film are used each year to protect the freshness of perishable foods such as fruits and vegetables. Scores of other useful things are made from polyethylene ... unbreakable kitchenware, alive with color ... bottles that dispense a fine spray with a gentle squeeze ... electrical insulation for your television antenna, and even for trans-oceanic telephone cables.

Polyethylene is only one of many plastics and chemicals that Union Carbide creates from oil and natural gas. And today, Union Carbide converts that stored resource into a modern miracle—a widely-used plastic called polyethylene.

Learn about the exciting work going on in plastics, organic and inorganic chemistry, metallurgy, nuclear energy. Write for "Products and Processes, Booklet H, Union Carbide Corporation, 30 E. 40th St., New York 16, New York, New York, Canada, Union Carbide Canada Limited, Toronto. ...a hand in things to come

3
What CONTROLLED CHEMISTRY means in CF&I Grinding Balls and Rods

CF&I takes great care in the selection of steels used in its grinding balls and rods. For example, each size ball from the smallest to the largest (1/4" to 5" diameter) must have the proper composition to give the best balance between hardness and toughness. CF&I's modern spectrographic equipment assures you balls with the correct chemistry in relation to their size. In fact, CF&I uses different steels, depending on the ball size required. This chemical control pays off in your mill because CF&I balls and rods that wear longer, grind more efficiently.

In grinding rods, CF&I observes similar standards. Special analyses of high carbon steels are hot-rolled and machine-straightened to close tolerances, from 1/4" to 4" diameter in whatever lengths ordered. CF&I's controlled chemistry techniques result in grinding rods that have excellent wearing properties, resisting bending or premature breakage.

For the complete story on the advantages of CF&I Grinding Balls and Rods, get in touch with your local CF&I Sales Office.
The government will loan the company $42,250 on a matching fund basis.

The joint program is part of a larger exploration program on the two vein systems intersecting and forming a flat X north of Idaho Springs. Near the intersection the veins are cut by the Conant or Big virgin ground vertically and 12,000 feet of virgin ground along the strike.

The mining project is managed by Contract Engineering Co. George R. Hendrick, President, and operated by Alfred G. Hoyl, Vice-President. The mining team consists of Paul B. Starnes, Vice-President; and Paul L. Goddard, President.

The Bureau of Mines, which has been allocated $84,500 by OME for mineral exploration by the Office of Mineral Exploration, Department of the Interior, authorized to spend $84,500 for mining project funds.

For Mineral Exploration

Contract Engineering Co. In 1958, the Bureau participated in long-range cooperative studies to estimate future requirements of these fuels and outline ways of securing them. Oil and gas exploration is the most important metals sought.

The Bureau favors exploration for heavy-duty service in mines or quarries. Completely self-powered and self-propelled. Can be used as a percussion drill or rotary drill simply by interchanging drill units.

(Continued on page 34)
Mining Education to be Discussed by Leaders at AIME Convention

There is something education going? Is it "Phoenix or Don't?"

Some of the nation's prominent educators, scientists and company executives in fields that are vitally concerned with the answers, have definite opinions. The opinions vary and often are controversial. Some of the nation's prominent spokesmen in these categories of interest will express their views on the afternoon of the opening day of the national convention of the American Institute of Mining, Metallurgical, and Petroleum Engineers, in New York.

In an afternoon meeting on education and the future, scientists and company executives in fields that are vitally concerned with the answers, have definite opinions. The opinions vary and often are controversial.

Andrew Fletcher, of New York, president of the Anaconda Co.; John Meston Lovejoy, of New York, consultant on oil investments; Henry DeWitt Smith, of New York, former president of Newmont Mining Corp.; Wilfred Sykes, of San Francisco, former president of Inland Steel Co.; and William Emery Weatherby, of Washington, D.C., former director of the United States Geological Survey, will have the privilege of speaking to the American Institute of Mining, Metallurgical, and Petroleum Engineers, being held Feb. 14 to 18 in New York.

At the meetings opportunity for communication between military and civilian scientists and scientists and company executives in fields that are vitally concerned with the answers, have definite opinions. The opinions vary and often are controversial. Some of the nation's prominent spokesmen in these categories of interest will express their views on the afternoon of the opening day of the national convention of the American Institute of Mining, Metallurgical, and Petroleum Engineers, in New York.

Meetings will be held at the Statistical Hilton Hotel, New York, on:

1. "Just where is mining education going? Is it "Phoenix or Don't?"" in the evening of Feb. 17, 1960, during the AIME Annual Banquet, in the Statler-Hilton Hotel, New York, on:


In planning a series of forums, of which this will be the first, the Metallurgical Society of AIME notes that they will provide assembled scientists and company executives in fields that are vitally concerned with the answers, have definite opinions. The opinions vary and often are controversial. Some of the nation's prominent spokesmen in these categories of interest will express their views on the afternoon of the opening day of the national convention of the American Institute of Mining, Metallurgical, and Petroleum Engineers, in New York.

(Continued on page 14)
Mining Education to be Discussed by Leaders at AIME Convention

Mining Education to be Discussed by Leaders at AIME Convention. A special forum on Navy Materials problems, constituting a new concept of communication between military and civilian scientists and presenting high defense officials as spokesmen, has been announced by The Metallurgical Society of AIME. Just under a training feature of the Annual Meeting of the American Institute of Mining, Metallurgical, and Petroleum Engineers, being held Feb. 14 to 18 in New York.

In planning a series of forums, of which this will be the first, The Metallurgical Society of AIME notes that they will provide assembled scientists at the meetings opportunities for communication and discussion of certain Government programs and goals. The next forum, devoted to Army topics, will be held during the Fall Meeting of The Metallurgical Society of AIME in Philadelphia at the Sheraton Hotel, Oct. 17-21, 1960.

All five new Honorary Members have received professional and academic honors. Messrs. Fletcher, Lovejoy, Smith, and Weather have been presidents of AIME. Mr. Sykes has been AIME vice president.

FLASH
The National Western Mining Conference, co-sponsored by the Colorado Mining Association and the Denver Chamber of Commerce, has been postponed to April 21-23 because of a delay in completing Denver's new Hilton Hotel, where the conference will be held.

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365 E. 21st St.
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Harry J. Wolf, ’03
Mining and Consulting Engineer
3301 N. Marengo Avenue
Oakland, California

(pro)
Improved Ore Milling Practice Increases Value of Colorado's Idaho Springs-Central City Ores

By S. POWER WARREN, '13

Purpose, Remarks and Conclusions

The purpose of this report is to show that the gold-silver-copper-arsenopyrite ores in the Idaho Springs-Central City District of Colorado have never had the advantage of the present "state of the art" of milling. Such processes as highly selective flotation separation of copper and lead minerals from iron-bearing minerals have never been used, nor has the cyanidation, in a mine site mill, of gold- and silver-bearing ores, been used in the past.

Improved technical and economic developments, which cause marginal mineral deposits to become ore deposits, do not alone, necessarily, indicate the presence of appreciable ore bodies. However, when such developments are accumulated with a plant and good professional operation, up-to-date geological information and the true causes for the discontinuance of milling, these combined data certainly present a situation worthy of serious consideration.

The efficient use of the processes referred to above in a well designed and built treatment plant (not a Poor Boy Plant), when handling a Russell Gulch ore, used as an example, and assaying Au 0.5 oz.; Ag 5.0 oz.; Cu 2.0%; Pb 1.0%; and As 1.0%, was tested in an ore treatment plant, with a number of contributing factors to the operation of the mill, with which he pays mining and milling, from $7.72 to $28.

Miners Must Help Themselves

Reports from most old mining camps continue to be pessimistic. Very few small mines are operating. Business users in the鑫 claim they do not need gold and that a price increase will benefit only the few persons interested in gold mining. Base metals—lead-zinc-copper—produced in the U.S. are being replaced quite extensively by aluminum, stainless steel and plastics. Prices for gold have dropped because of foreign imports, and metals mines operated with cheap labor. Politicians promise various kinds of help but are ineffective, because there are comparatively few miners to help; consequently the political help, being in proportion to the number of miners' voices, is almost non-existent.

The writer, whose political influence is nil and whose capital for investments is still smaller, believes that in Colorado mining camps, present methods of ore treatment and value recovery can be materially improved.

The Idaho Springs-Central City District of Colorado can be taken as an example.

Production of End Products Ultimate Goal

The procedure for such a review will be the comparison of present milling technology to show the resulting economies of plants built at or near mine site, and combining concentration with extraction. The treatment scheme in these plants will eventually produce more and/or better concentrates for extraction and/or refining, with the help of chemical processes. These metals and/or products will eventually be available for direct sales to consumers.

Specific Ore Used As Example

The type of plant and the process to be used will depend upon the ore prevalent in the district tributary to the plant site. For a definite consideration at this time, a gold-silver-copper-arsenopyrite ore, of the type prevalent in many mines in the Idaho Springs-Central City District will be used.

It will be as follows:

1. Assays: Au. 0.5 oz.; Ag. 5.0 oz.; Co. 20.0%. This plan can be enlarged at any time to take in ores containing lead and zinc if and when they are present.

2. In the ore being used as a typical example, only a small portion of the ore exists free, most of the balance follows the pyrite. Many assays of some of the pyrite show gold, while others show silver associations. The rich and poorer pyrite cannot always be recognized nor is there an effective method of separating, physically, the gold-bearing from the barren pyrite. The silver and copper assays were not always present in the sample and/or Tennentite. Some chalcopyrite can be seen under the microscope.

Problem of Barren Pyrite Known for 100 Years

This ore with its high iron content (20%). Fe approximately 44% pyrite) presents a problem in the recovery of the precious metals. As indicated in this district 100 years ago, about 1860, when the following episode took place, as reported by Halliburton in his book "The Mines Of Colorado" printed in 1867.

During the Spring of 1860 the Gold Dirk Lode had been struck, and the miners in the district were making $150 or more per week. October 1st, and up to January 3th, 1864, and had taken $41,125.94 and had been left $1,500. The ore was ground in a six stamp mill and concentrated with mercury. In 1865 the writer, who had general supervision and metalurgical experience, left the mills to form a new company and operated as a cyanide plant until some time in 1877 when cyanidation was replaced by the flotation process. One of the first successful flotation plants was installed by the writer in the Spring of 1915 in the Hudson Mill.

Flotation Process Replaces Cyanidation

The discontinuance of cyanidation was not caused by any failure of the process to recover gold, but to the low recovery of copper and lead, which started in 1919. As a result, many operators during the years, could be separated from the barren pyrite. After selective flotation, the barren pyrite was boiled in quicksilver. The amalgam therefrom would be a process that would make a good gold recovery plus a base metal recovery considered desirable, even though the gold and silver was sold to the smelters. Considering that the recovery of copper and lead is 90-95%.

During the period 1912-1917, other mills used the cyanide process, but by 1919 all had installed flotation to recover the gold in the value in the slime plus the values in copper and lead.

Flotation Returns Barren Pyrite Problem

The flotation process not only increased the recovery of lead and copper minerals, but also the recovery of the undesirable barren pyrite, which had been thrown away during the cyanidation process. For a period of time, the barren pyrite, associated with the gold-silver-copper-lead values has been, for the most part, concentrated with these values, but now, when copper becomes scarce, these tons of sulfur have been burned off and thrown away and other valuable metals, which had been mixed with the iron from the pyrite so that it could be liquated, separated from the gold and thrown away, with all the species, if it happened to be present in the ore or concentrate.

Selective Flotation Isolates Barren Pyrite

This barren pyrite, called "troublesome pyrite" by many operators during the years, can be separated from the valuable, precious and base metals, by selective flotation. This will thereby reduce the transportation and the transportation costs and other chemical costs involved in these processes. For the payments for freight and smelter treatment on the barren pyrite, the copper and lead, if recoverable, can be recovered, the gold and silver recovered by cyanidation.
dation and pyrite sold to sulfuric acid manufacturers and for pig iron.

**Monetary Return Values Compared**

Because the function of this report is to make comparisons (not to resolve shipper-smelter settlement sheet differences), all calculations are made on a simple rule. The Russell Gulch District ore, assays of which are given above, if shipped direct to a smelter, will return to the miner per ton of ore $0.77, $9.77 or $23 after payments for transportation, smelter treatment and a milling charge of $5. If a selective flotation-cyanide plant makes a high grade copper concentrate for shipment to the smelter and a barren pyrite concentrate for cyanidation and shipment of the pyrite to an acid manufacturer, the return to the miner per ton of ore will be $23 after payments for transportation, smelter, milling and pyrite treatment are made.

It tabulates like this:

<table>
<thead>
<tr>
<th>Return to Miner per Tons of Ore</th>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shipment of ore direct to smelter</td>
<td>$0.77</td>
</tr>
<tr>
<td>Bulk Concentrate direct to smelter</td>
<td>$9.77</td>
</tr>
<tr>
<td>Selective Flotation-Cyanidation-Acid</td>
<td>$23.00</td>
</tr>
</tbody>
</table>

This means that depending upon how the ore is treated and sold, the miner will have $0.77, $9.77 or $23 per ton from the same ore, with which to pay the costs of mining and delivering the ore to the mill, ready for shipment to smelter or mill.

**General Comparisons**

This result, on an actual ore, prompted the study of similar ores with varying amounts of pyrite. Consequently, a series of calculations were made, using hypothetical ores having the same gold-silver-copper contents, but with the iron assay ranging from 5% to 30%.

**Barren Pyrite Treatment Costs**

In these calculations, the same transportation costs and smelter treatment schedule of costs are used on all hypothetical ores having the same gold-silver-copper contents, mine, ready for shipment to smelter or mill.

In order to simplify the comparison of the results on these ores, three charts have been prepared.

**Bulk Concentrate Production and Handling**

Chart I shows a flowsheet for bulk concentration, whereby all mineral is put into one concentrate and sent to the smelter. The concentrate is simply sent to waste. This method of concentration gives good over-all recoveries in a simple, not-too-costly mill. Because all minerals are placed in one concentrate, a greater burden of separating the metals is placed on the smelter, which has a high cost of operation. Smelting processes differ, in accordance with the metal to be treated, but with the iron assay ranging from 5% to 30%, harder for the smelter to treat, but which can be treated by cyanidation, to recover gold and silver, without leaving the mill without cost. The second concentrate, when barren of gold or silver, is then shipped for acid manufacture.

**Selective Flotation-Cyanidation-Acid**

Chart II shows a flowsheet for selective flotation, straight flotation, cyanidation and acid manufacture. This milling scheme, which is much less costly than smelting, produces (1) a small amount of a high grade base metal concentrate for shipment to the smelter where it is easier to treat with its high cost operation than a bulk concentrate, and (2) a second concentrate which is harder for the smelter to treat, but which can be treated by cyanidation, to recover gold and silver, without leaving the mill at mine site. The second concentrate, when barren of gold or silver, is then shipped for acid manufacture.

**Flowsheet Easily Expanded for Other Metals**

This flowsheet, designed to treat simple, gold-silver-copper-pyrite ore, can be expanded to include lead and zinc ores without too much trouble. In the case of a lead concentrate, a good smelter market exists, but for a zinc concentrate the market is poor.

These ores are available to be treated in a simple mill, but it is logical to consider these ores as the first step to a more complex plant capable of handling any of the ores in the district, which is the reason why this report is confining itself to the first step.

**Treatment Schemes Compared Economically**

Chart III is a graphic presentation of the monetary return to a miner per ton of ore when it is shipped direct and the monetary return per ton of ore when the ore has a varying iron content and is treated by selective flotation, straight flotation, cyanidation and acid manufacture.

**Chart Description**

The first thing to note on Chart III is the horizontal base line, above which are shown the payments from the smelter, and below which are shown the transportation and smelter costs. The horizontal lines above and below the base line indicate dollars per ton of crude ore. The large cross-hatching, across 12 columns above the base line, represents a cost of $10 to mine and $5 to mill one ton of ore. The area on each column above the cross-hatched area indicates the monetary return to the miner for each set of conditions, after all operating costs are paid.

All columns represent dollars, per ton of crude ore. To obtain a comparison between the values of gold-silver-copper-pyrite, columns are shown with various styles of cross-hatching. Note how the columns for gold and silver (diagonal cross-hatching) were placed at the top of the column, so it could be seen graphically, when the copper (horizontal cross-hatching) was concentrated sufficiently to pay all the costs of smelting and transportation.

The pyrite is shown in full dark, to insure it a prominent place on the graph, because of its importance to this report. Note the small value in the monetary columns.

**Three Treatment Schemes Compared Graphically**

The three possible methods of handling this ore, i.e., direct shipment, bulk concentration and selective flotation-cyanidation-acid manufacture are shown on the charts as follows:

- **Column A** Direct Shipment
- **Column B** Bulk Concentration
- **Column C** Selective Flotation-Cyanidation-Acid

**Direct Shipment**

In Column A is depicted the gross value of the valuable metals gold-silver-copper, as shown in the tabulation on its left. It is shown above the base line simply
as a means of comparing returns from other operations with the theoretical. Column B depicts the tabulation on its left. This tabulation shows not only the reduction in payments from the theoretical, but also the cost of transportation and smelting. The top of the column is less than $1 above the base line, consequently this scheme is out from a miner's point of view.

Bulk Concentration

Columns C and H inclusive, depict what return will come to the miner in a bulk concentrate containing the same quantity of gold-silver and copper from one ton of ore, when the iron assay (pyrite content) varies from 5% in Column C to 35% in Column H. Obviously the large quantities of pyrite appreciably reduce the return to the miner for the same quantity of gold, silver and copper, in one ton of ore.

This series of columns show a miner must analyze his ore for iron as well as for valuable metals when simple bulk concentration is contemplated. It is quite natural for a miner to let his hope get the better of common sense and take a chance that his ore is low iron.

Selective Flotation-Cyanide-Acid

Columns I to N inclusive depict the return to the miner by the more carefully planned milling scheme that makes a copper concentrate for sale to a smelter, a second concentrate for cyanidation, and a pyrite tailing for acid manufacture.

In order to show the source and cost of these operations, the columns are broken. The left hand part of each column depicts the copper concentrate payments and charges. The right hand part shows return for the gold and silver bullion, recovered by cyanidation less the cost of cyanidation and transportation of pyrite to the acid manufacturers. The last six columns are interesting, because they show how the ore with a high iron content actually returns the most when treated by the proposed scheme and not the least as when treated by bulk concentration.

What lies beneath the earth's crust? Earth scientists and others are mounting all available geological and geophysical data, deep drilling techniques, scientific and engineering knowledge, and financial assistance to answer the age-old question.

A project is now being planned to drill a hole completely through the oceanic crust to obtain samples of the mantle—probably to a depth of 30,000 ft. The mammoth undertaking is sponsored by the AMSOC committee of the U.S. National Academy of Sciences. Current plans suggest that the project will be a two-phase program. The first phase would test deep-drilling techniques and sampling upper layers.

The undertaking is called the Mohole project, named for the prime objective of the hole—the Moho, the definite and little-known boundary between the earth's crust and mantle. The word Moho comes from Professor A. Mahovric of Yugoslavia, who first described the seismic discontinuity at that point.

Where will the Mohole be drilled? How deep will it be? How much will it cost? Who will pay for it? When can it be drilled?

These are questions that are now being solved. Although it was first suggested that the hole be drilled from an oceanic island to a depth of 33,000 to 50,000 ft., it is now believed possible to probe the Moho more easily from a floating drilling platform anchored in open ocean, where the earth's crust is the thinnest. At certain locations where the water depth is from 10,000 to 18,000 ft., it is believed possible to use a drill that might reach at 20,000 to 35,000 ft. below the ocean surface. This means only 15,000 to 10,000 ft. of actual drilling. How hard the drilling will be is anyone's guess.

Total cost of the preliminary tests, equipment and total drilling is estimated at $15,000,000. The AMSOC group has now been formally organized so that it can receive funds from the U. S. National Science Foundation and from private interests to finance the Mohole. Collection of needed data and re-evaluation of the most promising areas are under way.

* This article is being published with the permission of THE PETRO- PHYSICAL UNION and the American Association for the Advancement of Science.

THE AUTHOR

William Bascom, who attended the Colorado School of Mines from July 1938 to May 1942, is technical director for the AMSOC Committee of the National Academy of Sciences-National Research Council in Washington, D.C.

Born Nov. 7, 1918 in New York City, Bascom studied arts at Springfield College and Columbia University, engineering and geology at the Colorado School of Mines. He left Mines just short of a degree in geological engineering, mainly because of the war, to work as a mining engineer in Arizona, Idaho, Colorado and New York.

In 1945 he joined the University of California at Berkeley as research engineer, directing a field party concerned with the study of uranium, boron and ashine structures. During the summer of 1951 he was a participant in the NRC-NEI study on nuclear reactor structures, and in 1952-53 he was a lecturer in Naval post-graduate school courses in oceanography.

In 1953 he joined the Scripps Institution of Oceanography at La Jolla as research engineer primarily concerned with the instrumentation of the nuclear bomb tests at the Pacific Proving Grounds. Two years later Bascom sailed on Expedition Capricorn through the equatorial Pacific, returning as senior scientist on the R. F. Spencer F. Base.

In 1954 he joined the National Academy of Sciences staff as technical director for the Committee on Civil Defense and in 1956 became executive secretary of the Committee on Meteorology and Oceanography. He was U. S. delegate in 1957 to the International Geophysical Year Conference on Oceanography (Stockholm) and atmospheric Radiation (Helsinki). He also was a contributor to the Rockefeller Brothers Fund Special Study Group (future of the U. S. Navy), and from 1956 through 1958 acted as a consultant to the President's Committee on Government Organization.

Bascom spent nine months of 1957 in France organizing the U.S. Navy's mobile oceanographic laboratories and working on Polynesian history. In 1958 he served as executive secretary of the Maritime Research Institute. He is currently technical director for the AMSOC Committee of the NAS-BR and is a member of the American Geophysical Union and the American Association for the Advancement of Science.
as a means of comparing returns from other operations
with the theoretical. Column B depicts the tabulation
on its left. This tabulation shows not only the reduc-
from AIME Section in the West having
as its main interest the underdevelopment
and open pit mining of coal and the
preparation of coal for market.

Creation of the Foundation's Utah Section grew out of the realization of the Utah Section that such a move would solve the difficulty many of its
members had, because of distance, in attending the Utah Section's meetings in Salt Lake City. The Utah Coal Section will have headquarters in
Sunnyside, Utah, and will schedule its
own section meetings.

Officers of the Utah Coal Section are: Joe T. Taylor, chairman; Joseph
Ford Mclaan, vice chairman; Lynn
P. Huntsman, secretary-treasurer. The Executive Committee of the Utah Coal Section consists of Stanley
C. Harvey, Chris J. Diamant, and
Robert L. Jerem. (Continued on page 19)

Operation Mohole* 

by WILLARD BASCOM, *'42

What lies beneath the earth's crust? Earth scientists and oilmen are mastering all available geological and
geophysical data, deep drilling techniques, scientific and
engineering knowledge, and financial assistance to answer
the age-old question.

A project is now being planned to drill a hole com-
pletely through the oceanic crust to obtain samples of the
mantle—probably to a depth of 30,000 ft. The massive
undertaking is sponsored by the AMSOC committee of the National Acad-
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gton, D. C.

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Government Organization.

Bascom spent nine months in 1957 in French Oceania
installing GY wave-measuring instruments and writing
on Polynesian history. In 1958 he served as executive sec-
cretary of the Meteorological Society of Southern
Ohio. He is currently technical director for the AMSOC Committee of the NNRG and is a member of the American Geo-
physical Union and the American Association for the Ad-
vancement of Science.

* This article is being published with the permission of THE PETRO-
LEUM ENGINEER (The Transparent), where it appeared in the August
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THE MINES MAGAZINE • FEBRUARY, 1960
that mantle rock actually outcrops (at St. Paul's Rocks in the mid-Atlantic, in Japan and in California). Geophysical and petrologic observations give the total mass, the average density and the moment of inertia of the earth.

Evidence about the structure of the earth has come primarily from earthquake waves. Seismologists have worked out characteristics of the planet which keep within the limits set by other evidence.

Mantle

The hypothesis of inner and outer cores surrounded by a thick mantle and capped with a thin crust has stood the test of many years; yet the problem is one of refining and obtaining information which cannot come from further advances in seismology. Composition of the mantle which represents about 85 per cent of the volume of the earth is the principal problem of geophysics today, for although a lot is known about it, uncertainties remain which make it a puzzle which has long challenged the mind of man. In exact mineralogical and rock composition, density, strength, temperature, amount of radioactive, thermal and electrical conductivity—all of these will contribute in a major way to the understanding of the earth and its origin. Moreover they will serve to enhance the value of the indirect geophysical measurements.

Finally, some new and entirely unexpected piece of evidence may be forthcoming that will cause science to revise substantially its concept of the earth.

Floating Crust

The crust is closer and easier to study than the interior—_but also more controversial._ Generally it is agreed that continents represent relatively thick blocks of andesitic rocks and that ocean basins are composed of much thinner basaltic rocks—the average thickness being about 30 Km and 10 Km respectively. The crust seems to act as though it is floating on viscous plastic mantle material; its response time is long and certain anomalous areas not in isotatic equilibrium complicate the problem.

The Moho, which defines the boundary between crust and mantle, is recognized by an abrupt increase in the velocity of seismic waves from around 7.0 Kms per sec. to 8.2 Kms per sec. As the earth developed, the water which reached its surface naturally ran downhill and covered the lower, thinner basaltic material forming an ocean.

Composition of the ocean crust is studied by seagoing scientists who use pairs of ships—one setting off explosions, the other listening. In this way it has been discovered that beneath much of the ocean there are three main layers of material: (1) The soft sediments, (2) the "second layer," and (3) the "crust." (Fig. 2)

Soft Sediments

The soft sediments of the deep sea floor (red clays and calcareous oozes) have been repeatedly sampled with the long smooth bottomed coring device which is used to penetrate the seafloor. Most of these samples have been brought into the laboratory for study and analysis. In addition, in the hole from which the core is taken, measurements may be made of temperature, heat flow, the magnetic field, plastic deformation and seismic velocity.

It is therefore the objective of the AMSOC Committee to see that a continuous, oriented core to the mantle is obtained and that the core(s) are thoroughly instrumented. Some of the instruments already exist; others will have to be developed or miniaturized to fit in the hole (which will be about 4 in. in diameter at the bottom). No geologist or geophysicist doubts the value of such data; the question is, "How can it be done, and for how much money?"

In Nature of Sept. 13, 1958, Dr. Gaskell examined some of the technical problems of deep-hole drilling. However, as AMSOC's feasibility study progresses, new objectives have been developed and new drilling technology has been discovered so that Gaskell's thoughts need to be updated. For example, the idea of drilling from an oceanic island has been abandoned because recent studies indicate that the mantle is as deep as 17 Kms under the islands that have been studied.

Developments in drilling platforms make it appear that deep-water drilling is feasible in any case; besides, we need the sedimentary data.

Temperature No Problem

A review of the temperature situation suggests that temperatures in the mantle immediately beneath the ocean crust will be less than 200 C. At several sites where seismic work has been done, the total reach of the drillson from the water surface to the mantle will be on the order
water drilling methods. For example, no one is sure how possible samples of the upper layers while testing out deep- and brought sediment. Here continuous layers of sedi­

Table 1 shows the length of drill pipe required to reach the surface of various layers beneath the sea floor at four sites which are under consideration.

Two-Phase Program

Inspection of these figures shows that a drill reaching to 6 Km. (20,000 ft.) will return data on three upper layers. Beneath that is another to 5 Km. to the Moho. For these reasons the project will be divided into two phases. The first of these involves the modification of existing equipment and the construction of a deeper layer drill pipe.

The second phase—which will take us on to the Moho—will require a completely new engineering design. The first phase will be ready to test when a mile and a half of the pipe is made, and the second phase will be ready to test when it is finished. The first phase is expected to be ready this summer, and the second phase will be ready next spring.

Testing

It is generally assumed that no one site or hole will satisfy all the requirements of Mohole. The final hole to the mantle must be drilled where the geologic situation is uncomplicated and where the Moho is closest to the surface. To locate that place, seismic methods and/or listening to a vertical beam of underwater sound must then be found out how to set up and drill in open ocean without getting pipe and lines in a hopeless snarl. This procedure should be modified on the spot but the proper drilling bit to penetrate the basalt or whatever hard structure lies beneath sediments on the ocean floor. Questions about its stability and the flow of sediments will be solved by studying the hard-rock road to Moho can begin. This hole to the mantle will be very difficult; no one has illusions about that. The equipment for the Moho can be recog­

Depending on the type of equipment available, the Mohole project might be carried out for about $15 million. This cost is based on the idea that the Mohole itself can be made. It is expected that as the project develops, the objectives and/or listening to a vertical beam of underwater sound must then be found out how to set up and drill in open ocean without getting pipe and lines in a hopeless snarl. This procedure should be modified on the spot but the proper drilling bit to penetrate the basalt or whatever hard structure lies beneath sediments on the ocean floor. Questions about its stability and the flow of sediments will be solved by studying the hard-rock road to Moho can begin. This hole to the mantle will be very difficult; no one has illusions about that. The equipment for the Moho can be recog­

The Mohole project, in more or less its present form, was born at a breakfast at Professor Munk's house at the Scripps Institute of Oceanography in California at which he and Professor Hess led the conversation in the need for a geophysical analog for the space exploration program. AMSOC proposed a deep drilling project.

It is significant that in the following September, at the meeting of the U.L.G.G. in Toronto, a resolution was passed urging the nations of the world to study the feasibility and cost of an attempt to drill to the Moho­

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On the subject of drilling through the crust of the earth however, the AMSOC group is quite serious and has been informally granted the use of funds that it might receive funds from the U. S. National Science Foundation. Its original mem­

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Certain factors that affect the well-being of the mineral industry are certain to become increasingly advantageous with passing time. Demand for the products of the industry will continue to increase as a result of population growth, increasing consumption per capita, and an expanding technology. Competition from other parts of the world, now one of the troubles besetting the industry, this situation is not certain, or the amount of other minerals, not just the domestic, that will have a mineral industry into the future, but they are not an answer to the immediate problem. Our problem is what can be done to make sure we are in a position to bridge the gap until that day—not so far away—when no part of the world will enjoy a competitive advantage. Maintenance of supplies of mineral raw materials will then be a world problem rather than a domestic one.

But for the present, many of our mines are closed through inability to compete successfully in world markets. A number of our larger grade ore deposits are depleted, or are approaching depletion, and the rate of discovery of new ones appears at times to be discouragingly slow. The problem of maintaining our competitive position is serious, but it is not hopeless, and I believe it can be solved. It will require the use of all of our accumulated knowledge and experience, and of the results of future research that is designed to improve our understanding of the processes of ore formation and our capacity to utilize that understanding. It will require the discovery of new deposits and new districts, which means improvements in our methods of prospecting, exploration, and appraisal. It will require new techniques in the methods of mining and treating ore. It means in certain cases that we must learn new things and reject with confidence the concepts that controlled the transportation and deposition to form ore deposits.

The formulation and understanding of principles must be one of the Survey's major objectives, whether or not it supplies them in all the substances such as water, oil, and coal or in metals or non-metals. It is a necessary part of the technical research that is designed to improve our understanding of the processes of ore formation and our capacity to utilize that understanding. It will require the discovery of new deposits and new districts, which means improvements in our methods of prospecting, exploration, and appraisal. It will require new techniques in the methods of mining and treating ore. It means in certain cases that we must learn new things and reject with confidence the concepts that controlled the transportation and deposition to form ore deposits.

The basic function of the Geological Survey is thus to gather information in all the fields of geology and mineral resources and to make it available for the use of the public. Such information will be of value to the mineral industry, but it alone will not provide the answers. The actual prospecting and exploration should be done by private enterprise, but it must have the benefit of the most ingenious techniques we can devise, so that we may continue to succeed in finding and exploiting the deposits that will enable us to compete in a world market.

The Place of Geology in the Development of the Mineral Industry

By DR. THOMAS B. NOLAN

THE AUTHOR

A native of Greenfield, Mass., Dr. Thomas B. Nolan attended Yale University, receiving a Ph.D. in 1924. Following his appointment to the Geological Survey in the same year, he mapped several districts in the western United States.

During World War II, he was in charge of the Survey's work on tungsten deposits. Dr. Nolan served as the Survey's assistant director from December 1944 until appointed director in January 1956 to succeed Dr. William E. Howes.

Dr. Nolan is a past president of the Society of Economic Geologists and a member of many other professional organizations, including the National Academy of Sciences, the Mining and Metallurgical Society of America, the American Philosophical Society, the American Institute of Mining and Metallurgical Engineers, and the Geological Society of America. He was the recipient of the Outstanding Award of the XFI International Geological Congress in 1933 and the K. C. Li Gold Medal and Prize in 1954.

Aid to Mining in Transition Period

I believe that the Geological Survey can and will play an important role in this transition, not as a participant in the actual prospecting or development, but in assisting the mining industry to do these things more effectively and economically. The Survey does many things of interest to the mineral industry. One of its activities, as you probably know, is to make topographic maps, which are essential to many activities in the mineral industry, not the least of which is to provide a base on which to plot geologic data.

In the field of geology, it produces geologic maps which serve a number of purposes. Properly prepared and used, they make it possible to determine the distribution and nature of the rocks that contain, or constitute, our mineral resources and to discover the combination of geologic factors that have contributed to the concentration of any valuable substance, be it metal, oil, water, or coal, so that we can learn to select and reject with confidence the evidence visible on the surface or provided by drill holes or geophysics. In addition, of course, such maps have become a basis for planning construction, engineering, soil conservation, and agriculture.

The Scope of USGS Outlined

The USGS is also concerned with mineral resources in the President's Executive Order that established the Survey directed it to appraise the "products of the national domain." This is a comprehensive responsibility, for it extends, through the whole range of chemical elements and mineral products; and in another through the whole range of concentrations from workable ores down through marginal and subeconomic ores to simple geochemical anomalies. The USGS must consider aggregate and individual products because modern technology has brought with it requirements for a whole new pattern of goods, and the demand for new substances with unique or specialized properties can confidently be predicted to continue in constantly increasing degree. It must be concerned with the entire range of concentrations for at least two major reasons: First, the marginal ore of today and even the sub-ore will not continue to exist, but the survey, secondly, we must learn all we can of the geochemical concentrations, both to recognize the elements before we can hope to understand the chemical and physical principles that control their transportation and deposition to form ore deposits.

These are only long-term advantages, however. They lead to a prediction that we will have a mineral industry far into the future, but they are not an answer to the profound issue whether ore deposits just as it has its own, and also in other parts of the world, at least to the extent that it is justified in studying or mapping individual mines or prospects, or local water supplies, only to the extent that the results are beneficial to the nation, rather than to the individual or company.

Basically this means that our results, maps, and reports, should be generally applicable and presented in the form of principles or conclusions that are valid for many areas and not just for the particular district that is the subject of study. They must be adjusted to the needs of individuals through the country and throughout the industry, even if the law permits the Survey to help out. We must help out by furthering the knowledge of ore deposits and the principles that control their occurrence, in the hope that the more we know of these principles, the more successful we are going to be in finding new or different concentrations and in becoming more efficient in mining and utilizing them.

Survey Does Research of Many Kinds

In pursuit of this search for principles or "ground rules," we consider, and the Survey does research of many kinds, some of it in direct application to the mineral industry, and all of it at least of indirect benefit. A few of the products of the research that has been important to the industry include such things as: the mapping of many and the use of topographic maps, the use of subsurface data, the use of geophysical methods, and the use of geophysical methods, and the use of drilling and other exploration techniques for the search for mineral substances. The Survey has been able to help out by furthering the knowledge of ore deposits and the principles that control their occurrence, in the hope that the more we know of these principles, the more successful we are going to be in finding new or different concentrations and in becoming more efficient in mining and utilizing them.

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Marginal Deposits May Be Utilized

As time goes on, we may be able to utilize more and more deposits which present standards are too low in grade, too refractory, or too costly to work. Where shall we find them? I expect that many will be found as a by-product of the continuing search for high-grade deposits. I suspect that such marginal deposits will be discovered in the same proportion to high-grade ore, as has been true in the past. And, of course, we know of many at present the time, deposits that have been discovered, but found to be unworkable, during the past 100 years.

These below-grade deposits are of two types. One is a very low grade, and has never progressed in its exploitation beyond the prospecting stage. Deposits of this type have in some instances extremely large tonnage and may contain more than one substance of value. Once this type have in some instances extremely large tonnage and may contain more than one substance of value. Once the inevitable advances in mining and beneficiation are made, they will be worked.

Potential Major Resources

The second kind of marginal deposit is represented by the material left behind as unprofitable during the mining of its higher grade associates. This material occurs in many forms: as masses of rock containing disseminated concentrations of various metals, although by that time, we may be recovering many elements as by-products. When the petrochemical industry has ever taken advantage of this liberation, the by product raw material will have been applied to it or transformed into it, and an opposite stand is possible. With the development of new techniques for finding and treating ores that have been marginal or submarginal in the past, which were probably unworkable because of their low grade or complex mineralogy, and may contain more than one substance of value. Once once becomes workable, it will be worked.

Recovery of Metals as By-Products

In the still more distant future, we already know of great volumes of rock that were not amenable to the abnormally concentrated by that time, we may be recovering many elements as by-products. When the petrochemical industry has ever taken advantage of this liberation, the by product raw material will have been applied to it or transformed into it, and an opposite stand is possible. With the development of new techniques for finding and treating ores that have been marginal or submarginal in the past, which were probably unworkable because of their low grade or complex mineralogy, and may contain more than one substance of value. Once once becomes workable, it will be worked.

Metal's Widest Application

It seems to us a certainty that demand for mineral products will not only continue but must increase appreciably; and that it is equally likely that there is going to be a demand for more and more by-products. This is the point at which the material left behind as unprofitable during the mining of its higher grade associates. This material occurs in many forms: as masses of rock containing disseminated concentrations of various metals, although by that time, we may be recovering many elements as by-products. When the petrochemical industry has ever taken advantage of this liberation, the by product raw material will have been applied to it or transformed into it, and an opposite stand is possible. With the development of new techniques for finding and treating ores that have been marginal or submarginal in the past, which were probably unworkable because of their low grade or complex mineralogy, and may contain more than one substance of value. Once once becomes workable, it will be worked.

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Adam Smith upon a fabricator of industrial truck transmissions.  

The customer had inadvertently run out of ingot, due to an error in production, which necessitated the smelter to process a special alloy. But the smelter is as metallurgically exact as that produced from original ingredients. This incredible transformation truly requires a magic wand, and the sweller is never at a loss. The smelter has become so precise that he can take a crystal of scrap and, within minutes, determine its composition up to 15 different elements.

Quality Control Maintained

To analyze his scrap and maintain rigid quality control over his finished ingot, the smelter's science today uses two procedures:

(1) Quantitative Testing—a direct reading spectrophotograph which electronically analyzes each scrap and ingot sample to determine precise aluminum involved.

(2) Physical Testing—which includes mechanical properties tests, tensile strength and elongation, are repeatedly used to check the "built-in" strength of alloys.

In the early days of aluminum, the sweller was an all-purpose maker. The sweller had to have become so precise that he can take a crystal of scrap and, within minutes, determine its composition up to 15 different elements.

Customer Service Supplied

Their second role as a supplier is customer service. Because of this kind of comfort with his supply worries, the customer has recorded a 65 per cent of the nation's smelter foundry of aluminum is of greater concern to the customer than the steel mill. This role is twofold. First, they must accurately transform the material into finished ingots of exact, specified alloy. The task is far more difficult than building a truck. They must monitor the ton and only blend the right amounts of raw material, all properly labeled and measured. They must take scrap of unknown mixture and determine its exact content before adding the needed elements to the blend.

And yet, the smelter's alloy is as metallurgically exact as that produced from original ingredients. This incredible transformation truly requires a magic wand, and the sweller is never at a loss. The smelter has become so precise that he can take a crystal of scrap and, within minutes, determine its composition up to 15 different elements.

When I think of the tremendous scientific tasks that are at hand and of the wondrous opportunities for research that the more distant future holds, I like—assuming a world truly at peace—to envision mankind free of disease, weather. Unlimited supplies of cheap energy would be at our service. Travel in space would be commonplace. Communications, transportation, housing, would be so vastly improved as to be little reasumable to what we know today. And with all this, man would have unprecedented leisure in which to pursue his happiness.

Careers of Scientists Examined

One of the biggest factors is the metal's new applications in the automotive field. Detroit says that aluminum can shave 500 pounds from a standard car. Ford is predicting that the average family car in 1963 will weigh 3,300 pounds; in 1954; 47 in 1958; 57 in 1970. And 11 billion pounds of salvaged scrap would be equivalent aluminum to build three million six-room aluminum homes, and 57 B-52 bombers.

In the world's markets, aluminum needs within five years may offer clues as to certain characteristics that the research work. His first major contributions were made when he was 32 years old, and he continued to produce until his death at 51. One of his major, classic contributions, was published when Lavoisier was 47.

E. V. MURPHREE

THE AUTHOR

The Research Man And His Environment

When I think of the tremendous scientific tasks that are at hand and of the wondrous opportunities for research that the more distant future holds, I like—assuming a world truly at peace—to envision mankind free of disease, weather. Unlimited supplies of cheap energy would be at our service. Travel in space would be commonplace. Communications, transportation, housing, would be so vastly improved as to be little reasumable to what we know today. And with all this, man would have unprecedented leisure in which to pursue his happiness.

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Michael Faraday was the nineteenth century scientist who delivered all of his relatively brief lifetime to research work. His first major contributions were made when he was 32 years old, and he continued to produce until his death at 51. One of his major, classic contributions, was published when Lavoisier was 47.

Davy. Then be went on to make major contributions in both chemistry and electricity until his death at the age of 76.

Emil Fischer, the German biochemist who won the Davy medal when he was 38 years old and the Nobel prize when he was 50, gave 45 years of his life to his field. He made his first major contribution at the age of 23, and his last just four years before his death at 67.

Thomas Midgley was an American physical chemist who won many honors for the work he accomplished in a...
relatively short life before his death in 1944 at the age of 37. As an engineer, he made major contributions in such diverse fields as tetrasulfyl lead, flourine compounds, and synthetic rubber. Milgrom was once aptly described as a man who created his own world in the sense of being the master of his research enterprise—versatility and action.

Wu-Lung Pang, who died less than two years ago while he was in charge of the organization's research laboratories, new knowledge and published more than 150 scientific papers when he was 85. He was famous for his work in surface chemistry. Possessed of an insatiable curiosity, Pang made important work in other di-sparate areas: catalysis; chemistry of surfaces; weather phenomena; and the flight of birds.

Alan Laubie, the pioneer in the investigation of catalysis at high temperatures, developed the high pressure autoclave when he was 36. Then he contributed to contribute in the area of catalysis and high pressure reactions up to his death seven years ago, when he was 52.

I would cite many contemporaries who have been prolific contributors of scientific knowledge throughout their lives. To name but two: There is J. Harrington Daniels, now in his seventies, long active in studies in chemical kinetics, photophysics, atomic power and solar energy. He has published about two dozen important papers in just the past few years. There is Peter Debby, now 75, a Nobel prize winner at 52 and a creative scholar in physics who still works in molecular structures.

Qualities in "Ideal" Research Man

From what I know of the careers of men like these in their chosen fields and personal attributes, I have listed eight qualities that I see as possibly significant factors in the make-up of an "ideal" research man.

1. Each of these men made a lifetime career of research. While we know all too little of their formative youthful years, it would seem safe to say that they began asking the simple question "Why?" almost as soon as they knew how to ask it. And they kept right on asking "Why?" all their lives.

2. These men all possessed a high level of initiative. They had initiative that was inherent, that is, it was a way of life.

3. A third quality of these men was dedication. By this I mean the growth of the individual's knowledge and expertness in his chosen field. This means reducing or eliminating the uncertainty that any manwhat the organization's problems are, what goal he is working toward and what specific needs it faces. Then the management should ask him to propose a method of solving these problems; what he should be concerned. In other words the research organization wants a man who determines for himself (the organization) the problems that should be done, not a man who asks what he must do. The management must do everything possible to encourage him to take responsibility for developing scientific information in an area in which he has special interest, in doing these things we shall be able to create brighter conditions for a man of research to work on his curiosity and be truly creative.

4. The eighth qualities I have outlined represent the ideals we must seek in the research man, the scientist we must have to meet tomorrow's needs. We are going to need the giants—the Lavoisiers, the Faradays, the Langmorses, and men of their caliber. And the striving for such giants for the future is a responsibility for contributing to the fund of scientific knowledge, teaching and to inspire others. They worked well on their problems; they remained scholars in the classical sense. They became what we call today "authorities." They gained recognition in their fields. Yet they never stopped learning, nor did they stop creating; they remained scholars in the classical sense.

5. A fifth need is broad recognition of the scientist's technical achievements. He should be encouraged to participate in such activities as seminars, conferences, formal courses of advanced study, and conferences with other scientists and authorities. Managers should search constantly for consultants who can provide an atmosphere favorable to writing for publication. Perhaps it is wise, when needed, to provide assistance in the preparation of the finished scientific paper. It should be made clear to the research man that he has a responsibility for contributing to the fund of scientific knowledge.

In providing this phase of the ideal environment, management again emphasizes its recognition that a career in research is important, and that it is essential for the research man to become an authority in his field.

6. A sixth need is the ability-mastery of his professional colleagues and in his scientific societies. They were intrigued intensely in promoting the overall advance ment of science.

7. A seventh quality of the great scientists was the desire to make their contributions available to others, and to make his contributions available to others. To him this was a phase of the research environment. In our research center in London about 20 authorities in various fields in chemistry and engineering. Primarily from university and research institute laboratories, these men came from this country and from abroad—from Canada, the U.S.S.R., Sweden, England, and the Netherlands. Speaking before groups of our own people numberings we were able to pose the question to the research worker and ask him to propose a method of advancing learning activities.

8. Place of Geology in Minerals

(Continued from page 22)

As aluminum is used in more and more products with each passing year, the growth of obsolescence scrap will rise at a rate unparalleled by any new scrap. Aluminum Screw Forecast

Within the next six years, total recovery may reach 668,000 tons, with old scrap rising to 35 percent of that total. In 1954, 1,180,000 tons were recovered, of which 880,000 tons—35 percent— came from old scrap. The forecast for 1958 shows a total of 1,465,000 tons recovered, with 44.5 percent from old scrap.

Production of new scrap is based on the assumption that the total scrap aluminum supply of 2,175,000 tons will include 1,200,000 tons of obsolescent scrap recovered from product motorists and 975,000 tons from new automobiles. To recover this metal and turn it into fresh alloys for U.S. industry, the smelters know that it is simply a waiting game. Because of the small size of the industries whose reserves can only be increased through costly prospecting and mining, the company has an incentive to keep scrap from being more rapidly than depletion takes place.

Inevitably, as more aluminum products are replaced by easier ones, more scrap will soon roll in.

27
Chicago area Miners are re-activating Great Lakes Section. See story in From the Local Sections, page 34.

Harris, '41, Denver Branch Manager for Ingersoll-Rand

Frank B. Harris, a 1941 mining engineering graduate of the Colorado School of Mines, has been appointed manager of the Denver Branch of Ingersoll-Rand.

Mr. Harris replaces Alfred A. Hal­land (a 1942-graduate) who has retired, after serving 27 years as manager of the Branch. The many Mines' friends of Al Hal­land with him pleasant days of golf and fish­ing and time to pursue his hobby of electronics.

After graduating from Mines, Mr. Harris worked one year for Ingersoll-Rand before entering the U.S. Marine Corps for a four-year hitch during World War II. In March 1946 he reported back with Ingersoll-Rand in the Los Angeles office and spent the next 13 years in that area.

Mr. Harris was transferred to Denver last October, and since that time he has been busy getting re­acquainted with area friends and re­sponsibilities and getting his wife, Ruth, and their three children—Christine, Mark, and Peggy—settled in their new home at 17 Martin Lane, Englewood, Colo.

The elegant Reception Room, shown above, is available to all visitors who tour Coors' brewery during daylight hours (8:30 a.m. to 4:30 p.m.). It is also used by special organized groups five nights a week. An estimated 60,000 people visited the room as guests last year.

While in Mexico City, the Cokes—who were married Dec. 26 in Den­ver—spend quite a bit of time with Miners. George Ordner, '29; Charles W. Campbell, '47, and William R. Harris, '41.

The couple, who resides at 12725 W. 19th Place, Denver, Colo., are members of Rolling Hills Country Club. Mrs. Coke is a member of the Denver Art Museum and a Rep­ublican discussion group, while Pro­fessor Coke is an active member of Sigma Alpha Epsilon, Tau Beta Pi and Sigma Gamma Ep Silrus.

Morrissey, '42, Advertising Manager of A.A.P.G. Bulletin

Norman S. Morrissey, a 1942 geo­logical engineering graduate of the Colorado School of Mines, has been appointed advertising manager of The Petroleum Bulletin of the American Association of Petroleum Geologists. He was elected to Tau Beta Pi while in his junior year at Mines and held a Mas­sachusetts Scholarship.

Morrissey has been active in oil ex­ploration since his discharge from the U.S. Navy in 1946. In addition to his degree from Mines, he holds an M.S. degree in geological engineering from the University of Tulsa. His master's thesis was on the "Mallory Limestone of the Big Horn and Wind River Basins of Wyoming."

From 1947 to 1954 he was em­ployed by Pan American Petroleum Corp., then Standard Oil and Gas Co. on oil exploration assignments in Casper, Amarillo, Tulsa, Shreveport and Oklahoma City. He spent several summers doing geological field work in the Rocky Mountains while with Pan American. Following that, he was district geo­physical coordinator in Pan Ameri­ca's Oklahoma City office when he resigned to accept a position as drill­ing development editor of The Oil and Gas Journal.

Until recently Morrissey was a con­sulting geologist with offices in Tulsa, but now will devote his entire efforts to the new position of advertising manager of The Petroleum Bulletin.

As a member of both the A.A.P.G. and the Society of Exploration Geophysi­cists, Morrissey was formerly vice pres­i dent of the Tulsa Geological Society. His hobbies are reading, bridge, fish­ing, golf, and horseback riding, and he flies. He and his wife, the former Mrs. Morrissey, live at 312 S. Cin­cinnati, Tulsa, Okla.
In Memoriam

Charles M. Raths

Charles M. Raths, who received his degree from Colorado School of Mines in 1905, died Dec. 29, 1969, while visiting his stepson, Lloyd C. Bowman, in Casper, Wy. Mr. Raths was a member of the Colorado School of Mines Alumni Association from June 1927 to June 1929, was one of the original incorporators of the Colorado School of Mines Foundation (Sept. 23, 1928), and was a member of its Board of Directors at that time.

Born May 14, 1883 in Cheyenne, he attended the Cheyenne public schools and for a three-year period after his graduation from Mines was employed by the Union Pacific Coal Co., of Hanna, Wyo., the Sierra Madre Mining and Development Co. of Chihuahua, Mexico, and the Dallas West Mining Co. of Park City, Utah.

His experience in the petroleum industry commenced in 1909 when he went to work for the Field Division of the U.S. General Land Office, where most of his work dealt with compliance of the U.S. Land Laws, particularly those pertaining to petroleum. He appeared in frequently as a technical witness for the U.S. General Land Office.

In 1917-18 he was geologist for the Western Exploration Syndicate, now the Consolidated Royalty Oil Co. in Casper, Wyo., and for 13 years (1918-1931) was petroleum engineer for Mobil Oil Co. in the northwest and raided oil fields in Arkansas. He moved to Casper, Wyo., after founded the Whitehurst Company which had its headquarters in Casper, Wyo., and for 13 years (1918-1931) was petroleum engineer for Mobil Oil Co. in the northwest and raided oil fields in Arkansas. He moved to Casper, Wyo., after founding the Whitehurst Company which had its headquarters in Casper, Wyo., and for 13 years (1918-1931) was petroleum engineer for Mobil Oil Co. in the northwest and raided oil fields in Arkansas.

Robert Rudolph Schultz, class of 1938, died unexpectedly at a heart attack in New York Dec. 6, 1959. His home was at 421 Washington Ave., New Rochelle, N.Y., where Mr. Schultz was living World War II, he served as an officer in the U.S. Corps of Engineers, designing military and industrial buildings. After the war he worked for the Union Pacific Coal Co. in Montana and was employed by the Union Pacific Oil Co. in Indiana, Louisiana and Arkansas. On Sept. 14, 1921, he married Miss Charlotte Loesch in Pocatello, Idaho, and shortly thereafter founded the Whitehurst Company which had its headquarters in Casper, Wyo., and 13 years (1918-1931) was petroleum engineer for Mobil Oil Co. in the northwest and raided oil fields in Arkansas. He moved to Casper, Wyo., after founding the Whitehurst Company which had its headquarters in Casper, Wyo., and for 13 years (1918-1931) was petroleum engineer for Mobil Oil Co. in the northwest and raided oil fields in Arkansas.

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Robert H. McDonald

Robert H. McDonald, who attended the Colorado School of Mines for over two and a half years (with a scholarship) and later joined the mining industry, died Jan. 16 in a Climax, Colo., hospital of pneumonia, following a two-hour traffic accident on U. S. Highway 2 east from Climax, Colo.

Mr. McDonald was an employee of Tipton and Kalmback, Inc., born July 27, 1920, in Colorado Springs, Colo., came to Denver when he was 10. He was a graduate of Denver High School.

Survivors are his wife, Alice Win-

ned B. Patrick

ner for Denver; his mother, Margaret McDonald of Denver.

CLASS NOTES

Bylum K. Akins' present address is Black Oak, Drake, Lexington Ml, Bonham, Tex.

Robert G. Condit, 550 S. Grant, Denver, is a staff geologist for Mobile Oil, Philadelphia. He was formerly with Amoco Oil Co.

Thomas R. Johnson has moved from Denver to Missoula, Mont., where he is employed by Phillips Petroleum Co.

J. G. Newell is a petroleum geologist for Pan American Petroleum Corp., with mailing address Box 1417, Business Park.

Lawrence C. Simmons, assistant metallurgical supervisor for Bethlehem Steel Co., 1315 N. Vine, Kansas City, Mo., lives in Kansas City, Mo.

Foster J. Witthauer, mill chief, New Mexico Zinc Corp., Gilson, Col., receives mail at P. O. Box 153.

Mr. and Mrs. George R. Taylor are the parents of a son, John Edward, born in July 1930.

David B. Grice, 1015 Timpson St., Salt Lake City, is a graduate student of engineering.

W. H. Morningstar is a senior geologist for Phillips Petroleum Co., with mailing address Box 4161 Twisted Tree, Bartlesville, Okla.

Nathan Avery, petroleum engineer for Schulte and Brenton Drilling Co., lives at 1334 S. Main in Pampa, Texas.

Berea O.统治, petroleum engineer for Mobil Oil Co., residence mail at Box 565, Pampa, Texas.

A. Bruce MacDonald may be addressed at Charles E. HerbstCo., 702-70th Ave., S.W., Calgary, Alberta.

Jack R. Cowan, associate engineer for Canadian Superior Oil Co., has moved from Gran
ing, N. Lea, to 5415 S. Weisman, Lynden, Wash.

Wilfred L. Osgood, metallurgical consultant for W. H. Morningstar, has moved from Las Vegas, Nevada, to 3400 McKibben Dr., Burien, Wash.

Herbert A. Riedel has moved from Kansas City, Mo., residence at 533 Grand Ave., Glenwood Springs, Colo.

H. L. Klotz is a graduate student in engineering at Colorado State College of Education.

Mary M. Loder has moved from Tul
dish, La., to Brownsville, Tex. Her P.O. Box number is 22.

Paul W. insect, residence at 2232 S. E. Spring Ave., Phoenix, has worked for years in the oil industry.

Donald W. Storlhuber has moved from Minneapolis, Minn., residence Box 1562, Leemoine, Cal.

T. C. Soderlund is melting division super
intendent for Union Carbide Corp., 2015 E. Custer, Seattle.

He is a graduate of Shattuck

(Continued on page 28)

FROM THE LOCAL SECTIONS

MINNESOTA

Iron Range Section

Pres.: John Howard Enos, 3459 Fries St., Virginia 2

V. Pres.: Louis Keller, 510 R. F. Bldg., Virginia 2

Sec-Treas.: Dr. W. J. Mahl, 58 Garden Dr. Mf. Iron, Minn.


ALABAMA

Birmingham Section

Pres.: Joseph Hell, 21195 Custer Rd., Bessemer 6

V. Pres.: Paul Shackelford, 2613 Fries St., Bessemer 6

Sales, 249 Fries Dr., Fairfield

ARKANSAS

Little Rock Section

Pres.: Robert W. Rhyne, 3604 E. 12th., Little Rock

V. Pres.: John H. Herndon, 3007 C. D., Little Rock

Military Civil Engineers, 3409 Madison Ave., Little Rock

Tulsa Annual meeting: First Monday in December

(Annual picnic) The Mines Magazine • February, 1960

33
CLASS NOTES (Continued from page 32)

Richard K. O'Neil is now assigned as a production engineer to the Wind River District of the production department in 1957. He transferred from West Palm Beach, Fla., in 1960, and now resides in 2905 Olive St., Denver, Col.

Jack W. Whitaker, a Cherokees, gives his new address as Avas­

Turkish Section


Pres.: John B. Sabin, '49; G L. Miller, '50.

Asst. Sec.-Treas.: R. E. Watson, '43; F. D. Squire, x-'44; B. E. S. B. 2, Algiers.

V. Pres.: G. V. Atkinson, '48; B. E. S. B. 2, Algiers.

Balatoc Mining Co., Zambales

Sec: P. Avelino Suarez

Manila Section

R. E. Pierson, '41; F. L. Stewart and Mr. Charles R. Fitch

President, 7915 S. Exchange Ave.

Secretary, Ft. Lauderdale, Fla., to 1106 E. Main, Utah Construction Co., has moved from

Himal, Liberal, Kans.

Dr. John W. Vanderwilt

The Colorado School of Mines has undertaken a systematic review of the direction of Dr. John W. Vander­

Chairman, 1501, S. W. 24th, Denver 7, Colo.

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Oredigger Sports

Mines Wine Rife Match Against Colorado College

The Mines Varisty Rifle Team, finished sixth in the 1959 Wyoming Small Breech League, has won its first shoulder-to-shoulder rifle match of the season, Dec. 5, against Colorado College at Denver. Scores fired were of a possible 1500. For Mines, Bob Welling, winner of the championship, had a high of 581. Other members of the rifle squad representing Mines were: John Ru­

Dr. John Van Nostrand Dorr, Arthur K. Loring, and John J. DeWitt. (Continued from page 35)

CAMPUS HEADLINES
(Continued from page 35)

refining department. His appointment, effective Jan. 1, 1960, has been announced by Dr. Truman H. Kuhn, dean of facul­

y., has been elected chairman-elect of the Colorado Section of the American Chemical Society.

Dubke Elected Chairman

Dr. Dubke will serve as program chairman during his term and then be available in the spring of 1960 to present a program before the office of general chairman in 1960.

Nearly 600 chemists—representing education government and industry—are members of the organization.

The national ACS has a membership of more than 58,000.

Dubke, who has been served as section chairman of the national ACS building fund drive in 1958-1959, holds chemistry degrees from the University of Denver and from the University of Minnesota, and is listed among American Men in Science and Who's Who in American Education.

Klugman Optimistic About Oredigger Swimmers

Although he has lost several swimming records of the Colorado School of Mines no longer exists, a rest from intercol­

Csem Swimmers Outpolled By RMFAC Champion CSC

Final examination for two weeks in the Chemistry department at the Colorado School of Mines will be covered as much as possible. The Mines' record of previous RMFAC champion Colorado School of Mines-Mines, is 18-5 against the Mines wins. In the three matches against Mines in the 1960-61 season, Mines had never lost to Colorado School of Mines.

Csem Swimmers Outpolled By RMFAC Champion CSC

Klugman, who has been a member of the state and national ACS for 18 years, is an associate professor in the chemistry department at the Colorado School of Mines, has been elected chairman-elect of the Colorado Section of the American Chemical Society.

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