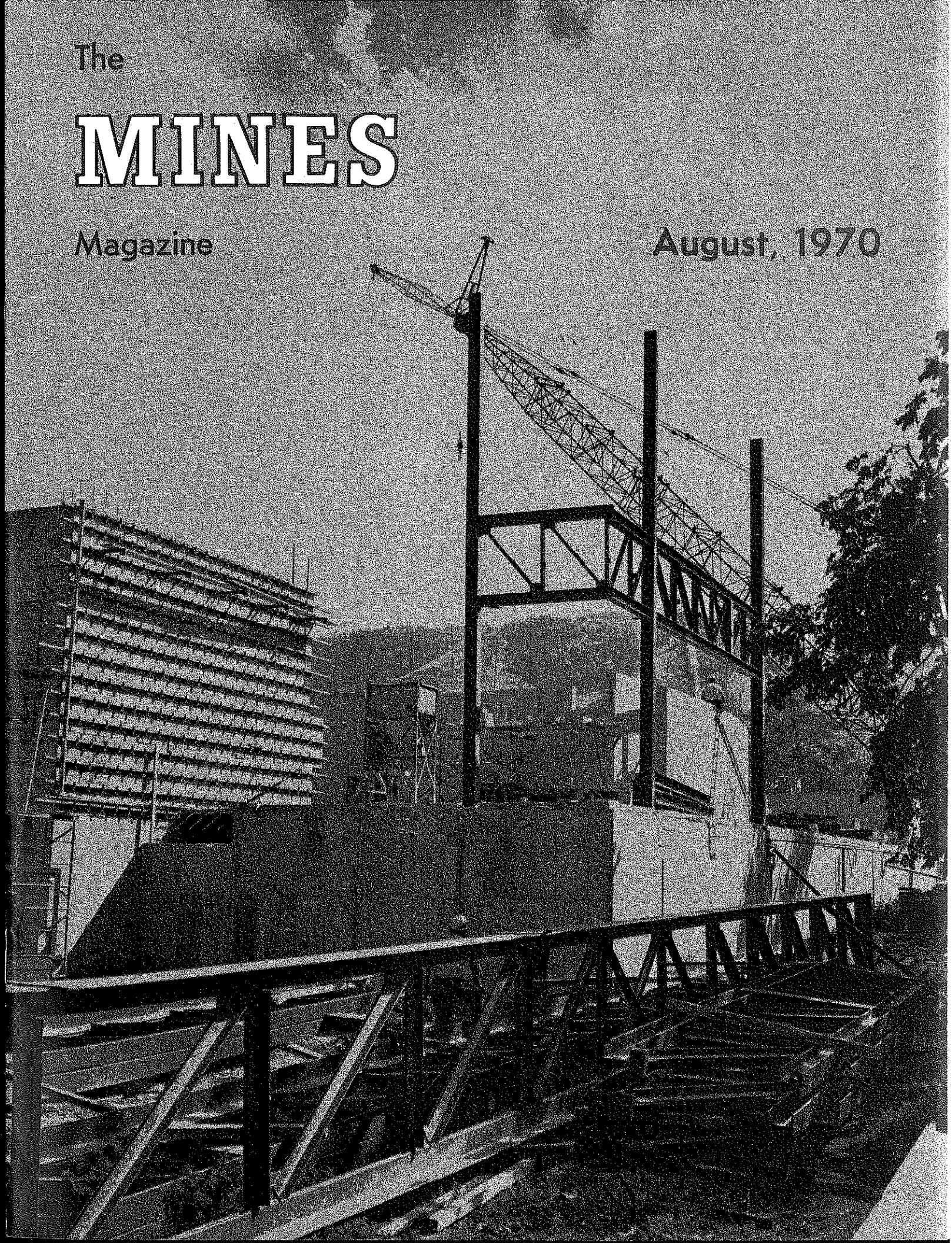
The

MINES

Magazine

August, 1970



THE MINES MAGAZINE

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Calendar

Due to the remodeling of Guggenheim Hall, the ALUMNI OFFICES will be located in the New Gym, Room 307, for the next several months. The phone number will be the same.

Symposium on Nuclear Power, United Nations Headquarters, New York, N. Y., Aug. 10-14.

2nd Inter-American Conference on Materials Technology, Mexico City, Aug. 24-27.

Symposium on Advanced Experimental Techniques in the Mechanics of Materials, El Tropicano Hotel, San Antonio, Tex., Sept. 9-11.

Wyoming Geological Association Symposium and Field Trip, Casper, Wyo., Sept. 21-23.

1970 Mining Convention, sponsored by American Mining Congress, Hilton Hotel and Brown Palace, Denver, Colo., Sept. 27-30.

52nd ASM Materials Engineering Congress and Exposition, Cleveland, Ohio, Oct. 19-22.

SME Fall Meeting and AIME World Lead Zinc Symposium, Kiel Auditorium, St. Louis, Mo., Oct. 21-23.

Society of Petroleum Engineers of AIME Annual Convention, Houston, Tex., Oct. 4-7.

1970 Metals Show, sponsored by Society of Metals, Public Auditorium, Cleveland, Ohio. ASM headquarters at the Sheraton-Cleveland, Oct. 19-22.

Fall Meeting of Society of Mining Engineers of AIME, St. Louis, Mo., Oct. 21-23. Field trips on Oct. 19 and Oct. 20.

The MINES Magazine

Volume 60 August, 1970 Number 8

Front Cover

The cover picture shows progress as of June 15, 1970 on the Graduate and Professional Center on the campus of the Colorado School of Mines. The building was made possible by some $2 million in private donations, led by gifts of $1.4 million from Dr. Cecil H. and Ida Green. The State of Colorado purchased the ground for the structure and added $600,000 to complete its funding. The new center will be a complex including an auditorium, lecture halls, laboratories and major research facilities.

Features

Departments

Official organ of and copyright 1970 by the Colorado School of Mines Alumni Association. Second Class postage paid at Golden, Colorado. Subscription price $6.00 per year United States and possessions; foreign $7.50. Single copies 75 cents except special editions. Published monthly (12 times), plus Annual Year Book and Directory of Mines Men issued separately. Address all correspondence relating to The MINES Magazine to **CARTER KAANTA, EDITOR, 2177 WEST 7TH AVENUE, DENVER, COLO. 80204,** except matters of advertising interest, which should be sent to **W. V. BURGER, ADVERTISING MANAGER,** The MINES Magazine, Golden, Colo. 80401.

Dr. Guy T. McBride Jr. Named President Of the Colorado School of Mines

DR. GUY T. McBRIDE, JR., has been named president of the Colorado School of Mines, according to an announcement July 25 by the board of trustees.

McBride, 50, is a vice president of the Texas Gulf Sulphur Co., and is the general manager of its phosphate division.

He succeeds Dr. Orlo E. Childs, who resigned in June to become vice president for research at Texas Tech University. Dr. McBride's appointment is effective Sept. 1. Until then, Dr. Truman H. Kuhn, named interim chief executive officer by the board after Childs' resignation, will continue to direct the activities of the School of Mines.

The board of trustees also designated Dr. McBride as a professor of mineral engineering. In making the dual appointment, the board indicated that Dr. McBride intends to do some teaching at the 96-year-old mineral engineering university in addition to his duties as president.

Dr. McBride has an outstanding background as a university teacher and administrator, as an engineer and administrator in industry, and in research.

He has wide experience in the field of ecology and environment control, and presently serves on the committee for pollution and environmental control of the American Mining Congress.

Dr. McBride has served with Texas Gulf Sulphur in research, engineering, and management capacities in New York and North Carolina since 1958.

He is responsible for engineering and designing many of the company's projects, one of which is the new $95 million phosphate mine and related fertilizer materials plants at Lee Creek, N. C. As vice president and general manager of the phosphate division, he is in charge of production and sales of this complex which ranks among the top phosphate producers in the world.

Prior to his present position, he served as dean of students and associate professor of chemical engineering at Rice University, Houston, Tex.

He was at Rice from 1948 to 1958 as a teacher in chemical engineering, director of graduate research, administrator in student affairs, and consultant to industry.

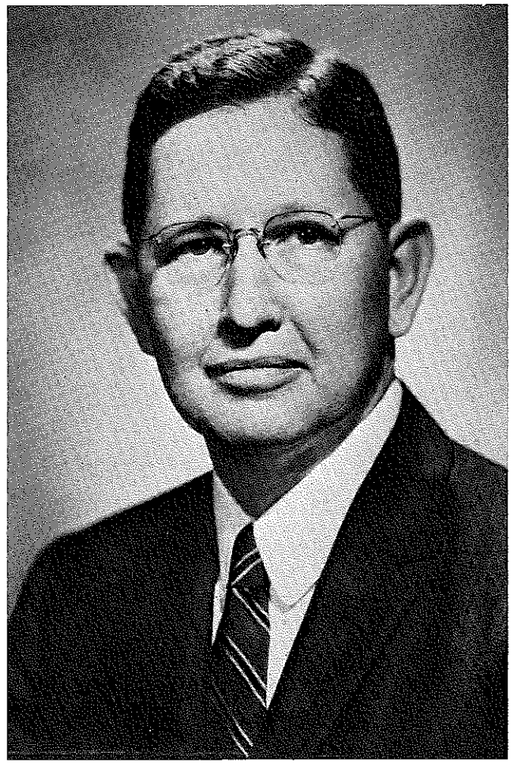
His experience includes service as a research associate and instructor in chemical engineering at Massachusetts Institute of Technology and as an engineer with the Standard Oil Company of California.

Dr. McBride holds a B.S. degree in chemical engineering from the University of Texas and a doctor of science in chemical engineering from the Massachusetts Institute of Technology.

In 1963 he received the honor of distinguished engineering graduate from the University of Texas.

He was a member and president of the Chappaqua, N. Y., Board of education from 1962 to 1966.

He is a registered professional engineer in Texas, Louisiana, and New York.



Dr. McBride is active in many honorary and professional societies related to the earth sciences and mineral resources fields, including Tau Beta Pi, Sigma Xi, the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) and the American Chemical Society. He is the author of several publications in these fields.

He is a member of the Governor's Council of North Carolina for Economic Development, the advisory committee of the Water Resources Research Institute, and vice president and director of the North Carolina Engineering Foundation.

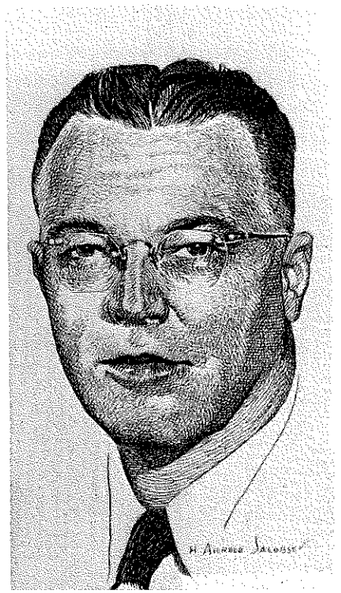
A native of Austin, Tex., McBride and his wife, the former Rebekah Jane Bush, have three children, Rebekah Ann, 24; William Howard, 22; and Ellen Thrasher, 18.

Unleaded Gasoline And Smog-Free Autos—How and Why

By C. K. Viland

Introduction. Some California students made headlines not long ago, protesting auto-induced smog by burying a brand new 1970 Maverick —but misinformation led them to bury the wrong car. They should, instead, have buried one of the ten-year old jalopies used to transport them to and from the demonstration. These older cars have **no** anti-smog emission devices, whereas the 1970 Maverick had **three.** Most of these old autos, also with larger engines, were producing perhaps five times more air pollutants than the 1970 car they took off the road.

Both oil refiners and auto makers have made substantial progress to keep pace over the past seven years with ever-stricter pollution laws. For example, 1970 models emit 69% less exhaust pollutants than 1963 autos. By 1975 new cars must be down to 13% of pre-control days. California has had the first and toughest standards, usually followed nation-wide. Federal standards are met with three anti-smog devices on all 1970 model cars sold: (1) a positive crankcase ventilation device to recycle back to the engine's intake all piston "blow-by" gases; (2) a device to lower emissions of carbon monoxide and unburned hydrocarbons, and new this year (3) a gasoline evaporation control device. For 1971 models, California is requiring a fourth control: a means of limiting emissions of nitrogen oxides. Since this problem requires a new approach to prevent the air's oxygen and nitrogen from combining during combustion, or to otherwise lessen nitrogen oxide emissions, and also considering projected anti-pollution standards up to 1975, the auto makers have asked the oil companies to provide unleaded gasoline for their 1971 models. As oil refiners will not have time to build the necessary additional equipment to replace lead anti-knock compounds with higher octane hydrocarbons, Detroit will redesign and modify 1971 engines to operate on unleaded "regular" gasoline of about 91 octane number instead of present 1970 average leaded regular testing 94. Shifts in blending and possible lower lead limits may also result in somewhat lower than 100 octane rating for "premium" gasoline, especially in California where new laws to phase out lead entirely will be in effect. A discussion of future emission controls, anti-smog devices, engine changes, lead alkyl anti-knock compounds, octane numbers, alternate power plants, and how high-octane lead-free fuel will be made, follows:



C. K. Viland, P.E. 1929

The above Minox copy of an artist's pen and ink sketch of Mr. Viland was made less than 10 years ago for an article published in a petroleum journal. Since his retirement from Tidewater Oil Co., he has been living at Taylor and Canon Sts., Bodega Bay, Calif. 94923.

Auto Emissions. The undesirable auto exhaust emissions are: carbon monoxide, unburned hydrocarbons, nitrogen oxides (mostly as nitrous oxide (N_2O) and nitric oxide (NO) as it leaves the tailpipe and commonly referred to as NO_x) and particulate matter, largely carbon and compounds of lead.

The "benign" emissions are: excess oxygen and nitrogen from air, plus carbon dioxide and water from combustion. Ideally, these should be the only emissions when burning hydrocarbons free of impurities such as sulfur (now largely removed by modern catalytic refining of oil in the presence of hydrogen.) Carbon dioxide is converted back to oxygen by plant life—about 70% of this by the oceans' microscopic plankton.

Progress in Emission Control. Since 1963, following California's earlier regulations, all new cars sold in the U. S. were required to have positive crankcase ventilation control. After California imposed limits on carbon monoxide and on unburned hydrocarbons exhausted, these were made mandatory nationwide. The same situation applied to evaporation control and will apply to NO_x emissions which are to be controlled. The emission standards (maximum permissible) projected to 1975 may be summarized as follows:

PAST, PRESENT AND PROPOSED AUTO EMISSION STANDARDS
GRAMS PER MILE

YEAR	Hydro-carbons	CO	NO_x	Par-ticulates	Total	Percent
Per-1963	11.0	80.0	4.0	0.3	95.3	100
Calif.—1966	3.4	34.0	....*	....*	41.7	44
Federal—1968	3.4	34.0	....*	....*	41.7	44
Calif.—1969	2.2	23.0	....*	....*	29.5	31
Federal—1970	2.2	23.0	....*	....*	29.5	31
Calif.—1971	2.2	23.0	4.0	....*	29.5	31
Calif.—1972	2.2	23.0	3.0	....*	28.5	30
Calif.—1974	1.5	23.0	1.3	....*	26.1	28
Calif.—1975	0.5	12.0	1.0	....*	13.8	14
Federal—1975	0.5	11.0	0.9	0.1	12.5	13

*Uncontrolled.

From the above it will be noted all 1970 model auto air-pollutant emissions are only 31% of those prior to control. Future controls (up to 1975) will require a further drastic reduction to less than half the pollutants allowed from today's new cars (a reduction of 87% of the pollutants prior to any control).

The auto makers have announced "kits" will be made available to bring older pre-1963 cars (back to 1955) up to approximately present standards. These will reportedly cost $35-$50 per car plus installation. It seems likely these may be required to be installed. If so, an early end to auto-induced smog is now a real possibility.

Smog. Smog, characterized by its reddish-brown color (partly from nitrogen dioxide — NO_2) was first noticed and named in Los Angeles about 1944. The Los Angeles Basin is an ideal place for its formation. There is a large concentration of autos, industry does not burn smoke-producing coal, trash burning is prohibited, there is much sunlight even above periodic fog, hilly country encircles the metropolis except for the ocean frontage, and last but not least, there are frequent periods of "temperature inversion." This is a layer of air at higher temperature at an altitude than at ground level. It forms a "lid" and the basin becomes a trap. Sunlight turns some of the air's oxygen (O_2) into ozone (O_3), a powerful oxidant. Nitrous and nitric oxides from any combustion are further oxidized to nitrogen dioxide — a reddish-brown gas. The unburned hydrocarbons, nitrogen oxides and carbon monoxide react in various combinations in the atmosphere under the influence of sunlight, causing a typical eye-irritating reddish-brown smog blanket.

Total air pollutant production in the U. S. is about 2½ million tons from all sources. Excluding carbon dioxide, autos contribute 68 of the 142 million tons of pollutants entering the atmosphere each year. Of this, about one-quarter million tons is lead (expressed as metal) and about one-third of the lead is in the form of particulate matter.

Present Emission Control Devices. The **Positive Crankcase Ventilation** device was first to be mandatory. It works exceedingly well as long as the PCV valve is kept clean (a good detergent oil is necessary.) As noted in the foregoing tabulation, this device removes two-thirds of the unburned hydrocarbons and over half the carbon monoxide otherwise exhausted. The second reduction to be noted in emissions was accomplished by engine modifications either (1) in causing some **afterburning** in the hot exhaust gases by injecting air, or (2) by **better control** of **spark advance** and of **air-fuel ratios.** Starting in 1969 for California, and in 1970 throughout the U. S., all new cars sold were required to be equipped with a third device **preventing evaporation** from gas tanks and carburetors. Substantial hydrocarbon losses occur from the carburetor particularly when a hot engine is stopped or idling.

Future Emission Control Devices. (1) **Exhaust Gas Recycle.** Emission of nitrogen oxides can be lowered by returning some of the exhaust gas back to the intake manifold. Lead in gasoline, through production of some of the particulates emitted, plus the corrosive effect from chlorine and bromine scavengers in the lead-mix, make manufacture and upkeep of an exhaust gas recycle system more costly. A loss in engine efficiency also results.

(2) **Lower Compression Ratios.** The lower compression ratios needed to efficiently burn 91 octane gasoline tend to reduce combustion temperatures, and therefore also favor production of less nitrogen oxides from the air used.

(3) **Improved Exhaust Gas Reactor.** As previously stated, many of the newer cars have simple air injection into the exhaust manifold to oxidize some of the unburned hydrocarbons and carbon monoxide. In proposed improved exhaust gas reactors now being tested, the hot gases are caused to pass through a labrynth and react with oxygen, either supplied by an air pump or as excess oxygen available in the exhaust. The presence of lead and lead scavengers which contain bromine or chlorine causes attack on metal or ceramics, the materials from which the reactors might be fabricated.

(4) **Chemical Methods.** The Ford managed Inter-Industry Emission Control Group (IIEC) started by Ford and Mobil Oil Company and later joined by other oil companies (American, Atlantic-Richfield, Marathon, Sohio and Sunoco) and certain foreign auto makers (other U. S. auto makers cannot participate because of anti-trust laws) has spent over $7 million on all possible methods of exhaust control. One successful method of eliminating NO_x reported by this group is ammonia injection into the exhaust system. Under proper condition (about 350°F) and with controlled composition in the exhaust gas, the NH_3 reacts with NO_x to produce water and free nitrogen — both non-pollutants.

(5) **Fuel Injection.** An early major change may see electronic fuel injection replacing carburetors. Fuel injection permits no evaporation loss at the engine. (Substantial losses occur from hot carburetors.) It is also the best means of adequately controlling air-fuel ratios. Emissions disappear on deceleration as fuel supply is shut off.

Fuel injection for gasoline engines is universally used in piston engined planes. Many high-priced European

cars have offered this option for years. Recently one model of the low-priced Volkswagon has adopted electronic fuel injection as standard equipment.

Ford Motor Co. is doing environmental research on engines in several independent ways — in its own Research Department, in the IIEC cooperative group and under defense contracts. In the latter program they have modified the military jeep vehicle for direct diesel engine-type fuel injection (into combustion chambers rather than into intake ports). Prototypes are under test by both Ford and the Military. Using a glow-plug rather than conventional spark-plug, fantastic increases in power are reported — up to 40% on "regular" gasoline. However, the test vehicles are also equipped with exhaust gas recycle to control nitrogen oxides emission, so reportedly the power gain is reduced to 25% and 10% better gas mileage. The results were confirmed in a much larger Lincoln engine.

(6) **Catalytic Converter (or Muffler).** Catalytic mufflers were developed and tested thoroughly more than ten years ago using both noble metal (platinum) and other catalysts. They have not been adopted or seriously considered until quite recently since all catalysts were "poisoned" by even small amounts of lead additive. Now, with unleaded fuels becoming available there is evidence this device will be the basis for an optimum solution to auto-produced air pollution.

Universal Oil Products Co. of Des Plaines, Ill., was the pioneer in this field. They have favored a catalyst using a small amount of platinum mounted on a suitable inert carrier. It is know activity can be increased by certain promoters such as rare earths, especially rhenium. Recently U. O. P.'s President, John O. Logan, before a Presidential Task Force claimed a newly developed single-catalyst converter for a car burning lead-free gasoline will reduce nitrogen oxides, hydrocarbons and carbon monoxide up to 90%, hurting neither performance nor gas mileage. He claimed it will maintain efficiency for the life of the car with lead-free gasoline. It requires no air pumps, exhaust gas recycle, extreme leaning nor enriching of fuel mixtures. Mr. Logan stated tests have shown this catalytic converter will remove all but 72 parts per million of nitrogen oxides out of 746 produced. Hydrocarbons are reduced by 73% and carbon monoxide by 94%. UOP's claims are based on extensive tests of over 50,000 miles. On leaded fuels emission reduction over the first 25,000 miles are limited to no more than 75%.

General Motors have been working with UOP and are conducting field tests. At a recent stockholders' meeting G. M. proudly showed prototype cars equipped with catalytic exhaust devices. American Motors has also arranged for testing the UOP catalytic muffler in a taxi fleet using non-lead fuel.

The Ford-managed IIEC cooperative group has also developed both single and two-catalyst converters. In the two-catalyst version the muffler reduces nitrogen oxides, and the second oxidizes the hydrocarbons and carbon monoxide remaining in the exhaust.

A number of other firms have been developing catalytic converters for auto exhausts including Grace Chemical Company and American Cyanamid. Some of the catalysts are known to be non-noble metal based.

Atlantic-Richfield's President Charles F. Jones says, "We believe that in the long term a catalytic reactor and unleaded gasoline will emerge as the optimum system."

(7) **Other.** Esso Research and Engineering Division of Standard Oil Company (New Jersey) have been cooperating with Chrysler Corporation. Recently it is reported they have devised a "Synchrothermal" emission control system. This, they say, results in an overall reduction of hydrocarbons, carbon monoxide and nitrogen oxides by 92%. Details are not available.

Summary of Devices. In a typical stop-and-go driving cycle, auto exhaust emissions of carbon monoxide and hydrocarbons drastically increase during deceleration because of loss of oxygen — air is practically shut off by the butterfly valve in the carburetor while fuel continues to flow through its jets. With fuel injection replacing carburetors, the load on a catalytic converter would be drastically reduced, since all fuel supply to the combustion chamber is shut off during deceleration. Consider a combination of three devices — (1) the present positive crankcase ventilation system, (2) electronic fuel injection of either the low-pressure (port intake spray) or high-pressure (direct, diesel type), and (3) a catalytic converter or muffler. These three with unleaded gasoline should exceed proposed 1975 emission standards; and at the same time provide lowest total initial and operating costs for the car. They would result in high efficiency. Lower use of fuel should easily pay for the somewhat higher priced non-leaded fuel of desired octane rating.

Lead Additives. Well over a quarter million tons per year of metallic lead is used in anti-knock additives — about 22% of all lead consumed in the U. S. Nearly all of this is thrown into the air as exhaust, much as very fine particulates smaller than ten microns.

Tetraethyl and other soluble lead alkyls are added to gasoline solely to increase octane number at minimum cost. Lead in gasoline contributes to engine combustion chamber deposits. These build up progressively, finally reaching an equilibrium higher octane number and simultaneously the unburned hydrocarbons show increase in the exhaust. Part of the deterioration of emission control as a new car accumulates mileage apparently is caused by these deposits. This condition is reversible, as smog-emission control becomes better when non-leaded gasoline is used in the same car. Ford and other engineers claim lead deposits cause up to 35% of the hydrocarbon emissions. Reasons are not fully understood. One factor in lead additives adversely influencing hydrocarbon emission, however, is fouling of sparkplugs, causing misfiring; and another is lead deposits forming on the engine's valves.

"Motor-mix" lead comprises 61 mol % tetraethyl lead, 36% mixed ethylene dibromide and dechloride, and the rest solvents, dye and inerts. Tetramethyl lead may be substituted for, or mixed with TEL. The lead additive is vaporized by combustion and by reaction with the halide scavenger compounds in the mix, so that it does not deposit in the engine. Thus lead becomes a poisonous air pollutant. In stop-and-go driving the bromide and chloride scavengers form acids which consense and corrode engine components, particularly the exhaust system, especially the muffler and tail pipes.

Present national average 94 octane "regular" gasoline contains about 2.3 grams lead (as metal) and 100 octane "premium" 2.8 grams.

Effect of Eliminating Lead Additives. Without lead, octane rating of refinery "pool" gasoline (combined "regular" and "premium") would be about 90-92 for most oil companies, but higher for some and lower for small refiners with limited facilities. Thus late 1970 and early 1971 gasoline octane numbers would be about 91 in most unleaded "regular" and 97-100 for premium containing lead for the next few years. California laws may limit 1971 lead contents to not over 0.5 grams per gallon and 2.0 for "premium."

Without adjustment about 20% of cars, nationwide, are satisfied by 90-91 octane gasoline and 85% with 97 octane. By retarding the spark 3-4½ degrees, 90-91 octane fuel will satisfy 45% of today's autos and a 97 octane product about 95% of the car population.

Octane Number. Octane number of a gasoline is determined by matching its "knocking" tendency in a standard one-cylinder variable compression ratio laboratory engine with a mixture of iso octane (2,2,4 trimethyl pentane) and normal hexane. Thus, a gasoline matching 94% iso octane and 6% n. beptane is 94 octane number. 100 octane gasoline matches iso octane. Ratings over 100 are determined with increasing amounts of tetraethyl lead in the reference fuel. Since an engine's octane requirement depends on factors besides compression-ratio — i. e., spark setting, humidity, temperature, air-fuel ratio and importantly atmospheric pressure, refiners set octane ratings by areas. For example, a recent Ethyl Corporation Survey shows average "premium" in San Francisco tested 99.8 octane and "regular" 93.7. In Denver at the same time these averages were 97.0 and 90.6 respectively, many the same brands and giving equal performance in engines tuned for maximum efficiency.

Some types of hydrocarbons have inherently high octane ratings and certain individual pure hydrocarbons test 100 octane or higher. Notable high octane stocks are branched-chain isoparaffins, most aromatics, and a few of the lighter cycloparaffins. These can be selectively manufactured, or may be fractionated or solvent extracted from mixtures of petroleum hydrocarbons.

Manufacturing High Octane Lead Free Gasoline. The newer oil refining methods use many catalysts, and have substantially increased basic octane numbers of blending stocks for gasoline. Platinum catalyst reforming of naptha is a good example. Within only a few years it has become widely used, world wide. With selected feed, or under severe operating conditions, it can produce 100 octane gasoline, unleaded.

Petroleum technologists have known for about 30 years how to produce non-leaded 100 octane gasoline in quantity. Indeed, most oil refineries are today operating equipment capable of producing such fuel, but in insufficient amounts to make all non-leaded fuels at 1970 octane ratings. The needed new capacity will cost billions of dollars. The extra cost of manufacture — between 1 and 3 cents per gallon must be borne by the consumer. One major East and Southeast Coast marketer (American Oil) now offers a premium non-leaded gasoline at about one cent above competitive 100 octane fuels. Cost differential may disappear if lead used for gasoline additive is taxed as recently proposed by the President.

Now, the question arises — how to produce economically in large quantity unleaded gasoline of present day octane ratings, 94 for "regular" and 100 for "premium" gasoline. Auto makers expect to raise new engines 1971 compression ratios in step with petroleum refiners' ability to supply these fuels.

All of the following methods are commercially proven and commonly used processes. Oil refining methods are based on commercial practice or on pilot plant work done under the direction of the author.

Preliminary Processing. The heart of a modern oil refinery is a two-stage atmospheric and vacuum primary crude distillation unit where lighter fractions are recovered. Most other fractions boiling between diesel fuel and asphalt is then charged to the refinery's catalytic cracking unit. These heavy distillates are there converted into high octane gasoline by mixing with a hot powdery clay-like catalyst. This is circulated between the two large main vessels as a fluid, by mixing with steam and oil vapors on the way to the reactor; and with air when going to the regenerator. Carbon formed on the surface of the catalyst in the reactor is burned off continuously in the regenerator. This provides heat for operation of the plant. Besides high octane gasoline catalytic cracking produces gas, a light hydrocarbon feed for the alkylation process, and some distillates heavier than gasoline. Such catalytic cracking units in a large refinery may charge 100,000 barrels per day of feed and circulate 85 tons per minute of catalyst. Older refineries use two or more smaller catalytic crackers.

Alkylation Plant. This process combines saturated and unsaturated light hydrocarbons (usually isobutane and mixed butylenes) to form alkylate, a product testing well over 92 octane unleaded. A large portion is the 100 octane hydrocarbons, iso octane. With catalytic cracking, alkylation was the basis for making World War II Grades 100/130 and 115/145 aviation gasoline containing tetraethyl lead. Either one or two catalysts may be used — anhydrous hydrofluoric acid or concentrated sulfuric acid.

Catalytic Hydrodesulfurization. Reformer feed stocks are pretreated for desulfurization and denitrification by passing over a hot fixed bed of cobalt molybdate catalyst in the presence of hydrogen gas. This is done to avoid poisoning of the reformer catalyst containing platinum. Diesel oil, kerosene and other gasoline stocks are usually also treated by this process to remove impurities, especially sulfur.

Catalytic Reforming. This process involves passing heated napthas, usually in the 200°-390°F boiling range over a fixed bed of catalyst comprising 2-3% platinum thinly mounted on a suitable base such as alumina. This process produces high octane naptha from any petroleum feed stock for long periods of time without in-situ regeneration (by burning off carbon deposits). In many cases runs are of such long duration that it is more expedient to replace the catalyst charge and have the old catalyst remanufactured. With ordinary feed stocks using higher operating temperatures 100 octane (unleaded) gasoline may be made but more frequent regenerations are then required. Hydrogen gas is a by-product, as a typical reaction involves dehydrogenating napthene hydrocarbons to form aromatics. Some feed stocks, however, will produce 100 octane (unleaded) under mild non-regenerative conditions. Such stocks include catalytically cracked naptha, hydrocrackate, and selected feed stocks especially high in napthene content. Octane ratings of well over 100 (unleaded) can also be achieved by solvent extracting a normal reformer product using glycol, liquid SO_2 or other solvent and reforming under mild non-regenerative conditions. The low-octane raffinate remaining may be blended to jet fuel or recycled back to the reformer, making a 98 or higher octane extract product, overall.

Catalytic Hydrocracking. Heated distillates from almost any source such as crude oil distillation, catalytic cracking or coking of asphalt is processed at high pressure through a fixed bed of catalyst in the presence of hydrogen gas. Since hydrogen is chemically consumed in the production of the lighter gasoline and other refined distillates, liquid yields would

normally be in the order of 110% plus perhaps 15% of alkylation feed stock, largely isobutane. Since hydrogen requirements are large, a hydrocracking installation requires a large supporting hydrogen generating plant. Usually this is done by catalytically steam-reforming natural gas or other hydrocarbons. In such a plant the hydrogen comes from both the hydrocarbon and the water consumed, and substantially pure carbon dioxide is a by-product.

In making 100 octane gasoline the heavier portion of hydrocrackate naphtha would be catalytically reformed, and the lighter portion blended into regular gasoline. All hydrocrackate products, being treated in the presence of hydrogen, are produced completely sulfur-free, including the kerosene or jet fuel fraction and the heavier diesel oil. This process has great flexibility in producing desired products. For example, if sufficient jet and diesel fuel is available from other operations, recycling can make gasoline the prime product.

Increased Aromatics. One of the arguments the "anti-non-leaded gasoline" group brings up is that aromatics will tend to increase in high octane non-leaded fuel. This is so. They say aromatics and unsaturated hydrocarbons are chemically the most active, hence increase smog by reaction with other compounds in the atmosphere under the influence of sunlight; and that some types of aromatics are even carcinogenic. All this is true, but — (1) standards for emissions permissable have been steadily getting lower ever since 1963; (2) the making of non-lead high octane gasoline tends to eliminate unsaturates; (3) only heavy, very high-boiling polynuclear aromatics are believed to be carcinogenic. These are **not** present in the gasoline boiling range, and to the writer's knowledge there is no evidence of their formation during combustion. The multiring heavy aromatics which have produced carcinoma on skin of mice are found in the bottom product from catalytic cracking and would normally end up as a portion of heavy industrial or bunker fuel oil.

Alternate Power Sources. All other known power sources including the gas turbine have drawbacks as great or greater than the internal combustion engine. The gas turbine is costly, and is inefficient in stop-and-go driving. Batteries of suitable capacity, weight and cost rule out electric vehicles for an overall transportation unit. Substantially more electric power generating capacity would be needed, and some areas are already faced with power shortages. Steam power presents some nearly insurmountable problems. Start-up time is long, water freezes. For good fuel mileage all waste heat must be put to use. All steam must be condensed and none wasted. This adds weight. The air's nitrogen (79%) is heated to combustion temperature at atmospheric pressure. Heat recovery from exhaust gas then requires complex, heavy, expensive equipment. This is not true for the internal combustion engine where all combustion gases are put to work and cool during the expansion which occurs within the engine after combustion.

Conclusion. The internal combustion engine is likely to remain the power source for passenger cars for the foreseeable future. 1970 new car auto emissions have been reduced to only 31% of the pre-control era when no auto anti-smog devices were required. By 1975 projected emissions of carbon monoxide, hydrocarbons and nitrogen oxides will total about 13% of that from pre-1963 autos. Auto makers have announced they will make "kits" for autos back to 1955 models, which if required to be installed would reduce emission of pollutants from old cars to approximately 1970 standards.

Lead-free gasoline which will become generally available in late 1970 will make all autos very small pollutant producers. In engine modifications, fuel injection may replace carburetors soon; and the catalytic converter or muffler using either a platinum-based or non-noble metal catalyst will undoubtedly play an important part in totally eliminating auto induced smog during the 1970's.

Pollution Causes Climatic Changes*

OF ALL the troubles brought to this planet by air pollution, one of the most dangerous is unquestionably the change in weather patterns brought about by dirty air.

While upper-atmosphere physicists and meteorologists have felt for a long time now that polluted air could cause changes in the weather, there has been little research in this area until relatively recently. These recent studies, however, clearly indicate that in some places pollution has grown to the point where it is affecting the weather not only over large sections of this country, but possibly global climatic conditions as well.

Thus, as the *Wall Street Journal* put it in a recent article on this subject, when people in LaPorte, Indiana, want to go on a picnic, they first have to check the production plans of the large steel mills in Gary, 30 miles northwest of LaPorte. The reason is simple: When steel production increases in Gary, LaPorte gets more rain. Weather experts say the smoke from the steel mills is causing it.

And increased rainfall is only one of the many climatic changes caused by air pollution. In some cases, pollution can reduce precipitation. There's also evidence that contaminated air raises temperatures in cities by preventing the escape of heat, and that it screens off sunlight and can produce fog, hail and thunderstorms. Even more frightening, on a global scale, it has increased cloud cover, weakened trade winds and lowered the earth's temperatures.

Until fairly recently, climatologists have been relatively cautious about blaming changes in the weather on pollution. However, that caution is rapidly evaporating under the impact of mounting evidence that dirty air is the culprit.

The feelings of scientists today on this subject have been summed up by Dr. Charles L. Hosler, a meteorologist who is Dean of Penn State's College of Earth and Mineral Sciences. "We're putting astronomical quantities of materials into the atmosphere," he said, "and there's no question that it's affecting the weather. I'm afraid that the changes are already greater than most people suspect, and there may be a threshold beyond which small changes in the weather could bring about major shifts in the world's climate."

While the processes through which pollution of the upper atmosphere changes the weather are not as yet fully understood, scientists believe they now know in general terms what's been happening. It's simply that the earth's air today is loaded with dust.

There has been an order of magnitude increase in the turbidity of the atmosphere during the past decade, even in places with supposedly "clean" country air, and some 800 million tons of pollutants are being spewed into the air around the world each year. And the problem is a global one, despite the fact that the U. S. supplies some 20 per cent of the world's pollutants. Research has shown, for example, that the dustiness of the air over the Pacific Ocean has increased 30 per cent in the past decade, while the dust fall in central Asia, as measured by Russian scientists, is some 19 times as great as it was 40 years ago.

While the dust particles in man-made pollutants are very small, they are large enough to have a strong attraction for water vapor, which condenses and freezes on them, forming ice crystals, which in turn form clouds. If sufficient moisture is present, the clouds droplets grow in size and eventually fall as rain.

Scientists now believe that pollution-generated rainfall is by no means an isolated occurrence, but can happen in any region where the air is dirty, and they've accumulated some evidence to support this theory.

As an example, Belleville, Illinois, ten miles southeast (and downwind) of St. Louis, now gets about seven per cent more rain annually than areas upwind of St Louis, where there is less pollution. Moreover, the extra rain falls mainly during the week, when the pollution from St. Louis industrial plants is heaviest.

Interestingly enough, Belleville even gets more rain than St. Louis, since the prevailing winds tend to blow the dirty air away from the city itself. As Richard D. James pointed out in his *Wall Street Journal* article, during the past 18 years, Belleville has had rainfalls of at least one-quarter of an inch on 83 more days than St. Louis, and all but one of these rainy days was a weekday, the one exception being a Saturday.

It is LaPorte, however, which provides the most graphic example of what has been happening, primarily because of a study recently made by Stanley Changdon, a meteorologist with the Illinois State Water Survey, while surveying the area's water resources.

Changdon found that Chicago's automobile manufacturing plants and factories, as well as Gary's steel mills, spewed huge quantities of water vapor and dust particles into the air—a combination almost ideal for the formation of ice crystals under the proper atmospheric conditions. And, sure enough, researchers flying through the thick clouds of smoke coming from the industrial plants in the area found billions of ice crystals being formed.

The prevailing wind currents sweep the polluted air toward the Southeast, and, while many communities in the area feel the effects of this dirty air, it is LaPorte which is the hardest hit. Between 1946 and 1967, for example, it averaged 47.1 inches of rainfall per year, which was 19 inches, or 47 per cent, more than the precipitation at locales upwind of Chicago. There is little indication that the pattern is any different today, and it may even be getting worse.

Changdon discounts the possibility that LaPorte's rain is due to chance, or is somehow connected with nearby Lake Michigan. For one thing, he points out that from 1955 to 1965 the city had considerably more rainfall than any nearby weather stations which would also feel any effect from the lake.

Two other factors make it even more unlikely that the lake has anything to do with it. For one thing, LaPorte's rainfall pattern closely follows that of Chicago's haze and smog pattern, and its precipitation increases and decreases with the area's steel production. "Peaks in steel production," Changdon notes, "occurred seven times between 1923 and 1962, and all of these were associated with highs in LaPorte's precipitation."

Curiously enough, while pollution can, and frequently does, cause more rainfall, it can also have the opposite effect, when clouds become so overseeded that no rain falls. This happens when pollution creates so many dust particles that they cannot attract enough water vapor to grow to raindrop size.

This has happened in many places around the world, although one of the best-documented examples is the sugar-producing area of Queensland, Australia, where precipitation has been sharply reduced. During the sugar cane harvesting season, the leaf is burned off before cutting, causing thick columns of smoke to rise into the air. Rainfall has been reduced downwind of these areas

*Reprinted courtesy of Engineering Opportunities, Feb. 1970 (Madison, Wis. 53701).

by as much as 25 per cent from levels in nearby regions unaffected by the pollution.

There is also a suspicion that the same kind of thing may have been responsible for the changes in the rain and snow pattern over the northeastern part of the United States during the past five years. And anyone who lives in that section of the country can tell you that there has been a decided change in the pattern.

Vincent J. Schaeffer, Director of the Atmospheric Sciences Research Center of the State University of New York, is one of those who is convinced that pollution is responsible. He notes that, instead of the downpours the Northeast used to have, it now gets fine, misty rain and snow in which the drops or flakes are so tiny that they tend to drift down, rather than fall. There were more than 20 of these last year, he added, where there used to be only two or three a year. Moreover, rain and snow of this type tend to drift great distances, additionally changing regional precipitation patterns.

Pollution can also cause dense fogs. Dean Hosler, for example, has studied and photographed a massive fog bank about 1,000 feet high which regularly forms near a paper mill in Lock Haven, Pennsylvania, and spreads some 23 miles down the nearby Bald Eagle Valley. The fog is present about a third of the time, and especially in the fall and winter.

Hosler is convinced that under normal conditions it wouldn't be there, He points out, for example, that it appears on days when little or no fog is observed elsewhere in the state. Nor is this type of phenomenon an isolated example. "This type of thing is repeated all over the country, hundreds of times, in different locations," Hosler says.

There is also evidence that pollution is associated with violent weather. In one eight-year period, for example, downtown St. Louis had an average of five more days of thunderstorms than a rural area with less pollution 13 miles upwind, an 11 per cent difference.

Chicago's Midway Airport had five per cent more thunderstorms than O'Hare Field, 16 miles to the Northwest in an area which is less polluted. And the all-time champ, LaPorte, has had 130 days of hail during the last 14 years, or about four times as much as other weather stations in the area. However, little is known as yet as to how or why pollution causes this.

There is evidence, however, on the responsibility of dirty air for other kinds of more subtle weather changes. It is now accepted that, by acting as a blanket, it is one factor, along with massive amounts of heat-absorbent concrete, responsible for keeping cities warmer than suburban areas by retaining the heat from automobiles, furnaces, industrial plants, etc.

Thus, average annual temperature minimums in the center of Washington, D. C., run around five degrees higher than those in outlying areas of the city. Moreover, the temperature differences are greatest on weekdays, when pollution, primarily from automobiles, is at a peak. In New Haven, Connecticut, the minimum temperature on Sunday differs from that of the countryside by only 1.2 degrees; on weekdays, however, the difference is twice that.

Variations of such magnitude can have an important effect on the frost-free season. For example, downtown Chicago's frost-free period is 197 days; in the surrounding counties, however, it's only 160 days. To find open country with a frost-free period as long as that of Chicago you have to go 400 miles to the South.

Polluted air also means less sunlight, as most of us have learned. Cities today average from 15 to 20 per cent less sunshine annually than the surrounding countryside, and in many metropolitan areas the clear blue sky is almost a thing of the past, appearing only under almost perfect meteorological conditions. During the four winter months, for example, London has only about 96 hours of sunshine, compared with as much as 268 hours in the open countryside.

There is also some evidence that pollution from jet aircraft engines in the upper atmosphere is responsible for increased cloud formation in some areas. Thus, Dean Hosler notes that cloud cover along the heavily traveled New York-Chicago jetway has increased to the point where that section of the route in Pennsylvania near his home is now covered by cirrus clouds about 90 per cent of the time. This was not the case before.

Prof. Reid A. Bryson, a University of Wisconsin meteorologist, says the same thing is happening on the New York-London jet route. Cloud cover in the air lanes between these two cities is up ten per cent, he estimates, and is increasing.

Prof. Bryson, along with other meteorologists and climatologists, is also becoming increasingly concerned over the fact that the clouds, along with the greater turbidity of the atmosphere, are contributing to another potentially dangerous phenomenon: The trend toward cooler temperatures around the world.

Scientists estimate that average annual temperatures all over the world have dropped by one-third to one-half a degree during the past three decades. This doesn't sound like much until you stop to consider that the last Ice Age came about through a temperature drop of only four or five degrees.

Upper-atmosphere physicists point out that dirt and clouds have already increased to the point where enough sunlight is being reflected away to over-ride other factors which would tend to raise the temperature of the earth, such as the growing amounts of CO_2 (from the increased consumption of fossil fuels) in the atmosphere. The CO_2 acts as a one-way filter, which permits the sun's ray to pass through while deflecting the heat given off by the earth.

While meteorologists still don't have enough data to be able to predict confidently what will happen to the earth's climate in the future, they are sufficiently worried about it to be planning a number of local, national and even international meetings to discuss the matter. Their concern has been summed up by Prof. Bryson as follows:

"The only basis we do have (for concern) is to look at the past to see what did happen. Looking at the climate of the past, it is clear that small changes in the past 10,000 years had very large ecological effects, and they can happen bloody fast. The end of the Ice Age took less than a century. Kapow! Just like that! It's fast, and that worries me, because we don't know for sure that in a few years we might not have a significant change that would disrupt our entire climate."

Scientists are convinced that we simply cannot wait until this happens, because it will then be too late. Moreover, it is becoming more and more obvious that fighting pollution will require local, regional, national and even international cooperation.

The evidence is plain for all to see. When Gary's steel mills are going full tilt, it rains in LaPorte; Sweden establishes what is probably the world's best anti-pollution program but can do nothing about the dirty air that drifts in from England's industrial plants; New York's pollutants show up several weeks (or months) later over Alaska and Siberia.

Will the effort that's required be forthcoming? No one is confident that it will, despite President Nixon's assurances that we are now prepared to wage the good fight. The true test will come when we learn how much money will be available for the fight on pollution; how the money will be administered and spent; whether the anti-pollution laws (many of which are already on the books) are administered as they should be; whether industry will go along with (and help pay for) the controls needed to do the job; and, perhaps most important, whether the public will respond with the kind of total effort that will be necessary.

If nothing else, at least the nation's press appears to be convinced of the need for such an effort. It's an unusual event when *Time, Life, Newsweek, Look, Fortune* and even *Sports Illustrated* all devote a considerable portion of their editorial coverage to the same topic in the course of only a few short weeks, particularly when that topic is neither war, nor politics, nor the jet set, nor the entertainment world. And yet that is just what happened during the early part of this year. It is gratifying to learn that the press, at least, has become convinced that pollution is everybody's business.

Lord Ritchie-Calder, the eminent British science writer and science adviser to the United Nations, may have put it best when he ended a recent article in *Foreign Affairs* by noting that "mankind shares a common habitat. We have mortgaged the old homestead and nature is liable to foreclose." Can we halt this foreclosure? He believes we can, but he doesn't think it will be easy, because "there are no frontiers in present-day pollution and destruction of the biosphere." Thus, intergovernmental action on an international scale will be necessary—and this is never easy.

He also pointed out in his article that pollution has an effect on the total environment, and not only on portions of it. He wrote that the atmosphere "is not only the air which humans, animals and plants breathe; it is also the envelope that protects living things from harmful radiation from the sun and outer space. It is also the medium of climate, the winds and the rain. Those are inseparable from the hydrosphere—the oceans, covering seven-tenths of the globe, with their currents and extraordinary rates of evaporation; the biosphere, with its trees and their transpiration; and, in terms of human activities, the minerals mined from the lithosphere, the rock crust.

"Millions of years ago the sun encouraged the growth of the primeval forests, which became our coal, and the plant growth of the seas, which became our oil. Those fossil fuels, locked away for eons of time, are extracted by man and put back into the atmosphere from the chimney stacks and the exhaust pipes of modern engineering. About six billion tons of carbon are mixed with the atmosphere annually.

"During the past century, in the process of industrialization, more than 400 billion tons of carbon have been artificially introduced into the atmosphere. The concentration in the air we breathe has been increased by approximately ten per cent and if all the known reserves of coal and oil were burned at once, the concentration would be ten times greater."

He goes on to note that this is more than just a public health problem, more than a question of how much CO_2 goes into someone's lungs, more than a question of smog, since the carbon cycle in nature is such a delicate mechanism, and upsetting it can have disastrous consequences. However, he is concerned that the growing amounts of CO_2 in the atmosphere; and the greenhouse effect which results, may cause the earth's average annual temperature to *increase*, rather than decrease, in the future.

The British scientist estimates that, at the present rate of increase, mean annual temperatures could rise by as much as 3.6 degrees Centigrade over the next 40 to 50 years. Already the north-polar ice cap is thinning and shrinking, and the seas, with their CO_2 blanket, are changing their temperatures, so that marine plant life is increasing and transpiring more CO_2.

As a result, fish are migrating and changing their latitudes, while on land the snow line is retreating and glaciers are melting. The melting of ice caps and glaciers will raise the level of the sea, and rivers originating in glaciers or permanent snow fields will increase their flow. And if ice dams, such as those in the Himalayas, break, the floods will be catastrophic. In the course of this process, precipitation patterns will change, and some areas which are now fertile may become arid, while dry areas may suddenly find themselves with heavy rainfall.

Thus, Lord Ritchie-Calder's view of what the future holds. Nor are other leading ecologists, like Rene Dubos of Rockefeller University, LaMont Cole of Cornell, Paul Ehrlich of Stanford, Barry Commoner of the University of Washington in St. Louis, Eugene Odum of the University of Georgia, and Kenneth Watt of the University of California at Davis, any more sanguine about the future. They are hopeful, however, that the series of major environmental teach-ins at universities across the country that will climax in the nationwide teach-in of April 22 will awaken the public to the dangers it faces.

Time thinks it may be necessary to develop a new way of thinking to solve present environmental problems. "So far," the magazine noted, "the key to so-called progress has been man's ability to focus his energies on a single problem, whether fighting a war or going to the moon. But thinking in compartments is the road to environmental disaster."

Many people are reaching the same kind of conclusion. It has become obvious that we can no longer afford to operate under the assumption that infinite growth is possible on a finite planet. There are many ecologists who believe today that only a catastrophe, or a series of catastrophes, can change that assumption. However, Barry Commoner and others still believe that man will reform when faced with overwhelming reasons for doing so. The main question is whether it is not already too late to do so, or, if it is not, whether man now is, or will in the near future be, willing to do what has to be done.

One of the biggest problems seems to be that of how to prove to man that his very survival is at stake. One trouble is that, despite the warnings of the more pessimistic ecologists, it is still not possible to do so to everyone's satisfaction, primarily because to date man has demonstrated an almost uncanny ability to adapt himself to his environment, and many people think he may be able to do so once again.

Rene Dubos has ruefully noted that modern man (in this case perhaps unfortunately) can adjust to environmental pollution, intense crowding, deficient or excessive diet, and monotonous and ugly surroundings. If such adjustments are added to the process of natural selection, and those who most readily adapt to regimentation, overcrowding and esthetic privation rise to positions of leadership and also outbreed their less adaptable fellows, the eventual result, while perhaps somewhat less catastrophic than pessimists today might allow, could be equally tragic.

As *Newsweek* put it, "the real specter that pollution casts over man's future is not, perhaps, the extinction of Homo Sapiens, but his mutation into some human equivalent of the carp now lurking in Lake Erie's fetid depths, living off poison."

It is not a choice which is likely to make anyone happy.

Paul H. Keating—
Mines' Most Colorful Professor

By Den Galbraith

THAT two-toned, red-and-black car was something else, believe me, for it was not two-toned in the usual fashion, top and bottom, but right and left, the right half black with red wheels, the left half red with black wheels. Or maybe it was vice versa. No matter!

Yet the owner of that car had even more character. Years afterward, students from the Colorado School of Mines would be unable to conjure up the names of buddies they had associated with for four years, but they would remember Professor Paul Hepburn Keating forever.

As we finally heard the story, his reason for that weird paint job was not sheer whimsy or senility. It stemmed from a tragic-comic accident and court case he had been involved in. What stuck in Keating's craw about that case was the testimony of two ladies, both eye witnesses. One testified that Keating drove a brown car, the other, green.

"I swore that day," Keating told me after class one day, "that if I became involved in another car accident, the bystanders would remember the color of my car."

More important, he resolved that day to teach students to "observe and think."

Colorful Character. Thinking back, I saw a lot of Prof. yet essentially I knew nothing about him. Sure, I can describe him, skinny, wiry, angular, fair-haired, face etched like a copper plate, those horn-rimmed glasses from another era, the jaunty tilt to his hat, but that tells us so little. Put everyone from Berthoud Hall in a line-up and an outsider would have picked Keating as one of the janitors. Only when he was mad did he seem like a dignified professor.

"I'm going to shake up the troops," Keating told me one morning at breakfast, grinning in anticipation.

He did. Feeling obligated to repay many of the faculty and their wives for dinners, Prof. invited them all to the local hotel. To spice up the occasion, he invited a lady young enough to be his granddaughter to act as his partner for the affair, creating quite a stir for she appeared in gown cut distressingly low.

Enigmatic! A paradox! All that and more. Here was a fellow who bordered on eccentricity, yet he abhorred publicity. When Col. Wendell Fertig, of **They Fought Alone** fame, wrote an eulogy for him for **Mines Magazine,** he searched high and low for a photograph, finding only one, taken in a group.

In many ways he was a "loner," yet he enjoyed people, or at least certain people. Supposedly he had been married four times, but the number of times varies with the teller. Prof. never soured on life or people, but apparently he got fed up with married life, or at least married life for himself.

Quite often he squired ladies around town. Rumors floated around that he had agreements, signed, sealed, witnessed, and notarized, with certain favorites, stating that: (1) they would not marry each other, and (1) neither one would marry anyone else.

I can't verify that, wouldn't have asked him, don't care, really, but it sounds like him.

No Fuss, No Muss. He lived a simple, completely uninhibited life and his motto, if he had a motto, was, "No fuss, no muss." Being unattached, myself, I ate many meals with him. They never varied: soft-boiled eggs and coffee for breakfast; three cups of black coffee for lunch; two to five extra-dry martinis and a steak sandwich for dinner. But, I'm sorry, sometimes his meals did vary a bit—sometimes he skipped the steak sandwich at night.

His bachelor apartment at Golden, while teaching at Mines, looked like an antique shop out of Charles Dickens, for he lived like a pack rat, and woe unto anyone who attempted to "muck out" the debris. Wood and aluminum crystal models, waiting to be polished, were stacked in crates near the entrance or lay helter-skelter on the floor. You ducked under, stepped over, and maneuvered around things.

Clothes were scattered around in all the rooms, everywhere except in closets. No room, there. If you were a friend, he cleaned off a chair so you could sit down.

"His apartment always worried me, but mostly intrigued me," Mary Louise Kohlhass, wife of a Mines professor, reminisced awhile back. "What in the world was that crated bath tub doing in the middle of the living room?"

That crated bathtub worried me, too, but I had learned not to ask questions.

Dusty books piled on his bed nearly reached the ceiling. He explained that he couldn't sleep in a regular bed and used a camp cot. The camp cot was nearly buried under old reports and manuscripts. No one realized, back then, that he suffered from emphysema and slept sitting up in a chair.

Loss of a Friend. The latest style in clothes never concerned him. His clothes never matched except that his battered shoes matched his battered hat. Oh, boy, that hat! He must have bought it in year one, and certainly it enjoyed "multiple use." Fish flies on the outside, notes and dollar bills on the inside. I am sure he carried camp water in it and used it as a pillow. Yes, that hat had character, all right, but I remember its demise.

That day I walked along a Denver street. Ahead of me I noted a familiar figure, fists clenched, striding with a purpose. At the corner, Keating walked directly to a trash can, pushed back the top, pulled off that gray felt, stared at it fondly for a few moments, roared in a loud voice, "Goodbye, you forlorn son-of-a-bitch," threw it in the receptacle, then hurried into a nearby store to buy a new one, oblivious to the wondering, snickering bystanders.

Full Life. Born on July 9, 1897, in Pueblo, Colorado, Prof. completed high school there, then attended the University of Wisconsin and the Colorado School of Mines, graduating from the latter school as a mining engineer in 1921.

Shortly after graduation, Keating married Marie Kaskell of Denver, but she died at the birth of his son, Paul, Jr. He never fully recovered from her loss, but probably no more than two or three confidants ever realized his innermost thoughts.

For many years he floundered around in various parts of the country at several occupations: mining engineer, geologist, plumber, politician, importer-exporter, bartender, court stenographer, county surveyor, and entertainer, playing both guitar and piano. For a short time he wrote feature articles for King Features Syndicate, and he authored two small books, *Identification of Oriental Rugs* and *Building and Flying a Tobogoplane*. Off and on, he wrote considerable poetry, most of it with the salty flavor of Robert Service.

Probably 1937 was the important year in his life, for that year he decided to return to Mines to teach crystallography and mineralogy. He stayed at Mines until his retirement in 1962, interrupted only a period during World War II when he served with the Intelligence Service in England.

For many decades, Mines has enjoyed a world-wide reputation as an engineering school and Keating, as much or more than any other individual, reflected the spirit of that institution.

Dr. Lester LeRoy, a friend and associate, put it this way: "Mines and Paul are synonymous. He was a teacher fanatically dedicated to the philosophies and objectives of Mines, and a friend to hundreds of students who had enrolled in his crystallography and mineralogy courses."

Crystal Paul. Students either hated him or loved him, he was that kind. He walked no middle ground. Those who hated him the most had generally flunked his courses the worst. Students soon learned that Keating wore two hats at Mines, for when they went in to be interviewed by the Readmissions Committee, guess who was the chairman? Yes, that same character!

Students from around the world will remember his "bedroom-bathroom" technique of teaching and his vivid, lusty terminology, some of it sheer poetry, much of it unprintable. Years later they would pick up rocks and recall them as "cat-sick green" or "dog-(something-or-other) brown." And the monoclinic system (having two axis at right angles and a third running "slaunch-'n'dicular" to them) will always conjure up the image of a Chick Sales outhouse.

Newspaper reporters tagged him as Crystal Paul. But whether he was just a good mineralogist or the best really makes no difference. The difference came in teaching students to "observe and think." Every quiz had the letters R.T.P.-T.T. at the top.

Read the Problem. Then THINK.

His approach to teaching proved distinctive and refreshing, for he eliminated most of the "cold-cocking" that engineering courses normally require. Never would he tolerate sloppy or haphazard work. He emphatically demanded a good use of English, and he insisted that students write and speak correctly.

"An engineer must be able to communicate in a precise manner," Keating would tell his classes.

Part of his success at teaching came from a deep understanding of human nature. He anticipated shenanigans dreamed up by students. No one slept through his lectures. Maybe once, but they never tried it a second time. Completely fair, he would allow students to make up an exam they had missed, or flunked, if they had a legitimate excuse or plausible reason. One catch—the make-up exam always came the following morning at five o'clock. And the second time around the quizzes always seemed a bit tougher.

Unusual Quizzes. Just imagine taking an oral exam blindfolded or a written exam in total darkness. Unusual? Perhaps! Yet the unusual was the usual with Paul Keating.

One class of students will never forget the time he passed around fourteen specimens, each a different color of sphalerite, a zinc mineral.

"A dirty trick?" Keating said.

"Maybe! You should've seen some of the answers on those papers. But I'll bet a ten-inch watermelon tourmaline against a three-ounce gold nugget that no one in that class will ever again identify a rock on the basis of color, alone. They'll think . . . observe and think."

About once a week that first year, it seemed like my roommate, Lee Garrett, came back to the room with, "Well, guess what that character Keating pulled on us today?"

Maybe Prof. had passed around an unknown in a closed can, such that the students had to roll the specimen around, determining its system by sound. If it sort of staggered around, flip-flopping right then left, you probably had a dodecahedron, a twelve-sided crystal, but you had to think.

"That's nothing," I would tell Garret. "Guess what Crystal Paul threw at our section. He passed around unknowns in velvet bags, so that we had to identify their systems by feel."

His quickie, unexpected short quizzes could be deadly and your grade could fluctuate rapidly. "Lucking out," even once in awhile, was a rarity.

One impromptu quiz comes to mind. One at a time and alone with him, he asked students to run a hand down into a boot sock and identify one of two specimens at the toe. If he heard "cryolite," his face crinkled in a happy grin. Cryolite has the property of retaining a cold feel, while most other minerals more-or-less adjust to room temperatures. Marble has the same property. Go lay your hand on your marble-topped coffee table and you'll see what I mean.

Don't think students didn't get unhappy about some of those exams, and he knew it, but he always thought of the end result. And if students didn't learn something on the first go-round, the chances were good they sat through his courses a second time.

Embarrassing Moment. Over the years, Keating built up a valuable collection of gems and semi-precious stones. He loved to show his gems and he lectured widely.

When Crystal Paul showed his collection to a class, he would start his lecture: "The British Royal Museum owns the largest cassiterite (a tin mineral) crystal in the world. It weighs 34 ounces. Mine weighs 65 ounces . . ." and then he would toss the gem across the room to some unsuspecting student.

One of his bedroom-bathroom techniques proved embarrassing on one occasion. A prominent couple had inveigled him to show his collection to a group of friends. Among other things, Keating gave them a layman's method for distinguishing between a diamond and quartz, employing only a drop of water. Water, as you know, seeks its own level, unless restrained or controlled by surface tension and other factors. A drop of water on glass will flatten out like a fried egg, yolk busted; on a diamond face, the drop of water will stand up, almost a hemisphere, like the yolk of a fresh egg.

Without a word, one of the ladies handed over her diamond ring for a demonstration.

"Bad news!" Keating chuckled. "Hells bells! That drop of water flattened out like a buffalo chip. There were some funny looks exchanged, some directed at me. Remember one thing—make sure the surface of the diamond is spotlessly clean, free of grease. Better yet, forget it!"

A Few Boobytraps. At his home in Rye, Colorado, he lived like a hermit-recluse, way back in the woods. He rarely left the kitchen, except for a walk to the woodpile, sleeping in a large leather chair. Guests spent the night in his den, every square inch of walls and ceiling covered by tantalizing pictures of nude women from around the world. His fluorescent fireplace was a work of art. Confidants swore he had a secret room. A three-foot pile of unanswered letters from former students filled one corner of the kitchen. By then Prof. had quit reading scientific publications and concentrated on Mike Hammer stories by Mickey Spillane.

Folks around Rye will remember Keating's antics for a long time.

Since he spent most of the years at Golden, teaching, he had kept the Rye home boobytrapped to discourage prowlers and looters. On my first trip to Rye I stopped at the only cafe in town and asked a young waitress for directions.

"Don't get out of your car when you get there, mister," the young girl warned me. "Honk your horn and wait until he comes to the door. Otherwise you might step in a bear trap, or something."

Or something was right. Like the wires he had strung around to trip the switch on a siren, a wailing, caterwauling monster whose sound carried fifteen miles. After an old-maid school teacher, birdwatching, and a couple of prowling animals tripped the siren, Prof. reluctantly agreed to disconnect the fiendish gadget.

Tear-gas grenades were conveniently placed in every room of the house, and doors and windows were wired for hair-raising jolts. Undoubtedly, the young college girl, taking the census out in that neck of the woods, regretted her rashness of grabbing the knob on the back screen door. Poor girl! She barely had time for a terrified scream before she found herself brutally cartwheeled to the ground. A few minutes later when Mr. Miller, the nearest neighbor, got there, he found her staggering to her feet, groggy, wild-eyed, incoherent, mumbling that she must have been struck by a bolt of lightning.

She had had enough. Under "Occupation," she wrote "eccentric professor" and vacated the premises.

An oldtimer, delivering butane, had a similar experience. He drove back to town and told his boss: "If you want butane delivered to that screwball professor, get someone else."

One winter Prof. noted his stack of stovewood was dwindling at a rapid rate. Thinking about that didn't make him happy. All sorts of fiendish ideas ranged through his head on how to put an end to such shenanigans, once and for all. Finally, he drilled a long hole in one stick of wood and loaded it with dynamite caps and sawdust.

That recipe produced results. Fortunately for the fellow who again borrowed a pickup load of wood, he was outdoors when his stove exploded and the stove lid went through the roof.

Humorous Incident. When a person as widely known as Paul Keating passes on, friends like to offer intimate memories or humorous incidents from their past association. Clark Barb, former head of the Petroleum Engineering Department at Mines, was probably Keating's closest friend and confidant. Barb remembers a story which Keating told on himself.

Shortly after Keating retired from Mines, he had an attack of some sort which left him quite weak. The doctor gave him a list of medicines and pills to take, such that he was doped-up much of the time and often sleepy.

That night Prof. went to sleep as he ate supper. He had a wild dream about out-of-this-world monsters who delighted in torturing him in strange ways. Mostly they seemed intent on freezing his nose. When Prof. finally awoke, he felt his nose, so realistic had the dream been. It actually felt frozen.

Then he realized his face had been lying in a bowl of frozen strawberries.

Helping Hand. "Paul Keating would assist, both personally and financially, any student whom he felt needed help, and who could survive with that little extra boost," Lou Scher told me the day we learned of our friend's passing on. "I am one of those students. What I needed was a good boot in the britches, and that's what that man gave me. I sincerely believe that if it had not been for his help and guidance during those crucial years, I never would have finished school and made a go of my profession."

Lou's first year at Mines could be called a classic fiasco. He flunked most of his courses the first semester, and dropped out of school before the second semester finals. At that point his father refused to send him any more money. Discouraged, the young fellow tried to find to job.

Keating sensed Lou needed help and guidance. He found Lou, gave him some money to live on and a part-time job, and made him promise to retake the courses he had flunked at Mines at some other school, then return to Mines.

Getting back into Mines wasn't easy, for two members of the Readmissions Committee said, No! Keating said, Yes! The other two kept saying, No! and Keating kept saying, Yes! Finally Keating pounded the table long enough and hard enough that the other two conceded, provided the young fellow never flunked another course. Lou Scher went on to graduate and has done well as a petroleum engineer.

On February 18th of last year, I visited with Paul Keating for the last time, a sad visit, for he knew the end was near. In between his frantic gulping of oxygen, we reminisced about old friends and associates, Clark Barb, Tony Pegis, Johnny Hollister, Truman Kuhn, Dr. F. M. van Tuyl, but every few minutes he kept mentioning that Lou Scher would be back in from Venezuela. I felt that he would hang on until Lou arrived.

Lou Scher made it to Golden on the 26th of February. He drove down to see Prof. on the 27th, even though his leg was in a cast and the doctor had warned him not to drive. Keating slipped in and out of comas all day and Lou had only one brief chat with him before he went into another coma, the last one as Lou and I learned the next day.

A Farewell. Telling you about his long, tough struggle with emphysema wouldn't help any and I don't want to think about it. I would rather remember him in front of class with that sly, hell-for-leather, devil-take-the-hindmost grin on his face and hear the guy behind me mutter: "Oh, brother! What is that character up to now?"

Whether you liked him or hated him, you had to admit one thing: he was an institution, a truly unforgettable character.

As so aply put by Dr. Fred Moore, another professor at Mines: "It is in the people and the things which are Mines that Paul Keating achieved his stature."

Thanking him while he was alive would only have proved embarrassing, and he would have snorted and said, "Go to hell!"

So long there, ol' Paul Keating. Thanks for making life a bit more interesting and meaningful. Yes, and thanks for the boot in the britches. It helped a lot of us.

Climax Mine Wins Citation For Preventing Water Pollution

A CITATION for "outstanding contributions" in preventing water pollution has been awarded to the Climax mine of Climax Molybdenum Company at Climax, Colo., by the Colorado Water Pollution Control Commission. Climax Molybdenum is a unit of the Molybdenum and Specialty Metals Division of AMAX (American Metal Climax, Inc.).

The Climax mine is located in central Colorado at an elevation of 11,200 feet above sea level on the Continental Divide. The headwaters of the Arkansas and Eagle Rivers flow near the mine property.

The mine is the world's leading source of molybdenum. It produces an average of 40,000 tons of ore per day for a flotation plant which recovers, on an annual basis, approximately 50-million pounds of molybdenum in a di-sulphide concentrate. By-product tungsten, tin and pyrite concentrates are also recovered.

The Climax mine uses an extensive system for re-circulating water used in processing the ore. This involves a continuous re-cycling of more than 25-million gallons of water per day needed in the molybdenum extraction process. As a result, mine industrial water is kept separated from river drainage on both slopes of the Continental Divide.

Additional systems have been developed at Climax to capture underground mine drainage water and prevent it from contaminating nearby streams. This system is used for active mine openings and older mines which were operated in the late 1800's, but later abandoned and acquired by Climax as it expanded its own operations and needed more land.

Between 1967 and 1969, Climax spent $122,000 to install a collection system for mine drainage water flowing from the portal of its Storke Level operations. As a result, heavily mineralized water is prevented from entering the Arkansas River where it might be harmful to fishlife. In the same area, muddy water from a sand and gravel washing plant at Climax is retained in a series of settling ponds for clearing and reuse.

Climax has also installed basins and dams immediately below its tailing (process waste) storage areas to collect seepage water. This water is returned through pumping stations to the industrial water circuit, eliminating another potential source of stream contamination.

This citation awarded to the AMAX Molybdenum and Specialty Metals Division for its efforts at the Climax mine is the fourth award the corporation has received during the past two years for its activities in pollution control and protection of the environment. Others were from the Sports Foundation, Inc., *Business Week,* and *The Environment Monthly.*

Catalogs and Trade Publications

HYDRAULIC CONTROL VALVES (652)

Monoblock hydraulic control valves are described in a new bulletin (HU-1841) from HUSCO Division of Koehring, Waukesha, Wisc. 53186, one of four divisions of the company's Hydratech Group. The valves offer full circuit protection, take up a minimum of space and provide unlimited control with capacities from 3 to 185 G.P.M. and operating pressure to 2500 P.S.I. **Circle 652 on Reader Service Card.**

ACQUISITION SYSTEM (653)

A four-page brochure, describing the V-4991 Digital Data Acquisition System, is now available upon request from the Analytical Instrument Division of Varian Associates, 611 Hansen Way, Palo Alto, Calif. 94303. The growing use of computers for the processing analysis, and presentation of geophysical and environmental field data has created a strong demand for a means of digitally recording the data in the field. The V-4991 system from Varian is a completely self-contained digital data acquisition system for just such a use. It is specifically designed for airborne, marine or station digital recording of field data, and also provides for the entry of other essential parameters such as time, navigation and identification input channels, plus an internal clock. **Circle 653 on Reader Service Card.**

PHOTOMICROGRAPHS (654)

The new II/I Polaroid camera for photomicrographs in seconds, a direct reading exposure-meter, and a camera stand, are described and illustrated in a two-page release. These components can be used with all microscopes. Write to Hacker Instruments Inc., P.O. Box 646, West Caldwell, N.J. 07006 or **Circle 654 on Reader Service Card.**

CUTTING ATTACHMENT (655)

The Harris Calorific Co., 5501 Cass Ave., Cleveland, Ohio 44106 is now manufacturing a new cutting attachment for the low cost fuel gases such as propane and natural gas. The new 36-2N fits Harris 19-2 or 50-3 handles. The attachment features solid forged head, triangular tubes, valve forward design and flat tip seat for long life. It has capacity to cut steel up to 3" thick. Ask for Bulletin 700215. **Circle 655 on Reader Service Card.**

WASHING PLANT EQUIPMENT (656)

A 32-page bulletin describing Telsmith washing, scrubbing, dewatering and classifying equipment for materials processing plants has been released by Smith Engineering Works. Covered by the bulletin are various features and operating advantages of Telsmith super-scrubbers, rotary screens, screw rewashers, sand tanks, cyclones and dewatering and classifying tanks. There is a section devoted to describing Telesmith's newly designed, low surge sand classifiers. Another discusses Telesmith's newly designed, low surge sand classifiers. Another discusses Telsmith Blend.A.Matic, a recently developed fully automatic system for blending sand graduations to meet highly exacting product specifications. For a free copy of Bulletin 292-A write Smith Engineering Works, 532 East Capitol Dr., Milwaukee, Wisc. 53212 or **Circle 656 on Reader Service Card.**

ELECTRICAL CONNECTORS (657)

A new 90-page general catalog (H-600) covering its complete line of waterproof heavy duty electrical connectors is now available from Joy Manufacturing Co., Oliver Bldg., Pittsburgh, Pa. 15272. The connectors are particularly designed for use in a wide range of industries—wherever it is essential that connectors withstand physical abuse and exposure to moisture, corrosion and harsh environments without impairing circuit integrity. The catalog includes a complete illustrated index, full descriptive information on a wide variety of plugs and receptacles and application photographs and drawings. **Circle 657 on Reader Service Card.**

AIR COMPRESSORS (658)

A new four-color, 16-page catalog has been issued by Ingersoll-Rand Company covering their line of stationary air compressors, 25 through 125 horsepower. These air-cooled models are excellent for continuous duty applications and have found wide usage in all industries. Actual delivery ranges from 115 to 550 cfm at 100 psig. Units are available for pressures from 30 to 250 psig applications. The catalog points out the reasons why Ingersoll-Rand compressors are unsurpassed, shows their pertinent features and gives physical information on the baseplate mounted units as well as the complete packaged plant. Standard and optional equipment is described and sample specifications are included. A condensed description of all other Air Power Compressors available together with product and literature illustration is shown. Ingersoll-Rand Co., Air Power Compressor Div., P.O. Box 552, Corning, N.Y. 14830. **Circle 658 on Reader Service Card.**

Send Us Your Bulletins

Send your publications to The MINES Magazine, 2177 W. 7th Ave., Denver, Colo. 80204, for review in these columns.

To all MINES readers these publications are FREE, and may be ordered by giving index number.

On requesting publications from manufacturers, please mention the MINES Magazine.

FIRE FIGHTING MONITOR (659)

A 4-page brochure describing the new Stang Firefly portable fire fighting monitor is now available from John W. Stang Mfg. Co., 767 N. Main St., Orange, Calif. 92667. The monitor can be pulled over rough terrain . . . up and down curbs . . . over hose and pipe lays and through narrow openings with a minimum of effort. The Firefly can deploy an effective water stream with only one man operating the unit. Other portable monitors now in use, usually require three men for operating under pressure. **Circle 659 on Reader Service Card.**

MARKETING SOLUTIONS (660)

What are the 10 toughest marketing problems with the greatest potential for playoff and profit improvement? Consultant Burr W. Hupp posed this question to a number of top business executives recently, and came up with what he calls "the 10 most wanted marketing solutions." High on Hupp's list of marketing problems managements are anxious to solve is the "No Problem Syndrome"—the problem of getting line managers to acknowledge that marketing problems do exist. To illustrate this, he quotes a corporate executive of a major Eastern firm who told him, "Believe it or not, some of our divisions actually replied that 'we have no marketing problems!' That in itself shows there's a problem . . ." The complete report of Hupp's findings appears in the May, 1970, issue of the Drake Sheahan/Stewart Dougall newsletter, **Marketing for Profit.** Copies are available without charge from Burr W. Hupp, Director, Drake Sheahan/Stewart Dougall Inc., 330 Madison Ave., New York, N.Y. 10017, or **Circle 660 on Reader Service Card.**

SELF-SEALING COUPLINGS (661)

A new industrial bulletin describing 5600 Series PUSH-PULL* Self Sealing Couplings has just been released by Aeroquip Corporation, Industrial Division, Jackson, Mich. 49203. The 8-page publication, Industrial Engineering Bulletin 132, gives complete engineering data on 5600 Couplings ranging in size from ⅛ inch through one inch. Bulletin 132 lists the various components available for 5600 Series Couplings, including replacement O-Rings for special fluid applications. The bulletin also includes dimensional data, a pressure data chart showing rates of flow in gallons per minute, and operating characteristics for each coupling size. One of the bulletin's most useful charts is a fluid compatibility table, indicating the suitability level of couplings and elastomer seals for the range of fluids likely to be encountered in typical industrial operations. **Circle 661 on Reader Service Card.**

PNEUMATIC PRESSURE CONTROLLERS (662)

Bulletin 310 available from United Electric Controls Co., Watertown, Mass. 92172, introduces the 310 Series Pneumatic Pressure Controllers which convert process pressure or vacuum to on-off pneumatic signals. Sharing a single, weatherproof, exceptionally compact enclosure, these controls are available with 20 ranges within 30" Hg. Vac and 6000 PSI, internal or external adjustment, and up to three pneumatic switches. A unique non-bleed pilot valve provides snap-action switching with N. O., N. C. or dual relays, while non-snap-action switching is provided by up to three N. C. non-bleed pilot valves and no relays. **Circle 662 on Reader Service Card.**

CONVEYOR ACCESSORIES (663)

A variety of conveyor accessories including skirt-board rubber, chute and launder lining, scraper rubber and pulley lagging are described and specified in a new six-page bulletin produced by Hewitt-Robins Bulk Handling Equipment Division of Litton Industries. The new publication, 4302-A, which also provides installation procedures and recommended cements and solvents, is available from the company, 666 Glenbrook Road, Stamford, Conn. 06906 or **Circle 663 on Reader Service Card.**

PROCESS EQUIPMENT (664)

Bulletin No. 200-B briefly describes the various types of process equipment and systems manufactured by BARTLETT-SNOW. For some 80 years B-S has designed and fabricated process equipment. During this period the company has been privileged to serve many of the largest concerns in the United States by offering complete design and fabrication responsibility, and by creatively engineering equipment to meet customer requirements. **Circle 664 on Reader Service Card.**

THICKENER UNDERFLOW (665)

A system for automatic control of thickener underflow is described in a new application bulletin (No. 60-1) prepared by the leading manufacturer of slurry valves. The bulletin reproduces an actual recorder chart to show how one of the major copper producers has achieved continuous operation of the thickener at optimum density, while at the same time effecting a substantial reduction in supervision time and better water recovery. Clarkson Co., 735 Loma Verde Ave., Palo Alto, Calif. 94303 or **Circle 665 on Reader Service Card.**

TUNGSTEN CARBIDE COATINGS (666)

Hard tungsten carbide coatings with extreme resistance to wear are described in a new technical data bulletin just released by Metco Inc., 1101 Prospect Ave., Westbury, N.Y. 11590. Called Metco 438 and 439, the tungsten carbide coatings are both self-flushing and self-bonding. They can both be applied in-plant with the Type 3M Plasma Flame Spray System. The new Bulletin 150D features a table comparing the two coatings for hardness, bonding properties, surface finish, thermal shock resistance, melting point, density, coating thicknesses, etc. Also included is a list of over sixteen potential applications. **Circle 666 on Reader Service Card.**

HYDROCARBON ANALYZER (667)

The first commercial flame-ionization hydrocarbon analyzer to equal the response speed of infrared instruments is the subject of a new 12-page bulletin from Beckman Instruments, Inc. Bulletin 4104 fully describes the Model 400 Hydrocarbon Analyzer which is temperature-controlled and designed for both ambient air monitoring and vehicle emissions studies. Complete operating specifications are listed. The standard safety features of a flame arrestor and flame-out indicator are also described. Descriptions and illustrations of the various options and accessories available for the instrument are included. Process Instruments Division, Beckman Instruments, Inc., 2500 Harbor Blvd., Fullerton, Calif. 92436. **Circle 667 on Reader Service Card.**

BELT FASTENERS (668)

A 20-page manual (Bulletin F/200) designed to simplify the selection and ordering of fasteners for any belt is available from Flexible Steel Lacing Co., 4607 W. Lexington St., Chicago, Ill. 60644. The first of its kind, this booklet covers all four basic types of belt fasteners, and a complete line of belt maintenance tools. New recommendations are included for today's wide range of high strength, synthetic fabric belting, as well as belting made of conventional material. **Circle 668 on Reader Service Card.**

WATERLEVEL CONTROL (669)

A new, solid state electronic device which automatically monitors and controls the level of water or any water-base liquid is now available. AquaTone Model ESS-110 will activate any 110V AC level maintenance system or alarm system for an automatic control over level rise or drop. The AquaTone sensor is mounted remotely in the area to be monitored, such as a vat, manhole, steam table, storage vessel of any type, tank, pumping area, wells, flow lines, etc. When water or conductive liquid either rises to or passes below the sensor probes, a 110V AC light or sound alarm, pump, or solenoid can be automatically activated. The unit may be programmed by the user to detect either the presence of the liquid or absence of the liquid, whichever application is needed. Zeigler Electronics, Inc., Dept. AP, 17810 S. Western Ave., Gardena, Calif. 90247. **Circle 669 on Reader Service Card.**

WANT MORE INFORMATION?

Use MINES Magazine's convenient READER SERVICE CARD, circling numbers that correspond to items interested in, drop card in mail. No stamp necessary!

Personnel Placement

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

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

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

Client's Code Number	Degree	Age	Marital Status	No. of Children	Preferred Fields of Work	Locality Preferred	Languages Spoken
MN 18	Mining	44	M	2	Mining-Metals Mill	Colorado	English
MN 34	Mining	39	M	1	Mining Geology	Western USA/Foreign	English/Spanish
MN 35	Mining	45	M	6	Mining Engineering	Open	English
MN 36	Mining	30	M	1	Open Pit or Underground	West, Northwest U.S.	English
MN 37	Mining	29	M	2	Production	Rocky Mountain or Western U.S.A.	English
MN 38	Mining	25	M	0	Mining—Open Pit or Strip	Domestic or Foreign	English
MN 40	Mining	30	S	..	Mine Planning Operations	Western U.S.A. or Foreign	English
MN 42	Mining	23	S	..	Exploration, Prospecting	Australia	English
MN 43	Mining EM-MSc	27	M	0	Exploration, Geology and/or Research	Colorado	English/German
MN 50	Metallurgy	29	M	1	Mineral Processing Production or Engineering	Rocky Mountain States	English
MT 42	Metallurgy	25	S	0	Sales or Technical Representative	Open	English
MT 47	Metallurgy	33	M	3	Mill Operation	West. U. S.	English
MT 48	Metallurgy	35	M	2	Development, Project Management	Colorado	English/Spanish
MT 50	Metallurgy	29	M	1	Mineral Processing Production or Engineering	Rocky Mountain States	English
MA 05	Mining—Math	26	M	3	Operations research, Systems analysis	Open	English
GE 31	Professional Degree	25	S		Geological Exploration Development, Management	Western U. S. A.	English
GE 34	Geol. Engr. Civil Eng.	39	M	3	Prefer Management	Open	English
GE 36	Geology	43	M	1	Production—Mining or Non-metallic Processes	Western U.S.	English
GE 37	Geol. Engr.	42	M	3	Geological Exploration	Western USA/Foreign	English
GE 38	Geology	35	M	2	Mineral Prop. Evaluation Mine Manag. & Planning	Western USA/Foreign	English
GE 40	Geol. Engr.	43	S	..	Exploration, Engineering or Research Geologist	Western U.S.A. or Foreign	English
GE 41	Geol. Engr.	39	M	3	Exploration Geologist	U.S.A. or Foreign	English
GP 15	Geophyics	49	M	3	Petroleum Expl.	Rocky Mountains	English
GP 17	Geophysics	34	M	1	Geophysics	Colorado	English
GP 18	Geophysics	23	S	0	No Mgmt. Trainee	Rocky Mountain	English
GP 19	Professional Engineer	24	M	0	Mineral Exploration	Southwest U. S. or South America	English
GP 20	M.S. Geology & Geochemistry	28	M	0	Mineral Exploration	Rocky Mountain Area	English/French
PE 15	Petroleum	24	S	0	Reservoir Engr.	Rocky Mtn. Region	English
PE 16	Pet. Eng.	27	M	2	Prod. Engr.	Rocky Mtn., Canada or Alaska	English
PE 17	Pet. Eng.	34	M	4	Pet. Engr.	Open	English
PH 02	Physics	23	S	0	Engineering Physics	Rocky Mtn. Region	English
PH 04	Engr. Physics	27	M	0	R.& D. Engr. Marine Engr.	Coastal except N.E.	English
PR 11	Masters in P.R.E.	30	M	2	Management Systems	U.S.A.	English
PR 12	Chem./Ptrlm. Refining	22	S	0	Chemical-Petroleum Refining Industry	Open	English/French

Plant News

Ennis

Ennis Named General Manager Of Linatex Corp. of America

Robert E. Ennis has been appointed general manager of Linatex Corp. of America. Mr. Ennis comes to Linatex from Hewitt-Robins (Canada) Ltd., where he served as president and chairman of this Litton Industries Division.

He is a graduate of Virginia Polytechnic Institute with a B.Sc. in Mining Engineering. Mr. Ennis has had extensive experience across North America in his previous association with Humphreys Engineering Company, Denver, Colo.; as mining and metallurgical engineer, and Henry J. Kaiser Co., (Canada) Ltd., as senior mining and metallurgical engineer.

In the position of General Manager, Mr. Ennis will be responsible for the corporate expansion program and all manufacturing, marketing and sales for Linatex Corporation of America at its Stafford Springs, Conn., Addison, Ill., and Phoenix, Ariz. plants. This company is the supplier of world-renowned Linatex and its full line of anti-abrasion engineered equipment including valves, cyclones, material conducting hose, Linaclad Perforated Screens and Metalbak Lining System.

Coal Beneficiation System To Be Built by Dravo Corp.

A raw coal beneficiation system that will process two million tons of coal per year is to be built by Dravo Corporation, Pittsburgh, for Amherst Coal Co. at Slagle, W. Va.

The new system will handle coal from Amherst's McGregor mine, also located at Slagle, and will operate as part of an existing plant.

Dravo's turnkey contract includes design and construction of an 800-ton-per-hour raw coal screening section and a 400-ton-per-hour fine coal washing section.

The new facilities will provide fine coal beneficiation through a unique system using water-only cyclones as primary cleaners and heavy media cyclones and froth flotation cells as back-up units.

Construction of the facility will begin in July with completion scheduled for March, 1971.

Allis-Chalmers Grate-Kiln At Minntac Plant, Minn.

Allis-Chalmers has been awarded a contract to manufacture two large capacity iron ore pelletizing lines for the expansion of United States Steel Corp.'s Minntac plant near Mountain Iron, Minn.

Arthur G. McKee & Co., Cleveland, Ohio, will erect the equipment for U. S. Steel Corp.

The "Grate-Kiln" system lines to be supplied by Allis-Chalmers will have a design capacity of 3 million gross tons each, adding 6 million gross tons to Minntac's capacity. Last year Minntac produced some 6 million tons of pellets on its three Allis-Chalmers pelletizing lines which went into operation late in 1967.

Canadian-Made Haulers Used in Southern Colorado

A fleet of four Canadian-made Normac-Poole rear dump haulers are now hauling uranium out of mines in southern Colorado.

The six-ton haulers were purchased recently by Union Carbide from Northern Machine Works Limited (Normac) in Bathurst, N. B.

The dumper, which also comes in 12-ton, 14-ton and 22-ton models, is basically a trailer with a gooseneck that "quick-hitches" onto a standard tractor. In the Colorado mines, the six-ton haulers are pulled by Massey-Ferguson 50 horse power diesel wheel tractors.

Consolidation Coal Establishes Educational Refund Policy

Consolidation Coal Co. has established an educational refund policy for active, full-time employees of Consol, its subsidiaries and affiliated companies.

John Corcoran, president of Consol, said that the company will reimburse 75 per cent of net expenses for approved educational courses to eligible employees. Reimbursement will be made upon satisfactory completion of courses, Corcoran said, and will include expenses for tuition, incidental fees and required textbooks.

Bucyrus-Erie Announces Mining Shovel Order

Bucyrus-Erie has announced receipt of a $4.3 million order for a fleet of model 280-B electric mining shovels from a major United States copper producer. These 15-cubic-yard shovels will be the primary excavating tool in a southwestern United States copper mine.

Electric mining shovels of this type are a key product of Bucyrus-Erie's mining machinery line, and are manufactured at the company's South Milwaukee, Wis., plant.

Technical Societies

AMC Mining Convention Sept. 27-30 in Denver

THE 1970 Mining Convention, sponsored by the American Mining Congress, is being held Sept. 27-30 in Denver. AMC President is Cris Dobbins; Convention Program Chairman, William H. Love.

Top industry leaders, officials in the Administration and leaders of the House and Senate will comment on major policies affecting the mineral industry.

The technical sessions will include intensive discussion of productivity improvements aimed at reducing costs, achieving greater efficiency and safety in all phases of mining operations, and gaining a fuller understanding of the mining industry's vital contributions to the nation's economy and well-being.

Environmental quality, a problem of mounting concern to every citizen, health and safety, taxation, public lands, and the fiscal and economic climate in which the industry must operate will be explored in depth.

Mineral Law Institute In Albuquerque, N. M.

"Use of the Public Lands—the Decision Making Process" was the theme of the 16th Annual Rocky Mountain Mineral Law Institute held July 9-11 at the University of New Mexico, Albuquerque, N. M. Twenty-one papers and a movie were scheduled for the program, and subject coverage included almost every new subject of current interest to the mineral lawyer and landman.

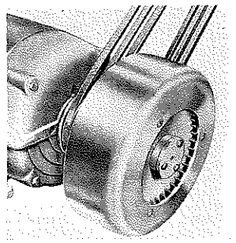
National Metric Study Conferences

Secretary of Commerce Maurice H. Stans has reported pending activities in the U. S. Metric Study now being conducted in the Department's National Bureau of Standards (NBS). This undertaking was authorized by the Congress under Public Law 90-472. The Director of the U. S. Metric Study is Daniel V. DeSimone of NBS.

National Metric Study Conferences are scheduled in August 1970 with engineering industry and professional societies, in September and October with consumer-related groups, in October with educators, the construction industry, and labor, and in November with groups from other sectors of the economy.

In addition, surveys will be carried out by means of questionnaires, meetings and interviews.

With the Manufacturers



Magnetic Slip Coupling (546)

The Tormag made by Fairchild Hiller Corp., Winston-Salem, N. C. 27105, is a permanent magnet, eddy current slip coupling, used to transmit power from a source to a load. The primary feature of this slip coupling is a softer start, which is the result of the air gap between rotors. This air gap, bridged by magnetic lines of force that transmit power, eliminates the need for fluids, seals or friction materials that require replacement and eventually result in excess wear on the motor, the equipment being run as well as the coupling itself. **Circle 546 on Reader Service Card.**

Positioning Device (549)

A new hydraulic positioning device, which speeds underground mine operation and assures greater safety, is now available on Long-Airdox Company's line of Rosco mobile feeders, feeder-breakers and feeder-crushers. One-man hydraulic positioning eliminates time lost by blocking under the Rosco crawlers to increase the discharge height, removes a potential safety hazard encountered in tramming the machine on blocks or cribbing, and eases the machine placement onto the belt tail section. **Circle 549 on Reader Service Card.**

Air-Separator (553)

A completely self-contained air-separator developed by a British firm divides dry powders into two batches, one above and the other below a predetermined particle size in the range three to 60 microns. The Microsplit combines high extraction efficiency and output with low power consumption, reports the company. It can be installed in closed circuit with almost any type of dry-grinding mill, including ball and tube, ring and roller, pinned disc and cage, and disintegrators, to extract powders of exceptional fineness and uniformity. **Circle 553 on Reader Service Card.**

Drilling Machine (547)

A new type of foundation drilling machine recently has been designed and manufactured by Watson Manufacturing Co., Fort Worth, Tex. The new machine will be known as Watson Model 3250 CM "Tie Back" Drilling Unit, and is designed to drill tie-back anchor holes up to 30 inches in diameter, with a separate hydraulic driven, continuous drilling auger, at angles varying from vertical to horizontal, and to depths listed only by the specific drilling conditions. **Circle 547 on Reader Service Card.**

Polyelectrolytes (555)

A complete line of polyelectrolytes developed for solids/liquid separation processes in the mining industry has been introduced by Calgon Corp., P. O. Box 1346, Pittsburgh, Pa. 15230. Specific applications listed by the manufacturer are as flocculants in solids/liquid separation processes such as tailings thickening, selective clarification, selective flotation and vacuum filtration. Dosage rates vary depending upon individual requirements. **Circle 555 on Reader Service Card.**

Knurling Tool (543)

New knurling tool does a permanent job making worn housings good as new. Restores tight fit to worn castings and weldments—right in your own shop! Produces tough ridges of raised metal — bringing back the original "round" and original I.D. of bore. New knurled metal grip stops bearing slippage — holds race with precision fit. (Roberts Electric, 849 W. Grand, Chicago, Ill. 60622). **Circle 543 on Reader Service Card.**

Hydrocarbon Detector (551)

Century Geophysical Corp. of Tulsa has introduced a new light-weight portable detection unit for hydrocarbons, which may be the first gas safety or pollution control device to grow out of research and development for the U. S. space program. The new Model HD-78A hydrocarbon detector builds upon Century's nine years of gas leak detection experience and brings down to earth some of the space technology used by Century personnel on flight-rated active radiation dosimetry for the Gemini, MOL, and Apollo programs. **Circle 551 on Reader Service Card.**

WANT MORE INFORMATION?

Use MINES Magazine's convenient READER SERVICE CARD, circling numbers that correspond to items interested in, then drop card in mail. No stamp needed!

Campus Headlines

Boyd

Boyd Addresss Summer Students

DR. JAMES BOYD, M.Sc. 1932 and D.Sc. 1934, chairman of the Copper Range Co. and former dean of faculty at the Colorado School of Mines, was the speaker at a luncheon Friday, July 17, at the Holiday Inn West, 14707 West Colfax.

Dr. Boyd, head of one of the country's largest copper producers, addressed the concluding session of a six-week summer class in mining and metallurgy for 34 high school teachers, counselors, and administrators.

Dr. Boyd served on the faculty at Mines for several years and was dean of faculty following World War II. He earned his master of science and doctor of science degrees at Mines. He has achieved notable success as a corporate executive, educator, government official, and geologist.

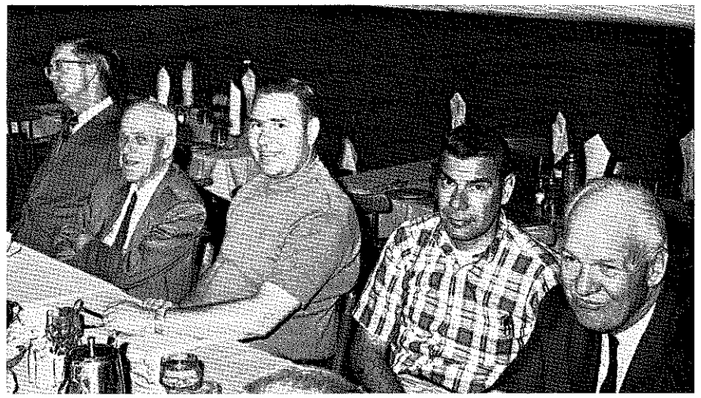
The son of a mining engineer, he was born in Western Australia, first educated in England, and then came to the United States and was graduated from the California Institute of Technology.

Dr. Boyd was chairman of the National Science Foundation's advisory committee on mineral research from 1953 to 1956. In 1963, he was awarded the Rand Medal by the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) "for his distinguished service and devotion to the Nation and the mineral industry."

He was national president of the AIME in 1969.

In 1966 he received the Cal Tech Alumni Distinguished Service Award, one of 23 such awards ever given by the University.

Dr. Boyd was instrumental in founding the Parker-Boyd Fund, established as a memorial to the late Dr. Ben H. Parker, president of the School of Mines Board of Trustees at the time of his death last July 31. The fund, set up through the Colorado School of Mines Foundation, Inc., provides scholarships for Mines students.



DURING A RECENT LUNCHEON HELD FOR 34 SECONDARY TEACHERS attending a mining-metallurgy course co-sponsored by the Colorado School of Mines and the Colorado Mining Assn., two representatives of the Mining industry were honored guests. Harvey Mathews, former vice president, Stearns-Rogers Corp. (second from left) and Mr. Mar Coats, manager of American Smelting and Refining Co.'s Globe Plant (far right). Other guests from left to right, Dr. A. W. Schlechten, vice president for Academic Affairs at CSM, Prof. Niles E. Grosvenor, Mining Course coordinator, and Dr. Joseph J. Finney, of the CSM Geology Department.

Secondary School Teachers Attend Field Summer Course On Mining and Metallurgy

THIRTY-FOUR secondary teachers, counselors and administrators attending the second annual field summer school mining-metallurgy course entitled "A Total Concept of the Mining Industry" at the Colorado School of Mines in Golden, spent the week of July 6 to 10 on an extensive survey tour of the mining facilities within the State of Colorado.

This course, offered jointly by the Colorado School of Mines and the Colorado Mining Association, was offered for six weeks during the summer to familiarize the students with the potential of the mining industry and pertinent developments which effect our nation.

During the six weeks, over 50 instructors from national and regional mining industries functioned as instructors to the students with special emphasis placed on areas of interest to the State of Colorado and Colorado's relation to the nation's mining.

During this statewide tour, the students visited American Metal Climax, Incorporated-Urad Mine, Climax Mine and Henderson Project; American Smelting and Refining Co.-Black Cloud Shaft and Millsite; the East Campus of Colorado Mountain College in Leadville; New Jersey Zinc Co.-Eagle Mine in Gilman; Union Carbide Corporation-Rifle Plant in Rifle; Idarado Mine and Pandora Mill at Ouray; Union Carbide Corp.-Niland Maybe Mines in Paradox Valley; and the CF&I Steel Corp.-Monarch Quarry in Monarch.

In addition to this week-long tour, the students also visited the Gardner-Denver Manufacturing Plant, and the CF&I Steel Corp. Mill in Pueblo and attended a day-long geological field session.

Upon completion of the course, the teachers received six semester hours of credit which may be directly applied to graduate work or elective work for renewal or reinstatement of earth science and administrative teaching certificates where courses are unspecified.

CSM Offers Tours Of Edgar Mine At Idaho Springs

COLORADO School of Mines is again offering free tours of its experimental mine daily. The mine was originally developed in the 1870's as the Edgar Mine, after discovery of the Edgar vein which contained silver, gold, copper and zinc. Colorado School of Mines obtained the mine in 1921 and since has used it for experimental mining processes.

The tours are conducted daily Monday through Saturday from 8:30 a.m. to 3:30 p.m. Each hourly tour starts on the half-hour and includes a tour of the present mine and associated mining equipment used for proces-

(Continued on Page 23)

$1.7 Million Given Mines During 1970

A TOTAL of $1.7 million has been received by the Colorado School of Mines during the past year in grants, fellowships, scholarships and other funds from 67 regional, national and international foundations, corporations, individuals and corporate-foundations.

A total of 37 grants, 68 scholarships, 15 fellowships, and 30 other monetary gifts were received by the school.

The following foundations, Boettcher Foundation, Texas Instruments Foundation, Green Foundation, Union Oil Company of California Foundation, Foundary Educational Foundation, Brown Foundation, Inc., ASARCO Foundation, National Science Foundation, and Schlumberger Foundation granted $1,036,000 for 14 grants, 11 scholarships, one fellowship, and four other grants for individual departments.

Two private individuals, Major General and Mrs. James F. Phillips and Mrs. Betty D. Wilson gave $3,000 to individual memorial funds at CSM.

The following corporations, Cities Service Research and Development Co., Phillips Petroleum Co., Gulf Oil Corp., Texaco Incorporated, United States Steel Corp., St. Joseph Lead Co., Chevron Oil Co., University of Science and Art, FMC Corp., Tenneco Oil Co., Stearns-Rogers Corp., International Nickel Co., CRC-Crose International, Newmont Mining Co., Cleveland-Cliff Iron Co., Dow Chemical Co., Signal Oil and Gas Co., Kaiser Aluminum and Chemical Corp., Standard Oil Company of California, Kennecott Copper Corp., Bethlehem Steel Corp., ARMCO Steel Corp., Kennecott Exploration, Inc., Union Carbide Corp., Olin Corp., American Selco Inc., Cabot Corp., Hecla Mining Co., Texas Gulf Sulphur Co., Adolf Coors Co., Colorado School of Mines Research Institute, and the Herbert Grunfeld and Ernest Grunfeld Trust, donated $529,000 for 10 research grants, 21 scholarships, nine fellowships, and 13 other grants for individual departments, memorial funds, faculty improvement, library fund, and construction costs for additional buildings.

The following corporate foundations, ASARCO Foundation, Pan American Petroleum Foundation, Getty Oil Co. Foundation, Mobil Oil Foundation, Standard Oil (Indiana) Foundation, Humble Oil Education Foundation, Marathon Oil Foundation, Atlantic Richfield Foundation, Gulf Oil Foundation, Pittsburgh Plate Glass Industries Foundation, American Metal Climax Foundation, Inland Steel-Ryerson Foundation, Union Oil of California Foundation, Alcoa Foundation, UOP Foundation, Gulf-Western Foundation, Cities Service Foundation, Humphreys Foundation, Shell Companies Foundation, Concrete Masonary Corporation Foundation, Phelps Dodge Foundation, Ensign-Bickford Foundation, Bechtel Foundation, and Union Pacific Railroad Foundation, donated a total of $129,000 for 13 grants, 34 scholarships, five fellowships and 13 additional donations to CSM's departments, faculty, and funds.

To date these 67 foundations, corporations, individuals, and corporate-foundations have donated to the Colorado School of Mines over $4.4 million, in the forms of grants, scholarships, fellowships and other funds.

Edgar Mine Tours

(Continued from Page 22)

sing of ores. The mine is located just outside Idaho Springs by exiting off of Interstate 70 to Colorado Avenue and proceeding north on 8th Avenue to the exterior entrance to the mine.

The mine is made up of more than 4,000 feet of tunnels and other workings, and is furnished with more than $250,000 worth of equipment, much of which has been contributed by manufacturers of mining equipment.

The Mining Department of the Colorado School of Mines is proud of the Experimental Mine and the function it serves: educational tours for the public and cooperation with industry, state and federal agencies in research and education.

The free tours will be conducted until Sept. 7, Labor Day.

Executive Secretary

Col. Fertig

New President of Colorado School of Mines

As we file the last of our material for the August issue (July 25) the search for a new president has not resulted in any announcement, although we understand that the search is narrowing. Dr. Truman Kuhn is handling the affairs of the school in a competent manner during this period of intensive search for a new president. It seems it is better to spend the time in solving the problem after careful research than rushing into an early appointment.

It is hoped that an announcement of an appointment of a new president will be made prior to the beginning of school in September.

Alumni Meetings at Conventions

An Alumni breakfast will be held during the American Mining Congress Convention in Denver Sept. 27-30. Exact location and date of the breakfast will be announced in the September issues of The MINES Magazine and notice will be present at the registration desk. This should be an excellent meeting and we anticipate a large attendance.

Preparations are being made for some type of Alumni meeting during the Society of Mining Engineers Convention to be held in St. Louis Oct. 21-23. More information will be presented in the next issue of MINES Magazine.

Guggenheim Hall — Progress continues in the rehabilitation of this fine old building and it now appears that we should be back in our new quarters shortly after the first of 1971. The change will be for the better and the old rickety windows will no longer allow free passage of the cold northwest winds during the winter.

Alumni Meetings

It is hoped that Local Section meetings will be held in many locations during the ensuing academic year. We are perhaps getting the jump on things by scheduling a meeting in Los Angeles for July 20; in Anchorage, Alaska August 1; and in Seattle, Washington on August 7. The Local Sections have been neglected in the past year or more and an effort will be made to correct this situation.

Alumni Headliners

Smith

Jake Smith Vice President Of Barber-Greene Company

JAKE R. SMITH, E.M. 1950, has been appointed vice president of Barber-Greene Company and general manager of The Smith Engineering Works (Telsmith) Division at Milwaukee. Barber-Greene is the parent company at Aurora, Illinois.

Jake R. Smith succeeds Gerald L. Smith, who died unexpectedly of a heart attack May 23.

Jake Smith brings 20 years of experience into his new position. He joined the company in 1950 as a sales trainee and subsequently was promoted to northwest district sales manager, export sales manager and vice president of export sales. Most recently he has been vice president, domestic sales. Under his direction, the firm's domestic sales have more than doubled during the past 10 years.

Jake Smith holds a degree in Mining Engineering from the Colorado School of Mines. He is a member of the American Institute of Mining Engineers; and through the company maintains memberships in the National Sand and Gravel Association, National Ready Mix Concrete Association, National Crushed Stone Association and AED.

Smith Engineering Works manufactures the Telsmith line of stationary and portable processing equipment for mines, quarries and gravel pits. Besides Milwaukee, Telsmith products are manufactured in England, France, South Africa, Australia, Brazil, Mexico and Canada.

Membership

The final notice has been mailed to those Alumni who were active in 1969 but have not yet sent us their dues for 1970. We hope that you will do so for you have already received the magazine for the first six months of 1970. Thus we have a vested interest in your continuing your subscription.

We recognize that the economy has slowed down, and it may be difficult if not impossible for you to remain an active member. If this is the case, just let us know and we will note it on our records so that we can be back in touch with you for 1971 when we hope that things will be back in better order.

McLaren

Evans

McLaren Transferred to Houston By Humble Oil and Refining

T. M. McLAREN, Geol.E. 1952, formerly Western District uranium geologist in the Denver office of Humble Oil & Refining Company, has been promoted to Eastern District Manager of the company's Minerals Department. He moved from Denver to Houston on July 1.

Mr. McLaren graduated in Geological Engineering from Colorado School of Mines in 1952. He joined Humble in 1954 and served in a number of field assignments before joining the Minerals Department when it was formed in 1966. At that time he was named geological coordinator in the company's headquarters office. He moved to Denver in 1969 at the time of his appointment as Western District uranium geologist.

Hugh Evans Named Manager Geophysical Corp. of Canada

HUGH EVANS, Geop.E. 1949, has been named manager of Century Geophysical Corporation of Canada. Announcement was made by Peter I. Bediz, Geol.E. 1941 & M.Sc. 1942, president of the Canadian firm, and executive vice president of the parent company, Century Geophysical Corporation, Tulsa.

Mr. Evans, a 1949 graduate of Colorado School of Mines in Geophysical Engineering, has 21 years of experience in geophysical exploration, primarily seismic work, including various phases of field operations, methods, data reduction and processing, interpretation, research and management for a major oil company and for a geophysical contractor. His experience of application encompasses a wide sphere both geophysically and geologically.

Mr. Evans also is a graduate of the Banff School of Advanced Management, and is a member of the Alberta Association of Professional Engineers, the Society of Exploration Geophysicists, and the Canadian Society of Exploration Geophysicists.

His paper, entitled "Zama North," a geophysical case history, won the best presentation award at the general session of the 1968 International S.E.G. Convention held in Denver.

Pakiser Receives Citation For Distinguished Service

LOUIS C. PAKISER, JR., Geol.E. 1942, received a Citation for Distinguished Service from Secretary of Interior Walter J. Hickel on June 30 in Washington, D.C. The citation in recognition of Mr. Pakiser's outstanding accomplishments in scientific research and administration reads as follows:

"Mr. Pakiser's career with the Geological Survey has been distinguished from the beginning in 1952 by dedicated and superior service both as an administrator and a scientist. His geophysical studies of the intermontane basins of western United States constitute a major contribution to the earth sciences with impact on geological thinking concerning the nature of the fundamental processes of faulting, volcanism, and crustal deformation. The Geological Survey's programs in the two important areas of crustal structure and earthquake research owe their existence to his initiative and leadership.

"In 1961 he organized the Branch of Crustal Studies, which, under his leadership, has carried out the largest program of seismic-refraction exploration of the continental crust ever undertaken in the western world. Mr. Pakiser not only organized and managed the program, he also played a major role in the scientific analysis of the data. The results have forced a complete revision of classical ideas on crustal structure and constitute one of the most significant advances in the earth sciences in recent years.

"In 1966 Mr. Pakiser organized the Office of Earthquake Research and Crustal Studies, which is the core of the Geological Survey's expanded effort in earthquake research. Within three years he has built an organization that is one of the world's leading centers for research in solid-earth geophysics.

"In addition to his accomplishments in developing the Geological Survey's program, Mr. Pakiser has played a major role in formulating national policy in the field of earthquake research through his membership on the **Ad Hoc** Panel on Earthquake Prediction convened by the President's Science Advisor and his membership on the **Ad Hoc** Interagency Working Group for Earthquake Research of the Federal Council of Science and Technology. In recognition of his dedicated service and outstanding contributions, both as a scientist and administrator, the Department of the Interior bestows upon Mr. Pakiser its highest honor, the Distinguished Service Award."

* * *

A small boy had gotten a bad sunburn and was beginning to peel. As he washed his face, his mother heard him mutter: "Only four years old and wearing out already!"

Travis and DeSantis Receive Promotions From Asarco

LEE C. TRAVIS, Met.E. 1948, former manager of Asarco's smelter in El Paso, Tex., has been named general manager of the company's Western Department.

Mr. Travis joined Asarco in 1948 at its Globe plant in Denver, Colorado after his graduation from the Colorado School of Mines as a Metallurgical Engineer in 1948. He served in various technical positions with Asarco in the western United States, becoming smelter superintendent at Selby, California in 1960. In 1963, he was transferred to company headquarters in New York as an ore buyer and in 1966 to El Paso as assistant manager of the smelter there. He became manager of the El Paso plant in 1967, the position he held until his recent promotion.

Another Mines graduate, **P. A. DeSantis,** Met.E. 1951, also received a promotion.

Mr. DeSantis joined Asarco at Leadville, Colo. in 1951 upon his graduation from the Colorado School of Mines. He served in various technical positions in Asarco plants in the western United States before being transferred to El Paso in 1965. Prior to his promotion to general superintendent at El Paso, he was assistant general superintendent at the plant.

Owens Promoted to Vice President Of Production for Union Oil

W. D. OWENS, P.E. 1945, has been appointed to a new position in Union Oil Company of California's Union International Oil Division: vice president of production. The division handles Union's exploration and production operations outside the United States.

Mr. Owens came with Union in 1949 as an engineering trainee after graduate work at Oregon State College; he had received his degree in Petroleum Engineering from Colorado School of Mines.

Over the years, he has worked for Union as division engineer in Midland, Texas, and as its chief production engineer and later director of secondary recovery at its headquarters in Los Angeles. Prior to his recent appointment, he was Union's manager of budgets.

In addition to his position with Union, Mr. Owens is active in industry technical societies. He is a member of the Society of Petroleum Engineers, the American Petroleum Institute and the Independent Petroleum Association of America.

Mr. Owens, his wife Ruth, and their four children live in South Pasadena, Calif.

Swaisgood Returns to Denver For Dames and Moore

JAMES R. SWAISGOOD, Geol.E. 1959, has returned to Denver to assume the management of Dames & Moore's office located at 100 South Union Blvd. near the Federal Center. Mr. Swaisgood had been transferred to the firm's Honolulu office two years ago after establishing the Denver office in 1966.

He has been an employee of Dames & Moore for 10 years. In addition to Honolulu and Denver, he has been assigned to the firm's offices in Los Angeles, Salt Lake City, and Madrid, Spain. He was graduated from the Colorado School of Mines in 1959 with a Geological Engineering degree and, in 1965 and 1966, worked toward an M.S. in mining engineering at CSM, majoring in rock mechanics.

Cedarblade Directs Planning For Mobil Oil Co. in Turkey

D. L. CEDARBLADE, P.E. 1944, 50 Cross Ridge Road, Chappaqua, N.Y., has been appointed vice president of plans, programs and manufacturing coordination for the Mobil Companies in Turkey. The appointment became effective Aug. 1, and his headquarters will be in Istanbul.

Mr. Cedarblade received a degree in Petroleum Engineering from the Colorado School of Mines in 1944 and an M.B.A. from the Harvard Business School in 1956. He worked for Shell Development Co. from 1944 to 1946 and for Gulf Oil Corp. from 1946 to 1956, when he joined Mobil as an engineer-economist.

Mr. Cedarblade held various economics and planning posts in Manila, Hong Kong and Melbourne, Australia, before returning to New York as a senior planning associate in 1968.

He is married and he and his wife have a son, Lee.

Distler Made Mine Manager, Climax Western Operations

WILLIAM F. DISTLER, E.M. 1939, has been promoted to manager of mines for Climax western operations. The appointment was announced by E. J. Eisenach, E.M. 1939, executive vice president of mining and operations for AMAX Molybdenum and Special Metals Division.

Mr. Distler, former mine superintendent of Miami Copper Co., and an authority on mine caving systems, joined Climax in 1953. He was promoted from general superintendent at the Climax mine to Henderson Project manager in 1967. In addition to his present responsibilities in mine planning, layout and project direction of the Henderson Project, the Climax and Urad mines will be under his supervision.

Address Changes

1920-1939

Edward S. McGlone, '23, 2500 E. Las Olas Blvd., Apt. 1209, Fort Lauderdale, Fla. 33301.
J. A. Riley, '23, 55 Old Hill Road, Westport, Conn. 06880.
Henry S. Sanderson, '30, c/o Hauf & Forsythe, P. O. Box 1715, Billings, Mont. 59103.
Milton J. Williams, '33, 10751 Clair Dr., Sun City, Ariz. 85351.
William Z. Bancroft, '36, 2642 Vista del Oro, Newport Beach, Calif. 92660.
Lee M. Talbert, '36, 1393 Nathan Lane, Ventura, Calif. 93003.
Edwin F. White, '36, Route 5, Box 837, Golden, Colo. 80401.
Eugene E. Dawson, '38, 1469 Bellevue, Burlingame, Calif. 94010.
Dr. John H. Dismant, '39, 2513 Spur, Odessa, Texas 79760.
Harry J. McMichael, '39, F. C. Torkelson Co., 1945 S. Eleventh East, Salt Lake City, Utah 84105.

1940-1959

Reeve M. Duhme, '40, Rt. 2, Box 11A, Park Canyon, Austin, Nevada 89310.
William R. Lewis, '40, 18 Upland Drive, Broadmoor, Colorado Springs, Colo. 80906.
Earl Y. Palmer, '40, 3607 Godfrey Court, Midland, Texas 79701.
Charles F. Cigliana, '41, c/o A Soriano Y Cia, Mining Dept., P. O. Box 247, Makati Rizal D-708, Philippines.
Herbert A. Poitz, '41, 1414 Tucumcari, Rt. 16, Houston, Texas 77090.
John W. Tynan, '41, 12703 Taylorcrest, Houston, Texas 77024.
Robert H. Gallaher, '43, General Delivery, Evergreen, Colo. 80439.
W. B. Emery, II, '48, Marathon Oil Co., 8th Floor, 539 South Main St., Findlay, Ohio 45840.
Lee M. Yarberry, '48, 580 S.E. 14th St., Pompano Beach, Fla. 33060.
Edward H. Brinley, '49, 1840 Berkeley Drive, Reno, Nevada 89502.
R. B. Coleman, '49, 10906 West 31st Place, Lakewood, Colo. 80215.
John G. Cowan, '49, 127 Salah Bowaker 8° etage, Alger, Algeria.
Marvin H. Estes, '49, The Estes Co., 1949 W. 12th Place, Denver, Colo. 80204.
Dr. David A. Rowland, '49, 5900 Bissonnet St., Houston, Texas 77036.
M. Bettencourt Dias, '50, P. O. Box 16, Lourenco Marques, Mocambique (Africa).
Philip V. Doyle, '50, P. O. Box 281, Durango, Colo. 81301.
Edward M. Feely, 3243 Wilshire Pl., Los Angeles, Calif. 90005.
Dr. Donald L. Johnson, '50, 1840 Pinedale Ave., Lincoln, Neb. 68502.
Clyde H. Mathews, '51, 3058 S. Cook, Denver, Colo. 80222.
George B. Morgan, Jr., '51, 4603 Fern, Shreveport, La. 71105.
Charles A. Champion, '52, 2820 "C" St., Anchorage, Alaska 99503.
John F. Fox, '52, Mobil Oil Corp., 150 E. 42nd St., New York, N. Y. 10017.
Thomas M. McLaren, '52, Humble Oil & Refining Co., P. O. Box 2180, Houston, Texas 77001.
James W. Newell, '52, 39 Canata Close S.W., Calgary, Alberta, Canada.
James H. Ogg, '52, 1612 Court Pl., Denver, Colo. 80202.
Edgar T. Gaulke, '53, Rt. No. 3, 2508 Persimmon Creek, Edmond, Okla. 73034.
Stanley C. Holmes, '53, 500 E. Vista, Bisbee, Ariz. 85603.
Charles O. Parker, II, '53, 4923 Alminar, La Canada, Calif. 91011.
Stanley O. Reichert, '53, c/o Layton & Assoc., 190 Hay St., East Perth, Western Australia.
Lt. John R. Witt, 524-30-4203, '53, U.S. Army Engineer District, Saudi Arabia, APO New York 09038.
Wm. F. Baumann, '54, P. O. Box 1185, Karnes City, Texas 78118.
Charles A. Sorvisto, '54, 14 Fairbairn Ave., East Killara, New South Wales, Australia.
Robert T. Forest, '56, 563 Penny Way, Sparks, Nevada 89431.
John A. Springer, '56, 100 Adrienne Court, Waveland, Mass. 39576.
Gerald J. Ott, '57, 752 Niantic Dr., Foster City, Calif. 94404.
James I. Pritchard, '58, 1023 Columbine, Golden, Colo. 80401.
Clifton C. Sammons, '58, c/o Boyles Bros., P. O. Box 847, Miami, Ariz. 85539.

1960-1970

L. Douglas Patton, '60, 333 Majestic Bldg., Denver, Colo. 80202.
Kent D. Pothast, '60, P. O. Box 162, Manson, Iowa 50563.
Roger C. Beach, '61, P. O. Box 167, Nederland, Texas 77627.
John H. Callanan, '61, P. O. Box 104, Bolton Landing, N. Y. 12814.
David A. Chasis, '61, 169 Frelinghuysen Ave., Newark, N. J. 07114.
Terril E. Wilson, '61, Apt. 14 H, Grad Circle, University Park, Pa. 16802.
Thomas C. Aude, '62, c/o Gen. Delivery, Kayenta, Ariz. 86033.
Dr. Fred J. Hilterman, '63, Mobil Oil Corp., Explor. Service Ctr., P. O. Box 900, Dallas, Texas 75221.
Dr. Denis E. Marchand, '63, R.D. No. 1, Winfield, Pa. 17889.
Capt. Robert D. Carnes, '64, P. O. Box 1027, Petersburg, Ariz. 99833.
William S. Devine, '64, P. O. Box 304, Newcomb, N. Y. 12852.
Earle M. Bagley, III, '65, Apt. No. 1A, 404 E. Comanche, Farmington, N. M. 87401.
Lt. Robert J. Barday, '65, c/o Arden Wood, P. O. Box 949, Canon City, Colo. 81212.
Wm. W. Everett, '65, c/o Everett, 25 MacArthur Rd., Pueblo, Colo. 81001.
Don R. Kidder, '65, 2201 Club Ave., Kingman, Ariz. 86401.
Cpt. William H. Miller, '65, 1111 Cypress Dr., Ft. Collins, Colo. 80521.
C. Michael Oldenburg, '65, 2542 Poli, Ventura, Calif. 93003.
Barry D. Quackenbush, '65, 3304 N.W. 62nd, Oklahoma City, Okla. 73112.
John Jay Schocke, '65, 533 W. Sycamore, Columbus, Kansas 66725.
Richard T. Todd, '65, P. O. Box 14, Big Bear Lake, Calif. 92315.
William DeRose, '66, 302 Pilgrim Ave., Taft, Calif. 93268.
Cpt. Kenneth L. Engelhardt, '66, 3230 S. Grant St., Englewood, Colo. 80110.
Ben C. Franciscotti, '66, 11806 E. 16th St., Tulsa, Okla. 74128.
Richard N. Kemp, 954 Pine Lake Dr., Jackson, Miss. 39206.
Hans Leitinger, '66, Mobil Oil Corp., P. O. Box 900, Dallas, Texas 75221.
Richard Lucic, '66, 943 Bermuda Ct., Sunnyvale, Calif. 94086.
Dr. Jan Dean Miller, '66, 1671 Harvard Ave., Salt Lake City, Utah 84105.
Parker Newbanks, Jr., '66, R.D. 1, Baden, Pa. 15005.
Henry A. Paasonen, '66, 170 Westchester Ave., Crestwood, N. Y. 10707.
Walter C. Pearson, Jr., '66, 1609 Esther Dr., Bakersfield, Calif. 93308.
Robert W. Randolph, '66, 1776 Via Flores, San Jose, Calif. 95132.
Lt. Mark E. Shaffer, 0110749, '66, 1076 Fraser St., Aurora, Colo. 80010.
Jerold R. Lowder, '67, 189 Sandy Lane, Norwich, Conn. 06360.
Gary Nollen, '67, 4303 Andrews Hwy., Apt. 702, Midland, Texas 79701.
James K. Park, '67, 11580 Burke, Omaha, Neb. 68154.
Cpt. John N. Teets, '67, USA Engr. Dist. Vog., APO New York 09165.
Robert L. Askew, '68, P. O. Box 908, Williston, N. D. 58801.
Brent C. Black, '68, R.D. No. 4, Tunkhannock, Pa. 18657.
Charles E. Brooks, III, '68, M.Sc. '69, 4469 Raleigh Ave., Apt. 203, Alexandria, Va. 22304.
J. Samuel Butler, '68, 511 Harold Blvd., Liberal, Kansas 67901.
Marion C. Chambers, Jr., '68, 170 E. Lake, Apt. 217, Elmhurst, Ill. 60126.
David L. Dickinson, '68, 7819 Antioch, Shawnee Mission, Kansas 66212.
Richard A. DiPaola, '68, Star Route, Hartville, Wyo. 82215.
John C. Hays, Jr., '68, c/o Dr. John C. Hays, 209 S. Nevada Ave., Colorado Springs, Colo. 80902.
Clifford V. Kangas, Jr., '68, 612 24th St., Apt. 15, Golden, Colo. 80401.
Robert B. Merrill, '68, 7710 Maple Ave., No. 1107, Takoma Park, Md. 20012.
Thomas Charles Pool, '68, 580 Harlan, Lakewood, Colo. 80215.
Richard M. Stephens, '68, 667½ Park Ave., Casper, Wyo. 82601.
Don Lee Stretesky, '68, 1939 Skelly Dr., Apt. 215C, Tulsa, Okla. 71504.
Ronald E. Uhlig, '68, 2600 Dewey Ave., Apt. 2, Rochester, N. Y. 14616.
Gerald S. Willett, '68, 1150 Coast Village Rd., No. 306, Santa Barbara, Calif. 93103.
Ensign John Allen Chapman, '69, 711 Underwood Rd., No. 13-C, Pensacola, Fla. 32504.
Robert J. Deurloo, '69, Alcoa Aluminum, 1501 Alcoa Ave., Pittsburgh, Pa. 15219.
William J. Haldane, '69, 265 N. 14th St., Brighton, Colo. 80601.
Lt. Barry J. Haupt, '69, Co. B, 1st Bn. USAEOCR, Fort Belvoir, Va. 22060.
Dr. Albert T. Janssen, '69, 7900 Alpha Rd., No. 1150, Dallas, Texas 75240.
Robert L. McLemore, '69, 615 Water St., Apt. 109, Golden, Colo. 80401.
Morris A. Miceli, '69, 7050 W. Cedar, Apt. 213, Lakewood, Colo. 80226.
Craig E. Moore, '69, 16103 White Oak Ave., Lowell, Ind. 46356.
Gregory L. Paolino, '69, Alcoa-Vernon Branch, Vernon, Calif. 90058.
Kenneth Eugene Porter, '69, 1612 North Adams, Tacoma, Wash. 98406.

Letters

May 1, 1970

Dear Colonel Fertig:

Thought you might find the attached announcements of interest.

"All in all, Colonel, things couldn't be better and I've never been happier in my life. It seems like life just gets better and better all the time. In my new affiliation here, we have the opportunity few people have in life—to find out who our real friends are. Frankly, Colonel, not only were we not disappointed—we were amazed by the help people gave us both here in the United States and in Europe.

To any young fellows at the School of Mines or elsewhere who are "fed up with the system" or disillusioned —I would emphatically say that there is more opportunity today than there has ever been here in the United States.

In fact, speaking as one who has lived in Europe, South America and the Middle East—I can honestly say that this country offers opportunity second to none. I say this as a member of a minority group—that all questions of religion and nationality aside, American people will help you and the American system has no equal.

Forgive this little espousal of patriotism—but then again why should patriotism have to be apologized for, particularly when this country has been so great to us."

Kindest good wishes to you for continued good health and success.

Most cordially,
Bert B. Davidson, Jr.
President
CHURNY COMPANY, INC.
Summerville, Mass. 02143

June 1, 1970

Dear Colonel Fertig:

May I take this opportunity to thank the officers and members of the Alumni Foundation for the signal award of Honorary Membership conferred upon me on Thursday, May 28. For the foremost institution of its kind in the world to select me is indeed an honor that carries my profound appreciation.

The spirit of the Alumni Foundation is well known and I am proud to be included among your company.

Sincerely,
W. T. Pecora
Director, U.S.G.S.

* * *

"What a welcome," grumbled the father visiting his son at college, "I'm barely off the plane and you ask me for money!"

"But, Dad," the son protested, "can I help it if the plane was 40 minutes late?"

Class Notes

1918

Donald D. Riddle, E.M. 1918, Orlando, Fla. writes: "Your April cover might have been even more interesting had it mentioned that it was Herbert Hoover who translated "Agriocla" into English with the help of his wife.

1939

R. John Morgan, E.M. 39, received the degree of Doctor of Philosophy at Iowa State Univ. at their winter commencement. Dr. Morgan lives at 1304 Crestmore Place, Ft. Collins, Colo. 80521.

1941

Somphun Visalyaput, E.M. 1941, heads one of the leading consulting firms in Bangkok and is also advisor to Union Carbide. His most recent address is — No. 7 Kasem-San Soi 2, Nat'l Stadium, Bangkok, Thailand.

1949

John H. Mason, Met. E. 1949, who has been an engineer group commander in Germany for the past two years, has been reassigned as Corps Engineer-Headquarters, 24th Corps, A.P.O. San Francisco 96349. John and Rita are maintaining their home address as 5107 Talbot Place — Alexandria, Va. 22304. Col. Mason was in Golden for two days over July 4th visiting old friends. With him was his son, Kim, who will graduate from West Point with the Class of 1971.

Leonard E. Olds, Met. E. 1949 and M. Sc. 1951, joined the faculty of the Department of Metallurgy at South Dakota Technology in September 1969. As an associate professor of Metallurgy, he has been developing a process to utilize the taconite ores of South Dakota in making steel by a process that should be economically feasible for small-capacity plants.

William W. Scott, Geol. E. 1949, has been carried in the Directory as deceased. Just recently we received a letter from Bill stating that he was not deceased but was actually employed in the Los Angeles City School System and that his home address is 244 Vanetia Drive — Long Beach, Calif. 90803. As far as we can determine this error occurred because we have two W. W. Scott's on our list of graduates; the second received his Doctor of Science Degree in 1923.

1952

Marvin A. Kunde, Met. E. 1952, was in the office for his annual visit. Marv is a tax lawyer with Jones & Laughlin Steel Corp. His home address is 724 Robinwood Dr., Pittsburgh, Pa. 15220.

Vincent V. Rex, P.E. 1952, writes that he is now doing the planning and economic Evaluation work in the Production Department of Creole Petroleum Corp. His address remains the same—Apartado 889 Caracas, Venezuela.

1953

Bruce A. Miller, Geol. E. 1953, has been named manager of the Fire and Extended Coverage Department of the Factory Mutual Engineering Association for the St. Louis District. Bruce's new address is 348 Chalmette Drive, Hazelwood, Mo. 63042.

Ralph Q. Sandall, P.R.E. 1953, who has been with Shell Chemical in New York, has been transferred to Houston, Tex., where his home address will be 5310 Jason, Houston, Tex. 77035.

1955

Frank M. Blakeslee, P.E. 1955, who has been employed by Haliburton since 1955, has been recently named manager of operations for West Germany, Holland and Denmark. He is stationed in Celle, West Germany. (Sorry we can't give a mailing address as one is not available in our records.)

1959

James H. Swaisgood, Geol. E. 1959, who is with Dames and Moore in Denver, where their address is 100 S. Union Blvd., Denver, Colo. 80228. Jim was with the firm in Honolulu before being transferred to Denver.

1960

Richard J. Pitney, E.M. 1960, has joined Kaiser Engineers as mining engineer-specialist. His business address is 300 Lakeside Drive, Oakland, Calif. 94604.

1961

Richard E. Palmer, P.E. 1961, is the corresponding secretary for the Local Chapter in Libya. Dick is with the American Overseas Petroleum, P. O. Box 693—Tripoli, Libya.

1962

Carl F. Nowak, Met. E. 1962, is a chemical process engineer with Corona Works, (Calif.) Alcoa. His home address is 5162 Wagon Wheel Dr., Yorba Linda, Calif. 92686.

Dr. Wm. M. Barney, Geol. E. 1962, has completed the service as a research scientist with the U. S. Army and has joined BP-Alaska, Inc., as a geophysicist. Dr. Barney, his wife Ann, and family will live at 8-5th Ave., E. Northport, N. Y. 11732.

1964

Robert K. Rooke, E.M. 1964, has been carried as "address unknown" while he was in the service and later in the Peace Corps in South East Asia. Bob stopped in to visit on his way back to Malaysia where he will be mining engineer with Associated Mines, Sungei Way, Selangor Malaysia.

1965

William G. Rankin, Jr., Math E. 1965, wrote "I have taken a Civil Service position with the Tank Systems Laboratory, U. S. Army Weapons Command, Rock Island, Ill. I will be joining the advanced concepts group and will conduct computer simulations to examine alternatives and assist in design." Bill's new address is 637 Boston Dr., Davenport, Iowa 52806.

1967

Robert K. Thomas, Met. E. 1967, has sent us a new address. It is 1745 Avenue B, Schenectady, N. Y. 12308. Bob is still with General Electric.

1968

Dr. Alexander Blood, D. Sc. 1968, formerly associated with Dames & Moore in Denver, recently accepted the position of chief geologist of TOSCO (The Oil Shale Corporation), with offices at the corporation headquarters — 18200 West Highway 72, Golden, Colo. 80401. His home address remains the same — Box 88 A. Rt. 3, Golden, Colo. 80401.

John W. Walker, Jr., P.E. 1968, writes us of his new assignment and address change. He says "I am presently serving as the S-2 officer and pipeline engineer for the 808th Engr. Bn. (Const)." His new address is Lt. John W. Walker, Jr., HHC, 808th Engr. Bn, Box 530 — Ft. Wainwright, Alaska — A.P.O. Seattle, Wash. 98731.

1969

Paul G. Hansen, Geol. E. 1968 and M. Sc. 1969, has moved from West Orange, N. J., to Anchorage, Alaska, where he is associated with Adams, Corthell, Lee Wince & Assoc., 503 E. 6th Ave., Anchorage, Alaska.

In Memoriam

Riley

Bryan

Scott Terry Riley

SCOTT TERRY RILEY, P.E. 1964, died from third degree burns March 24, 1970 in Los Angeles County Hospital as a result of a fiery gas explosion the previous afternoon in the garage of his home at 1630 Jersey Pl., Thousand Oaks, Calif. 91360.

Born May 19, 1941 in Scottsbluff, Neb., Mr. Riley spent his childhood and all of his school years in Springfield, Colo., where he was graduated as valedictorian of his high school class in 1959. During his school years he excelled in athletic events and other school activities and was a member of the DeMolay Chapter of Springfield.

In the fall of 1959 Mr. Riley entered the Colorado School of Mines where his activities included Alpha Tau Omega, Tau Beta Pi, Blue Key, Theta Tau, Track, Golf, ATME, Athletic Council, Student Council Treasurer, E-Day, M Club, Oredigger, Press Club, Who's Who in American Colleges and Universities. He graduated at the top of his class in Petroleum Engineering in 1964. On July 23, 1961 he was married to Judy Kay Hatchett, his childhood sweetheart.

Upon graduation from Mines, Scott Riley and his family moved to New Orleans, La., where he was employed by Chevron Oil Co. as a petroleum engineer. In 1965 the family returned to Denver and Mr. Riley worked for Midwest Oil Corp. as a petroleum engineer.

In 1959 Scott Riley began flying and as the years passed he continued to become more interested in flying as a career. As a result of this he received an assignment in 1967 to United Air Lines Flight School in Denver to become an air transport pilot for U.A.L. He was later assigned to United's base of operations in Los Angeles and in the summer of 1968 the family moved to Thousand Oaks, Calif.

Mr. Riley was a member of the United Methodist Church in Thousand Oaks, Air Line Pilots Assn. and Y's Men's Club of the YMCA. He was also a member of the Elkins Ranch Gold Club and played and coached the basketball team of the church.

Scott was an outstanding husband and father, spending much of his free time with his family. He was devoted to his father and mother and to his brother as well as his own little family.

Survivors include his wife, Judy; son, Kyle; daughter, Megan Gay, all of Thousand Oaks, Calif.; his father and mother, Mr. and Mrs. Don M. Riley, Sun City, Ariz.; brother, Bruce, Ft. Bragg, N.C.; many other relatives, and a host of friends.

An Appreciation of

Russell Ritchie Bryan

COLORADO School of Mines lost a valued alumnus when **Russell Ritchie Bryan,** Met. E. 1908, died at Cananea on Feb. 12, 1970. Mexico lost one of its old foreign residents who had spent much of his professional life in the country.

After graduating from public schools in Denver, Russ Bryan went on to professional studies at Golden. Born in Denver on March 27, 1886, he had still not strayed from his home state when granted a degree in Metallurgical Engineering by Colorado School of Mines in 1908. Thereafter he was seldom in it except for brief employment at the Tomboy, in Telluride, and a Bureau of Mines project at Colorado Springs during those years when he was amassing experience for later accomplishments. Interspersed with those early jobs were others at the Sunnyside in Eureka, at Anaconda Test Laboratory in Montana and work in California gold mines. He married Edith Ann Skinner in 1914.

In 1923 Russ and his wife moved away from the United States to settle at Pachuca, a four centuries old silver producing district in Mexico. He spent 13 years in experimental work which lead up to design, centralization and reconstruction of the Loreto mill of the Compañía de Real del Monte y Pachuca. The cyanide regeneration process and plant which he developed and built, was an indispensable part of the operation, essential to economic survival.

In 1936 an offer to go to the Philippines proved too attractive to ignore. He provided technical assistance at Tumbago Consolidated and at Surigao Consolidated and eventually formed a partnership with Edward Wisser and John Payne for general mining consulting headquartered in Manila.

Conditions during the pre-war period did not warrant continuance of the consulting firm. It was dissolved and Russ Bryan returned to Pachuca to continue with the organization he had left earlier. Never again did he leave the RDM Company until his retirement in 1965. Meanwhile, the United States Smelting Refining and Mining Company, which had acquired the RDM operation in 1960, sold its interest to a Mexican government corporation, in 1948. The government agency, La Comisión de Fomento Minero assumed the responsibility for RDM management, first under don Enrique Ortíz, and after his death, under don Oswaldo Gurría Urgell. Russ Bryan became an intimate friend and valued associate of both men who had infinite confidence in his ability and integrity. As a result, he spear-headed the tailings retreatment project, designed to recover silver from the huge accumulation of cyanide tailings. The Comisíon de Fomento Minero made Bryan responsible for the entire job, from initial experimentation to design, construction and operation of the new mill, in addition to his regular duties in charge of metallurgical operations of RDM.

Aside from purely professional papers which he presented through technical journals, Russ Bryan wrote other articles. One, with Carrell B. Larsen, in the Colorado Mines Magazine, dealt with historical aspects of Pachuca. Another, an AIME publication with M. H. Kuryla, covered milling and cyanidation at Pachuca.

Russ, and his wife who survives him, had six children, three daughters and three sons. Engineering held considerable appeal to the family, as well as to him. Two of his boys became engineers, one daughter married a geologist and another a mining engineer.

Russ Bryan's friends throughout the mining fraternity will remember him with affection. He had lived 84 years when he died, a long life during which he made friends throughout Mexico, the United States and the Philippines.

—Alan Probert

Donald Dyrenforth

DONALD DYRENFORTH, E.M. 1912, well known (retired) mining engineer, died April 26, 1970, in a Jacksonville, Fla., nursing home. Graveside services were held April 28 at Evergreen Cemetery in Jacksonville.

Mr. Dyrenforth, who last resided at 1130 Monticello Road, Jacksonville, Fla., was born in Chicago, Ill., in 1888, son of William Henry and Dora Ketchum Dyrenforth and brother of the late Dr. L. Y. Dyrenforth. He graduated from Evanston Township High School, Annapolis Preparatory School, and the Colorado School of Mines. His technical specialty was mineral beneficiation, but he also spent many years as a mine and mill superintendent and general manager of a lead-zinc-silver operation in Colorado.

The last 35 years of his active working days were spent with the Dorr Co. (Now Dorr-Oliver, Stamford, Conn.) from which he retired in 1953 as general manager North American Sales. He was well known, well liked, and well respected throughout the world wide mining industry. He was a recipient of the Distinguished Achievement Award given by the Colorado School of Mines in 1949 and was president of the Colorado School of Mines Alumni Association.

Mr. Dyrenforth was the inventor of several successful mineral classification machines and was a sought after engineering consultant by many major mining companies. He was a member of Theta Tau (Honorary) and Sigma Alpha Epsilon Fraternities and a Legion of Honor member of the American Institute of Mining and Metallurgical Engineers. He was a registered professional engineer in New York, Connecticut and Colorado and was a member of the New York Mining Club and the Chemical Metallurgical and Mining Society of South Africa.

He treasured a letter from the late Henry J. Kaiser that stated "without Don Dyrenforth's help and expertise the Grand Coulee High Dam would not have been completed on schedule. The Dorr Company can be justly proud to send him out as their metallurgical engineering expert."

Survivors include two sons, Donald R. Dyrenforth of Salt Lake City and William P. Dyrenforth of Jacksonville, Fla.; a sister, Mrs. John J. Lowitz of Rye, N.Y.; a brother, H. Brooks Dyrenforth of Jacksonville, Fla., and seven grandchildren.

A. Largue May

A. LARGUE MAY, E.M. 1911, 83, of 818 10th St., Beaver Falls, Pa., member of a pioneer Beaver Falls banking family, died May 15, 1970 at his home, following several months' illness.

A lifelong resident of Beaver Falls, and son of the late James M. and Hannah Reeves May, he was former vice president and retired cashier of Reeves Bank, which his grandfather, John Reeves, helped to organize, and former plant manager and owner of the Former Beaver Enameling Co., Ellwood City.

He attended St. Mary's Episcopal Church, Beaver Falls, where he was a former vestryman, Geneva College, and was a graduate of the Colorado School of Mines, and attended Pennsylvania State University. He held degrees in mining and electrical engineering.

He was preceded in death by his wife, Anne D. May, Aug. 26, 1969.

Surviving are a daughter, Mrs. Mary Drusilla Gillespie, two grandchildren, Patricia Anne and Hardy Dean Gillespie, Neptune Beach, Fla.; two sisters, Mrs. Marjorie May, Beaver Falls, and Mrs. Grace May Boggs, Washington, D.C.

Book Reviews

Material Handling

A vast quantity of information is available on mining and excavating machinery with additions made yearly as newer and better models are marketed. The use and application of this equipment is well documented in a wide variety of magazine publications, manufacturer's bulletins, and engineering texts. An effort was made to collect, review, and synthesize this wealth of information for the purpose of presenting a well formulated and generally acceptable selection procedure.

The applications of the machines overlap and often are as varied as the types of models available. Several machines lend themselves to very simple analyses, leading to a relatively straightforward selection procedure, while others had to be superficially treated because of the highly complex nature of their operation and application.

There are four principal factors to be considered in selecting a piece of mining equipment, 1) the mined material's characteristics and condition, 2) the dimensions of the working area, 3) the dimensions of the various models of equipment and their production capacities, and 4) the production rate desired from the working area. In reviewing these factors for the presentation of a selection procedure a job-oriented approach was used.

The analysis covers the following types of equipment: power shovels, draglines, clamshells, tractor-shovels, bucket wheel excavators, slushers, dredges, tractor scrapers, bulldozers, conveyor belts and hydraulicking.

Since several equipment selections may be feasible for a particular job, a rigorous cost analysis is necessary to differentiate the most suitable type and model from this group of alternatives. As a guide to this the factors involved in cost estimating are examined.

It is available gratis from the Publications Office, Virginia Polytechnic Institute, Blacksburg, Virginia 24061.

—L. Adler and H. E. Nauman

Quips

We're always being urged to tell the truth, but nobody wants to hear it.

* * *

One thing an alarm clock never arouses is our better nature.

* * *

Salesman: "I'd like to see someone with a little authority."

Clerk: "Well, I have as little as anyone around here."

* * *

If you drink a quart of milk a day for 1,200 months, you'll live to be 100 years old.

From the Local Sections

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

SECTION	PRESIDENT	VICE-PRESIDENT	SECRETARY-TREASURER	TIME AND PLACE OF MEETING
Alabama Birmingham			Wm. Haynes, '54	On call of the president.
Alaska Anchorage			**Reginald S. Y. Lee, '67** 628 E. 5th Ave., Anchorage 99501	
Arizona Arizona	William E. Saegart, '53	Robt. A. Metz, '55	**James D. Sell, '55** 2762 W. Holladay St. Tucson, Ariz. 85706	Annual Meeting, Dec. 7, 1970, Western Motel, Tucson.
California Bay Cities	Carl Foget, '61	Dave Strandburg, '61	**Tom Aude, '62** 54 Woodford Drive Moraga, Calif. 94556	Meetings held on call of the Secretary.
Santa Clara Valley			Stanley Y. Ogawa, '53	
Sacramento	Gail Penfield, '56		F. B. Sweeney, '57 6619 Auburn Blvd., Citrus Heights	
San Joaquin Valley	R. A. Ganong, '47		B. A. Ellison, '61	
Southern California	Bob Snyder, '67	Marsh Chapman, '38	Bob Governski, '64 (Sec.) Phone: 213 — 349-4155	Meetings second Thursday of each month at Nickolas Restaurant, 1449 W. Sunset Blvd.
Colorado Denver	A. E. "Ted" Seep, Jr., '68	Hal Kellogg, '55	Jack Dressel, '50	Luncheon meeting held third Tuesday of each month, Denver Press Club, 1330 Glenarm Pl.
Grand Junction	Arch F. Boyd, '26	Robert H. Sayre, '34	Robert F. Barney, '35	
District of Columbia Washington	A. A. Wyner, '25	Louis DeGoes, '41	Charles T. Baroch, '23 2001 N. Daniel St. Arlington, Va.	Regular meeting at noon, second Tuesday of each month at the Shrine Temple, 1315 K St. N.W.
Illinois Great Lakes	C. R. Fitch, '49 7915 Exchange Ave. Chicago 17, Ill.			
Kansas Wichita	Francis Page, '39		James Daniels, '51 307 Schweitzer Bldg., Wichita, Kans. AM 5-0614.	Meetings called by secretary. Contact secretary for date of next meeting.
Louisiana New Orleans	Charles Tyler, '53	Joseph L. DuBois, '50	Monte Richard, '60 Pan American Petr. Corp. P.O. Box 50879 New Orleans, La. 70150	Regular luncheon meetings — last Wednesday of the odd-numbered month except July.
Lafayette	John J. Wallace, '51	Edward J. Gibbon, '68	Stephen D. Chesebro, '64 P. O. Box 51345 Lafayette, La. 70501.	Regular luncheon meetings at Lafayette Petroleum Club on fourth Thursday of each month.
Minnesota Iron Ore Range	Paul Shanklin, '49			
Missouri St. Louis	H. A. Dumont, '29 227 Crane St. Edwardsville, Ill.			
Montana Butte	John M. Suttle, '42 Continental Dr. Butte			
Nevada Northern Nevada	Paul V. Fillo, '40	H. R. Fitzpatrick, '36	James H. Bright, '52 1450 E. 2nd St. Reno, Nev. 89502	Meetings held four times per year at call of the Secretary.
New Mexico Carlsbad	John Magraw, '53			
Four Corners	Lou Amick, '50	Al Loleit, '50	N. E. Maxwell, Jr., '41 405 S. Church St. Aztec, N.M. 87410	Special meeting at the call of the president.
New York New York	Robt. B. Kennedy, '38	Board of Governors: Ralph Hennebach, '41 C. D. Michaelson, '32 C. Bellin, '34 R. B. Kennedy, '38	E. T. Benson, '33 1175 Broadway, New York, N. Y.	Meetings on call every month or six weeks from September to May, usually at Uptown Mining Club, 49th and Park Ave.
Ohio Central Ohio			Raymond M. Schatz, '35 Battelle Memorial Institute Columbus	
Cleveland	Bob Garrett, '45			Meetings held on call of president.
Oklahoma Bartlesville	G. T. McIntyre, '30	Bill Fredrick, '56	Charles Strong, '58 Box 336, Bartlesville, Okla.	Regular meetings held every Tuesday at noon, YWCA, 411 S. Johnston St. After September, group will meet every Friday.
Oklahoma City	Ed Johnson, '49 844 First Nat'l Bldg.			Regular meeting held at call of the president.
Tulsa	Todd C. Storer, '47		Jerry McLeod, '57 1708 East 60th Pl. Tulsa, Okla. 74105	Meetings held at call of the president.
Oregon Lower Columbia River Basin	Michael DiLembo, '58	D. H. Griswold, '30	Wendell Cloepfil, '62	On call of the president.
Pennsylvania Eastern Pennsylvania	Samuel Hochberger, '48	Arthur Most, Jr., '38 1345 Woodland Cr., Bethlehem		
Pennsylvania-Ohio	Vincent G. Gioia, '56		David P. Rihl, '58 Dravo Corp., Pittsburgh and Terrace Rd., Carnegie, Pa. 15106	Meetings held first Wednesday of each month (noon), Cafe "B," Golden Triangle YMCA, 4th and Wood Sts., Pittsburgh.
Texas Coastal Bend	Ray Gouett, '52	Charles R. Russell, '54	Irwin M. Glasser, '43 Humble Oil & Regining Co. Corpus Christi, Tex. 78401	Luncheon Meeting — First Wednesday of each month at the Petroleum Club.
El Paso	Peter A. DeSantis, '51	William F. Dukes, '50	L. G. Truby, '48 4320 O'Keefe Dr. El Paso, Texas 79902	Meetings held on last Wednesdays of January, March and May. Special meetings on call.
Houston	Ronald E. Diederich, '57	Edward B. Reynolds, '66	James K. Applegate, '66 Marathon Oil Co. 2300 W. Loop, South	Luncheon meetings held at 12 noon on first Thursday of each month at White Horse Cellar, 1211 Fannin St.
Permian Basin	Hal Ballew, '51	Harry B. Hinkle, '59	Al Wynn, '65 4313 Princeton, Midland, Tex. 79701	Meetings held in Jan., Mar., May, Sept., and Dec.

Anchorage Section Organized

After several attempts at organizing an Anchorage Chapter of the Mines Alumni, Reggie Lee was successful in lauching the organizational meeting. An excellent group of 14 attended this luncheon meeting at the Captain Cook Hotel on April 2, 1970. Reggie was unable to attend due to other commitments. Steve Hackett handled the reservations and Dick Church "chaired" the meeting.

It was decided that the Anchorage Section would be officiated by one officer, i.e. a recording secretary. The meetings would continue with regular luncheons scheduled for the first Thursday in each even numbered month. The next meeting is set for June 4, 1970.

Those in attendance were: Dick Church '56, Jim Heisel '63, Harold Heinze '64, Joel Moss '42 (Homer, Alaska), Butch West '65, Fred Richardson '43, Ken Clodfelter '51, Steve Hackett '68, Joe Harbison '55, Dick Webb '64, Phil Howell '59, George Brinkworth '64, Bill Penttila '56, Bob McMullin '55.

I must confess that I'm "green" on the workings of a local Chapter. Would appreciate any ideas that could be used to generate active interest or program material or lists of available material that we could use. As you probably know, the large majority of our alumni are involved with oil exploration and production.

The Charter was not signed by the president and secretary of the CSM Alumni Foundation and is returned as requested in your letter of Jan. 5, 1970.

—**Ken Clodfelter, '51**
Recording Secretary

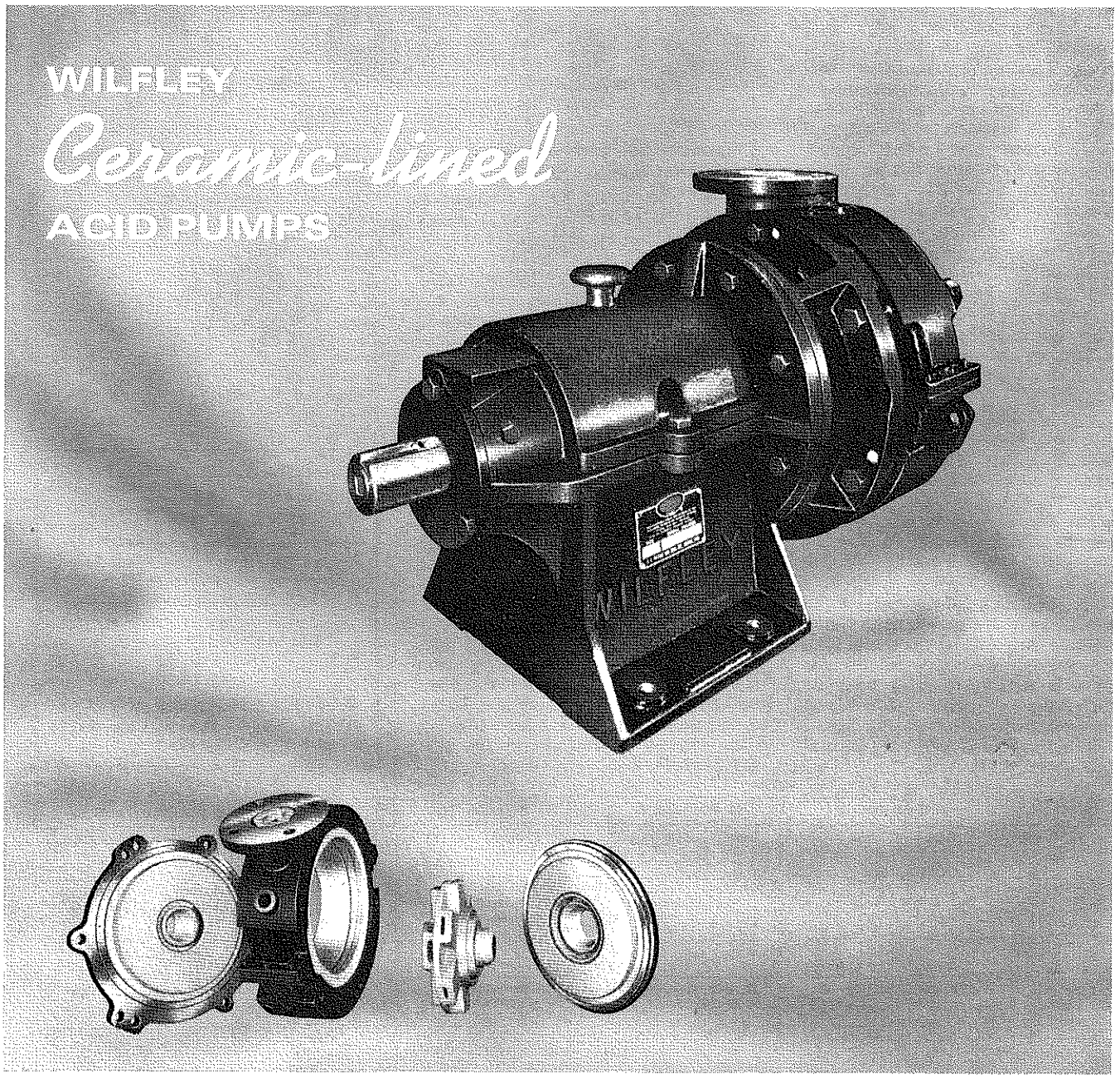
Brennecke Attends Meeting Of Alumni in Houston

Athletic Director Fritz Brennecke attended an Alumni meeting June 23 of the Houston Section. His remarks to the alumni dealt in the general field of recent campus happenings—such as the 96th Commencement, enrollment, new buildings in progress, the athletic picture, faculty retirements, etc. The meeting was organized by Jim Applegate '66 with help from Don Diederich '57.

Attending the meeting at the Houston Geo Club were the following 34 members: J. L. Ballard and Donald M. Davis '25; A. L. Ladner '27; John D. Marr '31; Mark Gardner and Robert W. Harrison '33; L. H. Boyd and R. A. Kerr '36; W. B. Barbour '37; W. E. Strain '38; H. E. Stommel '41; John Feather, Ray Parker and D. B. Schulz '49; Art Dickinson, Sol Meltzer and Jim Murphy '50; Duane J. Fritz '51; Pete MacMurrough '52; Bill Burpeau, Jack F. Earl, Dale Hieger, Tom Rollins and Guy Towle '53; Andy Juresin '54; Ron Diederich and Ralph Simermeyer '57; Paul Wichmann '58; Jim Applegate, Tom Perry Jr. and Ed Reynolds '66.

Advertisers' Listings

SECTION	PRESIDENT	VICE-PRESIDENT	SECRETARY-TREASURER	TIME AND PLACE OF MEETING
Dallas-Ft. Worth	Harold E. Potter, '27	Dewey D. Bowling, '49	Peter A. MacQueen, '50 P.O. Box 2050 Ft. Worth, Texas 76101	Meeting held on call of president.
South Texas			William A. Conley, '19 1515 Haskins Rd. San Antonio	Meetings held at 7 p.m. on first Thursday of February, May August, November at Old Town Inn, 416 8th St., San Antonio.
Utah Four Corners	See N.M. for officers			
Salt Lake City	Allen D. Trujillo, '62	Wallace W. Agey, '48	Carl D. Broadbent, '64 5750 Glenbrook St. Salt Lake City, Utah 84121	Four meetings annually on dates set by officers.
Washington Pacific Northwest	Sidney B. Peyton, Jr., '54		Boyd Watkins, '64 10427 Aqua Way S. Seattle, Wash. 98168	
Eastern Washington			Arden Bement, '54	Meetings on call of president; annual August picnic.
Wyoming Central Wyoming			George S. Rogers, '59 3209 Aspen Drive Casper, Wyo. 82601	
Canada Calgary	Richard C. Siegfried, '50 Canadian Superior Oil Ltd. 703 6th Ave., Calgary Tel.: 267-4110 Local 429			Calgary Section meets for a noon luncheon on the 3rd Monday of Sept., Nov., Jan., Mar., May—at Calgary Petroleum Club. Visiting alumni invited to attend.
France	Resident or visiting alumni may contact **Bernard Turpin, '60**, 33 Rue de la Tourelle, 92-Boulogne, France.			
Libya	R. E. Palmer, '61, Corresponding Secretary, c/o American Overseas Petroleum, P. O. Box 693, Tripoli, Libya.			
Peru	Martin Obradovic, '53			Meetings first Friday of each month (April thru December), 12:30 p.m., Hotel Crillon. Other meetings on call
Philippines Baguio	Francisco Joaquin, '26			
Manila	J. R. Kuykendall, 41	Jesus Jalondoni, '40	M. E. Natividad, '40 c/o Northern Motors United Nations Ave., Manila	Meetings held at noon, second Tuesday of each month.
Puerto Rico	Resident or visiting alumni may contact **L. L. Hagemann, '60**, Apt. 17, El Monte Apartments, Avenida Munoz Rivera, Hato Rey, Puerto Rico.			
Turkey Ankara	Alumni visiting Turkey contact **Ferhan Sanlav, '49**, Turkiye Petrolleri A. O. Sakarya Caddesi 24, Ankara, Telephone 23144.			
Venezuela Caracas	Z. Sancevic, '57	Jean Pasquali, '60	Ian Achong, '58 Cia. Shell de Venezuela Aptdo. 809, Caracas	



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