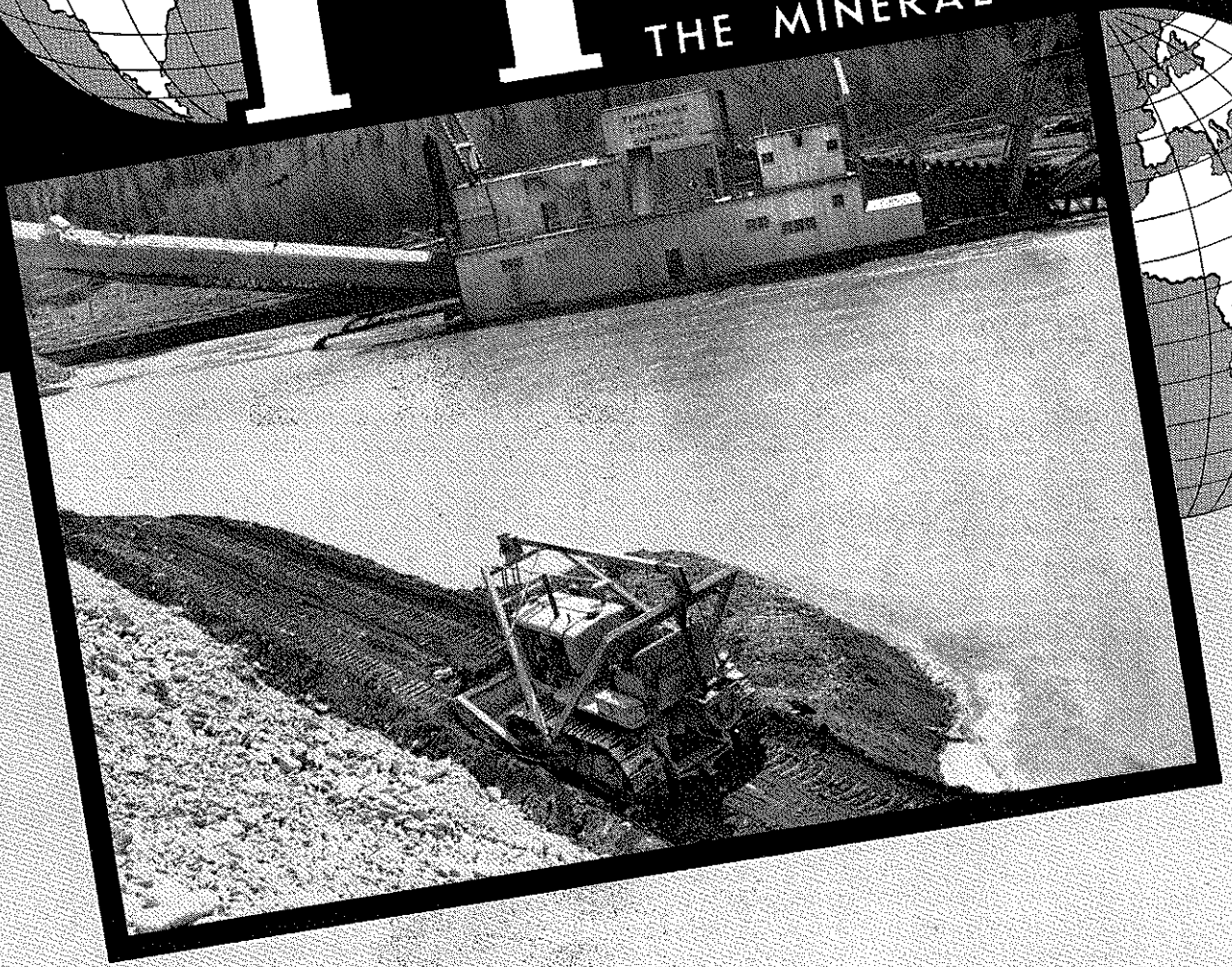
THE MINES MAGAZINE

AROUND THE WORLD WITH THE MINERAL INDUSTRIES



JULY · 1940

VOLUME XXX NO. 7

Letters

Your letters are welcomed for publication in this column every issue. Send along your bouquets, your suggestions, your news, your problems, your criticisms. You like to read them and so do others. These are a good start, let's hear from you.—ED.

THE LUCKY MAN

From WARREN W. CURRENS, '12

Your letter announcing my luck in the drawing at the Annual Banquet and the reward for that luck came along in due time.

The prize is a very handsome affair, very useful and very welcome. I consider it a present from the Association and, through you, thank the Association.

Denver seems impossibly far away from New Jersey but I have never given up hope that I can be among those present at some commencement festivities before I have to go in a wheel chair.
P. O. Box 268, Little Falls, N. J.

ORE DIGGER EDITOR IN OKLAHOMA

From JOHN A. BAILEY, '40

I was moved from Tulsa to Covington this week where I expect to be for the next month or so doing roustabout work with the Shell Company. I'm enjoying my job a great deal and believe that I'm in work that will hold my interest for a long time.

My work for the Ore Digger and Mines Magazine is already proving useful and I'm sorry that I was not able to spend more time on it. If there is any way that I can help out the Magazine in the future please let me know.
General Delivery, Covington, Oklahoma.

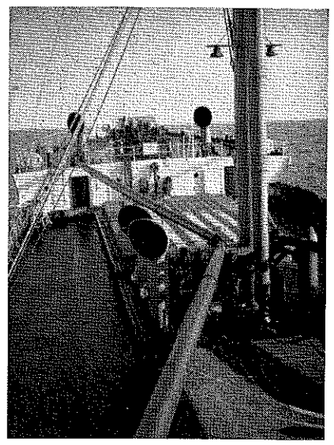
EAST AFRICA, EXCITING AFTER 13,000 MILE TRIP

From E. R. PEDERSEN, '39

On October 23rd, 1939, I left Fresno, California headed for British East Africa, via New York and Dar-Es-Salaam, a trip that was longer than anticipated—64 days.

On the way I stopped at Golden, Denver, Chicago and New York before waving farewell. Monday October 30th, our boat, the West Cawthon, a small freighter of about 6000 tons, of the American South African Line started on its voyage with ten passengers. Although it was around ten o'clock in the evening, we did get a fleeting glimpse of the Statue of Liberty.

The first two days were plenty rough for a fellow who had never been at sea and to play safe I continued where I left off in New York—close to the rail. After that the weather cleared up and I became a real sailor. As we traveled into southern waters flying fish became quite numerous. On October 11th we had a great thrill by a British bomber that circled around our boat ready for business and for once I heard some South Africans say they were happy about the large American flags which were painted on the sides of the ship and hatches. The large plane carried several men, two machine guns, and eight large bombs attached to the underside of the wing. As it was a land plane, it was quite probable that one of the large aircraft carriers was in the vicinity, although not in sight.



▼ Stars & Stripes Protect Cawthon.

We passed Ascension and St. Helena Islands, two dots in the Atlantic, almost within calling distance. Ascension Island was first and it came as a bit of relief as it was the first land we had seen for seventeen days. Seven days after passing St. Helena we reached Africa and passed the Cape of Good Hope. Here we were visited by a large British cruiser which passed within three hundred yards of us. Up the coast to Natal on the southern part of Africa we were

(Continued on page 375)

PERSONAL NOTES

John H. Abbott, '28, has written from the Philippines that he has changed his address to Dilly-Portugese Timor, Island of Timor. He did not state with what company he is now associated nor the work he is doing.

A. E. Anderson, '04, who has been Assistant Manager, Explosives department, in the Seattle district for E. I. duPont de Nemours & Co., Inc., has been promoted to the position of Manager. The Seattle district includes Washington, Oregon, California, Idaho and the three tiers in Montana, as well as the Alaska territory.

Joseph L. Barber, '39, Metallurgist for Creede Mills, Inc., receives mail in care of the company at Creede, Colorado.

C. R. Blomberg, '39, is employed by the Phillips Petroleum Company and at present is being addressed in care of the company, Drawer 188, League City, Texas.

Byron B. Boatright, '22, E. V. Foran and W. F. Knode announce the dissolution of the firm, *Parker, Foran, Knode & Boatright* and, with *P. C. Dixon,* '31, have formed a partnership under the firm name of *Foran, Knode, Boatright & Dixon.* They will continue practice as Petroleum and Natural Gas Engineers in the Second National Bank Building, Houston, Texas.

Charles W. Bowman, '36, as Sales Engineer for the General Electric Company is now located in Schenectady, N. Y., where he receives mail in care of the company.

Willard S. Briscoe, '30, who is associated with the Bethlehem Steel Company, is spending a few months in Tulsa, Oklahoma. His address there is c/o University Club, Box 1544.

James L. Bruce, '01, General Manager of Cyprus Mines Corporation, moved his California residence recently to 1321 Virginia Road, San Marino, California.

Ivan G. Burrell, '31, is Production Superintendent for The Ohio Oil Company, with address Box 529, Owensboro, Kentucky.

H. F. Carpenter, '23, has a change of address from Maguarichic, Mexico to Septima 300, Chihuahua, Chih., Mexico.

John J. Christmann, Jr., '36, who recently opened offices in Lubbock, Texas, as Petroleum Engineer and Consulting Geologist, has a new address, 2707-24th Street.

G. Harold Cronin, '26, left the latter part of May for an indefinite stay in Alaska to make mine examinations on the Seward Peninsula, on the Arctic ocean. Mail sent to his home, 4523 Wilson Boulevard, Arlington, Virginia, will be forwarded.

Eugene E. Davis, Ex-'29, Engineer for the Mountain States Tel. & Tel. Co., has been transferred from Cheyenne to Laramie, Wyoming.

Salvador del Rio, '28, has returned to the States from Colombia and is being addressed at Apt. 718, 333 East 43rd Street, New York, N. Y.

Donald G. Foot, '38, in the Flotation department of the Utah Copper Company, recently moved his residence from Salt Lake City to 70 East 17th Avenue, Garfield, Utah.

Homer D. Ford, '05, Manager of the Barber Asphalt Corporation, is residing at Apt. 2, 215 East Bayaud Avenue, Denver, Colorado, where he receives mail.

Harold L. Gardner, '27, who has been in the Philippines for the past year as Engineer for the North Camarines Mines, is on his way back to the States. His temporary address is Box 824, Kingsville, Texas.

PERSONAL NOTES

Charles E. Golson, '34, is Metallurgist for the A. S. & R. Company at their Santa Barbara, Mexico plant, and receives mail at the Tecolotes Club, Santa Barbara.

Kenneth B. Hutchinson, '39, is being addressed at Box 489, Miami, Arizona; he is employed by the Miami Copper Company.

Sterling Huyett, '36, who returned several months ago from South America, is mine superintendent for the Cameron Gold Mines, Inc., in Cripple Creek and represents this company in Colorado.

W. I. Ingham, M. Sc. '34, is being addressed at 201 Avenue E, Bismarck, North Dakota, where he will be for the summer doing some geological work.

William D. Jeffries, '37, Sales Engineer for E. I. duPont de Nemours & Company, has been transferred to Niagara Falls, N. Y., where he receives mail in care of the R. & H. department of the company.

William C. Lang, '39, Chemist for the Sun Oil Company, has a change of residence address to 1955 Croswell Place, Toledo, Ohio.

Walter E. Lorence, M. Sc. '23, has been promoted to the rank of Major in the U. S. Army and is at present stationed in Washington, D. C., where his address is 2220-39th Place, N. W.

Clifton W. Livingston, '33, who has been in the Philippines for several years, has returned to the States and is being addressed temporarily at 629 No. Orange Street, Glendale, Calif.

John M. McAnerney, '35, is employed by the St. Joseph Lead Company at Sheep Ranch, California.

LeRoy M. Otis, '14, who has been in Colorado on mine operation has returned to New York City and is receiving mail at the Lotos Club, 110 West 57th Street.

George G. Pasquella, '24, Consulting Geologist, has a change of address to Box 18, Mt. Carmel, Illinois.

Philip A. Pelton, '35, is being addressed at Box 571, Park City, Utah.

Orville O. Shott, '37, Sales Engineer, is being addressed in care of Bryan and Morgantown, Uniontown, Penna.

Sigmund L. Smith, '39, has returned to his home in Denver, 3335 Lafayette Street, after several months spent in Nevada.

Frank H. Storms, '24, General Representative in Northern South America for Ingersoll-Rand Company, has been transferred to Caracas, Venezuela, with Apartado No. 1347.

F. L. Tyler, '23, President of the Texas-Louisiana Oil Co., Inc., receives his mail through Box 2721, Houston, Texas.

E. D. Underwood, '36, Refining Engineer for the Arkansas Fuel Oil Company, resides at 228 Lister Street, Shreveport, La.

C. A. Wachter, Ex-'33, Party Chief, United Geophysical Company, has a change of residence address to 1255 E. Green Street, Pasadena, California.

S. P. Warren, '13, Consulting Metallurgical Engineer, is being addressed temporarily at his home in Golden, 914-19th Street, where his family will be for the summer.

Thomas L. Wells, '29, Consulting Engineer receives mail at 3 Ridgewood Road, Toronto, Ont., Canada.

Stanley A. Wickstrom, '38, is in the Engineering department of the Stanolind Oil and Gas Company in their Houston office. His mailing address is Route 3, Box 85, Houston, Texas.

The Mines Magazine

VOLUME XXX — JULY, 1940 — NO. 7

Contents

THE PROBLEM OF MINE VALUATION - - - - - - 340
By Howard N. Lary

THE "DOODLEBUG" vs. APPLIED GEOPHYSICS - - 343
By Dart Wantland, M.Sc., '36

A PILGRIMAGE TO EGYPT - - - - - - - - - 346
By George B. Somers, D.Sc., '30

RECOVERY OF NICKEL, COPPER AND PRECIOUS METALS FROM DOMESTIC ORES - - 352
By J. Koster, R. G. Knickerbocker, O. C. Garst, T. E. Evans and W. E. Cody

EDUCATIONAL TRAINING FOR TEACHERS IN ENGINEERING COLLEGES - - - - - - - - - 358
By C. O. Reiser, Elizabeth, N. J.

NON-METALLIC MINERALS - - - - - - - - - 359
By Kenneth E. Hickok, '26

Departments

LETTERS - - - - - - - - - - - - - - - 335
PERSONAL NOTES - - - - - - - - - - - - 336
WITH THE MANUFACTURERS - - - - - - - - 360
CATALOGS AND TRADE PUBLICATIONS - - - - - 362
ALUMNI BUSINESS - - - - - - - - - - - 363
PRESIDENT'S MESSAGE - - - - - - - - - - 364
LOCAL SECTIONS - - - - - - - - - - - - 365
WEDDINGS, BIRTHS, MEMORIAM - - - - - - - 369
BOOK REVIEWS - - - - - - - - - - - - - 370
GEOPHYSICAL NEWS AND REVIEW - - - - - - 371
REVIEW OF ARTICLES WORTH WHILE - - - - - 373
PATENT SERVICE - - - - - - - - - - - - 376

Front Cover

New Gold Dredging operation, Fairplay, Colo., showing "Caterpillar" Diesel bulldozer in foreground pushing black dirt into rock pile to seal pond for dredge.—Courtesy of Caterpillar Tractor Company, Peoria, Ill.

INDEX TO ADVERTISERS SEE PAGE 378

Official Organ of the Colorado School of Mines Alumni Association. Copyright 1940. Entered as Second Class Matter at the Postoffice at Denver, Colorado, under the Act of Congress of March 3, 1879. Subscription price $3.00 a year. Single copies 50 cents. No additional charge for foreign subscription. Published every month in the year by the Colorado School of Mines Alumni Association. Address all correspondence, including checks, drafts and money orders to Frank J. Nagel, Secretary, 734 Cooper Bldg., Denver, Colo. Address all correspondence relating to Mines Magazine to Frank C. Bowman, Editor, 734 Cooper Building, Denver, Colo.

PROBLEM OF MINE VALUATION

By
HOWARD N. LARY
Regional Administrator
Securities and Exchange
Commission, Denver, Colo.

Upon the request of your Engineers' Day Committee I agreed to deliver a short paper today on the subject of "Mine Valuation." At a later date and upon a request for a title for this paper, but before making any preparatory notes, I thoughtlessly suggested "The Problems of Mine Valuation." The title should have been "The Problem of Writing a Brief Paper on the Problems of Mine Valuation," for, like the complexities of modern living, mine valuation is now a complex problem that cannot be resolved into a simple code or course of action. The engineer of today, confronted with the problem of mine valuation, approaches it with a deep feeling of humility for he knows that, at best, his tools are meager.

This paper, which in essence is a too brief and therefore unsatisfactory discussion of the multiplicity of problems inherent in mine valuation, is in its entirety an expression of personal and professional attitude and experience, which may not under any circumstances be construed as an expression of opinion for or by the United States Securities and Exchange Commission.

What is the present day value of an ore deposit? Just as sure as I am standing here there is a value and in the future when exploitation and the record of exploitation are complete it will be possible to reconstruct its true value of today. But today the engineer cannot know the many, many factors that will go into that resulting figure. He cannot know the ultimate tonnage and grade or the ultimate realization costs or the ultimate net profit. He cannot know the true present day value because of the inadequacy of his present day tools. His value, then, is at best an intelligent guess based on factual data integrated in direct proportion to the probative value of its component elements and seasoned with reason and experience.

In this discussion I shall arbitrarily divide the whole problem into subordinate problems, but for facility in consideration only. In practice the engineer is soon aware that each subordinate problem, although separable in the abstract, is closely interwoven with each and every other one.

The geological problems are imposing. In the first place, the engineer must decide whether or not the property is susceptible of valuation. Many, because of insufficient ore exposures, inaccessibility, because of ore exhaustion, or because of insufficient geological indices, are not. Many may be ruled out because the minimum requirements of the investigating engineer are not present. Whether the property meets the individual test or not, the engineer must study available production records, mine and mill records, cost records, if any, and become acquainted with the broad geological features of the deposit. Before reaching his decision he must so organize his information that it definitely indicates to him one course or the other, or, failing, he must continue his investigation until he may reasonably make his choice.

Assuming a decision to proceed with the examination, the engineer must next return to the beginning and start on a long and often tedious job depending, of course, on the physical size of the contemplated project. In this paper I shall assume a project of sufficient size to warrant comprehensive investigation. In many, the project is smaller, consequently reducing the dollar risk, making large investigative investments inadvisable despite a greater proportionate risk of failure in the event of purchase.

Your engineer must first acquaint himself with the areal geology, then with the local geology, and if there are earlier reports on either subject he must consider their contents in light of his knowledge. Then must come the foundation stone of his ultimate report, a sampling of the mine. Upon his already informed judgment, he must decide upon the areas to be sampled, and the interval, size and character of the sample. I need not discuss the great degree of care that must be used in this slow and uninspiring task.

With sampling completed, the investigator knows only the value and grade of an infinitesimally small portion of what was once a part of the mineralized zone. From this information and guided at all times by obvious geological characteristics he can make an estimate of the proven and probable ore reserves, the accuracy of which, in large measure, is dependent upon the care in sampling and assaying, the size and frequency of the samples, and the quality of his geological interpretation.

If the geological considerations stopped here the task, while difficult, would be comparatively simple, but mines are bought and sold only infrequently on the basis of their readily ascertainable values. The valuator is interested, as well, in ore possibilities, for the anticipated rate of return is usually inversely proportional to the assurance of the existence of ore. While methods of ore estimation have not changed greatly in the last few years, the methods of probing mineral possibilities have. Geophysical tools, especially in conjunction with geological control, detailed structural mapping, both surface and underground, microscopical studies, especially in reference to paragenesis and metasomatism, and other lines of geological inquiry, have progressed rapidly in the past generation until today the competent investigator may, with far more assurance than formerly, consider the possibilities of additional ore extensions or occurrences. Often, and in critical areas rehabilitation, drifting, or drilling may be warranted. The resulting assumptions may not take qualitative or quantitative form since they are based on inductive reasoning, but they are as necessary to valuation as the more exact results. Here especially experience, and at times, intuitive reasoning, are of value.

From the results of such an investigation, the quality of which is dependent upon quality and comprehensive-

An address delivered to Colorado School of Mines students at Golden, Engineers' Day, March 15, 1940.

ness of the work of the investigator, it is possible to ascribe a gross dollar value to the property for proven and probable ores plus an arbitrary assignment for productive possibilities based on the then market value of contained metals. This, as I noted earlier, is the foundation of mine valuation.

In view of the many unknown factors in such an investigation, even in the relatively precise process of valuing proven ore, the resulting valuation often appears to condemn the large amount of careful work that has gone into its computation. The investigator realizes more than anyone else that the problem is much simpler in its inception than at later periods and that as factual knowledge having probative value increases, the apparent problems having no present solution multiply at an ever-increasing rate. Yet the investigator must occupy this figuratively remote position and take the property as he finds it, for the other extreme is complete exhaustion of all orebodies within the physical limits of the property.

Thus, despite the apparently illogical character of a thorough investigation and an estimate based both on fact and assumption, nevertheless, in competent and experienced hands, that estimate will stand the test of reasonableness and prudency. The right or reasonable balance of cost of investigation against the value of the valuation to his employer can only be left to the discretion of the examining engineer. He should possess a rough estimate of the prospective value of his reports to his employer before undertaking the assignment. If his work is circumscribed by financial restrictions placed on it by his employer or for other reasons, his report should set forth wherein the basic data which could have been obtained is deficient or of questionable value because of these restrictions.

With this information, the ascribed gross value at present day prices of its potential products, the examining engineer must proceed to an estimate of realization costs, or the cost of marketing its products. In essence, this covers the whole field of human relationships, for although ore in place is a natural phenomenon, the utility of its component parts is a phenomenon resulting from the working of the human mind. From the time it is first disturbed by the drill until it becomes an integral part of some article of commerce, its disposition, other than physical existence, is predetermined by the human mind. Today even its physical existence is threatened.

The examining engineer's first problem is the mechanical problem of extraction. What will it cost to mine these orebodies and transport their contents to a concentrating plant? Mining requires machinery for penetration and excavation. What this machinery will be is dependent upon the proposed rate and system of extraction. The rate is dependent upon known reserves, their physical character, and marketability of products. The system is dependent, almost to the exclusion of other considerations, upon the physical character of the orebodies.

The engineer, then, must possess from his geological investigations, factual knowledge of the physical characteristics of ore occurrences on the property. He then must plan in rough draft a practical development layout for the proven and probable orebodies. Upon this basis it is then possible to plan extraction upon certain daily rates or, if the factor of marketability is questionable, as it often is, then a minimum rate should be set up. With this phase worked out, it is then advisable to consider the cost of the surface and underground plant in addition to such equipment as is already on the property.

Immediately upon leaving the problem of basic valuation, there comes the problem of labor, both skilled and unskilled. This problem will be present in every step, and because of its presence throughout mine valuation I chose to consider it collectively under the heading of social problems.

An additional consideration that is mechanical, in part, and a part of the extractive problem, is the problem of dilution. It is absolutely impossible at any reasonable cost to mine clean. Therefore, the engineer must allow for this inevitable factor. Experience has shown that extraction following competent daily sampling of working faces generally runs below reported assay values and above calculated tonnage. There is no record of individual experience available, and since the ultimate results may be important factors of cost, it is necessary to consider this phase carefully. Many mines, as rule of thumb but having some basis in operating experience, use the factors 10% for overbreak and 10% for dilution for orebodies above mining width.

The examining engineer, having planned his methods of development and extraction, the rate of extraction, and the cost of capital additions to plant as well as having estimated his mechanical losses and gains in ore extraction, now approaches the next problem, concentration.

Concentration may be physical or chemical or both. I have chosen the phrase "physical problem" to cover that part of the concentration process that concentrates the like mineral constituents of the ore without apparent change of chemical character, and usually on the basis of some physical characteristics. I have used the adjective "apparent" for in the flotation process there is a microscopic chemical process that participates in the process of concentration.

If the anticipated value of the ore in the mine is not sufficient to pay transportation to smelting centers and smelter charges, concentration is necessary. The basic consideration in this phase of the whole problem is the mill test. In this test a representative sample of the ore is subjected to many experimental flow sheets or variations thereof. This may be done at the property and sometimes when the prospective property is large, small pilot mills are erected for test purposes, but more often the sample or samples are submitted to engineering laboratories usually operated in connection with equipment houses. After the mill test and based on the proposed rate of ore delivery, the problem of mill design follows. The problems of location for efficient transportation, gravity flow, sufficient water, tailings disposal, operating costs, replacement costs, and others are imposing in and of themselves but can only be mentioned here.

Then there is the inevitable tailing loss when a small proportion of the valuable constituents of the ore escapes with the tailings. The mill test will indicate a conservative factor that may be applied to this deduction from gross value.

The chemical problem for all but the larger units of the industry or precious metal mines is non-existent. Here, depending on the character of the ore, the concentrates will be marketed to purchasing companies such as smelting companies, reduced to impure metallic form in existing plants, or if precious metals, reduced by one of several processes to a relatively pure state. It, the problem at this stage, is usually a consideration of applicable smelter schedules with possibilities of slight discounts on fixed charges in return for dependability in ore characteristics and supply, or a problem similar to the problem of concentration which I have just mentioned. In the latter category are precious metal mines where the product is reduced to bullion in the vicinity of the mine in order to reduce transportation costs. Feasible methods are standardized and their cost of installation, operation and maintenance may be derived from comparable costs at other properties.

Legal phases of the valuation problem may be important or unimportant, they may be complicated or simple. In old productive districts the problems of ownership are usually sufficiently complicated to warrant employment of counsel for title abstracts. In others the chain of title may be relatively simple, in which case the engi-

neer may assure himself on basis of his own work. Water supply based on seniority of original claims is an important legal phase of nearly every valuation, especially if there is to be a concentrating mill in conjunction with the mine. Water law is especially important in our Western States and if the engineer is not conversant with it, and often he is not, the problem should be placed in the hands of counsel for opinion.

In addition to legal precautions regarding ownership of property and rights, there are many laws that affect mining, some of which are of recent origin. Stream pollution is now an offense in most states, thus making it necessary to impound tailings and clarify the overflow water. The application of property taxes and income taxes, both State and Federal, must be considered in any contemplation of profit. There are other taxes on sales and purchases, for social security, old age pensions, unemployment, and workmen's compensation. In recent years new Federal and State laws have been passed which govern wages and hours, labor relations, unemployment compensation and old age payments, security laws regulating offerings of securities, fair trade practices, and many others, all of which must be considered in any problem of valuation.

The social problem, using social in its inclusive meaning, is becoming increasingly important. It is under this title that I shall consider the cost of labor and its importance in the problem of valuation. Labor, as I have said, enters into every step from the first step in exploitation until some finished article reaches a final resting place. The problem for the valuator decreases, however, as the valuable product gets further and further away from the mine.

Of paramount importance under this title is the subject of management. From his own experience the examining engineer must estimate the capabilities of future management for efficiency in operation, leadership (for a mine is often isolated), and capabilities in the art of exploration. From his own experience he must estimate the productive capabilities of skilled and unskilled labor translated into tons per man shift, feet per shift, and then into dollars. In times of flux, such as the present time, he must consider the possibilities of increased demands regarding wages, working hours and conditions, and living conditions.

Other social problems are national or international in character. The comparatively free flow of goods in international trade has been upset by recent surges of nationalism. Now we have wars, declared and undeclared, in many parts of the world. At home new or revised legislation may add to or subtract from tax burdens or alter employee-employer relationships. All of these problems that may affect the exploitation of the property at some time in its existence must be examined in the light of experience and contemporary trends.

Finally, the financial problem. The geological solution answered the question of gross present value. Succeeding solutions or partial solutions answer the problem of capital investment, probable operating cost and probable maintenance cost. The answer to this final problem is the answer to the question of feasibility. The valuator must decide whether or not the mine, if under consideration for purchase or substantial capital outlay, may be reasonably expected to repay the capital investment plus interest thereon. Usually the anticipated rate of interest is in proportion to the apparent risk. Because a mine is a wasting asset, because mining, once undertaken, is not susceptible to intermittent operation, because mining is a capital goods or heavy industry, and because mineral products, except by law or cartel agreement, are subject to and responsive to the vagaries of supply and demand, imposing problems face the engineer. In effect, he must arrive at some conclusion on the value of today's dollar tomorrow and tomorrow's dollar today. To do this he must consider the past and present history of the dollar in the many functions under review. On this basis, and seasoned with his own good judgment, he must express an opinion in regard to the future cost of exploration and development, of labor and material costs, of taxes and premiums designed to promote the individual security of labor, and of property and income taxation. He must also express an opinion in regard to the future value of the product or products, the future trends in consumption, the possibilities of replacement by or displacement of other products, the product's competitive position, and of the effect of the secondary or scrap market. There are many other considerations. The result, whether itemized or included in a final figure, should be an expression of the degree of feasibility. The study may be brief or exhaustive, but its quality should bear some relation to the expected investment and the life of the property.

No discussion of valuation is considered competent without mention of the Hoskold annuity formula. Briefly, it is a formula that provides a mathematical solution to the valuation after the participating factors have been determined. These factors are (1) expected net yearly profit; (2) expected life of the property; (3) required rate of return to attract capital, and in some cases (4) the number of years required to place the property on production. The formula, the solution of which gives the present day value, gives an answer that is practical only insofar as the solution of the many problems I have discussed have been practical.

In view of the many unknown factors, what is the real value of such an imposing program of investigation? In the first place, the program I have given in such brief and unsatisfactory outline approaches a maximum. The determination of what to include, exclude, stress or slight, must rest with the examining engineer and his decisions will be based upon (1) the purpose of the valuation, (2) the present and potential character of the property, (3) the ability of his employer to follow his recommendations, (4) the anticipated value of his report, and (5) experience. The engineer will attempt to competently ascertain (1) the gross value of reasonably assured reserves, (2) the possibilities of future discoveries, (3) the overall cost of realization, and (4) the probable value of the product or products. Thus the valuation program is imposing only in proportion to the character of the proposed program of subsequent action. In the second place, it does place a dollar value on tangible and intangible resources of value by means of a method of valuation that has in practice proved to be superior to others. Finally, although there are many unknowns that cannot be reduced to precise determinations, nevertheless the rational extension of accurate information and the reasonable interpretation of human activity are in the long run our best criteria of the future.

In closing, I should like to emphasize an opinion that the increasing availability of tools for interpretation of ore possibilities will coincide with demands for their practical application. In early days, outcrops, grass root orebodies, and abundant speculative money that paid for the driving of random holes into attractive hillsides resulted in the discovery of most if not all of our mining districts. The production from these districts increased rapidly and with few exceptions consumption kept pace. Today those easily discovered occurrences have been well worked over, like the better kernels in a dish of popcorn. Had the present development of the human race transpired ten thousand years later, other outcrops now unknown would have been exposed. These undiscovered orebodies which are undoubtedly more abundant than those we now see, are the reserves of the future.

(Continued on page 366)

The "DOODLEBUG" vs. APPLIED GEOPHYSICS

By

DART WANTLAND, M.Sc., '36

Assistant Professor of Geophysics
Colorado School of Mines

Part II
The Buzzascope

In the early history of the West there wasn't much difference between the shootings of the quick fingered Deputy Sheriff and the quick fingered outlaw as far as the victim was concerned, as the life of "Billy the Kid" shows. In like manner there is, at times, a very thin line between what is sound and legitimate in a prospecting instrument and what is a doodlebug for the uninformed investor.

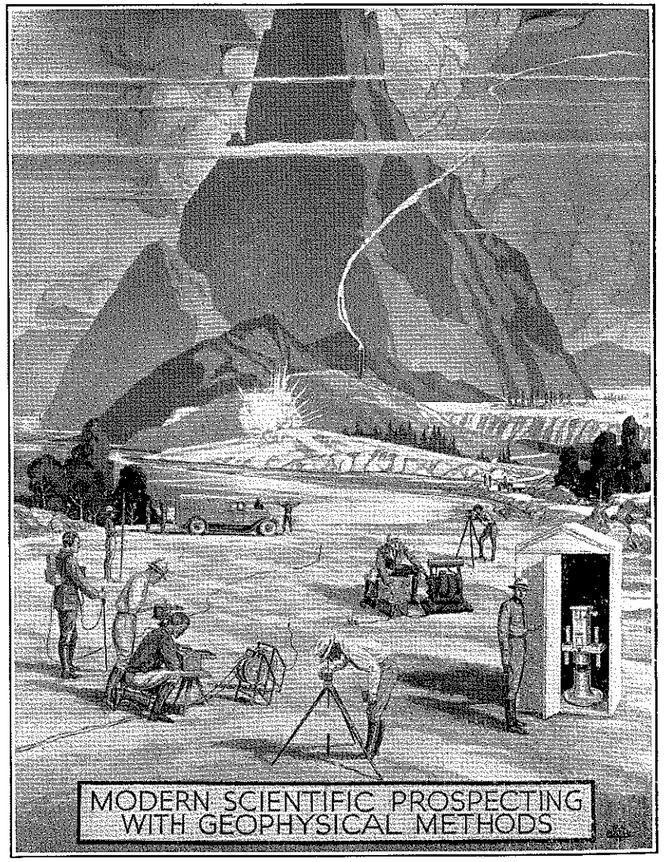
A borderline case along this line was that of the Buzzascope[2] which blossomed in about 1927. Mr. Buzz with his Buzzascope undeniably had a good proposition if it worked. In the operation of this instrument he would shoot off a pistol in a can, set into the ground, and attempt to record the time of travel of the energy thus sent into the earth as it was reflected from rock strata below. In this procedure Buzz, no doubt, took his idea from deep sea echo sounding methods; widely used in oceanographic surveys. He was successful in obtaining a hearing and in interesting several of the officials of oil companies who at that time had offices in the First National Bank Building of Denver. A test of his machine was arranged for at the Ft. Collins oil field. A number of company geologists and some of these officials went out with Mr. Buzz to witness the trial of his device. The test was not successful. It is pertinent in this connection that this gentleman failed to keep an appointment with Dr. Heiland for an inspection of his instrument.

Buzz came on the stage a little too soon. As is well known, at the present time, in the widely used reflection method of seismic prospecting waves sent into the ground from the explosion of a very small charge of dynamite.[3] These are timed to an accuracy of 1/1000 of a second as they are reflected back from horizons several thousand feet below the surface. It is thus possible, since the speed of travel of these waves is known, to quite accurately (± 0.5 of 1% of the depth) determine the depth to the reflecting bed.

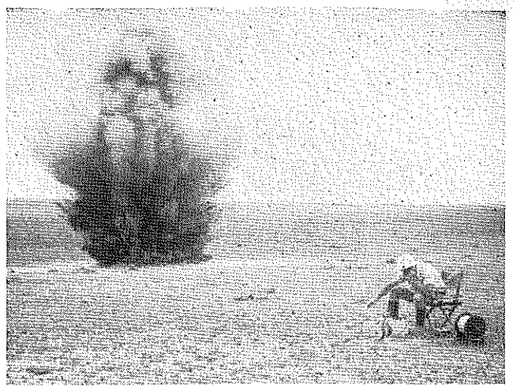
The story of the Buzzascope brings out the point that almost anyone with a new instrument or a new exploration method can obtain a hearing and usually get backing and endorsement if he will submit to impartial tests by qualified parties.

[2] This name fictitious for obvious reasons.

[3] Often a charge of ¼ of a stick or less of 60% dynamite is used.



Geophysicists have seen so much development in their instruments and methods and science has made such rapid and phenomenal strides in relatively few years that no new proposition can be safely "laffed off" without investigation. The sad part of the situation is that many people will often more readily invest their money in something with a certain amount of "hokus pokus" attached to it than they will in a scientifically legitimate, though less spectacular, geophysical survey. The Lucky Strike ad of a few years ago apparently summed up the situation with the slogan "It's fun to be fooled." More than one well has been drilled on a doodlebug location.



▼ Modern Scientific Prospecting with Geophysical Methods.

Shorty Hamilton's Treasure Finder [4]

Description of actual doodlebugs are rather rare though the literature on the subject in general is surprisingly extensive. One publication,[5] for example, contains a bibliography of 572 items. An account of a truly extraordinary doodlebug was sent to the Editor[6] of the Engineering and Mining Journal by Mr. W. P. Crawford of Bisbee, Arizona, in 1933. The story is as follows:

" 'Shorty' Hamilton was in the office the other day asking for an old carbon electrode, and, on being questioned, said that he was helping build a radio ore finder. Further questioning brought out this tale:

" 'This is the second machine we've built. The first one was a dandy. It had about $140 worth of platinum for points, but the lightning struck it and burned everything up. We're going to use the old arc-light carbons in the new machine. It's not as good, but it's lightning proof.

" 'The first machine was awful sensitive, especially to gold. We tried it out on gold watches and gold teeth and stuff like that and it worked fine. Jim wanted to go up in the Black Canyon country, north of Phoenix; said there was a lot of placer ground and gold quartz veins and we'd find a mine. We packed the machine in my car, and it didn't do much until we reached Bumblebee, and then it went crazy. The needle pointed northwest and the bell was ringing, and Jim says, 'There's a mine round here some place, pardner.' We followed the line as far as we could drive and then packed the machine—it wasn't very heavy—for three or four miles. The further we walked the better she was acting, and finally we come to an old prospector's cabin. He was home —an old fellow, all bearded up like a billy goat—and asked us to come in. We took the machine in the cabin and Jim took some readings. There was gold ahead of us all right and there was something close to the cabin that kept bothering with the quartz vein readings Jim was getting. The old fellow told us about his claims and it checked just what the machine showed; so we asked him if he wanted to sell. He was agreeable—wanted $5,000 for the four claims. We went down to Nogales, raised the cash and took it back. He signed the deeds, and after we counted out the money and everything was settled, he said, 'Gents, the place is yours.' He went over to his bunk, fished around under it with his cane, and dragged out an old suitcase. He opened it up to put his money away and we saw a big roll of gold certificates. Jim says, 'Shorty, there's what was a-boogering up our machine. It was them damn yellowback bills.' "

Legitimate Treasure Finders

"Shorty" Hamilton is not the only person interested in locating buried treasure. We often receive letters from persons who want to know if there are machines for that purpose. The answer is yes, though they cannot trace out "yellow back bills." In fact these instruments were *not* originally built for treasure finding but for the unromantic job of locating buried water pipes. Their applicability to the problem of locating metallic objects, such as treasure, if it lies within 10 to 15 feet or less of the surface is, so to speak, a by-product. The School of Mines now owns one of these instruments which is useful also in the teaching of geophysics as it neatly illustrates the basic principles of the inductive methods of electrical prospecting. In these methods alternating current carried in a large loop of wire laid out on the ground excites a secondary field in a conductive zone or ore body in the vicinity. The location of the conductor can be detected by suitable measurements with a search coil.

The pipe locator combines the loop and the coil into a portable instrument built on a smaller scale. In it a square sending coil, about 2′ on a side, sends out an alternating wave from an oscillator built into the coil. A similar coil forms a receiving unit and through ear phones plugged in to this coil a note can be heard. Both coils are connected by light side rods for carrying. An operator who walks between the coils walks with the instrument across an area where the presence of a pipe or buried metal is suspected. As a secondary field is created, by the wave sent out, in any nearby pipe the presence of the pipe can be detected by an increase of the sound in the head phones. This may sound slightly doodlebuggy for in effect the sending coil on the rear end of the machine tickles the pipe, as it were, and the squeal set up is detected at the front end or coil of the pipe locator. We know they are effective, however, as we have personally operated two of them of different makes testing on a water pipe in the one case and a small buried metal bound box in the other.

Such an instrument is applicable, incidentally, in examining the gold content of a placer deposit, a fact not generally known. Just what can be done with them as to locating ore and outcrops thereof is not a proven case, as far as we know, though certain claims have been advanced along this line.

Back in the Good Old Days of 1556

As noted in Part I of this article doodlebugs are of ancient if not honorable lineage. A water witch with forked stick is shown in the wood cut from that famous book "De Re Metallica," by Louis Agricola Bauer. This very old treatise of 1556 was translated from the Latin some years ago by Hon. Herbert Hoover and Mrs. Hoover.

There were skeptics as to doodlebugs and witch sticks even in Bauer's time which was only some 60 years after Columbus sailed the ocean blue. Bauer himself says in what is to our ears the quaint language of his day that—"There are many great contentions between miners concerning the forked twig, for some say that it is of the greatest use in discovering veins, and others deny it." There was also argument as to whether a fork from a hazel bush was the most efficacious or whether it was better to use hazel twigs for veins of silver; ash twigs for copper; pitch pine for lead and especially tin, and rods of iron and steel for gold.

One school of thought in regard to the use of twigs in locating veins held that the movement of the twig, as it was grasped in the proper manner in the hands of the operator, was due to the power of the veins. On the other hand, to quote Bauer "—those who say that the twig is of no use to good and serious men, also deny that the motion is due to the power of the veins as the twig will not move for everybody, but only for those who employ incantations and craft." The answer given to this by the twig operators was that "when one of the miners or some other person holds the twig in his hands, and it is not turned by the force of the veins this is due to some peculiarity of the individual, which hinders and impedes the power of the vein." They said further that "—the power of the vein in turning and twisting the twig may be not unlike that of a magnet attracting and drawing iron toward itself, this hidden quality of a man weakens and breaks the force, just the same as garlic weakens and overcomes the strength of a magnet. For a magnet smeared with garlic juice cannot attract iron—."

Bauer took what would today be called a scientific attitude when he said "since this matter remains in dispute and causes much dissension amongst miners, I consider it ought to be examined on its own merits." He pointed out that the form of the twig or rod used by the ancients for locating veins was of no importance and if attracted by the veins the force would draw the twig straight to it rather than act to turn the twig in the hands of the operator. After neatly disposing of a number of other points in drawing attention to the futility of forked twigs for locating veins he concludes with the following: "Therefore a miner, since we think he ought to be a good and serious man, should not make use of an enchanted twig, because if he is prudent and skilled in the natural signs he understands that a forked stick is of no use to him—." He adds "—for, as I have said before, there are the natural indications of the veins which he can see for himself without the help of twigs."

Ancestral Background

According to Mr. Arthur J. Ellis whose work has been previously cited, the true ancestral background of witch sticks and like divining rods is lost in antiquity. It is certain, according to this writer, that rods or wands of some kind were in use among ancient peoples for forecasting events, searching for lost objects and occult practices in general. The rod is mentioned many times in the Bible in connection with miraculous performances, especially in the books of Moses. It is not certain whether there is any actual connection between the rods and wands of very ancient times and the divining rod or witch sticks of the time of Bauer and down to the present day. Furthermore, space does not permit going into this rod and wand phase of the subject, nor to take up the matter of to what extent certain really smart men used rods to cover up and hide from the uninitiated their real methods of prospecting. This idea has been developed by R. W. Raymond[7] in discussing the rules followed by Baron de Beausoleil, a leading mining authority of his day (1576-1643).

The doodlebugger must be credited with keeping abreast of the times. While some water witches still cling to the old forked stick, many doodlebugs are highly pseudo scientific; utilizing the latest in radio and radioactivity. They will, no doubt, soon be harnessing cosmic rays to their chariot. Just as nature aids the physician in curing human ills, since the majority of people get well anyway, nature is kind to the water "dowser." There are relatively few places in the habitable and inhabited parts of the world where if a drill hole is sunk deep enough water will not be found. On the basis of this fact the chances of success are much in favor of the willow wand worker.

Conclusion

In conclusion we borrow a thought expressed by Mr. Oscar Weiss in an address before the World Petroleum Congress in London in 1933.[8] In pointing the future, Weiss set the ultimate aim of geophysical prospecting as the direct location of minerals. In this he was prophetic. The soil and gas analysis methods of prospecting, developed to a point of commercial application only within recent years, are knocking at the door of just this problem in relation to oil and gas.

We wonder then if it really is beyond the realms of possibility that instruments and methods will some day be devised for directly locating minerals and even, perhaps, for distinguishing between them. But such devices, indeed, would mark the arrival of the geophysical millenium and to paraphrase Bauer, ought not be given consideration by good and serious men. We doubt, however, if even Bauer himself would have believed such a commonplace marvel as transatlantic telephone would ever be possible.

In regard to this Buck Rogeresque picture of the future, we can paraphrase the words of the negro song "If that ain't stealin', I don't know" and say "if that ain't doodlebuggin' I don't know."

[4] Doodlebug story referred to in Part I of this article. Mines Magazine, March 1940.
[5] U. S. G. S. Water Supply Paper No. 416, by A. J. Ellis, The Divining Rod—A History of Water Witching.
[6] Permission has been obtained from the Editor of this publication for the use of this material.
[7] R. W. Raymond—Transactions A. I. M. E., Vol. 11, p. 419—1883.
[8] Proceedings World Petroleum Congress, London, section B, 1934.

MECHANICAL ENGINEERS SOUGHT BY WAR AND NAVY DEPARTMENTS

The United States Civil Service Commission has announced an open competitive examination to fill mechanical engineer positions, in the field of industrial production, in the War and Navy Departments. The examination is announced for three grades, with salaries ranging from $2,600 to $3,800 a year, less a retirement deduction of 3½ per cent.

Applications will be rated as received at the Commission's Washington office until June 30, 1941. Qualified persons are urged to file their applications promptly.

Except for the substitution of additional engineering experience, applicants must have completed a 4-year college course in engineering. They must also have had professional mechanical engineering experience and specialized experience in industrial production. The specialized experience must have included the planning or lay-out of industrial plants, or the making of surveys of plants for improvements in processes or products; and must have enabled the applicant to become familiar with the machinery, methods, and materials of production manufacture within the field of mechanical engineering. Certain substitutions of graduate study in engineering may be allowed for part of the experience.

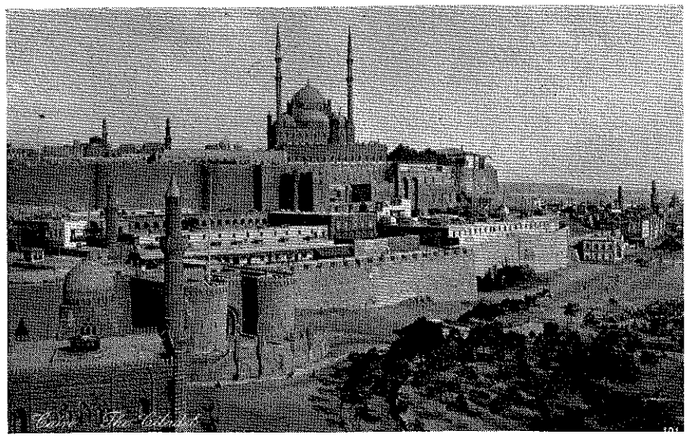
Full information regarding the examination, and the proper application forms, may be obtained from the Secretary of the Board of United States Civil Service Examiners at any first- or second-class post office, or from the United States Civil Service Commission, Washington, D. C.

A PILGRIMAGE TO EGYPT

By

GEORGE B. SOMERS, D.Sc., '30

Geophysicist, Socony-Vacuum Oil Co.
Cairo, Egypt



▼The Citadel, Cairo, Egypt.

My ship was scheduled to sail November 25th, 1939, at eleven A. M. In due time the shipping company bus gathered several of us up at the Hotel McAlpin and took us thru the tube to Jersey City where we were dumped out at the American Export Lines dock. Here we had our passports inspected, were assigned to staterooms, checked our baggage and finally boarded the S. S. "Exochorda" which was still loading cargo. It was a ship of a little less than ten thousand tons displacement, a sort of accommodation ship as it were, that was more or less of a freighter equipped to carry a hundred and thirty-five passengers crowded, — fortunately there were only sixty-two.

We sailed a little after one P. M. and were soon getting our last look for some time of the famous "Skyline" and the Statue of Liberty. Personally, I prefer a little more sky and a little less line. Altho it was my fourth time in or out of New York it was my first daylight view at such close range of the lady with the torch.

The trip under way it didn't take long for everybody to get acquainted. There were a dozen young French-Canadians going to France to study munitions manufacture for five months, another dozen Standard of California men headed for Iraq, Egypt, and Bahrein, one Standard of New Jersey man with his Welsh wife, a Persian who had just received his M. S. from the University of Illinois and was headed for home, a flock of Jews headed for Palestine, a Syrian who only spoke Arabic, two Greeks, a Scotch-born agent of the Export Line with a slightly exaggerated ego on his way to India, and some American engineers and professional men returning to the Near East for their work. One of them was a G. M. representative in Alexandria with his wife, two kids, and a Syrian nursegirl, two were mining engineers, another a Dollar Line representative, one a medical missionary with his wife and three young daughters, and the last an overly dignified American lady missionary just going out. We also had two Englishmen, one with an American wife, the other worked for Shell, two young diplomatic career men, one going to Berlin the other to Sofia, and one large dog.

By supper time it was beginning to get devildam rough, and most of the passengers became seasick. I had more or less successfully negotiated half my meal when the sight of a dish of capon with gravy on it finished me and I barely made a safe haven in time. Felt too sick to even undress that night,—in fact I didn't get my clothes off until late the next night (Sunday). Monday was quieter, and in the afternoon, along with a lot of others, I came up for air.

It stayed quiet Tuesday, and Wednesday, but that night we picked up a rough sea. Fortunately we all had our sea legs, for Thursday was the unofficial Thanksgiving on the 30th, and it would have been too bad to have missed that fine Vermont turkey, candied sweet potatoes, peas, carrots, celery, olives, pie, nuts, raisins, and fruit. It was extremely rough tho, in fact one wild pitch just after I sat down to eat started my chair backwards;—I spilled, slid, and finally ended up by a post over half way across the dining salon before the ship lurched in the opposite direction and my momentum was checked. My glass of water sailed at the same time and was smashed to bits, the water making the linoleum mat in my vicinity as slick as a greased pig. Afterward they anchored the chairs and tables, but it was indeed lucky that the tables all had a high retaining wall around them or otherwise the dishes would have dived floorward as well as exchanging places on the table itself.

Friday it was calm again and we returned to the ships games of shuffle board, ping-pong, bridge, chess, poker, black jack, etc. We had movies every three days with horse racing and Bingo in between. Our first movie was "The Family Next Door," the second was "Inside Information," and the third "Imitation of Life,"—all a trifle old, none exceptional, but all good entertainment and OK to me who had been in Germany long enough to get behind on my movies anyway.

I had hoped to see the Azores but there was naught stirring. A small one was passed in the middle of the night, but we missed the large ones by a good sixty miles. I've heard they are supposed to be all that is left of the lost continent of Atlantis but as far as I'm concerned it is still lost.

Late Sunday night, December 3rd, we saw a light house off the tip end of Portugal, and Monday morning approached the Pillars of Hercules. Several destroyers were cruising about, keeping an eye open for submarines, but none paid any attention to us.

We were finally stopped by a small converted yacht that mounted a business looking cannon forward. They checked our manifest, and passenger list, and then ordered us into Gibralter bay for further examination. In we went and anchored just off "The Rock." It was a grand, impressive sight which I was tickled to observe at such close range.

There was plenty to keep us interested for awhile at least. The bay was full of ships (probably close to a hundred) of all sizes, kinds, sorts, descriptions, and nationalities, — a mine sweeper went into action and passed with net trailing, a few feet on either side of our ship,—one British freighter started out of the harbor, and had a shot fired across her bows from the Rock, so she slowed up and allowed a small government boat to run along side—then went on,—several government boats came out to us with various officials, etc.

Tuesday we hoisted anchor and moved into the inner harbor not far from Algerciras, Spain, where we again anchored and settled down to pass the time as best we could. The monotony was broken by the Contraband control who came out and searched some of the 3200 mail sacks we were carrying.

We thot we were going ashore Wednesday but the tender came out too late and the trip was postponed until Thursday the 7th. On that trip most of the passengers went ashore for a big time. After leaving our passports with the Customs officials four of us chartered a horse and carriage for the afternoon, and drove first thru the town out nearly to the point, then back to the land end or "neutral ground" where a causeway leads into Spain,—a Spanish guard with a red tassel on his cap, and a business like looking rifle keeps out all who don't belong. As my passport stated "Not Valid for Any Country in Europe" I was breaking the spirit of it at least by being on Gibralter so I got no further, nor did anyone else.

Gibralter is a huge limestone rock over two miles long, roughly three quarters of a mile wide, and about 1300 feet high. It is lined with galleries and fairly bristles they say with guns up to sixteen inches in size, altho they are so well concealed that only a few are visible unless you want to count embrasures for guns that have no guns to be seen in them. There is a town of twelve or fifteen thousand persons on the west side but strangely enough altho it has been chiefly settled since the British arrived in 1704, the general language is Spanish.

Our hack took us thru the narrow streets of this town, and stopped at the Post Office for us to mail some letters and postcards. Then on we drove and saw the remains of the former Moorish castle, the old walls, cannon, casemates, gateways, the navy yard, dry docks, the new airport being built at the north and (apparently by W. P. A. workers) etc. We wanted to see some of the ancient galleries with their old style cannons but guards said "Nothing doing." The troops quartered here must have been transferred from a warmer clime or else the British were trying to economize, for all wore tropical shorts, and looked like they had lost their trousers. The weather was fairly mild but all the same I had my overcoat on and was glad I didn't have to dress like a boy scout.

The time passed all too quickly as we had to return at five P. M. At six-thirty, while in my stateroom waiting for supper, the ship was jarred by two distant blasts,—then came three more and we all rushed on deck. It was getting dark but some had seen two planes fly out and circle, and thot possibly destroyers were out there too. Nothing happened, and it was too dark to see anyway so we went to supper and while there felt six or seven more blasts,—supposedly so we heard later from depth bombs about ten miles way. Rumor has since claimed they got a U-boat or two but we don't know and probably never will.

That night we had a dance but altho there were nine or ten women aboard only four showed up. It hadn't been very well advertised, and the rest, tired from the Gibralter trip, had gone to bed. One of the four couldn't dance but she tried hard to learn, the other three were rather fat, overstuffed tho pleasant Jewesses from Palestine. I didn't dance,—decided to turn in early instead. A bunch of the boys brought back a load of liquor—it was fairly cheap at "The Rock," and staged a good celebration that lasted until nearly five A. M.

Friday morning we had fire and boat drill. After seeing the drill I realized fully why so many lives are lost in disasters at sea. Altho we were at anchor in the waters of a bay that was as smooth as glass it took nearly twenty minutes to launch the boats. Then they couldn't start the engine in the No. 1 boat, and the sailors in the others couldn't pull together. Gee what a mess—I could only hope we wouldn't get torpedoed.

At eleven a launch with four Spaniards came alongside and tried to sell cheap, gaudy shawls, tapestries, pajamas and shirts to the crew and passengers. They offered one shawl, a bright yellow one with fringe for two dollars but found no takers. The price came down to one-twenty-five but some one yelled "That's still too high." The boatman yelled back "What will you give me for it?"—I think he finally sold it for seventy-five cents or a dollar and still made a good profit.

At noon a convoy of oil tankers began to form and moved out into the strait,—if there was a sub sunk the day before it may have been lying in wait for this convoy. Some sixty-five or seventy ships went out escorted by destroyers and scout planes—such is the way the Allies combat the German U-boat menace.

We had two more movies here—"Twelve Crowded Hours" and "Five Came Back" but lying at anchor for nine and a half days with little to do for amusement after being on board for a couple of weeks is to say the least, monotonous.

Time was slaughtered by every means possible. There were shuffle board, ping-pong, and bridge tournaments, many games of chess and checkers, lots of reading, etc. Sunday, December 10th, finally along and with it the second opportunity to go ashore. The town on "The Rock" is built on a steep hillside so I scaled long stairways and trudged upward along narrow ramp streets that formed switchbacks until finally I came out at the old Moorish castle, built about 1200 years ago. It was interesting to climb around thru it and observe at close range the design or style of a Moorish fortification. Unfortunately the old galleries in the rock had been taken from the hands of the tourist bureau and returned to the military for the duration of the war so thanks to Adolph I missed that sight.

Next I wandered down thru the town to the museum which is built on the remains of a Moorish bath. The chief sights here were a large model of Gibralter with every place labeled, fossils found on the rock—the best being two Neanderthal skulls; stamps, coins, etc., issued here, old muskets and brass cannons and pistols used in former days for attack or defense. The remains of the Moorish bath was very interesting as there are only two or three such buildings where Christians and Jews can get in to see what the inside looks like,—normally they are only open to the eyes of Mohammedans.

My leave still having time to run I stopped off to see a Rugby game be-

tween two service teams, and finally reached the lighter in time to return to the ship. It might be added here that altho I saw "The Rock" from all sides that I could find no trace of PRUDENTIAL being written across the face of it and am inclined to believe that is all a lot of Hooey.

In order to help pass away time Mr. Twitchell, a mining engineer, gave an impromptu moving picture show with colored film. The scenes included gold mining operations and development at a mine in Iraq, scenes from his trip back to the U. S. i.e. Alexandria, Quebec, etc., and then some sights there to show the English and natives at the mine that the United States was pretty and at least semi-civilized. There were views of the Adirondacks, Ausable Chasm, Lake Champlain, Vermont, New Hampshire, New York City and The Fair, Washington, D. C. and Mt. Vernon. Had been to most of the places shown and enjoyed the pictures very much.

Late the afternoon of the 13th, the Captain returned from "The Rock" and announced we were leaving;—at nine P. M. we hoisted anchor and were on our way. As we passed Gibralter a heliograph sent us a message to slow down as we passed the mine fields,—I suppose to prevent the vibration of our engines or propeller from setting off a mine; then came the go ahead signal and away we went.

The Mediterranean the next day (Thursday) was as smooth as glass and we had a fine trip along the rather mountainous Spanish coast. That evening we had a propaganda film by the American Export Lines called "Yankee Cruise," which showed one of their ships on tour with sights seen at ports of call along the route. The Standard of California furnished a short film of their operations in Arabia, and Mr. Twitchell showed another reel of his colored mining films.

Friday was another fine day with the Captains dinner to top it off. The dining salon was decorated with flags of the countries where our ship stops. Each person was provided with a gay paper hat, a noise making clapper, a horn and a balloon. It being an American ship only three men aboard showed up in Tuxes, the rest of us just wore regular clothes. My hat was a fez and all who had been in the Near East assured me I was a dead ringer for an upper crust Egyptian—I'll have to see one before knowing whether to take offense or not. (Since then I've seen some and I fear my figure had something to do with that crack.)

Except for a fancy menu card and

▼ Bay of Naples with Vesuvius in background.

a few frilly dishes the supper was about the same as usual. However the Company furnished wine (Capri), and champagne called "Sparkling Tears of Christ" to wash it down, and all present had a good time.

Saturday, the 15th, we docked at Genoa at about 8:30 A. M. but it was 11:45 A. M. before we got thru the Italian red tape and succeeded in going ashore. Normally the ship comes here from Naples on the return trip, and police couldn't be told otherwise, as a consequence they were unprepared for landing routine and even left the stamps for OKing passports back home,—thot the passports were fixed in Naples.

To add to our troubles, sunny Italy was anything else but. It rained and rained and was so cold that snow formed on the hills in and around the city. In some ways the rain helped for part of our cargo couldn't be unloaded except in dry weather and thus our stay in port was prolonged.

Four of us caught a taxi and were soon at the Piazza de Ferrari in the heart of town, right by the Post Office. Unfortunately one doesn't buy stamps in a Post Office in Genoa at least, but in tobacco shops or at a concession counter near by. By talking Spanish to one man, and French to another I bought post cards and stamps. The national coin of the country is the lira or lire which is pegged at present at roughly twenty to the dollar, or a nickel apiece. Imagine counting how much money you have in nickels and hundredths thereof.

Being hungry we tackled a man to locate a good restaurant, and he proved to be a Viennese Italian so I talked German to him and found our eating place without any trouble. Outside the restaurant hung turkeys, rabbits, pigs, deer, pheasants, and possibly other animals I didn't recognize without their jackets. Inside, in one part was a wine shop, in another a quick lunch counter and grocery store with meat market. We climbed up a narrow winding stairway at the back to a nice restaurant where we started to get by on Spanish but found a waiter who spoke English. Our lunch was spaghetti and ravioli washed with Chanti wine. For dessert we had a cake of several layers that had what looked like chocolate icing in between but which proved to be something filled with brandy, very good, and mixed with the wine quite potent.

By asking directions of different passersby in four languages, we finally reached the American Express office near the main railway station where we hoped to get a guide. It being Saturday afternoon the place was closed which was unfortunate as it was pouring hard by this time and we craved shelter. We caught a taxi and said "Campo Santo" which is good Spanish or Italian for cemetery, and drew a long ride up hill and down to what is said to be the finest cemetery in Europe. A book could be written on it but a few words will have to suffice here.

It is divided first into sections for the Catholics, Protestants, and Jews so they can get along without fighting or contamination. The Catholic part is also subdivided into sections for the poor, the better off, and the rich. Our guide's English was not too hot, and his German worse so I may make some mistakes in quoting, but we understood him to say that the poor are buried free for seven years, then the bones are thrown into a pit unless called for by relatives. The better off rent a tiny space for thirty years and then must rerent for a similar period or go to the boneyard like the poor. The space being so small the bodies may be buried several deep to economize on space.

The rich section is gorgeous—I wouldn't blame the spirits if they walked around at night just looking at the place. There is a beautiful circular church, splendidly decorated, in the central part, while out from it in long corridors are crypts, over which are ornate tombstones with statues carved in marble from near Lake Como, Carrara, Belgium, and other places. The work on the statues is exquisite, even lace, and designs on the cloth are shown. A stairway by each stone leads down into a crypt where several bodies can be laid to rest. Besides these there are also a large number of mausoleums more or less in a section by themselves. It might be added here that some of the best Italian sculptors have designed these expensive statues and that they have produced marvelous works of art.

Our guide offered to show us some more of the city for an additional sum so we went from there to see the Columbus house. It really only marks the spot where he lived as a boy of nine or ten, as the original house is gone and he was born, they claim, in a small nearby town. We also saw some of the old wall and a former gate, then part of the Old Town. Altho not so well known because the Chamber of Commerce doesn't advertise it, it is said to be one of the best examples of a medieval town in Italy at least. The streets are very narrow and winding, buildings are at least three hundred years old, with many over four hundred. Our guide showed us one he claimed was over two thousand but that may be only an example of poetic license.

Then came a cathedral of great antiquity which was very fine, and afterward we went thru a souvenir shop. Lack of time prevented us from seeing the city gardens, home of Pagganini, or some such musician, and the places where cameos are carved from the shells of large marine gastropods. These cameos are then set in beautiful handmade Etruscan filigree work of silver, sometimes gold filled. Being cold and wet by this time we returned to the ship to thaw out, change clothes, and rest our feet.

It wasn't long before I was back uptown at the Piazza de Ferrari where a large fountain was lighted and playing. Also saw the old Palace of the Doges,—thot they were only in Venice but it seems they had one or more here too. Ate fine Italian supper with Barbara wine, and then met a Greek, who was one of our passengers and spoke Italian, and together we took a ramble thru Old Town. The narrow streets were thronged with people and the tiny one room shops were doing a thriving business.

Sooner or later when European travel is mentioned, the subject of the open air comfort stations of Paris and other French cities is bound to come up. All I can add to it that by comparison with those of Genoa they are models of modesty and propriety, in fact they are almost prudish. All I could do was hope that my big Stetson would attract enough attention to distract the passing Italian girls from making too close observations, and that no one from the ship would pass by.

The ship sailed from Genoa early Sunday morning, that is about 8:30 A. M. and supposedly was going to follow the coast. We headed out tho further than expected and about noon passed the small island of Gongona. Shortly afterward we passed between Corsica and Capraia, and an hour later were close to the island of Elba. There was certainly a strong flavor of Napoleon in the vicinity. Afterward we passed another small island called Pianosa, and south of it the tiny rocky island of Monte Christi where Dumas had Edmund Dantes find his fabulous treasure. Having read the story five or six times I got an enormous kick out of seeing the island for myself.

We reached Naples at 8:00 A. M. on Monday morning and had a big thrill passing Capri, the mountains above Sorrento, and seeing Vesuvius on one side of the bay, and Naples on the other. We passed the guard boom at the mouth of the harbor and soon docked at a large new wharf with several Italian destroyers, and splinter fleet boats close at hand. We had been told we would only stay in port from two to four hours, but at the last minute were given eight much to everyone's delight.

Again four of us chartered a car with guide and chauffeur and headed thru Naples, and onto the new highway that leads to Vesuvius and Pompeii. Enroute we stopped at a factory where jewelry is made from corals and cameos cut on the spot. Many of the cameos are made from the shells of a large marine gestropod, one to a shell. It seems the shell has three layers but one is not usable and is removed. One of the remaining layers is white, the other brown. A design is placed on the white layer and any excess removed. Next the design is carved, and the whole polished, and mounted. They also have some carved shells to be used as lamp shades, that are very attractive and unique.

Before reaching Pompeii we turned off and took the trail to Vesuvius. Went first thru a town destroyed by lava in 1906, during the last bad eruption, and were soon climbing fast and furiously for nearly twelve kilometers. Finally we ran out of road and finished the ascent on foot. I had heard and studied about rope lava for years but this was the first climb over it. Vesuvius, fortunately, had had a minor eruption two days before, and was still cutting up didoes. Soon we were in the main crater and found the rocks were still warm, while in cracks in the lava we could see glowing rock not over a foot below,—all too close for comfort in fact. A man met us and made ashtray, and coin souvenirs for us from molten lava right at the surface. A little way further we got within twenty feet of an active vent (there were fumeroles on all sides) where the lava was coming out and flowing a short distance. Next we climbed the crater wall to where an active vent had formed a sizeable cinder cone and was giving off clouds of smoke and sulfurous gases as well as throwing bombs and lapilli to height of thirty or forty feet.

It didn't seem more than a moment before we were on our way back down the winding highway. At the base we foolishly wasted time eating lunch, spaghetti, salami, and wine called "Lacrimas de Cristo" or Tears of Christ. The champagne of that name is very good but I've tasted better cider at home than that wine. We also had a musical trio play for us while eating, a piccolo and two guitars,—they ran thru the well known Italian airs in murderous style, and we were all glad to escape and forget them.

We entered Pompeii by what is known I think as the Marine gate which in earlier days was closer to the sea than at present. A few more steps brought us to the museum where we saw numerous casts of bodies of men and dogs found in the ruins, household utensils, surgical and dental instruments, Lares and penates, charred cloth, bread, grain, fruit, etc., door locks, scales, pictures, statues, and numerous other things. Many of the best specimens tho are in the museum in Naples which we didn't have time to visit.

Next we saw a temple destroyed by earthquake in about 63 A. D. and now restored, (Pompeii was destroyed by

hot ashes and pumice in 79 A. D.), the Hall of Justice, lots of stores and shops, and the Temple of Apollo in which we found several interesting statues. One with a hole in the back of its head had formerly had that hole connected by a pipe with an underground chamber so that a priest could act as the voice of the oracle and thus impress the people. Another rather startling one was of an hermaphrodite but we were told there were several such statues and paintings in the ruins as the Pompeiians seemed to feature such unusual persons.

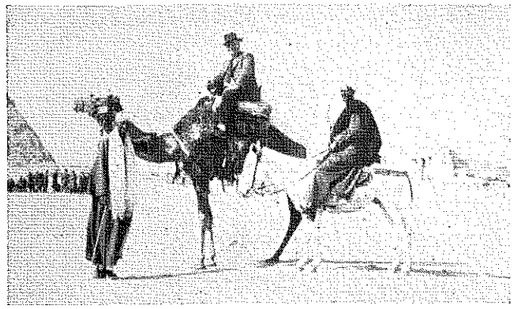
The Forum or main public square was quite large, and here we turned north I believe. At any rate we went thru a public bath house and saw the hot, tepid and cold water and steam baths, the dressing room with its brasier to supply heat, and poles for hanging up clothes, some more casts of people trapped here, possibly slaves, and numerous small statues.

Our route led us by many houses and gardens where we could see pretty fountains and mosaics, the house Bulwar Lytton described in his "Last Days of Pompeii," and finally one of the finest homes yet unearthed, that of the Brothers Vettii. Many houses by the way, are known now by the design in the mosaic forming the floor by the front door. There is the "Home of the Dog," "Home of the Wild Boar," etc.

In the fine house tho we found that the artium because of lack of windows, had a square hole to admit light in the roof, while under it in the floor was a catch basin or pool to catch the rain water and carry it off. By the front door was a painting that for respectability sake has been covered up with a door and locked, but is shown to men visitors with special permit, and to women by themselves who tip the guide,—never to mixed groups.

Inside the house is a patio with garden, statues, original Roman lead pipes, etc. Formerly there was another statue here but it is now hidden with some very spicy pictures in a side room and only shown by special permit. We had one. Off of this patio are several rooms with the original paintings, most of them of mythological subjects, still on the walls. To a casual observer they are not so bad but to the better initiated some are rare, particularly the one of the wooden cow or origin of the Minotaur of Crete.

There is also a vomitorium off the dining room, just a plain room with a catch basin in the floor. The Roman custom was to eat until full, retire to this room for a few minutes, then return and enjoy another meal.



▼ George B. Somers investigating the Pyramids.

From here we wandered past numerous old houses and gardens with mosaics and fountains to the middle class red light district where our permit again gained admission. Here the small rooms, stone beds, rare and spicy wall paintings, and scratches on the walls were very interesting.

Unfortunately our time was running short and we couldn't take in the arena, tragic theater, etc., but we did get to see public drinking fountains showing stone walls worn by drinkers' hands, stepping stones across the streets at intersections for pedestrians, and ruts worn by chariot wheels in the stone roads.

We went back by the main street or Street of Abundance, got a kick out of the sign on one of the stones in the street pointing to house No. 4 or red light of the rich. We didn't enter as all of the paintings, etc., have been put in the Museum in Naples, and only the shell of the inside remains.

Back past the voting chamber and thru the Forum we soon regained our car and headed for Naples. We ran out of gas shortly after we entered town, fortunately near a service station or rather pump, and here learned how a car can be weaned for our chauffeur bought a litre (roughly a quart) of gas which is the daily ration per car, except for business trips like ours. Gas, by the way, is five and a half lires a litre which figures out at over a dollar a gallon.

We didn't see much of Naples except the University, an old fort, a monastery or something on a hill, and that is about all. We reached the ship with a few minutes to spare and sailed at 4:00 P. M.—dead tired but gloriously happy. We passed between Capri and Sorrento and were soon headed for the open sea to the south.

At 11:30 P. M. just before the moon set we came within sight of the fiery crater of Stromboli. It brightened and showed activity about every ten minutes for the next hour and a half, and once flared high and made a grand spectacle. By the time we were abreast of the volcano tho, the moon was down and nothing could be seen of its general form.

The night was so dark I gave up all hope of seeing the Straits of Messina, between the toe of the boot and Sicily, and went to bed. At four A. M. the ship slowed down to pass thru the straits and the change in vibration of the engine woke me up. One look out the port hole and I grabbed a bathrobe and dashed on deck—the only passenger that got to see the sight. The strait was rather narrow, and lined with houses, streets, etc., all lighted up like a church on Sunday night. The two long lines of light against a pitch dark background made the scene look like the "Great White Way," and a sight not soon to be forgotten. Hope to see the towns by daylight next time.

While in Italy by the way we got a few Fascist salutes, chiefly from officials but sometimes by individuals. It was more like an official salute and far less obnoxious than the Nazi salute with its accompanying "Heil Hitler" so universal in Germany. Giving it was easy and natural to a "Heil Hitler" expert like myself and I gave it perfectly to the first one who sprang it on me even if a fraction of a second late.

There followed two days of perfectly calm weather, a barely perceptable vibration from the engines being the only motion. We thot we were going to see Crete but the ship took a more southerly course and never sighted land.

Thursday morning, December 21st, just twenty-six days after sailing from New York, we were at Alexandria. A government boat met us outside the harbor and inspected the passenger list, passports, manifest, etc., then permitted us to enter the harbor and dock. A custom's porter came aboard

with a card bearing my name so I turned my baggage over to him and marched down the gangplank to be met by a company representative. With him to steer me it was a matter of moments to pass the customs and in a few minutes more we were at the Socony-Vacuum canning factory or shipping department. Here I met the manager and was sent on a tour of the plant.

It was an interesting trip for they make it all here including the can. Old barrels and cans are reconditioned, different grades of oil are blended, and, if I understood correctly, even the machinery was made locally. While this was all very interesting the high light was a small storeroom cut in rock and kept closed by a locked door. It seems that in building the plant they cut into a hillside to obtain more space and ran into this old crypt with Greek columns which had been cut by hand from the rock over 2500 years ago. Originally it was full of bones but they disintegrated as soon as touched. One room had been filled up to make space for the factory but two more were open and used for storage space. Cut in one wall were a number of compartments from two of which led tunnels. My guide, the plant engineer, told me that one went sixty feet to another chamber full of bones and the second led toward the heart of town. He had followed it for a kilometer or two but the air was bad and he came out without finding where it led to.

The manager's car then took us uptown where I got some money changed and bought a newspaper, "The Egyptian Mail." The monetary unit here is the Egyptian pound which has a slightly higher value than the British pound,—that is a little over four dollars. It is divided into one hundred piasters, and that, or possibly the half piaster, is about the smallest unit the Americans use. There is another called the millieme, I think, ten of which make a piaster. The sights in Alexandria were all strange but as they were much the same as in Cairo I'll describe some of them later as I go along.

At the depot I found myself slated for a first class compartment together with a Standard of California man and a Shell man I had known on the "Exochorda." The train pulled out at 12:15 P. M. on the dot and at 3:05 P. M. we arrived in Cairo, eating enroute.

There were many strange sights along the way so that the time passed all too quickly. The Nile delta, of course, was flat as a pancake, and almost entirely under cultivation. Being December there weren't many crops in the fields but we did note alfalfa, cabbage, sugar cane, cotton, rice, and something like corn. There were many water buffalo, some grazing, some plowing, others walking in a circle attached to a pole that turned a water wheel to furnish irrigation for the fields. There were many burros, as usual carrying enormous loads, and quite a few camels—dromedaries I think is a better term as all we saw only had one hump. I saw one haystack ambling down the road but as the train went by a camels head was seen to stick out the front end. There were also some regular cattle, geese, chickens, herons or cranes, and some other animals.

The little farming villages were collections of mud or adobe huts usually more or less surrounded by a wall. They reminded me very much of Mexican settlements in parts of New Mexico but nowhere did red chili peppers hang from the roofs which, by the way, seemed to be made of straw or brush.

Almost all the men in the country wore a sort of white cap or turban, and a flowing grey nightshirt. On their feet were sandals so that they flop-flopped along as they walked. These villagers are also common in the cities but generally the red fez predominates there altho the nightshirt is still popular. I could see a sort of vest at the top and front of the garment, and traces of an undershirt but wondered what else were underneath. Finally tho at a railroad station my curiosity was satisfied as one man raised his skirt to get some money, and underneath I found he wore a baggy pair of poorly fitting trousers, or rather breeches, with side pockets. Why the nightshirt unless he was ashamed of the cut of his breeches I don't know as it wasn't necessary, but it really looked almost immodest to see him raise it and go for a trouser pocket.

In Cairo I was met by the Chief Geologist who took me to the Carlton Hotel where a room awaited me, and after washing up I went to the office to meet some of the gang.

Believe it or not winter office hours here are 8:30 to 1:00, and 4:00 to 6:00 from Monday thru Friday, and from 8:30 to 1:00 on Saturday. In summer I have been told they work from 8:00 to 2:30 and quit for the day, but that remains to be seen. The office boys run around in jet-black nightshirts and fezzes, and wear a Socony-Vacuum badge over their hearts.

Mr. Fath gave me two tickets for a theatrical benefit for the British Red Cross which he was unable to use, altho I only needed one in spite of my width. Two other men from the office were also going so all three of us donned our Tuxes, ate supper together, and at 9:15 were at the theater,—supper, by the way, is served in Egypt at 8:00 P. M. We managed to stay for the first act but then we skipped. As we went out the man at the door who had tickets for readmission asked "Are you coming back?" In unison we replied "What do you think?" and out we went. It was ham performance and the acoustics were terrible.

Cairo is said to be one of the most cosmopolitan cities in the world, and that isn't much of an exaggeration. Most of the women wandering around tho are foreigners as Egyptian women generally seem to obey the Koran and stay home,—or if they do go out are usually escorted, and many wear a diaphanous veil, tho not all. Men apparently hold all the jobs, even waitresses and chambermaids being men wearing the customary nightshirt. Those in the hotel dining room however, wear a white gown with a broad bright colored girdle as a cinch.

By the way, you can laugh as much as you like to but my figure here seems to be the style—skinny birds don't count much, altho there are many among the porters and working class.

There are traffic cops at many corners but everywhere else you can go where and how you please. Pedestrians walk in the streets and autos have a tough time of it unless they blow their horn hard and go fast—then everybody jumps. There are lots of cars but am not sure but what American cars predominate.

Arabic is undoubtedly the prevailing tongue while strange as it may seem French seems to be second, and English third. One also hears a lot of Italian and Greek but at the present time the German talkers are keeping remarkably quiet.

Of course there are a lot of uniforms on the streets, mostly Egyptian, but with a good sprinkling of Tommies, Kilties, Sikhs, etc. English naturally predominates as far as English goes, and I fear my perfectly good American tongue is apt to become contaminated.

Arabic sounds alright to the ear but you ought to see it written. There are twenty-eight characters and each has at least four different shapes or forms, depending on whether it stands alone, at the beginning, middle or end of a word. Complicated is no name for it.

This ends the story of the Pilgrimage; what happens later will be told in another installment if and when I hear from this one.

RECOVERY OF NICKEL, COPPER AND PRECIOUS METALS FROM DOMESTIC ORES

BY THE COMBINED ELECTROTHERMAL AND ELECTROLYTIC METHOD

By
J. KOSTER[2],
R. G. KNICKERBOCKER[3],
O. C. GARST[4], T. R. EVANS[5],
and W. E. CODY[6]

(Continued from May Issue)

Electrolytic Production of Nickel and Copper

REVIEW OF NICKEL-COPPER ELECTROMETALLURGICAL INDUSTRY

There are two industrial processes by which electrolytic copper and nickel are recovered from copper-nickel sulfide ores, namely, the Stanley and the Hybinette processes. Briefly, the Stanley[22] process consists of sufidizing completely the converter metal to Ni_3S_2 and Cu_2S, fusing with sodium sulfide, and allowing the melt to solidify in pots. On cooling, the melt separates into two layers, the top rich in copper and the bottom rich in nickel. The tops are blown to blister in a series of converters, and the copper is cast into anodes, which are refined electrolytically. A portion of the precious-metal slimes is recovered here.[23] The bottoms are re-treated with sodium sulfide in the above-described manner. In the second treatment the tops are not rich enough in copper to be converted directly, so they are returned to the first-treatment pots and combined with the raw converter metal. The bottoms, however, are comparatively pure nickel sulfide contaminated with only a small percentage of copper sulfide and some sodium sulfide. The small amounts of copper and the sodium sulfide are removed by leaching with hot water, chlorinating with salt, releaching with hot water, and finally calcining with soda ash and releaching to obtain black nickel oxide contaminated by only 0.1 percent copper. The oxide is smelted with carbonaceous fuel and coal as reducing agent in an open-hearth furnace, and the nickel oxide is reduced to metallic nickel. The metallic nickel is cast into anodes and refined electrolytically in a neutral boric acid-nickel sulfate electrolyte. A portion of the precious-metal slimes is recovered here.

In the Hybinette[24] process the converter white metal is first used to remove traces of copper from the nickel electrolyte by replacement and precipitation of cement copper, after which it is roasted to a very low sulfur content. The roasted white metal is then leached with sulfuric acid to provide electrolyte for the insoluble-anode, copper-electrowinning cells. This electrolyte is electrolyzed with lead anodes; electrolytic copper, sulfuric acid, and nickel sulfate being the products of the electrolysis. The solution is evaporated, the nickel sulfate crystallized out, and the sulfuric acid returned to the copper leach tanks. The leach residue, which is much lower in copper than the original converter matte, is smelted with coke and suitable fluxes and soluble high nickel-low copper anodes cast from the resultant metal. These anodes are refined electrolytically in a compartment cell; the neutral sulfate-boric acid electrolyte is kept free of copper dissolved from the anodes by contact with raw converter white metal or anode scrap in cementation tanks. Electrolytic nickel and precious-metal slimes are the end products of this electrolysis.

R. G. Knickerbocker[25] has reported the use of coke, blast-furnace, matte anodes for copper electrolysis at the plant of the Missouri Cobalt Co. in Fredericktown, Mo. These anodes were far more complex than those used in the present work but were used in a manner similar to that reported in this paper. However, the Missouri Cobalt Co. did not recover the nickel in the spent copper electrolyte by electrolysis because of the high cobalt content, but separated it from the cobalt and iron by a complex series of precipitations and purifications. Nickel oxide was precipitated and either reduced in an oil-fired reverbatory furnace or sold as an oxide. Cobalt oxide was marketed as such.

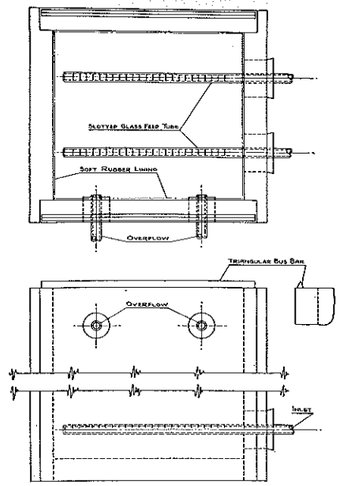
PRESENT WORK ON ELECTROLYSIS OF WHITE-METAL ANODES FROM BUNKERVILLE ORES

The white-metal or converted nickel-copper matte described in the preceding section of this paper was cast into anode molds with or without copper lugs, depending on whether it was to be used for electrolysis or in leaching to make up the electrolyte.

A portion of the copper-nickel converter anode metal was ground through 28-mesh, mixed with suitable agglomerate, and sintered to oxides on the laboratory sintering machine, and reground. The sinter was then leached with 10-percent sulfuric acid to provide electrolyte for the copper-electrowinning cells. In plant practice, the leach residue would be charged into the electric converter. These nickel-copper sulfide anodes were used in the copper cells. The copper electrowinning cells were conventional multiple-system tanks as used by the majority of commercial copper refineries. Cathodes were the regular copper starting sheets. The experimental copper-refining cells were made of maple. All joints at corners were half-lapped and screwed in place as tightly as possible. After assembly the wooden cells were lined with a thin coating of soft rubber. The electrolyte was fed by glass tubing, which passed through rubber stoppers cemented to the cell walls. Spent electrolyte was conducted from the cell by a similar set of pipes. The main busbars and the anode cross bars were triangular sections of copper. Cathode cross bars were rectangular in cross section and were soldered to the starting sheets. Figure 5 is a drawing of one of the cells.

Electrolysis of the anodes formed copper sulfate, nickel sulfate, elemental sulfur, and sulfuric acid during the course of electrolysis. Inasmuch as the rate of copper dissolution from the anode was considerably slower than the rate of copper deposition at the cathode, the solution was constantly being depleted of copper and at the same time was being built up in nickel sulfate and sulfuric acid. When the solution had reached a copper concentration so low that the cathode deposit would not adhere, a portion of the electrolyte was returned to the copper leach tanks and again built up in copper. By this method of alternate leaching and electrolysis, the nickel concentration was built up to about 30 grams per liter and the copper concentration reduced to below 5 grams per liter. The low copper solution was then electrolyzed with lead anodes in a separate series of cells to free the solution of copper. The copper produced in the cells in which the soluble anodes were used formed firm adherent cathodes, but that formed in the cells with lead anodes dropped to the bottom as "soft copper."

After the lead anode electrolysis, the solution contained less than 0.05 gram copper per liter. The solution was treated hot with anode scrap from the first series of copper refining cells or with metallic nickel powder, which cemented out the small amount of copper remaining in solution. The free sulfuric acid was neutralized with calcium carbonate, and the precipitate of calcium sulfate was filtered off and washed free of nickel sulfate. The washings were combined with the filtrate; the solution was heated and held about 90° C. while being agitated and blown with air. At all times during this blowing process the solution was in contact with precipitated nickel carbonate, which was added to the tanks. During the course of this treatment the ferrous iron was oxidized to the ferric state and precipitated as oxide or basic sulfate. A portion of the nickel carbonate chemically equivalent to the iron precipitated went into solution. The iron precipitate was filtered off, and the nickel was precipitated from part of the filtrate as basic nickel carbonates by treatment with a saturated solution of sodium carbonate. The nickel carbonate was filtered off and washed free of soluble salts with hot water. The washings were combined with the filtrate, and sodium sulfate was crystallized therefrom. The precipitated nickel carbonate was of the composition given in table 14.



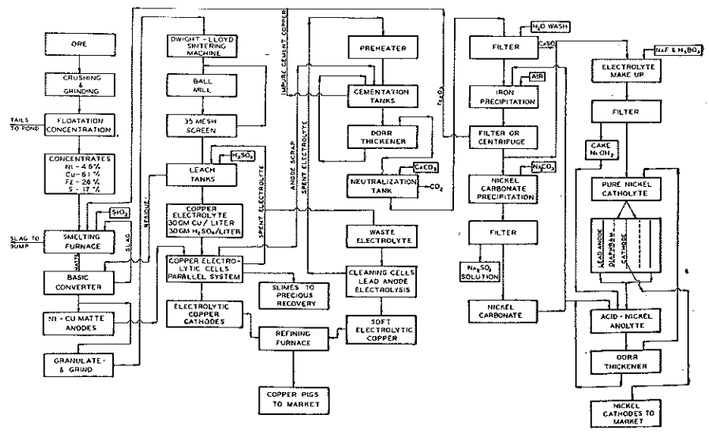
▼ Figure 2—Copper refining cell.

TABLE 14.—Analysis of Nickel Carbonate Precipitate

	Percent
$NiCO_3$	73
$NiSO_4$	7.7
H_2O	19.3

That portion of the iron-free solution that was not treated with sodium carbonate was made up into pure nickel catholyte by the addition of boric acid and sodium fluoride and adjustment of the nickel concentration to 30 grams per liter. Nickel was recovered from this solution as electrolytic nickel by electrolysis in a compartment cell.

The cathode was placed in a slotted diaphragm frame covered with light canvas. The anodes of soft lead were separated from the cathode by these canvas diaphragms. The purified nickel electrolyte was introduced into the top of the cathode compartment through flow tubes drilled in the frame, passed down the face of the cathode, out through a like system of flow tubes drilled in the bottom of the frame, and into the anode compartment. The anolyte flowed past the face of the anodes and out into the anolyte sump. The acid anolyte was then treated to neutrality with the precipitated nickel carbonate, filtered, and returned to the purified-nickel catholyte tank. Figure 3 is a diagrammatic flow sheet showing the sequence of the processes.



▼ Figure 3—Diagrammatic Flow Sheet.

DISCUSSION OF RESULTS ON ELECTROLYSIS OF NICKEL-COPPER ANODES

Copper Electrolysis

Three different anode compositions were used in the copper-refining cells. These compositions were as shown in table 15.

TABLE 15.—Converter Anode Compositions, Percent

Anode No.	Cu	Ni	Fe	S	Cu/Ni
1	44.01	28.42	2.95	21.75	1.55
2	44.40	28.08	.34	25.82	1.58
3	44.42	39.46	.30	13.21	1.12

The precious-metals content of the anodes was:

	Ounces per ton of 2,000 lb.
Ag	3.93
Au	1.12
Pt	.65
Pd	1.32

Anode composition 2 is more than completely saturated with sulfur and would not be made in normal converter practice unless the pyritic sulfur content of the ore increased. To prepare this anode, metal of anode composition No. 1 was crushed and fused with niter to remove the iron, the slag being discarded. This sulfide was fused with a large excess of sulfur and cast into anodes. This anode metal was prepared for strictly theoretical reasons, as it was desired to study the effect of variation in sulfur content upon anode electrolytic characteristics. Voltage across the copper-refining cell varied with anode composition as shown in table 16. Copper concentration of electrolyte was 30 grams per

[22] Peck, R. L., Refining Nickel-copper Matte at Port Colborne: Eng. and Min. World, November 1930, p. 632.
[23] Aldrich, C. H., and Bryan, J. K., The British Empire's Largest Copper Refinery: Eng. and Min. World, November 1930, p. 639.
[24] Gowland, W., and Bannister, C. O., The Metallurgy of Nonferrous Metals: Griffin & Co., 1930, p. 551.
Lathe, F. E.: Jour. Soc. Chem. Ind., vol. 44, pp. 433-443 T.
[25] Knickerbocker, R. G., Electrolytic Separation of Copper from a Copper-cobalt-nickel Matte: Min. and Sci. Press, July 10, 1920, pp. 45-50.

liter, and temperature of electrolyte was 55° to 60° C.

For the purpose of this discussion, the percentage of sulfur saturation was calculated on the assumption that all of the sulfides present were in solid solution as Ni_3S_2, Cu_2S, and FeS.

Complete saturation of the anode metal with sulfur caused excessive anode polarization and high power costs per pound of copper plated. The voltage across the cell was so high when anode No. 2 was used that the copper plated did not form firm adherent cathodes, such as were produced when the other anode compositions were used. Reduction of sulfur content gave an anode that approached the voltage drop of conductivity copper anodes.

The anodes being composed of a mixture of copper and nickel sulfides, the ratio between copper and nickel in the anode greatly affects the anode reactions. The effect of variation of the copper-nickel ratio on anode dissolution characteristics is summarized in table 17.

The effect of anode composition on over-all copper-refining-cell characteristics is presented graphically in figures 4 and 5.

Table 18 presents typical operating data for the copper cells.

According to the results tabulated under anode composition No. 3, 94.3 percent of the copper produced will be in the form of adherent cathodes and 5.7 percent in the form of soft copper. It is interesting to note that all of the nickel in the soft copper is as nickel sulfate, which can be water-leached and returned to the electrolyte.

At the beginning of the electrolysis tabulated above under anode composition No. 3, the temperature of the electrolyte was varied over a wide range, and suitable voltage measurements were made. Since these measurements were made at the beginning of the electrolysis, when the copper concentration of the electrolyte was at its highest and before enough slime had collected on the face of the anode to affect the voltage, these measurements do not reflect the average operating condition of the electrolysis but are 0.05 to 0.1 volt lower than the mean voltage for the entire 10-day run. These measurements are given in table 19.

TABLE 19.—Relation of electrolyte temperature to total cell voltage

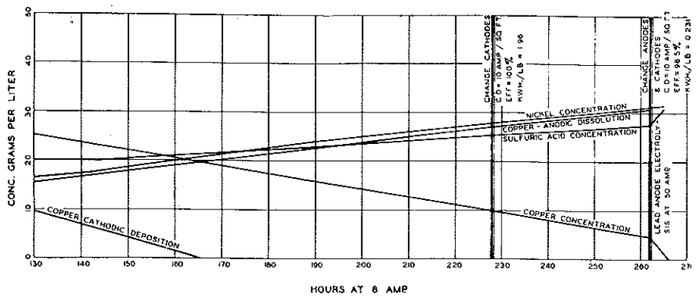
Temperature of electrolyte, °C.	Voltage across cells
24.5	0.71
36	.68
46	.64
53	.56
59	.49
62	.48
64	.47

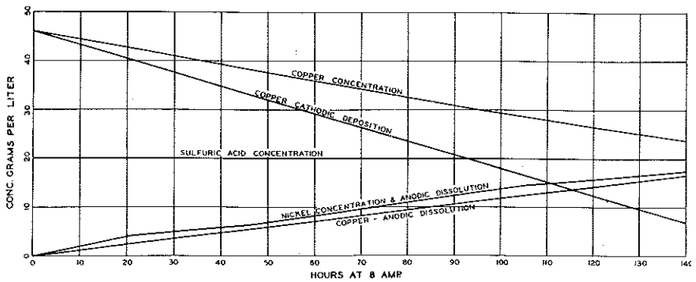
TABLE 16.—Relation of cell voltages to the sulfur content of the anodes

Anode composition	Saturation, percent	Total voltage through cell	E drop at anode	E drop at cathode	E drop through solution
Conductivity Copper	0	0.45	0.13	0.10	0.20
No. 3	51.4	.45	.15	.10	.20
No. 1	93.4	.50	.20	.10	.20
No. 2	120.0	1.65	1.20	.25	.20

TABLE 17.—Relation of anode Cu-Ni ratio to anode dissolution characteristics

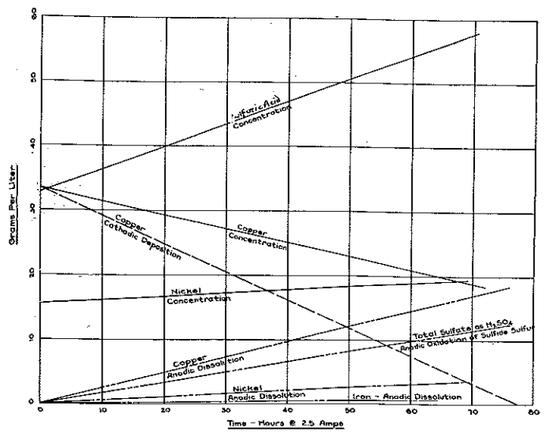
Anode composition	Cu/Ni	Anode efficiency, percent Cu	Ni	Fe	Total	Cu/Ni from anode
Conductivity Copper	00	100	—	—	100	00
No. 1	1.55	52.7	13.2	3.4	69.3	4.01
No. 3	1.12	42.9	48.5	1.5	92.9	.888





▼ Figure 5.

Suitable starting sheets were produced using the copper-nickel sulfide anodes over a comparatively wide range of operating conditions. Acid concentration at the beginning of electrolysis was 35 to 45 grams sulfuric acid per liter. Current densities of 6 to 10 amperes per square foot were utilized. Copper concentration of 40 to 50 grams per liter at the beginning of the electrolysis produced firmer starting sheets than those produced at



▼ Figure 4.

lower copper concentration. Starting sheets of 48 hours' deposition time could be stripped easily from the blanks. The starting-sheet blanks were conductivity copper plates ¼ inch thick, the surfaces being polished so that no scratches were visible.

Before use, the blanks were painted with a coat of graphite, compounded especially for this service. The paint was composed of 1 pound of fine flake graphite per gallon of 3.5-hour-bodied linseed oil. The paint was applied at a temperature of 50° C. and, after being painted, the blank was stored in a warm place for a few minutes so that the paint would flow out well and show no brush marks. The surface of the painted blank was then dusted with flake graphite so that no oil was apparent on it. The blanks were used immediately after being dusted with graphite. Electrolyte circulation at the beginning of electrolysis was quite slow so as not to wash the paint from the surface of the blank. After running for approximately 2 hours, the point was covered with a film of copper, and at that time the circulation of electrolyte was increased to normal value. Typical operating data for the starting-sheet cells are as shown in table 20.

TABLE 18.—Typical operating data for copper-refining cells

	Anode No. 1	No. 3
Current density	10 amp./sq.ft.	10 amp./sq.ft.
Ampere efficiency	95%+	95%+
Solution assay (gm./liter):		
Cu	33 to 19	45 to 4.5
Ni	16 to 20	0 to 30
Fe	5 to 6	0 to 0.5
H_2SO_4	32 to 58	20 to 25
Voltage across cell	0.50	0.51
Cu per kw.-hr., lb.	5.247	5.115
Kw.-hr. per lb. Cu	.190	.196
Cathode assay (percent):		
Cu	99.77	
Ni	.0008	
Fe	.0014	
Ag	.00076, or 0.22 oz./T	
"Soft" copper assay (percent unwashed basis):		
Water insoluble	92.65	
Water soluble	7.35	
Water-insoluble portion:		
Cu	99.10	
Ni	.0032	
Fe	.0043	
Total	99.1075	
Water-soluble portion:		
$CuSO_4 \cdot 5H_2O$	42.0	
$NiSO_4 \cdot 6H_2O$	37.8	
$Fe_2(SO_4)_3 \cdot 9H_2O$	8.9	
H_2SO_4	2.5	
H_2O	8.8	
Total	100.0	

TABLE 20.—Electrolysis data for starting sheets

Current density	Amp. per sq. foot, 9
Electrolyte temperature	°C. 57°
Electrolyte assay:	
Cu gm./l	47
Ni gm./l	1.2
H_2SO_4 gm./l	41.57
Voltage across cell	.27
Current efficiency, percent	100

Nickel Electrolysis

The electro winning of nickel from nickel sulfate solutions by means of insoluble anodes depends mainly on chemical control of the pH of the catholyte. If the catholyte becomes basic enough, a precipitate of nickel hydroxide or basic nickel sulfates will form in the catholyte at pH 7 to 8. On the other hand, if the catholyte becomes acid enough, hydrogen is evolved at the cathode in preference to nickel. The evolution of hydrogen becomes a major difficulty at pH 4 or under. Thompson[26] has correlated the pH of nickel electroplating baths using soluble nickel anodes with the structure and physical characteristic of the deposited nickel and has found that there are definite ranges in which specific common flaws occur in nickel plate. He summarized the results of carefully standardized plating tests in which the bath pH was varied, as follows:

1. The cathode efficiency may be increased either by raising the current density or the pH, or by raising both.
2. In the range of pH 6, or above, the current density has little or no effect on cathode efficiency.
3. Below pH 3 and up to 4, gas pits and streaks, which are usually attributed to hydrogen evolution, are very pronounced. Cracking and peeling of the deposits are generally encountered in this range. The nickel deposited is usually rather bright.
4. between pH 5.5 and 6.5, gas pits and streaks are found only rarely. Above pH 6.3, blistering, cracking, and curling are again likely to occur, also "burning" of the deposit near sharp edges, especially with high-current densities. This is characterized by dark or black bands or patches. The nickel appears grayer in color, verging toward bluish near the upper limit of pH. Above pH 6.3, it seems difficult to get deposits in still solutions. In agitated electrotyping solutions good deposits may be obtained up to nearly pH 7.0.

The presence of borates in the nickel electrolyte improved the characteristics of the nickel deposit and to some extent limited the ionization of free sulfuric acid present originally or formed in the electrolyte.

Several methods were tried in an attempt to control the pH of the catholyte during the course of electrolysis. Some of these were (1) rapid circulation of electrolyte, the catholyte feed to the cell being at all times saturated with and carrying in suspension nickel carbonate; (2) the introduction of alkali ion in the form of sodium sulfate, together with a somewhat slower circulation; and (3) the introduction of ammonium ion as ammonium sulfate. Keeping the catholyte feed saturated with nickel carbonate gave satisfactory nickel deposits, but this scheme was not deemed satisfactory, as the use of such a method would force the precipitation of all the nickel as nickel carbonate before electrolysis. The addition of sodium ion to the electrolyte when at all effective caused too high a pH to be maintained in the catholyte compartment. Addition of ammonium ion, while at first showing indications of desirable effects, was found to be ineffective for extended electrolyses within the solubility range of $Ni(NH_4)_2(SO_4)2.6H_20$.

The characteristics of nickel sulfate-fluoborate baths with soluble nickel anodes have been studied by the Bureau of Standards[27] and reported to be the only nickel baths that were buffered effectively. Electrolyte compositions in line with these baths were tried; it was found that these sulfate-fluoborate electrolytes gave deposits of satisfactory physical characteristics and were effective in the limitation of hydrogen evolution over a wide pH range, and that cell conditions would

[26] Thompson, M. R., The Acidity of Nickel Depositing Solution: Trans. Am. Electrochem. Soc., vol. 41, p. 333.

[27] Blum, Wm., The Uses of Fluorides in Solutions for Nickel Deposition: Trans. Am. Electrochem. Soc., vol. 39, p. 45; Brass World, vol. 17, p. 121.

stay in equilibrium for indefinite periods, thus making possible the deposition of the thick cathode deposits desired in electrorefining or electrowinning of metals. The nickel deposits formed from nickel sulfate-fluoborate electrolytes had less tendency to split, peel, pit, and three than did those deposits formed in other electrolytes.

As it is necessary to control the pH of the solution from which the nickel was deposited, a compartment cell was used for all experimental work. The construction of the cathode frame utilized in these experiments has been described by S. M. Shelton and coworkers.[28]

The purified electrolyte was introduced into the top of the cathode compartment, flowed down the face of the cathode, and out of the cathode compartment into the anolyte compartment. The cathode frame was constructed of a single piece of phenol-formaldehyde plastic board, such as is used for switchboard service. The nickel-winning cell, like the copper-winning cell, was made up of hardwood lined with a thin coating of soft rubber. The outlet boot and anodes were made of soft lead.

Inasmuch as the speed of circulation of the electrolyte was found to be a very important variable in relation to the cathode current density and to the nickel concentration of the catholyte feed, a method expressing rate of flow, taking into account these other variables, was evolved. By definition, the "flow number" is equal to the ratio between the nickel in solution actually introduced into the cell in the catholyte feed in a unit time and the amount of nickel that could theoretically be plated from the solution by the current through the cell in the same unit time. This may be expressed mathematically by the equation:

$$\text{Flow number} = \frac{\text{Grams of nickel introduced per hour}}{\text{Amperage through cell} \times \text{electrochemical equivalent of nickel}}$$

Using nickel sulfate-nickel fluoborate electrolyte of the following composition:

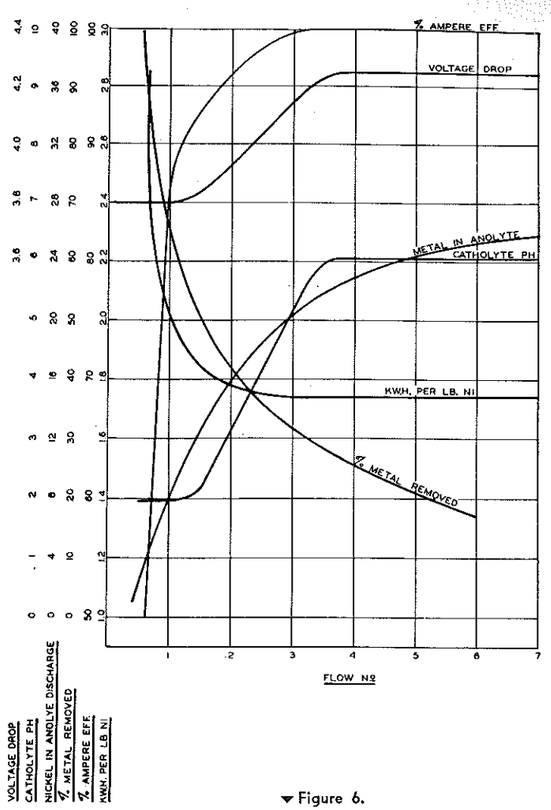
	Grams/liter
Ni	30
NaF	4.2
H_3BO_3	20
pH catholyte feed	5.8

at a temperature of 30° C., a study was made of the effect of variations in current density. Representative data are reported in table 21.

TABLE 21.—Effect of current density on cell voltage and energy requirements

Current density	Flow number	Volts across cell	Kw.-hr./pound nickel
20.6	6	4.40	1.83
18.5	6	4.20	1.74
9.25	6	3.2	1.34

[28] Shelton, S. M., Royer, M. B., and Towne, A. P., Electrolytic Manganese: Bureau of Mines Rept. of Investigations 3406, 1938, 28 pp.



▼ Figure 6.

Cathode ampere efficiency for these tests was 100 percent, as at flow rates as high as flow No. 6 the catholyte pH was maintained at such a point as to prevent the evolution of hydrogen. The deposits formed at higher current densities were finer-grained than those formed at low cathode current densities.

Inasmuch as it was desired to precipitate the smallest possible proportion of the nickel as carbonate, an extended study was made of the effect of variation of the flow number on the various characteristics of the nickel electrowinning cells. The catholyte feed for these experiments was the nickel sulfate fluoborate electrolyte, which had given the best results of any electrolyte used in the course of the experimental work. The electrolyte composition was:

	Grams/liter
Ni	30
NaF	4.2
H_3BO_3	20
pH	5.85
Electrolyte temperature	35° C.

Carefully standardized, floating siphons were used to feed the pure nickel catholyte into the cathode compartment at a constant rate. As considerable time was needed for the cell to reach equilibrium operating conditions, all tests were conducted so that plating conditions were maintained for at least 6 hours. In some instances plating conditions were maintained for 24 hours or longer, so that any discrepancies between long- and short-time cell operation would be disclosed. The results of these studies are summarized and presented graphically in the curves of figure 6. It can be seen readily that at fairly high values of flow number, a catholyte pH of 6.3 is maintained; in consequence, the ampere efficiency was 100 percent, with a corresponding minimum value for the energy requirements per pound of nickel of 1.74 kw.-hr. per pound of nickel plated.

As the flow through the cell was reduced, the pH of the catholyte solution was lowered. The results of this were reduced ampere efficiency due to hydrogen evolution, reduction of voltage across the cell owing to lowered resistance of the catholyte, and higher energy requirements per pound of nickel deposited. However, in spite of the seeming technical disadvantages of operating at a low flow number, there are economic advantages in so doing. At high flow numbers only a small percentage of the nickel introduced into the cell in the catholyte feed is deposited on the cathode, but at low flow numbers virtually all of the nickel introduced is plated. When operated at a low flow number of approximately 0.75, the anolyte discharge from the nickel electrowinning cell would contain 5 grams nickel per liter out of the 30 grams per liter contained in the pure nickel catholyte fed to the cell; the 25 grams per liter extracted electrolytically from the catholyte and deposited on the cathode would have been replaced with a chemical equivalent of sulfuric acid, making the acid concentration of the cell discharge 4.2 percent sulfuric acid. This dilute sulfuric acid solution then could be returned to the copper leach tanks after having been made up to the 100 grams per liter sulfuric acid required in the leaching operation. The grain size of the nickel produced in the more acid solutions is finer than that of the nickel deposited from the more nearly neutral solutions.

Inasmuch as the purpose of this part of the work was to develop an insoluble-anode, electrowinning-nickel process, it was necessary that the deposition conditions be such that the cell would stay in equilibrium for extended periods. This was necessary as industry demands electrolytic nickel cathode of certain definite minimum thickness. It is also quite expensive to remove and strip the cathodes more often than is absolutely necessary. Consequently, plating conditions were maintained for 120 hours. At the end of a 120-hour deposition period, two plates of nickel were stripped from the cathode, one from each side. The plates were more than ⅛ inch thick, which is acceptable to industry. There was no technical reason why the time of deposition could not have been extended.

Table 22 gives typical operating data on electrolytic nickel cells.

Table 23 compares industrial copper and nickel electrolysis operating data with the Boulder City laboratory data.

TABLE 22.—Typical operating data on nickel cells

Current density	Amps./sq. ft.	18.5
Voltage across cell	Volts	4.2
Ampere efficiency	percent	100
Nickel deposited	Kw.-hr. per lb.	1.74
Nickel deposited	lb. per kw.-hr.	.573
Flow number		6
Catholyte feed assay:		
Ni	grams/liter	30
NaF	grams/liter	4.2
H_3BO_3	grams/liter	20
Temperature of electrolyte	°C.	27 to 35
pH characteristics:		
Catholyte feed		5.2 to 6.9
Catholyte		5.5 to 6.1
Anolyte		1.4 to 1.6

Analysis of electrolytic nickel, percent

	From Bunkerville ore		From purified $NiSO_4$ solution	
Ni	98.69	99.27	99.66	99.71
Co	.59		.05	
Zn	.27		Spectrographic trace	
Mn	.18		—	
Cu	.038		.002	
Si	.03		—	
Fe	.015		.0016	
Al	Spectrographic trace		—	
Ti	Spectrographic trace		—	

The comparison does not take into account the fact that the electrolytic work at the Federal Bureau of Mines laboratories was done on such a small scale that the normal tank-house current losses due to poor contacts, solution leakage, etc., did not occur. The efficiency figures tabulated at 95+ percent would undoubtedly be lower in the course of normal tank-house practice. In studying this comparison, the low thermal-energy requirements in the preparation of the converter anode must be taken into consideration, as well as the energy requirement for electrolysis. The thermal-energy requirement for preparation of a 95+ percent nickel metal anode from a nickel-copper white metal is far greater than the electrolytic-energy requirement for electrolysis of this nickel anode.

Conclusions

1. A process has been developed for the production of electrolytic nickel and copper from copper-nickel converter white metal. While the energy required for the two electrolyses is somewhat higher than the normal energy requirements for the present commercial processes, this is more than offset by a saving in thermal energy.

2. Copper of satisfactory chemical composition and physical characteristics has been deposited electrolytically from a solution containing as little as 5 grams of copper per liter and as much as 30 grams of nickel per liter.

3. Nickel of satisfactory physical and chemical characteristics has been deposited from nickel sulfate electrolytes by means of insoluble anodes. The time of deposition has been maintained long enough to allow deposits of a thickness comparable with the usual commercial cathodes.

4. The precious metals values from the ore are entirely recovered in the copper cell.

5. Indications are at present that the precipitation of nickel carbonate before the nickel electrolysis may be eliminated. Further work in this direction is anticipated.

TABLE 23.—Comparison of industrial and experimental operating data

Process	Current density	Ampere efficiency, percent	Voltage across cell	Kw.-hr. per lb. metal	Flow number
Copper—electrorefining[1]	10 to 20	95	0.23 to 0.45	0.16	
Copper—electrowinning[2]	10 to 12	65 — 90	1.8 to 2.5	1.0 to 1.5	
Copper-matte anode electrolysis—U.S.B.M.	10	100	.5	.19	
Nickel—Stanley refining process[3]	11 to 12	93 to 94	2.4 to 2.5	1.1	
Nickel—Hybinette refining process[4]	10	85	3 to 4	1.7	
Nickel—Electrowinning—U.S.B.M.	18.5	100	4.2	1.74	4
Nickel—Electrowinning—U.S.B.M.	18.5	77.5	3.8	2.3	0.75

[1] Brookman, C. S., Electrochemistry: D. Van Nostrand & Co., 1931, p. 119.
[2] Perry, S. H., Chemical Engineer's Hand Book: McGraw Hill, 1934; sec. 25, by C. L. Mantell, p. 2358.
[3] Perry, S. H., Work cited in footnote 29, p. 2354.
[4] Gowland, W. A., and Bannister, C. O., The Metallurgy of Nonferrous Metals: p. 551.

EDUCATIONAL TRAINING FOR TEACHERS IN ENGINEERING COLLEGES

By

C. O. REISER

Elizabeth, N. J.

In order to provide instructors who are intensely interested and superbly equipped in the subjects which they offer, engineering colleges often make special efforts to obtain a faculty composed of men who are recognized as experts in their field. Certainly this is a logical method of selection but other factors also warrant consideration. Should not the one who is to make a profession of teaching have training which would fit him for this special phase of his work?

The graduate seeking a chemical job needs a knowledge of chemistry. Likewise, the teaching applicant should be selected on the basis of his knowledge of pedagogical methods as well as his understanding of the subject he is to teach.

In view of the fact that colleges and universities make every effort to keep abreast of the time and informed of recent developments, it seems rather surprising that they have allowed themselves to lag so far behind elementary and secondary schools in their requirements for educational training of their staffs. Opponents of this proposition may argue that the college student is nearing the time when he must shift for himself and will not have things presented to him on a silver platter; however, this reasoning instantly appears fallacious when the bases of educational psychology are examined. If proper presentation and organization of the subject will save the student a large per cent of the time he spends on it now, is it not better that this time should be saved and spent on subjects now sadly lacking in the curriculum which would help him to analyze complexities of life outside of his engineering work? If the application of educational psychology will help one to learn things which might not be absorbed otherwise, its value is apparent.

The cardinal principle of animal psychology embodies the maxim that the positive attitude is more conducive to learning than the negative. In other words, pat a dog on the head after he does a trick for you and he'll want to do it again; but whip him if he doesn't do the trick right and the next time you try to get him to perform he'll slink towards you with belly-turned tail. Similarly, human beings are so made up that they respond to praise and encouragement much better than to humiliation and degradation. Hence, no quiz should be given which every student will flunk with the idea that such an examination will stimulate the student and make him realize that he'll have to work harder. The proper type of an examination fails only those who are absolutely incapable of doing satisfactory work. The use of a curve in grading is for the purpose of ascertaining the correct number who should receive superior, average, and inferior marks, providing the law of averages can be assumed to hold for small numbers, and it should never be used to raise a class average from a low percentage up to a passing percentage. If the class average of an examination is much below the passing mark, then it is time for the instructor to ask himself if he is as capable as a teacher as his students are as learners.

In addition to making a subject more learnable by proper presentation, the interest which is aroused by so doing will better help the student to decide what field he is best suited. Men do not choose as a profession subjects which are uninteresting to them. Although students entering colleges are expected to know what they *want* to choose as a profession, this is not often the case because of the young men's immaturity and lack of contact with the fields for which they may be best suited. Suppose that a young man mentally and physically equipped for a chemical engineering vocation finds his introductory courses in this field dull and uninteresting because of improper dispensation but is fascinated by geological studies on account of their expert presentation. Is not the latter subject likely to be chosen to the detriment of the student?

The valuable knowledge which has been acquired by engineering faculty members can be more efficiently organized and dispensed if they are familiar with educational fundamentals. Without the proper presentation methods, a recognized industrial leader might conceivably be a failure in the transmission of his knowledge. The use of proven educational principles will result in better organization and selection of material, quicker and greater learning, and more student interest. As a result of this improved pedagogical efficiency, the student will find more time for extra-curricular activities and social studies.

The need for social broadening should not be neglected in the engineer's schedule. Engineering training places much stress upon the term efficiency. Shouldn't the engineer's social learning be made more efficient also? The fact that engineers are classed generally as introverts does not speak well of their present training. It is true that they are able to better mankind by building safe bridges and super highways and add innumerable blessings to civilization in general. However, in the ranks of politics and leadership their numbers are often lacking. Certainly more diversion of their efforts to the study of social structures and greater participation in outside interests should help to correct this weakness. Since the engineer must work with men as well as materials, courses in human psychology could be made to pay large dividends.

In summarizing, it may be said that the educational training of engineering faculty would provide more efficient learning, subject selection and organization. The resulting minimization of inequalties in instructorship, by presenting subjects on an equal basis would aid the undecided student in making a choice of the work for which he is best fitted. Finally, the time saved by more efficient teaching, could be used to advantage for the student's social broadening by means of extra-curricular activities and added social studies.

Prize Offer

Check the errors found in Mines Magazine as you read it. The reader reporting the most errors receives FREE one year's subscription to the magazine. The winner will be announced in the magazine the second month after publication. Send list of errors to Mines Magazine, 734 Cooper Building, Denver, Colorado.

NON-METALLIC MINERALS

By
KENNETH E. HICKOK, '26
Instructor, Department of Metallurgy
Colorado School of Mines

Part IV—Dimension and Crushed Stone

Dimension Stone is a convenient term applied to stone sold in blocks, slabs or shapes of specified sizes. Dimension stone includes cut stone, rough building stone, paving blocks, curbing and flagstones.

Building stone must be not only hard and durable but in addition must be pleasing in appearance. For these reasons granite, limestone, sandstone and marble make up the bulk of building stone and cut stone, most of which is used in the building trades.

Of minor or local importance soapstone, greenstone, basalt and others may be used.

In general the stone is quarried in slabs, roughed cut, and sawed or cut to dimension and shape. After cutting, the stone may or may not be polished, sandblasted, or otherwise treated for finish, depending on specifications.

Some building stone, such as that quarried in Boulder County, Colorado, is broken along bedding planes and roughed into rectangular slabs. The rough sandstone slabs are used in buildings (particularly for University Buildings) and the rough stone has a very pleasing appearance. This pink colored sandstone is locally used to quite an extent both cut and roughed.

The principal uses of dimension stone are building construction, monumental stone, paving blocks, laundry tubs, electric switchboards, table tops and similar uses.

The geographical distribution of dimension stone is world wide and while some stone crosses international boundaries it is a local condition and does not enter into international trade to any extent. Every country has stone suitable for dimension work and competition with other types of building material prohibits long hauls with the consequent freight charges.

Because of the widespread occurrence of dimension stone deposits, no country exercises political control over the industry. The only dimension stone politically controlled is marble from Terraza and Carrera, Italy. This marble is of slight importance compared to the industry as a whole.

Crushed Stone is stone that has been crushed and sized. It may be igneous, metamorphic or sedimentary and may be of any geologic age.

Size, texture, color, hardness and toughness are of major importance for some uses while chemical composition is the deciding factor for other uses.

The principal uses of crushed stone, without regard to chemical composition, are: concrete aggregate, riprap, highway surfacing, railroad ballast, sewage disposal, and municipal water filtering plants.

The principal uses of crushed limestone and marble are: smelting flux, manufacture of cement, as the source of quick and slacked lime, in the manufacture of beet sugar, rock wool, fertilizer, chemical industry, glass works, rock dusting coal mines, and as the inert filler in many products.

From the list of uses we see that crushed stone, particularly limestone, plays a very important part in most of the major industries, directly or indirectly. It would be hard to name any major industry that is not dependent on crushed stone as a part of the manufacturing process or as indirectly used in the form of chemicals, ballast, cement or highway surfacing.

Crushed stone is a very low priced product and so mining and sizing methods must necessarily be low cost. Quarrying is the most common mining practice but a few limestone operations are carried on underground. Sizing of the crushed stone is generally done as near the mine as is possible to avoid transportation costs on the crude material. The crushing and screening plants are as simple as possible and yet turn out a marketable product.

Marketing crushed stone is not only a local problem but is seasonal as well. The winter months are not good construction months and the industry suffers this seasonal depression except in the southern and southwestern states. Crushed stone is also a strong competitor of sand and gravel for use in concrete aggregate where conditions permit the two to be produced. The geographical distribution of stone suitable for crushed stone is world wide. Economic conditions play the all important part whereas political control is of no importance.

In spite of the fact that there is no chance to "Hit'er Rich the next round," the crushed and dimension stone industries afford employment to many men. The employment is not only direct but equipment manufacturers, makers of explosives and many others indirectly benefit from these industries.

During the year 1938 which was a notably poor year for the stone industry, the value of the dimension and crushed stone produced in the United States was almost equal to the value of gold produced during the same year. Total tonnage was approximately 158,000,000 tons and had a value of 142,000,000 dollars.*

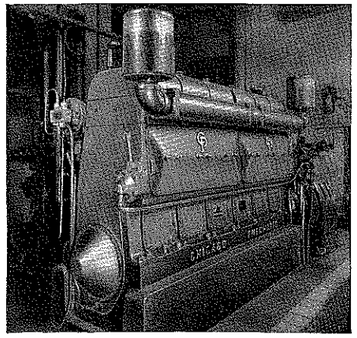
* Minerals Yearbook 1939—U. S. Bureau of Mines.

WITH THE *Manufacturers*

EQUIPMENT NEWS

Chicago Pneumatic Diesel

After two years of operation in the field, the reliability and economical operation of Type 8 and Type 9 C. P. Diesels has been proven beyond question. These units are available in sizes from 60 to 400 horsepower.



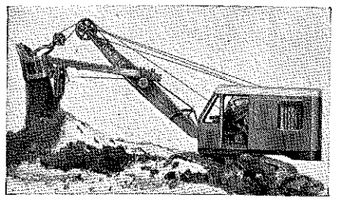
They are four-cycle, direct-injection type units. The mixing of the fuel and air results in a clean exhaust at all loads and a fuel economy approaching that of large, low speed Diesel engines.

Not a single wearing part is exposed to dust and dirt. Lubrication is 100% positive and automatic. No part requires hand oiling or greasing—pressure lubrication used throughout. Ample strength in all parts make for low maintenance cost. Alloy heat treated steels are selected to give the maximum service that combines to make for increased efficiency.

Quick easy starting is a feature not to be overlooked. Complete details of this Diesel may be obtained from Chicago Pneumatic Tool Company, 6 East 44th Street, New York.

New 1 to 1¼ Yard Shovel

A new, powerful 1 to 1¼ yard convertible shovel-dragline-crane, Model LS-100, is announced by Link-Belt Speeder Corp., 301 West Pershing Road, Chicago, Ill. Claimed for this new model are several advancements, including a combination of outstanding features of other Link-Belt and Speeder models.



▼ New Link-Belt Speeder LS-100 Convertible Shovel.

The machine is controlled by easy-throw levers and equipped with a new type of clutch, said to produce results never before attained by friction clutches — a booster system that actually does give the "feel" of the load at all times.

Further features are: fully enclosed travel brakes controlled from cab; fully enclosed traction gears running in oil; a 72″ diam., machine-finished, roller-path turn table with patented, self-aligning rollers; anti-friction bearings throughout; free floating center-pin bearings; and welded steel design for strength and resistance to shock loads and to provide positive alignment of machinery parts.

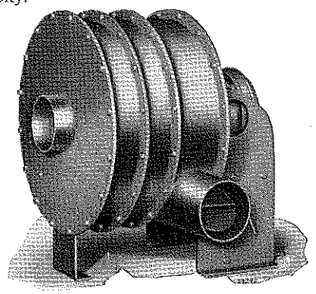
The manufacturer particularly stresses sturdy construction in this new 1-1¼ yd. machine. The engine is a heavy-duty industrial type gasoline or Diesel, of a size usually only found in larger units. Track shoes are 24″ standard (30″ optional); crawlers are smooth, self-cleaning and perfect guiding.

The machine may be quickly converted from one excavating or handling attachment to another, without mechanical alteration.

Complete details of the new LS-100 may be obtained by addressing Link-Belt Speeder Corp. direct or by contacting any Link-Belt Speeder distributor.

Type "G" Motorblower

A new "Motorblower" featuring reliability, quiet operation and low cost, has just been announced by the Ingersoll-Rand Company, 11 Broadway, New York City.



▼ An Ingersoll-Rand Three-Stage Type "G" Motorblower.

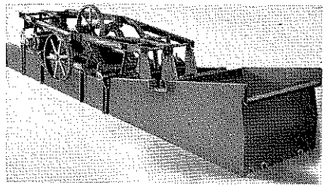
In addition to reliability and quietness, the manufacturer claims numerous features which make the Type "G" Motorblower ideally suited to furnishing air for general industrial uses. The unit can be installed on any floor, since it requires no special foundation. A built-in blast gate is located in the blower discharge and flexible pipe connections are provided for connecting either intake or discharge to shop piping.

The maintenance of constant pressure over the entire volume range is stressed as being particularly advantageous in furnishing combustion air to oil- and gas-fired furnaces. The blower characteristics are such that power consumption varies approximately in proportion to the volume of air delivered. Type "G" Motorblowers are built in 72 sizes: pressures from ½ to 2¼ lbs. and volumes from 100 to 4500 cfm are available. The discharge opening on all sizes can be located in any one of eight positions in steps of 45°.

Additional information is contained in Form 2671. Copies are available from Ingersoll-Rand Co., 11 Broadway, New York City, or any of their branch offices.

New Classifier

Morse-"Trueline" Rake Classifiers introduce an entirely new, efficient, and compact mechanism for rake type classifiers. The mechanism actuating the rakes consists of heavy welded channel iron drive arms, cast iron rocker arms, and heavy plate members attached rig.dly to the classifier rakes. The drive arms receive their movement from the main gear drive shaft. The extreme ends of the drive arms move in a downward and upward plane in unison at the starting and completion of each stroke of the rakes, thus completing a uniform straight line stroke of the rakes during the forward movement, length of which is governed by the

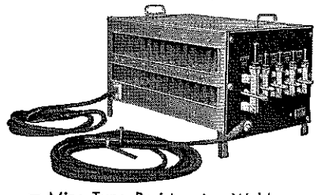


position and length of the rocker arms. The action is positive in a straight "Trueline" parallel to the tank bottom; and the mechanism is very simple, having few bearings requiring grease. The main gear and pinion are machine cut and cause the classifier mechanism to function smoothly and with the minimum power.

A rake elevating device and wrench are furnished for each set of rakes. Tanks provide large pool areas and, when desired, can be furnished for bolted construction at destination. This is a new development of the Morse Bros. Machinery Company, Denver, Colorado.

Announce General Electric D-C Arc Welder for Mine Service

General Electric has announced a new resistor-type, d-c arc welder designed particularly for mine service. Portability and sturdy construction are among the chief features of this new welder.



▼ Mine Type Resistor Arc Welder.

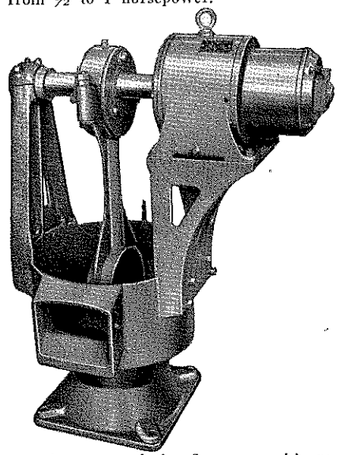
It is only 17 inches high, 20 inches wide, and 30 inches long, and weighs but 78 pounds. To withstand rough handling successfully, the resisitor units are wound in continuous coils without joints and are supported by spool-type porcelain insulators. Enclosing screens protect the interior from falling material.

Welding current can be adjusted over the welding range, in 10 steps of approximately 17 amperes each, by means of five heavy knife switches. It is nominally rated at 250 volts, and will operate on a power line of 225 to 275 volts.

Colorado Diaphragm Pump

In designing this diaphragm pump for handling thick pulps, acid or alkaline solutions or water with gritty solids, the Colorado Iron Works Company, Denver, have had in mind the production of a pump, simple and rugged in construction, light in weight and with renewable wearing parts easily replaceable.

It is made in various sizes and types, standard sizes being 2″ simplex and duplex, 4″ simplex, duplex, triplex and quadruplex, and 5″ simplex and duplex. All these sizes are made with belt or gear motor drives. Gear motor sizes vary from ½ to 1 horsepower.

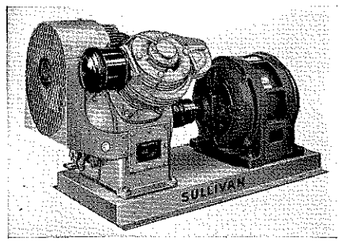


Valves are of the flat type with renewable rubber rings which, when seated, rest on renewable seats, made for economy and efficient operation. Ball valves can be used in any of the pumps where desired. Operation is very simple. Speeds may run up to 60 strokes per minute with a maximum stroke of from 1½″ to 2½″ depending on the size of the pump. The eccentrics are easily and quickly adjustable from ½″ stroke to the maximum.

The regular sizes made cover practically all the requirements as to capacities. Write for bulletin giving dimension tables and full details of capacities under varying conditions.

New Small Compressor

A new small Stationary Compressor of precision design is being offered by Sullivan Machinery Company, suitable for small industries and for standby service. It is compact, light weight and smooth running, requiring little floor space and minimum power.

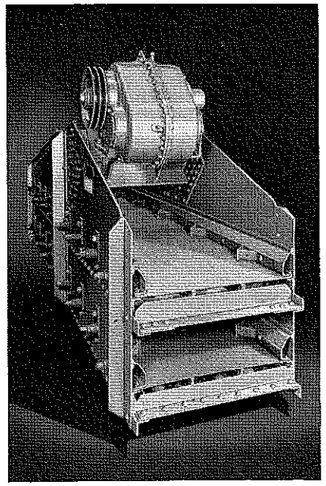


This WL-70 is a two cylinder, single stage compressor with complete air cooling—built-in aftercooler—force feed lubrication—heavy duty ball main bearings—low lift, long life valves—air filter silencers on each cylinder—automatic regulation—easy accessibility for inspection. There are five sizes: 96 to 233 C.F.M. displacement, 15 to 30 H. P., air pressures 30 to 125 lbs. The smallest size is only 2 ft. 5 in. long—2 ft. 9 in. wide—2 ft. 4 in. high. These WL-70 Unitairs are supplied as complete motor driven units on rigid steel sub-base, direct connected or V-belt driven; also less sub-base with V-belt sheave or flat belt pulley.

Ask for Bulletin A-34—Sullivan Machinery Company, Woodland Avenue, Michigan City, Indiana.

New Sta-Kleen Screen

Allis-Chalmers Mfg. Company, Milwaukee, Wisconsin, in connection with its line of vibrating screens, has added a new type of lowhead screen especially designed for helping keep the fine mesh cloth clean. Referred to as their Sta-Kleen Screen, it is claimed to be unusually well adapted to the screening of moist materials such as fine crushed stone, ore, and particularly coal, that usually cause "blinding."

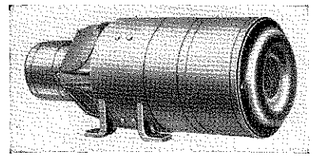


Several inches below the screen cloth this ingenious new design incorporates a sub-deck made of perforated metal with relatively large holes. The space between this additional deck and the screen cloth is divided into compartments each containing a special rubber ball. When the screen is in motion the rapid bouncing of these balls within their respective spaces sets up a secondary vibration in the screen cloth. Blinding is thus reduced to a minimum and without appreciable wear on the cloth. Its operation is said to be very effective. Additional information will be furnished by the Company on request.

General Electric Announces New Speed-Variator Equipment

The General Electric Company has recently announced as a standard "unit" a complete speed-variator equipment operating from an alternating-current source of supply to provide wide ranges of adjustable speed by means of the well-known generator-voltage-control scheme. Each equipment consists of an adjustable-speed, direct-current motor, an adjustable voltage motor-generator set with control, and a separately mounted generator-field rheostat. Standard speed ranges are available up to 16:1 ratio.

The adjustable-speed, direct-current motor can be mounted directly on the driven machine, with speed-changing control mounted near-by. The units are designed to operate from 3-phase, 60-cycle, 220-, 440- and 550-volt alternating-current power. The potentiometer-type generator-field rheostat provides speed changes in small increments over wide ranges.



▼ Motor Generator Set Used as Part of Speed Variator Equipment.

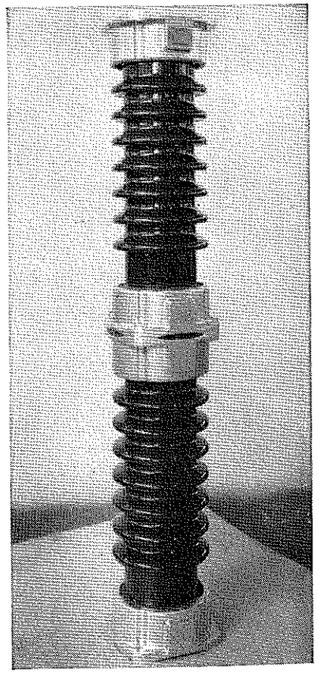
The speed variator is suitable for many industrial applications where adjustable speed has a direct bearing on control of quality and efficient output of the driven machine. This flexible power medium is applicable to material handling operations throughout the whole industrial field. Textile, paper, and other processing applications can use this drive to advantage. Machine tools, pumps, fans and printing machines are other natural applications. Heavy starting duty and slow threading speed, quick stopping and fast acceleration, coupled with flexible control, are some of the major features of this equipment.

New Lightning Arresters

A new line of Type "LV" unit design lightning arresters covering the range from 20-kv to 73-kv, and designed primarily for the small substation where reliable protection at low cost is the watchword, is announced by the Westinghouse Electric & Manufacturing Co. Complete arrester units 20, 25, 30, and 37 kv consist of three inch diameter porous block elements, and a multiple series gap of resistance type spacers, and metal electrodes. Entire assembly is encased in wet process porcelain, hermetically sealed.

Following unit design practice, units

(Continued on page 369)



CATALOGS AND TRADE PUBLICATIONS

(987) HEAVY DUTY COMPRESSORS. Form 3262 by Ingersoll-Rand Co., Denver, Colorado, office 1637 Blake St. 30 page catalog describing duplex heavy duty compressors, 75 to 250 horsepower, direct connected and motor driven with illustrations and construction details. Illustrations of various installations.

(988) CENTRIFUGAL PUMPS. Centrifugal Pumps types B&C by Gardner-Denver Co., Quincy, Ill. and Denver, Colorado. 13 page booklet describing side suction centrifugal pumps belt connected and direct connected with tables of capacities and friction losses.

(989) CUTTING MACHINES. Mounted Bottom Cutting Machine M-292 by Goodman Mfg. Co., 48th and Halsted St., Chicago, Ill. 15 page booklet describing mounted machines giving construction details and sketches showing plans of operation.

(990) NICKEL STEEL. Nickel Steel Topics, June, 1940, by International Nickel Co., Inc., 67 Wall St., New York, N. Y. Articles about a giant stainless steel plaque, ball joints on dredge pump lines and a hand operated combine.

(991) OIL FIELD PRODUCTION ENGINES. Bulletin No. 271 by The National Supply Co., Pittsburgh, Pa. Descriptions of various sizes of Superior gas and oil engines used for pumping and driving generators with specification tables.

(992) MINE HAULAGE LOCOMOTIVES. Bulletin No. H-377 by Goodman Mfg. Co., 48th and Halsted St., Chicago, Ill. 27 page catalog describing and illustrating various sizes and types of trolley locomotives with tables of dimensions.

(993) CONVEYOR EQUIPMENT. Link-Belt News, June, 1940, by Link-Belt Co., 307 North Michigan Ave., Chicago, Ill. Algoma Central & Hudson Bay Ry. Installs Unique Conveyor System to Load Iron Ore Into Lake Ships and other interesting articles.

(994) DRAW WORKS. Bulletin No. 274 by The National Supply Co., Pittsburgh, Pa. Description, illustration and drawing of the Ideal Type 75 Consolidated Rig. Table of specifications.

(995) PORTABLE ELECTRIC HOISTS. Bulletin No. 344-B by Shaw-Box Crane & Hoist Co., Muskegon, Michigan. Pamphlet illustrating and describing Shaw-Box portable electric "Budgit" hoists. Lifting capacities of 250 to 2,000 lbs., priced at $119 to $179.

(996) GAS & DIESEL COMPRESSORS. Bulletin WB-101 Fifth Edition by Gardner-Denver Co., Quincy, Ill. and Denver, Colo. Illustrations and descriptions of medium size compressors driven by gas and diesel engines with tables of capacities and dimensions.

(997) CAPACITOR MOTORS. Bulletin GEA-2915A by General Electric Co., Schenectady, N. Y. Description and illustration of the type KC ⅛ to ¾ horse-power capacitor-motor explaining applications, construction characteristics, modifications, ratings and advantages.

(998) TRUCK TRANSPORTATION. Automobile Facts, April, 1940, by Automobile Manufacturers Association, New Center Building, Detroit, Michigan. Articles on truck transportation, motor orders creating jobs in steel plants and Latin American road now being built.

(999) ROCK DRILL ACCESSORIES. Form 2410 by Ingersoll-Rand Co., 11 Broadway, New York, N. Y. 12 page pamphlet describing and illustrating new and standard rock drill accessories such as hose connections, air filters, manifolds, oilers and jack bits.

(1000) ROTARY VACUUM FILTERS. Bulletin No. F8-B by Denver Equipment Company, 1400 17th St., Denver, Colorado. Pamphlet describing various sizes of vacuum filters with illustrations and drawings, accessories and tables capacities and dimensions.

(1001) STEAM AND POWER PUMPS. Bulletin P-35-Eighth Edition by Gardner-Denver Co., Quincy, Illinois and Denver, Colorado. A 27 page catalog with descriptions and illustrations of various sizes of steam and power pumps and accessories with capacity, dimension and friction loss tables. A catalog for your file.

(1002) INSULATION MATERIAL. Insulator, May, 1940, by Armstrong Cork Co., Lancaster, Pa. Articles about installations using cork for packing houses, florist shops and condensation equipment. Sales representatives, Stearns-Roger Mfg. Co., 1720 Calif. St., Denver, Colo.

(1003) ROPE DRIVES. Industrial News, June, 1940, by Gates Rubber Co., Denver, Colorado. Description of rope drives on a diesel-electric

FOR YOUR CONVENIENCE

Send your publications to Mines Magazine, 734 Cooper Building, Denver, for review in these columns. Readers will please mention Mines Magazine when requesting publications from the manufacturer. Readers may order publications from this office by giving index number.

locomotive, 20-ton die press and crushing plant.

(1004) MANUFACTURING MINING MACHINERY. Bulletin G 365 by Goodman Manufacturing Co., Halsted at 48th, Chicago, Ill. 15 page booklet describing and illustrating the company's plant and manufacturing equipment.

(1005) MUCKING MACHINES. Bulletin No. 103 by Elmco-Finlay Corp., Salt Lake City, Utah. 33 page book telling the story of the Elmco-Finlay loader with illustrations, construction details and many installation examples plus how to order and pay for a loader.

(1006) WIRE ROPE HAND BOOK. Riggers' Hand Book by Broderick & Bascom Rope Co., 4203 North Union Boulevard, St. Louis, Missouri. 96 page hand book with sketches and illustrations on how to make wire rope slings, apply rope clips, attach sockets and how to select guy lines. This is for your library.

(1007) DRY VACUUM PUMPS. Form 3063-1 by Ingersoll-Rand Co., 11 Broadway, New York, N. Y. Description and construction details of single and two-stage heavy-duty dry vacuum pumps with table of specifications.

(1008) CAST CHROMIUM-MOLYBDENUM STEEL. The Moly Matrix, May, 1940, by Climax Molybdenum Co., 500 Fifth Avenue, New York, N. Y. Articles on cast chromium-molybdenum steel parts used in haulage equipment such as logging trailer running gear and industrial haulage trucks.

(1009) LABORATORY MACHINERY. Bulletin A-9 by Morse Bros. Machinery Co., Denver, Colorado. Leaflet illustrating laboratory and mill equipment.

(1010) ELECTRIC TRAVELING CRANES. Catalog No. 211 by Shaw-Box Crane & Hoist Co., Muskegon, Michigan. Description and illustrations of the type "C" electric traveling crane with construction details and capacity table.

(1011) SAW MILL MACHINERY. Catalog B-40 by R. R. Howell Company, Minneapolis, Minn., contains 64 pages of equipment and tools for the saw mill together with price list. They offer complete service for the saw mill operator. If you have a saw mill or need one you should have this new book. Sales Representatives are Mine & Smelter Supply Co., Denver.

(1012) DIAPHRAGM PUMPS. Bulletin 34-a by Colorado Iron Works Co., Denver, Colo. illustrates a simple type of diaphragm pump, simplex, duplex or triplex either belt or direct motor driven. Dimension drawings and tables are given and also capacity and power tables for different size pumps and densities.

(1013) BLOWERS. Bulletin Form 2671 by Ingersoll-Rand, 11 Broadway, New York, shows a new motor-blower with pressure ranges from ½ to 2¼ lbs. and volumes from 100 to 4500 cfm. Constant pressure and high efficiency is claimed throughout a wide range, easy to install and maintain. Dimension tables, capacities, horsepower, weights, etc., are given.

(1014) GUN PERFORATION & ACIDATION IN OPEN FORMATION, its development and application is nicely illustrated and told in "Tomorrow's Tools Today," May-June, published by Lane-Wells Company. A story in this issue of the 25,000th well they have gun perforated in the United States in 7 years, three months and three weeks.

(1015) HI-PRIME CENTRIFUGAL PUMP. Bulletin W-324-81 of Worthington Pump and Machinery Corp., Harrison, N. J., shows this new motor driven pump for small capacities at high heads. Primes up to 28 feet at sea level. 2 to 9 gal.-per-min. up to 225 ft. head. Rating and dimension tables given.

(1016) ANACONDA MINE CABLES. Pub. No. C-46 of Anaconda Wire & Cable Co., 25 Broadway, N. Y., is a 60-page book showing dependable copper conductors to transmit the current from the source of supply to the place of operation. In this book you have a wide range of applications and 12 pages of technical data. Sales Representatives, Mine & Smelter Supply Co., Denver, Colo.

(1017) OIL WELL DRILLING EQUIPMENT. The National Supply Co., Toledo, Ohio has published the following Bulletins: 236-A, spudding attachment for Type 40 Draw Works; 259, Single-shaft 360 ton Crown Blocks, roller bearings, specifications; 266, Rotary Connector Type D-6, illustrations and specifications; 270, Superior Diesel Oil Field Drilling Engines, 6 & 8 cyl., 15 to 375 H. P., table of speed and H. P.; 273, Swivels 7-types, shows construction and specifications.

(1018) SUMP & DRAIN PUMPS for wet pit operations, vertical type. Bulletin W-317-B6 of Worthington Pump & Mchy. Corp., Harrison, N. J., give illustrations and capacities, speed, heads, etc., 3 to 10" discharge, 540 to 7500 g.p.m.

(1019) INDOOR BUS BAR SUPPORTS. Data book 36-200, by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., contains 28 pages illustrating and describing a complete line of indoor bus supports for voltages 600 to 23,000 volts. Full of dimension tables and data on 93 distinct bus bar supports, various methods of holding, brackets, clamps and useful mountings.

(1020) CRUSHING ROLLS. Bulletin C16-B, Denver Equipment Co., Denver, Colo., illustrates the construction and application of this high grade crushing rolls. Tables of dimensions, capacities, H. P. and weights are given with a roll product chart which tells at a glance the proper crusher and roll setting.

(1021) DIESEL ENGINES. D-057 form 6085 of Caterpillar Tractor Co., Peoria, Ill., contains illustrations of 16 Caterpillar Diesel Power units including diesel electric sets, with H. P. and KW ratings. From this you can pick the plant for your purpose.

(1022) INDUSTRIAL AIR FILTERS, are illustrated and described in a 20 page book of Air-Maze Corporation, 520 Harvard Ave., Cleveland, Ohio. For use with your Diesel, Gas, Gasoline engine, Compressors. 99.83% of the dust is removed before the air enters your equipment. Sales Representatives, Mine & Smelter Supply Co., Denver, Colo.

(1023) MAKING MONEY WITH DENVER MECHANICAL GOLD PAN. Bulletin P1B-14, Denver Equipment, Denver, Colo., shows you how this is done.

(1024) SEMI-PORTABLE COMPRESSOR. Bulletin H-620-B23, Worthington Pump & Machinery Corp., Harrison, N. J., illustrates this 6-cyl. air-cooled unit powered by General Motors two-cycle Diesel Engine. 5 sizes, 142 to 445 C.F.M. displacement, 63 to 125 H. P. specifications, descriptions and illustrations.

(1025) DISTRIBUTION TRANSFORMER. Bulletin B-6096, Allis-Chalmers Mfg. Co., Milwaukee, Wis., contains 16 pages illustrating and describing the construction and application of their latest distribution transformer for ratings from 1½ to 25 k.v.a. and voltage from 2400 to 7620 volts. Construction pictures shows just how they are built.

(1026) ADJUSTABLE DIAMETER V-BELT PULLEYS. Cat. No. AD39, by American Pulley Co., Philadelphia, Pa., contains 7 pages of tables, dimensions and drawings showing pitch ranges and prices. Sales Representative, Mine & Smelter Supply Co., Denver, Colo.

(1027) EFFECT OF WATER ON PUMP MATERIALS. Leaflet 6108 by Allis-Chalmers Mfg. Co., and Milwaukee, Wis., points out the importance of investigating the type of water to be pumped and presents a number of factors in water that affect performance and service, and the effect of these various factors on different pump materials. Graphical illustrations are given.

(1028) MILLS—FLOTATION. In the supplement to TREFOIL, for July, Denver Equipment Co., Denver, you will find 4 pages for your engineering note book covering milling at Granby Consolidated, Copper Mt., B. C., including screen analysis of products, Flow Sheet, flotation equipment, analysis of various products, mill costs and other data. "TREFOIL" also contains, Lab. Notes, story of Gilpin Co., Colo., and other interesting items.

(1029) FINE REDUCTION CRUSHERS. The Traylorian, Vol. 9, No. 2, by Traylor Engineering & Mfg. Co., Allentown, Penn., shows a new Multi-Stage Fine Reduction Crusher. Less power and more capacity is claimed. Bulletin 113 gives full details of this new product.

(1030) RAKE CLASSIFIER. Bulletin No. 407 by Morse Bros. Machinery Co., Denver, Colorado, describes and illustrates the new "Trueline" Rake Classifiers, made in simplex and duplex models incorporating new ideas which make for simplicity, efficiency and ease of operating control. Tables of dimensions and capacities are given showing machines to fit your requirements.

Alumni Business

MEETINGS

Executive Committee Meetings

3rd Monday of each month, Alumni Office, 7:00 P.M.

Alumni Council Meetings

4th Thursday of each month, Argonaut Hotel, 6:30 P.M.

Publication Committee Meetings

2nd Tuesday of each month, Alumni Office, 7:00 P.M.

Magazine Staff Meetings, Alumni Office on call.

NEW ASSOCIATION MEMBERS MAY, 1940

Alumni

CHARLES A. BANKS, Hon. D. Engr., '40
San Francisco, Calif.

JOHN CHRISTOPHER, '25
Caracas, Venezuela

HOWARD J. HILTON, '10
Seattle, Washington

MAX SCHOTT, Hon. D. Engr., '40
New York, N. Y.

Associate

ADRIAN L. BURSON, Ex-'37 - Denver, Colo.
CHARLES S. KNOX, Ex-'27 - Denver, Colo.
JAMES A. O'KEEFE, '36
Benton Harbor, Mich.
ERNEST F. RIEFLER, '34 - Lynbrook, N. Y.
FRANK E. SIEGFREID, Ex-'38
Summitville, Colo.
JAMES H. WATERHOUSE, Ex-'41
Austin, Texas
S. T. WELLER, Ex-'12 - - - Denver, Colo.
JOHN H. WENZEL, '37 - Chinook, Montana

REPORTS

Executive Committee Meeting

Meeting of the Executive Committee of the Colorado School of Mines Alumni Association held on Monday, June 17, 1940 at 7:30 P. M.

Present were Committee Members, Frank C. Bowman, George W. Thomas, Frank J. Nagel; Committee Chairmen, C. Lorimer Colburn, Bruce B. LaFollette, Donald Dyrenforth, Kenneth Hickok.

Minutes of preceding meeting were read.

Treasurer's Report

Treasurer Thomas presented his financial report of the month of May, showing the Alumni Association to be in good financial condition at this time.

Alumni Loan Fund

In the absence of Athletic Chairman James W. Dudgeon, his report was read by the Chairman. Loans from the Athletic Loan Fund and the repayment of same were discussed. Standard procedure is developing in this and much aid has been rendered worthy students. Since this is a revolving fund this aid will continue.

Cash on hand in this fund was $175.27 which will not be sufficient to finish the fall term and another subscription drive will be put on this summer.

The procedure to be used in determining and granting of Alumni Scholarships was discussed.

Mr. Colburn advised that the New York Local Chapter had raised a fund of $1300.00 as a loan fund for worthy New York students who wished to study at the Colorado School of Mines. The dovetailing of this into funds already existing was discussed. Also other independent funds for assistance of ambitious young men with insufficient funds were discussed.

The Athletic Committee report was unanimously accepted.

Membership Committee

In the absence of Chairman Volk of the Membership Committee, Frank Bowman announced that during May five Alumni had joined the Alumni Association and seven Ex-Mines men had applied for associate membership.

The miners who became members of the association were Michael Ivanoff, '25, Norman, Oklahoma; F. F. Seeburger IV, '35, Langley Field, Virginia; Don Peaker, '32, Tulsa, Oklahoma; Glenn R. Stephens, '27, Golden, Colorado; and Norman Whitmore, '26, Los Angeles, California. Ex-Mines men accepted for Associate Membership were Charles S. Knox, Ex-'27, Denver, Colorado; James A. O'Keefe, Ex-'36, Benton Harbor, Michigan; Frank E. Seigfried, Ex-'38, Summitville, Colorado; Ernest F. Riefler, Ex-'34, Lynbrook, New York; John H. Wentzel, Ex-'37, Chinook, Montana; Adrian L. Burson, Ex-'37, Denver, Colorado; and James H. Waterhouse, Ex-'37, Austin, Texas.

The committee welcomes these men and hopes they will be happy in their membership.

Various ways and means of inducing other graduates and Ex-Miners to become members of the association were discussed.

Capability Exchange

The Capability Exchange reported eight calls in May of which three were filled with the remainder pending.

Public Relations Committee

Chairman Donald Dyrenforth of the Public Relations Committee reported that the football films were being well received at the local section meetings where they were shown. A helpful suggestion that these films embody views showing changes in the campus was favorably received.

The report of the Annual Banquet showed that the committee had stayed well within the allotted appropriation, notwithstanding the interesting entertainment and useful prizes.

The committee's suggestions for future banquets were helpful.

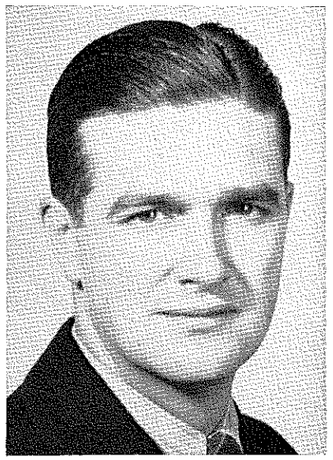
General

A short discussion relative to proper subjects for discussion at Alumni Council meetings followed.

Alumni are invited to write this committee their suggestions.

(Continued on page 366)

President's Message



E. J. BROOK

The sands of 1940 have half run thru the hour glass. I believe at this time it is well to pause, review the accomplishments of the first half of the year, and, in the light of the experiences gained during that time, chart our course for the coming months.

This administration embarked upon a program which has been reiterated several times, so that further elucidation is unnecessary. Our executive committee agreed that this program should aim at (1) strengthening of our internal organization and membership and (2) an endeavor to wipe out a former deficit in the treasury so that by 1941 the organization could be operating on a balanced budget.

Strengthening the internal structure of our association consists logically of three phases (1) establishing an administrative unit capable of coping with the intensified program so necessary for progress (2) reorganization of local sections to support the program by collective, organized effort in the various geographical districts in which they function and (3) an endeavor to impress the individual member with the necessity of his cooperative in assuming the responsibilities of membership.

The first phase so far as administrative functions are concerned has been practically accomplished by a reorganization of our committee set-up to more completely cover the activities in which the association is engaged with a minimum of overlapping and duplication of efforts. It may be said that a certain lack of coordination and "follow up" exists in the administrative branch. That situation is inherent in an organization which is dependent upon volunteer workers, who, necessarily, must subordinate their work for the group to the task of earning a livelihood. Our committee members are subject to no criticism for their zeal and efforts to accomplish the work assigned to them. A better coordinated program can be attained only thru the employment of a regular, full time, association manager. This is an impossibility at the present time, but should be a goal for the future.

The situation regarding an awakening of interest in local sections, while certainly not sensational or spontaneous, is nevertheless gratifying. New, live local sections have been installed in Seattle, Washington and Phoenix, Arizona, under capable leadership. Miners in Shreveport, Louisiana will receive their charter within the next few weeks. Other sections are planned for various localities where enough alumni reside to warrant such action. The localities in which your executive committee believe additional local sections should be formed are Fort Worth-Dallas, Texas; Carlsbad, New Mexico; Pueblo, Colorado; Baltimore, Md.; Washington, D. C.; and Wilmington, Dela.-New Jersey areas. The need in these localities is for some Mines Men to assume the responsibility and leadership of organizing these groups.

We are also encouraged that several local sections are reorganizing to carry on more actively and intensively their program of cooperation with the national officers. The Colorado, Utah, and Manila sections are at present undergoing such changes as their officers deem necessary to achieve this result. The presidents of several other sections have promised action along this front in the immediate future.

In order to stimulate interest in local sections a plan of a "Local Section Activity Contest" will be announced within a few weeks. This will not only promote competition among these groups but will disclose to local section officers the weakness in their organizations which require bolstering.

The third phase of securing the active cooperation of all our members is the most difficult to obtain. It can be achieved only by showing actual results in our program. Members are interested in belonging to a "live" concern; it is up to us to keep ours in this classification. The way to make it "live," is for each individual member to make a definite contribution to the group.

Elsewhere in the magazine is a financial statement of the status of our budget for the first half of the year. An analysis of this will disclose statistical data showing actual results are being obtained not only toward financial stability but in an increased activity of the various functions of the association.

Our organization moves into increased resistance to maintain the pace set thus far in our membership campaign for the ensuing six months. Those old stumbling blocks procrastination, passive resistance, and "Let George do it" will become tougher "nuts to crack." The local sections and the individually active member must offset those negative forces for us. That membership campaign is of paramount importance.

I hope this report, supplemented by our financial statement will give our membership a view of the year's work so far, and that the disclosure of certain phases in the future will meet with approval and support. In my inaugural address it was our hope that "Our members could visualize new horizons for a new year."

There is something about a horizon which intrigues us. Literally and figuratively there is a desire to increase our horizons, which apparently is inherent within each of us. The deeper we are in the valleys, the less we see of the horizon. The higher we climb, the wider it becomes and the more true its perspective. In spite of the countless depressions and valleys across which our paths traverse, we continue to climb, though often we wonder why. No matter how dim and distant the horizon seems to be in those moments of discouragement and "lows" there is ample compensation once the summit is attained and the panorama of an infinite expense of the unexplored is unfolded before us.

FROM THE Local Sections

BAGUIO

L. W. Lennox, '05, President; Frank Delahunty, '25, Vice-President; T. J. Lawson, '36, Secretary-Treasurer, Box 252, Baguio, P. I. Monthly dinner meeting third Wednesday each month.

BIRMINGHAM

Tenney C. DeSollar, '04, President; W. C. Chase, Ex-'05, Vice-President; Hubert E. Risser, '37, Secretary, Flat Creek Alabama. Meetings upon call of secretary.

BAY CITIES

Frank Hayward, '32, President; William J. Rupnik, '29, Secretary-Treasurer, 714 Hillgirt Circle, Oakland, Calif. Four meetings per year, 2nd Monday, March, June, September and December.

BUTTE

E. S. McGlone, President; H. M. Strock, '22, Secretary, 1309 Platinum St., Butte, Mont. Meetings upon call of Secretary.

CHICAGO

A. L. Lynne, '06, President; M. E. Frank, '06, Secretary, 4537 Drexel Blvd., Chicago. Meetings upon call of secretary.

CLEVELAND

K. D. True, '35, President; R. J. Maloit, '37, Secretary-Treasurer, 9701 Lamont Ave., Cleveland, Ohio. Four meetings during year, 4th Friday, March, June, September and December.

DENVER

Dent L. Lay, '35, President; R. J. McGlone, '27, Vice-President; A. L. Mueller, '35, Secretary, 430 E. 11th Ave., Denver, Colo. Four night meetings per year. July, October, January, April.

Important Announcement

Colorado section has changed its meeting date. Four night meetings per year. Meetings for balance of this year will be on July 19th and October 18th.

We promise you an interesting meeting. Join in the fun and enjoy a good night out. Remember the date July 19th, 6:30 P.M., Oxford Hotel.

Clark W. Moore, '32, President; R. J. Schilthuis, '30, Secretary, 1410 Gustav, Houston, Texas. Dinner meeting, second Friday of month. 6:00 P. M., Lamar Hotel, Houston, Texas.

The Houston Chapter held its regular monthly meeting on Friday, June 14 at 6:00 p. m. in the Cafeteria of the Lamar Hotel. Due principally to vacations, we had the poorest attendance in some time. The only regular members present were C. W. McGuire, '36 and Ralph J. Schilthuis, '30. Messrs. Lester Neuhaus and Nicholas Neff of the class of '40, who are here looking for jobs, also attended.

Our president, Mr. Clark W. Moore, '32, has been promoted to superintendent of the Mills-Bennett Production Company's operation in the Lopez field, and we regret to advise that he has moved from Houston to Bruni, Texas, Box 1001. This will serve to notify him through the magazine that he is being retained as president of the Chapter for the remainder of the term, operating by remote control.

LOS ANGELES

R. S. Brummett, 26, President; William Dugan, Ex-'12, Secretary, 315 West 9th St., Los Angeles, Calif. Four meetings during the year, 2nd Monday of month, January, April, July and October.

MANILA

A. F. Duggleby, '15, President; Ralph Keeler, '31, Secretary, Box 297, Manila. Dinner meeting, first Friday each month.

C. L. French, '13, President; Ben W. Geddes, '37, Secretary, 1112 University Terrace, Linden, N. J. Meetings upon call of secretary.

The last meeting of the New York section, until next fall, was postponed from May 14th to June 4th because the essence of the program, namely, the moving pictures of the Mines-C. C. football game, did not arrive in time. However, they finally did come and were thoroughly enjoyed. The "union" operators, Clare French and Jack Bonardi, spent some time trying to solve the intricacies of the projector and they were probably as surprised as the rest of us when the pictures came out right side up. It looked good to us to see Mines on the top-heavy side of the scoreboard.

Ted Carter also brought along a reel of moving pictures on geophysical prospecting which was very interesting and instructive.

A lot of new men, particularly some of the class of 1940, will probably be coming into the New York area this summer and they should be sure to let the section secretary know their addresses.

Those in attendance at this meeting were:

H. J. Wolf, '03; T. Pilger, Ex-'10; C. L. French, '13; J. G. Bevan, '21; Jack Bonardi, '21; Frank McKinless, '23; Bill Berry, '24; S. Del Rio, '28; Scott Turner, Hon. '30; Ted Carter, '31; Brad Bailey, '37; Ben Geddes, '37; and C. O. Reiser, '38.

SALT LAKE CITY

Otto Herres, '11, President; Kuno Doerr, Jr., '27, Secretary, 700 McCormick Bldg., Salt Lake City, Utah. Meetings upon call of secretary.

Axel E. Anderson, '04, Seattle, Wash., President; Louie C. Rhodes, '20, Spokane, Wash., Vice-Pres.; R. Kenneth Burgess, '28, Portland, Ore., Vice-Pres.; Daniel L. Beck, '12, Secretary-Treasurer, 1020-21 Lloyd Bldg., Seattle, Wash. Meetings: 2nd Monday, September, December, March, June. Visiting Mines Men please notify secretary and called meetings will be arranged.

A meeting was called by Axel E. Anderson, '04, at 6:30 P. M., May 27th, 1940, at the New Washington Hotel, Seattle, Washington, for the purpose of organizing the Northwest section of the Colorado School of Mines Alumni Association.

At this meeting, the following were present:

Axel E. Anderson, '04; Daniel L. Beck, '12; Edwin E. Bussey, '97; Charles W. Harkison, '06; Henry J. Hersey, '24; Howard J. Hilton, '10; Eric M. Smith, '05.

H. G. Washburn, '04, Wallace, Idaho, was in town on May 27th, enroute to the Azurite Mine, but because of previous appointments was unable to remain over for the evening meeting. Notes were received from

W. D. Spencer, '04, of Portland, Oregon, J. D. Vincent, '33, of Holden, Washington, and Leo A. Scherrer, '24 of Seattle, expressing their regrets that they were unable to attend the meeting.

The following officers were elected:

President—Axel E. Anderson, '04, Seattle, Wash.
Vice-Pres.—Louie C. Rhodes, '20, Spokane, Wash.
Vice-Pres.—R. Kenneth Burgess, '28, Portland, Ore.
Secy.-Treas.—Daniel L. Beck, '12, Seattle, Wash.

It was decided to assess members $1.00 per annum to defray expenses of mailing nature and chapter guests, stationery, etc.

Regular meetings are to be held quarterly, beginning on the second Monday evening in September. Special luncheon meetings will be called by the president on occasion, and particularly upon the occasion of visits to Seattle by outside members.

Members of this section are requested to phone Mr. Anderson's office, Elliot 3276, or Mr. Beck's office, Seneca 2755, whenever they have items of interest which may be placed in the Personal Column of the Alumni Magazine.

It was suggested that on occasion as the Vice-Presidents in Spokane and Portland should deem it wise, meetings of this section be held at these points for the benefit of members who cannot attend meetings in Seattle.

President Anderson stated that it was his ambition to visit personally, every member residing within the area of North Idaho, Oregon and Washington.

An Entertainment Committee was appointed, consisting of Messrs. C. W. Harkison, Edwin E. Bussey, and Eric M. Smith. A. Publication Committee was appointed, to be composed of Messrs. D. L. Beck, L. C. Rhodes, and R. Kenneth Burgess.

The general feeling expressed at the meeting was that the forming of the Northwest section should prove of benefit to members and visitors, due to the large number of travelers that pass through Seattle enroute to Alaska and points in the Orient. It is hoped that visitors will make themselves known by calling either personally or phoning the offices of Mr. Anderson or Mr. Beck.

Vice-President R. K. Burgess was in Seattle on business the middle of June and was the inspiration for a group to gather for luncheon at Don's Seafood restaurant. Those present were E. E. Bussey, '97 H. J. Hilton, '10; A. E. Anderson, '04; R. K. Burgess, '28.

Mr. Burgess will organize the Portland group and also work with the boys at Spokane.

PHOENIX

Two meetings in year, second Saturday in April and October. T. E. Giggey, '34, President; A. F. Hallett, '09; Percy Jones, Jr., '08, Vice-Presidents; E. M. J. Alenius, '23, Secretary-Treasurer, Box 2751, Phoenix, Ariz.

PITTSBURGH

S. L. Goodale, '04, President; A. M. Keenan, '35, Secretary, Box 146, Pittsburgh, Pa. Meetings upon call of secretary.

(Continued on page 274)

TULSA

John R. Evans, '23, President; D. H. Peaker, '32, Secy.-Treas., c/o The Carter Oil Co., Tulsa, Okla. Meetings upon call of secretary.

WICHITA

Thomas H. Allan, '18, President; John T. Paddleford, '33, Secretary-Treasurer, 429 First National Bank Building, Wichita, Kansas. Meetings upon call of secretary.

Mine Valuation—

(Continued from page 342)

The past inquiries of the scientist regarding structural control, magmatic differentiation, metasomatic alteration, weathering, electrical conductivity, mineral associations, paragenesis and others are now developing practical aspects and in the hands of competent men possibilities, although not measurable, are becoming probabilities. In my opinion the day of measurable quantities of ore in place with a "For Sale" sign on top are expiring. The valuation of the future will be based more and more on ore possibilities and to a lesser extent on measurable quantities of ore and the success of the valuator will depend upon his ability to read the geological signs that research has shown do exist.

Alumni Business—

(Continued from page 363)

Publication Committee

Chairman Bruce B. LaFollette reported that while the actual earnings of the publications are in advance of the budget requirements at this period, there was a deficiency in subscriptions and advertising for the month of May. More advertising is needed to keep this item in line with the budget estimate.

Book sales are advancing nicely and many are discovering that we are rendering a valuable service. It is desired to promote the service idea in connection with this activity and make our members conscious of the fact that this department is able and willing to act as a clearing house for their book requirements.

The situation in regard for material so far this year has been good but we can use a larger variety of material to advantage.

Good progress is being made on the Special Petroleum Number for August but some articles promised are very slow coming in. Mr. Buell, who is working up material, reports that we will have an outstanding number this year; however, the actual size of the issue will be governed to a large extent, as usual, by the amount of advertising obtained. Every Mines Man wants to see this number an outstanding success—so give us a hand in supplying advertising and material.

PRIZE WINNER

Ted Goudvis of the class of '40 is starting off in first class manner as a Mines graduate—one of the first things he does is to read a copy of MINES MAGAZINE from cover to cover and in doing so (unfortunately for the editorial staff) he notes 18 errors in the May issue. The editors cannot agree with him on all of the 18, however there are enough left to entitle him to the prize for that month, so to him goes a free subscription to the Magazine for one year.

TREASURER'S REPORT
COLORADO SCHOOL OF MINES ALUMNI ASSOCIATION
BUDGET FOR THE YEAR 1940

June 30, 1940 — 50%

RECEIPTS

	Budget Estimate 1940	Coll. to Date	Percent Collected	Credit Balance
From Accounts Receivable	$ 2,423.32	$ 2,147.73	88.	$ 275.59
Alumni Council	200.00			200.00
Capability Exchange	50.00	9.71	19.	40.29
Dues	2,892.16	1,744.00	60.	1,148.16
Entertainment Committee	300.00	264.12	88.	35.88
Interest	80.00	35.85	44.8	44.15
Miscellaneous	100.00	49.74	49.7	50.26
Publications	14,100.00	6,056.79	42.9	8,043.21
	$20,145.48	$10,307.94	51.0	$9,837.54

DISBURSEMENTS

	Budget Approp.	Disbursement to date	Percent Expended	Credit Balance
For Accounts Payable	$ 4,055.93	$ 3,954.19	97.	$ 101.74
Alumni Council	200.00	87.15	43.5	112.85
Bank Charge	50.00	25.00	50.	25.00
Capability Exchange	150.00	24.35	16.	125.65
Entertainment Committee	400.00	317.17	79.	82.83
Insurance	9.55			9.55
Membership Committee	400.00	161.12	40.	238.88
Miscellaneous	100.00	97.77	97.7	2.23
Postage	550.00	228.24	41.	321.76
Printing & Multigraphing	100.00	12.25	12.	87.75
Publications	10,694.00	3,727.05	34.8	6,966.95
Rent	480.00	240.00	50.	240.00
Salaries	2,500.00	1,207.75	48.	1,292.25
Stationery & Supplies	150.00	108.57	72.	41.43
Telephone & Telegraph	150.00	79.64	53.	70.36
Traveling	150.00	113.99	75.9	36.01
	$20,139.48	$10,384.24	51.	$9,755.24

RECEIPTS

Balance beginning of budget period	$ 423.27	
Income to date, budget period	10,307.94	$10,731.21

DISBURSEMENTS

Expenditures to date, budget period	10,384.24
Cash on hand	$ 346.97

RECAPITULATION

Accounts Receivable, June 30, 1940	$1,426.85
Cash on hand, June 30, 1940	346.97
	$1,773.82
Accounts Payable, June 30, 1940	1,289.42
Net credit, June 30, 1940	$ 484.40
Net deficit, January 1, 1940	1,209.34
Net gain, first six months 1940	$1,693.74

Respectfully submitted,
GEORGE W. THOMAS,
Treasurer.

WEDDINGS

Snyder-McCool

Raymond Snyder, '37, was married in St. Louis, Missouri, on Tuesday, May 14, 1940, to Miss Emma McCool of Mount Harris, Colorado. Prior to his present position with the Kingwood Oil Company, Mr. Snyder was employed by the Victor-American Fuel Company at Mount Harris. The couple are now at home at 525 No. Shelby Street, Salem, Illinois.

Yarroll-Morgan

Before going to Lucerne Valley, California to take over the duties of Mill Foreman of the cyanide plant for Mines, Inc., Warren H. Yarroll, '34, was married to Miss Helen Morgan of Los Angeles. The address of Mr. and Mrs. Yarroll is Box 113, Lucerne Valley.

Hunt-Wilson

Following close on his graduation from Mines this year was the marriage of Malcolm M. Hunt to Miss Marjorie M. Wilson of Golden which took place Sunday afternoon, May 26. The ceremony was performed in the garden of the home of the bride's mother, Mrs. May Wilson, the Rev. J. F. Starr officiating.

Mr. Hunt's home is in Prince Rupert, British Columbia but the couple are now located in Sudbury, Ontario, where he accepted a position with the International Nickel Corporation.

BIRTHS

Since April 18, 1940, Ann Allene Cockle has been a welcome addition to the household of Mr. and Mrs. Robert Cockle. She seems to be very happy in her new surroundings and is the pride and joy of her big sister, Janice, who is three years old.

Specifications of Ann at birth:
Weight, 6 pounds—3 ounces.
Fully equipped
Free Squealing—Automatic Feeding
Seldom Requires Oil—Sparkling Blue Lamps
Body Color—Delightful pink
Travels nicely—wet or dry.
F.O.B.—Money couldn't buy her.

Editor's Note: Her father is mine engineer for the Standard Silver-Lead Mining Company at Wilborn, Montana.

R. E. Westling, '37, reported recently that his household was increased to three on May 11 by the arrival of a baby boy. "All three doing nicely." Name of the baby was not given, however, "Court" Doolittle is saving a place for him in the class of '62.

The proud father is production engineer for the Gulf Oil Corporation at Tulsa, Oklahoma.

Mr. and Mrs. Robert J. Dalton announce the arrival of a nine-pound, fourteen-ounce daughter on May 29. Mr. Dalton, of the class of '32, is metallurgist for the Climax Molybdenum Company.

(Continued from page 361)

above 37-kv consist of combinations of two single units, for instance, a 40-kv arrester would consist of two 20-kv units, etc. The two units combine to form one integral arrester.

Features include absolute moisture proofing, brought about by the solder hermetical seal at each end casting. Greatest improvement is in protective ability against lightning, every arrester being guaranteed to discharge at least 65,000 surge amperes on a 5-10 micro-second wave. This is possible because of the three inch diameter resistance blocks, formerly used only on arresters rated 50-kv and above. Gap breakdown is uniform and stabilized by the resistance type spacers and metal electrodes. To insure their handling "long-tail wave" lightning, and freedom from radio interference each arrester is tested in the laboratory under rated power voltage.

Self-supporting, they may be mounted directly on transformers, or other equipment. Where small clearances prohibit this, mounting brackets may be used and are obtainable.

Further information may be obtained by writing Dept. 7-N-20, West. Elec. & Mfg. Co., East Pittsburgh, Pa.

Plant News

Allis-Chalmers Increases El Paso Office Personnel

J. E. Despins, Mining Division, Allis-Chalmers Mfg. Company, Milwaukee, Wisconsin, has recently been transferred to the company's El Paso district office. He will act in the capacity of office engineer under Mr. O. F. Metz, district office manager.

Mr. Despins is a graduate of the Michigan College of Mining and Technology and completed the company's graduate student course prior to his service with the Mining Division. He is a junior member of the American Institute of Mining Engineers.

Mechanical Supplies, Incorporated, Manila, P. I. Invites Correspondence from Manufacturers

Announcement comes from Manila that Mechanical Supplies, Incorporated have purchased the business and stock of the Berry Engineering Co.

Mr. Donald B. MacAfee is President and General Manager of the new corporation and is a machinery executive of many years experience in the Philippine Islands. As sales manager, Mr. MacAfee has visited most plants and has a comprehensive knowledge of the Far East mines and industrials.

The new corporation intends to increase its lines. Particular attention will be given to marine engines, rice mill equipment, mining machinery, logging and lumber mill equipment, machine shop tools, road and construction machinery as well as hydraulic pumping machinery and specialized equipment.

A complete stock of mill and mechanical supplies will be on hand in the corporation's warehouse at Manila.

Mr. MacAfee states that his corporation will willingly consider any new developments in mechanical equipment. Manufacturers are requested to write the corporation at its mail address in Manila, P. O. Box 1177 regarding lines of equipment available for export.

Mechanical Supplies, Incorporated in its location at 320 13th Street Port Area, Manila has large display quarters and a well equipped warehouse. The corporation has been organized by various Manila business men and its capitalization is sufficient to permit continual expansion.

Diesel-Electrics to Haul Iron Ore from Largest Open-Pit Iron-Ore Mine In the World

The first diesel-electric locomotives for the Mesabi Iron Range of the Lake Superior district will go into service in June in the Minnesota properties of the Oliver Iron Mining Company, a subsidiary of the United States Steel Corporation. Of the ten diesel-electric locomotives going into service, seven are equipped with General Electric apparatus installed in locomotives built by the American Locomotive Company.

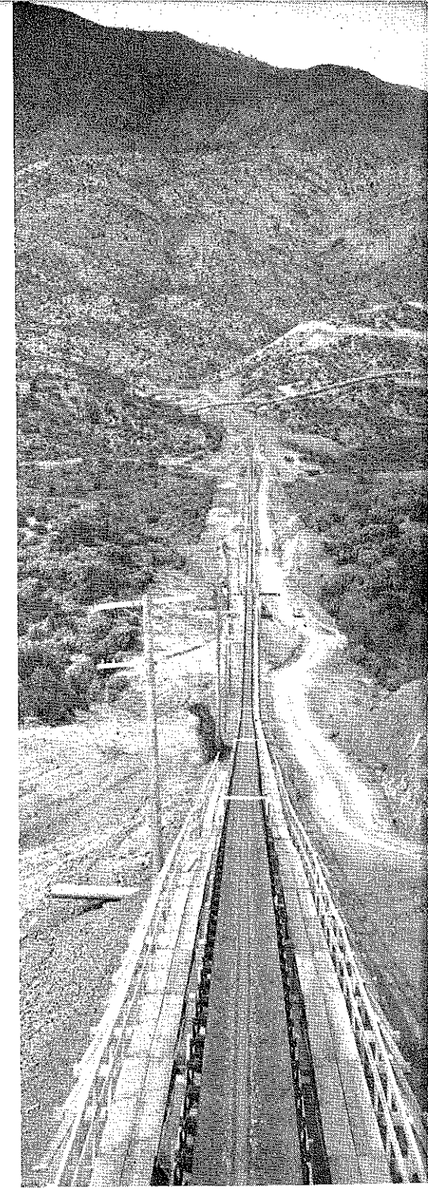
These locomotives, rated 1000 hp and weighing 125 tons each, will be used from 16 to 24 hours per day to haul trains of loaded ore cars from open pit mines, 200 to 400 feet deep on a two to eight mile haul to the top of the pit. The locomotives will push or pull the trains over the switchbacks and up heavy grades with 5 per cent maximum against the load.

High tractive effort, less smoke, and ability to negotiate sharp curves were among the reasons for the selection of diesel-electric locomotives.

The Oliver Iron Mining Company's Hull-Rust property at Hibbing is a huge excavation, 350 feet deep, 2½ miles long and a mile wide. Including the glacial overburden that covered the ore, more material has been taken from this pit than was removed in building the Panama Canal.

The 60 miles of standard gage railroad track used in the Hull-Rust open pit mine at Hibbing is shifted to new locations as mining progresses. This track shifting is accomplished by means of locomotive cranes which left the track in 30 foot sections.

The Hibbing property is part of the enormous Mesabi Iron Range of Minnesota, which in its 47 years of mining history has produced more than a billion tons of ore. The Mesabi has even been called the nation's storehouse of steel and has played a very major part in making the United States the leading steel producing nation of the world.



Operation of the world's longest belt-conveyor, manufactured by the Goodyear Tire & Rubber Company for the Columbia Construction Company, Inc., to carry aggregate from its Redding, California gravel pits to the Shasta dam at Coram (distance 9.6 miles) began in April.

Twice as long as the largest belt system ever built previously, it will operate at a speed of 550 feet per minute crossing the Sacramento river at two points; over five county roads and one main state highway; across four creeks and main line of the Southern Pacific Railroad.

Capacity load of the system is 1100 tons an hour. The belt (36 inches wide) weighs approximately one and a half million pounds, will carry 10,000,000 tons of aggregate for the dam in four years.

NEW Book Reviews

Soilles Growth of Plants. By Carleton E. Ellis and Miller W. Swaney—160 Pages, 60 Illustrations Reinhold Publishing Corporation, $2.75.

This new hobby, the soilless growing of plants, is an unlimited source of entertainment. It is of great educational value for children. The chemicals required are cheap and perfectly harmless. Suitable equipment can easily be built in the home workshop or may be purchased cheaply from dealers. Complete directions for carrying on plant culture, both in small and large-scale operation, is contained in "Soilless Growth of Plants." Here is information on how to build containers and grow flowers and vegetables for the family at small expense. In addition, full directions are given for making up "tested" nutrient solutions from the raw materials needed for growing plants. For those not hitherto participating in raising flowers, vegetables, and fruits it will afford a splendid opportunity for developing a new and extremely fascinating hobby.

Contents: Chemistry of Plant Life; Growing in Mineral Aggregates; Sand-culture Method; Sub-irrigation Method; Growing in Water; Water-culture System; Nutrient Solutions; Household Plant Culture; Growing Flowers for the Family; Growing Vegetables for the Family; Commercial Aspects; Special Chemicals; Plant Hormones; Doubling Chromosomes in Plants; Effects of Miscellaneous Chemicals on Plants; Common Detriments; Nutrient formulas—Index.

"A tremendously valuable auxiliary method of producing food and beauty, carefully and intelligently explained." *Herschel Brickell in New York Post.*

"The National Resources Committee places the culture of plants by the soilless method among the 10 most important technical trends of the day." *Memphis Press-Scimitar.*

"Whether you are interested in plants or only interested in what's going on in the world, you will find this book to be one of the best investments of the year." *C. C. Furnas in Saturday Review of Literature, New York.*

"It is to be recommended to all those who are interested in experimenting, either indoors as a hobby, or out-of-doors as a commercial venture." *Scientific American, New York.*

Between Pacific Tides. E. F. Ricketts and J. Calvin. Stanford University Press, 1939, 320 pp., 46 pl., 112 figs., $6.00.

An authoritative and above all an interesting account of some five hundred of the common and obvious marine invertebrates of the Pacific littoral from Mexico to Alaska, their life history and physiology, and their relations individually and in communities to such environmental factors as wave shock, type of bottom, and tidal level.

The classification is ecological by habitat, tidal zone, and station. A systematic index is provided, combined with an annotated bibliography of some four hundred titles, which brings together most of the scattered important references to Pacific Coast invertebrates.

The work has been prepared for the intelligent general reader and the tourist as well as for the class in zoology or the scientific observer along the shore. There is little description in a morphological or taxonomic sense; the many in situs photographs plus statements of the characteristic habitats are thought to provide more identifications than anything short of complete analytical keys and detailed descriptions by and for the specialist.

Man Makes Himself. By V. Gordon Childe. Oxford University Press, $1.75.

This readable book is a brief but fairly comprehensive outline of human culture history as viewed by an anthropologist. It is a thoughtful and thought-provoking account, intended primarily for the lay reader but well worth the specialist's attention as an interpretative exposition. The author's chief aim is to examine the known facts of prehistory and ancient history in order to determine the major events which mark the course of human progress. He begins by suggesting that Prehistory is a continuation of Natural History and that there is a notable analogy between organic evolution and cultural progress. More specifically, he suggests that during the early stages of human existence advancement consisted mainly in physical or bodily adaptation to environment and that since modern man came on the scene advancement has been marked instead by modification or adaptation, i.e., conquest of the environment.

This conquest process, ordinarily called culture history, is described in a succession of chapters bringing the story up practically to the present day. First, during the Old Stone Age, appeared the simple food-gatherers; next, during the New Stone Age, came the agriculturists and stock raisers, with marked increase in population; last of all, during the Bonze Age and later, urban civilization arose with its division of labor and consequent interchange of products, resulting in navigation and search for raw materials far and wide, giving rise to trading posts, colonization and ultimate conquests. As an essential to successful merchandising, writing and arithmetic were developed and with this achievement historic times may be said to have begun, about 3000 B. C. These major steps were so markedly different in character that the author calls them Revolutions and regards them as equally important with the Industrial Revolution of 18th Century, which has given rise to our present method of mass production.

But this is only half of the story. Economic advancements had all along profound social consequences, and our present difficulties are regarded as arising mainly from the fact that social improvements have not yet caught up with our industrial achievements. To many students, Professor Gordon thinks, our progress is doubtful, is nothing but a revival in scientific terms of the ancient doctrine of the Fall of Man, through tasting of the Tree of Knowledge. And so this essay is intended primarily as an antidote for present pessimism regarding the human future by showing that in the past the world has steadily advanced in spite of, if not because of, a succession of more or less violent Revolutions, of which the present turmoil is only another example.

—N. C. N. in N. H.

West Texas—New Mexico Symposium —Part I. Edited by R. K. DeFord and E. Russell Lloyd. Amer. Assn. Petroleum Geologists Bulletin Jan. 1940. 189 pp. illustrated.

Contains papers on the Pre-Permian stratigraphy and structure of the region. Besides presenting much unpublished information on an interesting and important area, will deal mainly with the Permian rocks of the West Texas-New Mexico Permian Basin. Considerable is given on correlation and attempts are made to clarify and improve the nomenclature. Several maps and numerous charts add to the value of the papers. The following papers are included in Part I.

Editorial Introduction. By Ronald K. DeFord and E. Russell Lloyd.
South-North Cross Section from Pecos County through Ector County, Texas, to Roosevelt County, New Mexico. By William C. Fritz and James Fitz-Gerald, Jr.
South-North Cross Section from Pecos County through Winkler County, Texas, to Roosevelt County, New Mexico. By E. Hazen Woods.
Geologic Section from Fisher County through Andrews County, Texas, to Eddy County, New Mexico. By Robert I. Dickey.
Stratigraphy, Eastern Midland Basin, Texas. By Lincoln R. Page and John Emery Adams.
Geology of North-Central Texas. By M. G. Cheney.
Sand Hills Area, Crane County, Texas. By Elliot H. Powers.
Structural Development, Yates Area, Texas. By John Emery Adams.
Older Rocks of Van Horn Region, Texas. By Philip B. King.
Paleozoic Stratigraphy of Franklin Mountains, West Texas. By L. A. Nelson.
Correlation of Pennsylvanian Rocks of New Mexico. By C. E. Needham.
Upper Paleozoic Section of Chinati Mountains, Presidio County, Texas. By John W. Skinner.

Altogether the Symposium is both interesting and valuable to the petroleum geologist, stratigrapher and student of geological history. —J. H. J.

Science Today and Tomorrow. By Waldemar Kaempffert. Viking Press, $2.50.

Waldemar Kaempffert's pen is not only inspired by imagination but is controlled by accuracy—two most important characteristics of a scientific writer. Others may set forth their material as clearly, but few can approach his skill in fascinating and persuasive presentation. He has an unusually comprehensive background. For eighteen years he was editor of the Scientific American, and for five years he was editor of Popular Science. He was the first director of the Museum of Science and Industry in Chicago (founded by Julius Rosenwald). At present he is Science and Engineering Editor of the New York Times.

In this volume the author gives us eighteen most readable chapters on astronomical, physical, chemical, and biological topics—every one a gem of popular scientific writing. The reader is given dramatic word-pictures of a nova ("A Star Explodes"), new aspects of the sun, and life on other worlds. There is a chapter on rocketing through space, and one on explorers of the atmosphere. The chapter entitled "The Mystery of the Atom" is a thrilling story. Another is titled "After Coal—What?", another, "Evolution Since Darwin", and another on "Carrel".

The thread that binds the book in a unified whole is the author's deep and continued interest in the social aspects of scientific development. To him it is a new and improving way of life. There is not a dull paragraph in the little volume.

—C. F. in N. H.

GEOPHYSICAL News and Review

Compiled by the Geophysics Department, Colorado School of Mines

Magnetic Measurements:

HIGASINAKA, H. *Magnetic Force Due to a Conical Body.* Jul. Shanghai Science Institute 1 (Section 1), 199-204, Feb., 1939.

The writer develops the mathematics of the magnetic field arising from a conical body. Such a body might represent a conical volcano or hidden dome, making it a useful case. In practice it is at times necessary to calculate the effect of such a shaped body at a point on the surface.

It is assumed that the body is uniformly magnetized. The formulae connecting magnetic potential, gravitational potential intensity and direction of magnetization and density of the body is used. The necessary equations resulting are developed with the aid of zonal harmonics and polar coordinates, and give the X, Y, and Z components of magnetic force.—D. W.

JOHNSON, E. A. *A Primary Standard for Measuring the Earth's Magnetic Vector.* Terr. Mag. At. El. 44(1), 29-42; Mar., 1939.

A New electromagnetic magnetometer to establish primary standards of high accuracy in measuring any component of the earth's magnetic field as described. The instrument consists of a Helmholz-Gaugain coil which sets up a measurable standard field, opposed to the component of the Earth's field being measured; while a rotating coil within the main Helmholz coil is used as a null indicator. The voltage generated by the rotating coil is detected by an A. C. amplifier.

The dimensions of the instrument are described and the mathematics of calculating the coil constant for the Helmholz coil are given. Errors in orientation of the instrument and its limiting sensitivity are discussed.—D. W.

JOHNSON, E. A. *Note on the Design of Efficient Magnets.* Terr. Mag. & At. El. 44(1), 81-83; Mar., 1939.

The writer presents design data on cylindrical magnets showing demagnitization-curves for Alinco, cobalt steel and tungsten steel magnets and the energy-density curves for same. Another set of curves gives the remanence of cylindrical magnets as a function of their dimension ratio for the 3 materials noted above. Alinco magnets appear to have high stability.—D. W.

STEARN, N. H. *Geomagnetic Exploration in* 1938; Geophysics 4(2), 118-122; Mar., 1939.

Experience bringing into "sharper focus" the functions of different geophysical methods brings out that magnetic prospecting is taking over the function of scouting, being characterized as the Kit Carson of Geophysics. Over 8 geophysicists report its use as preliminary to surveys with other methods in both mining and petroleum exploration in different parts of the United States and Canada, which include magnetic surveys as directional to extensive seismic work in California.

This scouting function is further evidenced by regional magnetic surveys by the Missouri Geological Survey in the NW portion of that state. The 6,100 square miles surveyed in 1938 bring the total coverage in that state to 25,000 sq. miles. The U. S. Geological Survey is reported using the method in the Highwood Mountain Area of Montana to detect possible laccolith feeders.

An area of perhaps the most active use of geomagnetics is reported as S. Texas where the method is credited with assisting in the location of 5 pools. In the area that on magnetic surveys is divided into 3 groups, viz.; 1. Those who "believe" in the method and credit it for a part in several discoveries; 2. Those who "disbelieve" and consider data supporting its applicability is purely empirical and no reasonable theoretical background for interpretation in the region has been developed, and results pointing its success statistically could be purely fortuitous; 3. Those who consider both sides of the question and are withholding judgment in the matter.

The author suggests an exchange of experiences among men active in the application of magnetic methods to speed up advancement, develop adequate articulation of sound scientific theory behind interpreting anomalies. An abstract cannot cover all the interesting points discussed.—D. W.

JOHNSON, C. H. *New Mathematical and "Sterographic Net" Solutions to Problem of Two Tilts—with Applications to Core Orientation.* A.A.P.G. Bull. 23(5), 663-685, May, 1939.

In obtaining the true dip of beds from oriented cores, it is necessary to correct the observed magnetic orientation of the core for errors due the deviation of the bore hole, from which the core is taken, from the vertical and apply an orientation correction and a strike-and-dip correction. The above ties in to the two-tilt problem and the author develops 4 fundamental equations for use in solving the problem and for the construction of graphic nets for the same purpose. The discussion and development and its application to the problem of core orientation is complete.—D. W.

Pendulum and Gravimeter Measurements:

Report of Houston Geological Study Group in Interpretation of Geophysics; Geophysics 4(2), 138-140; Mar., 1939.

The paper here reviewed was read by A. B. Miller at a meeting of the Houston Geological Society; it evolved from a series of lectures, lead by Paul Weaver, of the above study group. The two types of geophysical pictures discussed cover strong anomalies and weak anomalies. In the first type the anomaly is of such strength and measured on physical properties that permit the material causing it as well as the shape of the anomalous mass to be determined. In the second type the anomaly is small and caused by rocks whose physical properties differ so slightly from the surroundings that the type of material and shape of the anomalous mass are difficult or impossible to deduce.

Under each type examples of magnetic, gravity and seismic anomalies are presented and discussed. The geophysics of the soils is briefly covered and 11 references are attached. The paper gives an excellent and concise treatment of fundamentals of geophysical interpretation.—D. W.

HEILAND, C. A. *Gravimeters; Their Relation to Seismometers, Astatization and Calibration;* A.I.M.E. Tech. Pub. No. 1049, (Class L. No. 62), 1-26; Apr., 1939.

Comprehensive engineering information on gravimeters covering the entire field is presented. The working principles of a number of these instruments are illustrated in relation to corresponding seismometers; the mathematical discussion of the theory being confined to fundamentals.

Gravimeters are classified as 1. Pneumatometric (gas pressure) and 2. Mechanical (elastic force) types; on a basis of the comparison force against which gravity is measured in the instruments. The mechanical gravimeters are subdivided into unastatized and astatic varieties. The Barometric gravity methods (Hecker-Mohn) and the volumetric gravity method (Haalck) are taken up first. This is followed by a description and discussion, under class 2, of 6 different unastatized instruments, namely, those of Threlfall and Pollock, Wright, Lindbland-Malmquist, Hartley, Graf-Askania and Gulf; each being illustrated by diagrams.

A section is devoted to the astatization of Gravimeters and Horizontal Seismogravimeters (Ising gravimeter) and Vertical Seismo-gravimeters are treated. Under the latter 5 types are considered, namely: Bifilar gravimeters, Trifilar gravimeter, Truman gravimeter, Mott-Smith gravimeter and the Thyssen gravimeter.

A final section deals with the calibration of gravimeters and the various factors that affect instrument readings and corrections necessary together with methods of determining and applying same. A list of 26 references (16 from foreign sources) is given.

The paper assembles a large amount of specific and valuable data on gravimeters which instruments, as is pointed out, have come into increasing commercial use in this country in the last 5 years.—D. W.

KAUENHOWEN, W. *A Review of Geophysical Survey of the Reich as a Background for Prospecting for Mineral Deposits by O. Barsch, and The Subsurface of Schleswig-Holstein in Light of Seismic Refraction Surveys by H. Reich.* A.A.P.G. Bull. 22(4), 494-500, April, 1938.

The first named article is from Oel und Kohle (Berlin SW 68) vol. 12 (45), 1035-1039, Dec. 1936; the second from Pumpen und Brunnenbau Bohrtechnik (Berlin SW 68) 33(24), 763-69, Nov., 1937.

The publications here reviewed are of interest as they release for the first time results of investigations during recent years in determining the subsurface structure of the N. German plains. Results of torsion balance and gravity meter measurements in the province of Schleswig-Holstein (1934-1936) are present in two maps. To the end of 1936 some 35 new salt plugs had been discovered. The map of seismic results published by the second author give contours of equal times of arrival of seismic waves at 4 klm. distance from the shot point as determined by travel time profiles. The map repre-

sents essentially a contour map of the Pre-Tertiary surface in the area.

A comparison of the two maps suggests that the gravitational effects originate from much greater depths than the seismic effects. Pre-existing ideas of the subsurface trends were entirely revised on a basis of the seismic results.

The review covers two examples of regional geophysical surveys and their usefulness.—D. W.

Soil Analysis:

HOFFMAN, M. G. *An Advance in Exploration by Soil Analysis Methods.* Oil & Gas Jl. 37(44), 23-24, 115; Mar. 16, 1939.

The writer discusses the soil survey method of exploration showing type curves of the hydrocarbon values from analyzed samples, against the geologic structure involved in several type cases. The difference is noted in this technique, which attempts to locate the body of oil directly regardless of structure, and other geophysical methods that determine structure only.

The matter of the upward migration and diffusion of gases and their concentration in the crust of the earth, the imperviousness of strata to migration, oxidation and polymerization at the surface converting light hydrocarbons to heavy ones are all discussed. The Russian procedure of analysing gases collected from specially drilled holes and the American method of analysing collected samples of the soil for hydrocarbons are described.

Type curves showing a halo pattern over closed anticlines, high anomaly curve over stratigraphic traps and peak values over faults and their interpretation is discussed. It is held that more than a sample analysis of samples should be shown for example: 1. The relative amount of organic matter in the soil; 2. The character of the soil; 3. Topography; 4. Soil covering; 5. Surface geology for beds just below the surface; 6. Climate of the region; 7. Possible contamination.

The writer holds the method is an important exploration advance yet in its experimental stages. He suggests its use to check undrilled seismograph structures.

—D. W.

TUCKER, M. *Soil Analysis Evaluated by Test Holes.* Oil & Gas Jl. 38(5), 36-37; June 15, 1939.

The writer notes that the present program of drilling now under way on locations established by soil analysis surveys will provide the checks needed to establish the worth of the method. Such drilling tests will determine: 1. the proper layout of surveys on different types of prospects; 2. the magnitude of hydrocarbon soil showings required under varying conditions to indicate commercial production; 3. the selectivity of the procedure in outlining productive limits within short distances; 4. improvements in final interpretation of geochemical data; and 5. application of the method as a reconnaissance and as a detailing exploration tool. The above 5 items are discussed in detail by the author. Six profiles of soil analysis surveys from W. Central Texas, Michigan, W. Kansas, and 3 from localities in Oklahoma illustrate the points treated. Under interpretation it is brought out that soil analysis findings are very sensitive to faulting or fracturing which cause important exceptions to the "halo" arrangement of hydrocarbon maxima around petroliferous anticlines.

As an exploration tool the method appears justified after 15 wells drilled on areas showing normal conditions by soil analysis showed no oil though structure present was confirmed. This experience indicates that where no soil analysis anomalies were found an area would appear to be definitely unfavorable. A method of averaging station values to cut out irregularities due to soil variations is given.

The article is a timely and coolly critical treatment of numerous phases of this new procedure.—D. W.

Seismic Methods:

MOTT-SMITH, M. *On Seismic Paths and Velocity-Time Relations;* Geophysics 4(1), 8-23; Jan., 1939.

It is brought out that in seismic depth computations straight wave paths are generally assumed and the variation of wave velocity with depth is allowed for as determined by observations. However the curvature of the path caused by variation of velocity with depth is usually not considered largely because of the mathematical difficulties and complications of taking it into account. For deep reflections from nearly horizontal beds no correction for ray curvature is necessary but where reflecting horizons are shallow or their dip steep and velocity varies rapidly, curvature errors *should be* considered.

The difficulties of determining these errors lie in the necessity of substituting for wave velocities, empirically determined, a mathematical curve corresponding to some equation. The writer shows that only a few quite simple velocity depth laws lead to wave path equations that can be integrated easily and that the mathematical curve chosen must fit the wave velocities closely or errors of misfit may exceed those of path curvature which are being corrected for. It is also desirable that least squares can be applied in the fitting process.

The author investigates three types of assumed velocity-depth laws, namely: 1. The parabolic type without initial velocity; 2. The parabolic type with initial velocity; and 3. The exponental type. Graphs of the above curves are shown together with that of an empirical velocity actually found in the field. The degree of fit obtained and other factors are discussed.

Three types of velocity-time laws obtained from the curves previously noted are considered and it is shown that these relations conform closely to empirical velocities and can be easily fitted thereto. Velocity time equations of the type $V = V_o + At^{1/n}$ are easily handled mathematically and fit well at the shallow end of the curve which is important.

The seismic paths and wave fronts determined by the methods developed in the article may be applied by determining dips and depths directly or in the form of corrections to dips and depths calculated on straight ray path assumptions. It is noted that only the theoretical aspects of the subject are treated in the article.

—D. W.

DIX, C. H. *Interpretation of Well-Shot Data;* Geophysics 4(1), 24-32; Jan., 1939.

In connection with the determination of the distribution of reflection seismic wave velocity with depth from well shooting, the author considers that the real problem involved is: given the well-shot data, find the relation between velocity and depth. The method outlined in the paper gives a direct process for finding this relation which fits the data within the range of probable error and is easy of application.

The mathematics of the method is developed and its application to an example is given. A graph with time and depth as respective axes shows the data from well shots and the curve corresponding to calculated velocity distribution by the procedure set forth. It is further brought out that reflections calculated where this method is used to obtain the velocity depth relations are in good agreement with facts and that often sudden changes in velocity with depth render the average velocity method inaccurate. It is concluded that in view of the expense involved in obtaining well-shot data velocity logs should be worked up so as to fit all data as closely as possible. An example is cited where such treatment of data gave evidence to support the view that two questionable deep reflections were in fact multiple reflections and not true deep reflections.—D. W.

MCKINNEY, E. G. *Seismographing for Oil;* Oil Weekly 92(7), 93; Jan. 23, 1939.

An advertisement of a book under the above title, price $1.00, P. O. Drawer 2811, Houston, Texas, The Gulf Publishing Co. It is stated that the book is based on practical experience and presents a clear non-technical explanation of the seismograph and its use in oil prospecting.

—D. W.

HEILAND, C. A. *Geophysical Investigations Concerning the Seismic Resistance of Earth Dams.* A.I.M.E. T.P. 1054, pp. 1-28, February, 1939.

The paper treats of the use of geophysical methods in the field of structural engineering in relation to the dynamic design of structures that may be subject to ground vibrations, either artificially produced (as by traffic) or by earthquakes. The dynamic behavior of surface and subsurface formations upon which structures are built fall within the scope of the geophysical investigations.

Methods available for the determination of the dynamic characteristics of ground and of structures are divided into two groups; viz.: (1) Measurements of free vibrations produced by individual (controllable or non-controlled) impulses; and (2) measurements of forced vibrations produced by sustained periodic vibrations of variable though controlled frequency. These methods require the use of vibration detectors and seismic recording instruments and procedures. Forced vibrations are usually produced by unbalanced flywheel machines and the records obtained give the natural frequency and damping of the structure or formations investigated, which data is of great value in the proper design of proposed structures to make them earthquake-proof. The application of these methods to rigid structures and to earth dams as well as the determination of the frequency characteristics of earth dams by theoretical calculations, are treated. Another phase of the investigations covers the construction and use of scale models of dams and dam sites and the determination of the natural frequency and damping by tests thereon. Field measurements to obtain geological and physical data for model construction are described.

An analysis of prevailing frequencies of earthquakes was undertaken using earthquake records and quarry blasting data in order to determine the range of wave frequencies most prevalent in an area studied in detail so that a proposed dam could be protected against the frequencies most likely to occur. The basis of safe dynamic design is to plan structures that do not have a natural vibration period in resonance with prevailing frequencies of vibrations to which they will be subjected.

The paper clearly shows the usefulness of geophysical procedures in design problems of structures and dams and presents several unique procedures developed in solving problems presented in the extensive investigations undertaken.—D. W.

REVIEW OF *Articles Worthwhile*

Compiled by Departments of Mining, Metallurgy, and Petroleum, Colorado School of Mines

Condensate Wells—Completion and Recycling Operations, by E. V. Foran and P. C. Dixon. Reference: Oil and Gas J., Vol. 37, No. 45, March 23, 1939.

In Nov. 1932, Dr. Lacey before a A.P.I. convention discussed the retrograde phenomena; that property of liquids in which they display high vapor pressures at high pressures (3000-4000 psi). To produce certain fields where the retrograde phenomena is present, it has been necessary to use recycling which preserves the pressure while producing the liquifiable reservoir contents. Of the various names applied to these wells, "distillate well" is the best. Retrograde pressure condensation is a process wherein a condensate is procured by pressure reduction at constant temperature; retrograde pressure vaporization is the reverse of this process. Retrograde temperature condensation is a process wherein a condensate is procured by temperature increase at constant pressure; retrograde temperature vaporization is the reverse of this process. Normal condensation, even though it occurs in the retrograde range (above 700 to 800 psi) is not retrograde condensation. The first work done in Texas was at Big Lake, due to the success of high-pressure operations there, the first recycling plant in Texas was built at Auqua Dulce in 1936. Today, there are several distillate recycling plants in operation. Operating pressures in these plants are as high as 2,800 psi and input well as high as 3,600 psi. The Texas Railroad Commission has done much to stimulate recycling activities by a recent order which shuts in those wells which have been producing gas into the air. A distillate well is a gas well. It is advantageous to deliver the raw well effluent to the separator at a pressure equal to the shut-in well pressure; so that the pressure drop due to the processing may supply a portion of the necessary process cooling. To minimize the flowing pressure loss it is necessary to set large casing on top of the producing sand and to complete the well with a liner and screen thru the horizon, if the horizon is unconsolidated or with an open hole if the horizon is consolidated. Tubing is installed in output or recycling input wells for two reasons: First, to provide a syphon string to produce liquid condensate, and second, to provide the normal and necessary means of access and control of the well. Flow lines may be large to prevent pressure loss, and cooled for the same reason. In recycling all the wells should be located to conform to carefully planned pattern. A knowledge of the geology is important to prevent isolation and loss from circulation of portions of the reservoir gas. The recycled residue gases do not mix, but move and displace the original reservoir material in the direction where pressure gradients exist. Commercial recovery by condensation utilizes both the retrograde condensation range and the normal condensation due to temperature drop. A generalized process would collect the gas from the well, cool it, pass it thru a separator, then thru a liquidenser, and then the resulting liquids to storage. The problem of fractionation and color control has been solved by controlled stage separation and controlled rate of flow. Other problems are: hydrate formation and proper compression ratio. Tomorrow's production costs will be higher due to deeper wells which will be necessary.—H. T.

"Petroleum Supply of Axis Powers Short of Wartime Needs" from "Mining and Metallurgy", November 1939 issue, written by V. R. Garfias and J. W. Ristori.

Germany and Italy will be seriously short of petroleum and its products if large scale hostilities should develop. If Italy's outside supply of oil should be stopped by England or France with a blockade of the Mediterranean, she would have to try and get it from Rumania who is already taxed to provide oil for the Balkans. The alliance between Russia and Germany should open to Germany a chance to import a great amount of Russian oil. The fact remains that 1939 Russia has not exported any appreciable quantity of oil, and it does not have very much more than it needs to supply its own military and domestic peace-time needs. Official Russian figures are too big and are not a true picture of conditions.

Germany has a production of 25 million barrels in 1940 and her estimated wartime requirements are 90 million barrels. In 1938-39 she imported 80% from North and South America and this source might be cut off in a real war. 10% came from Rumania and 2% from Russia in that year.

Italy got 60 to 70% of her oil from North and South America in 1938-39. If these were cut off she must rely on Rumania. If Russia were able to export quantities of oil to Germany, transportation would be extremely poor and slow. Rumania could not furnish more than thirty-five million barrels, and Germany and Italy's combined deficit is estimated in war-time to be 104,000,000. Transportation here too would also offer many difficulties.

France and Italy are fairly well equipped with refineries to refine the crude they may be able to get, but England and Germany are more dependent on products already refined. For this reason Germany might suffer a serious gasoline shortage even if she could get all of the crude oil she wanted. England and France, it is assumed would be able to get petroleum and gasoline from the United States.

The amount of petroleum and petroleum products held in storage particularly by Germany and Italy will affect the situation, but these supplies could not last for more "than a few months of active warfare".

Facts to be drawn if war continues throughout 1940 are as follows:

(1) A blockade of pet. against Germany will be one of France's and Germany's most effective weapons.

(2) Russia cannot be of much assistance because of insufficient exportable surplus of petroleum and lack of transportation facilities.

(3) Rumanian fields would fall 30,000,000 barrels short of providing Germany's wartime needs in 1940; transportation is difficult if not impossible.

(4) Italy's entrance into war as German ally would be a drawback not a hindrance from pet's. scarcity point of view.

(5) Germany can help herself by (a) making peace before exhaustion. (b) Control Mediterranean shipping and the Iran-Mediterranean pipe line (c) neutral Italy (d) avoid break with Balkans.

It will be difficult for Germany to take possession of Rumanian oil fields. Break off of relations with Russia would be disastrous. Rumanian oil is absolutely vital to Germany's wartime needs.

—J. A. B.

Producing Oil with Gas-Lift, S. F. Shaw. Sci. of Petroleum, vol. 1, pp. 583-589, Oxford Press, London, '38.

The use of the gas-lift for elevating liquids was discovered in 1797, was used for the extraction of oil in the Baku field in 1900 and for the last fifteen years has been widely accepted in the oil industry.

The gas-lift operates by means of energy made available through the expansion of gas under pressure when ascending from the lower end of a pipe to the upper end, the gas in its upward movement carries liquid entrained with it.

The work done by isothermally expanding:

$$W = P_2 V_2 \log_e \frac{P_1}{P_2}$$

W is work done in ft.-lbs.
P_1 is the higher pressure in lbs. per sq. ft., abs.
P_2 is the lower pressure in lbs. per sq. ft., abs.
V_2 is the volume at P_2

Making the following assumptions the equation becomes:

$$W = 144 \times 14.7 \times 1 \times 2.302585 \log_{10} \frac{P_1}{14.7} = 4874 \log_{10} \frac{P_1}{14.7}$$

The lower pressure, P_2, is atmospheric, 14.7.
V_2 is 1 cu. ft. at 14.7.
Pressures are in lbs. per sq. in., abs.
Logs are to the base 10.

From weight-distance relations:

$W = 350L$
350 = the approximate lbs. per bbl. of 42 gal., sp. gr. of 1.
L = the no. of feet of lift.

The quantity of gas for 1 bbl. is

$$Q = \frac{350 \times L}{4874 \log_{10} \frac{P_1}{14.7}} = \frac{L}{13.926 \log_{10} \frac{P_1}{14.7}}$$

if 100% efficiency is assumed.

For other efficiencies

$$Q = \frac{L}{E \times 13.926 \log_{10} \frac{P_1}{14.7}}$$

Assuming isothermal expansion, E is equal to the percentage submergence (approximately) in the range of 10-30% and specific gravity of 0.75-0.85.

Example:
L = 4500 ft., the length of the eductor
P_1 = 300 psi gage or 314.7 psi, abs.
P_2 = 14.7 psi
Sp. gr. = 0.80

Under the assumed conditions the submergence is:

$300 \times 2.304 = 691$ ft. of water
$691/.8 = 864$ ft. of oil

$$100 \times \frac{864}{4500} = 19\% \text{ submergence}$$

L, the lift is $4500 - 864 = 3{,}636$ ft.

$$Q = 0.80 \times 3636/.19 \times 13.926 \log_{10} 314.7/14.7 = 818 \text{ cu. ft.}$$

The factor, *E*, will vary and it is affected by pipe length and diameter, entrance and discharge pressures, rate of flow, density, temperature, and viscosity of the liquid, gas density, temperature, rate of flow and perhaps viscosity.

Efficiency generally increases as submergence declines below 10% and decreases as submergence rises above 65%. Sufficient data is not available for exact determination of the relationship.

It has been observed that lifting efficiency increases as the pipe diameter increases, assuming other factors constant. There is a diameter for a given rate of flow that is better than any other.

The three general forms of gas flow are the continuous, periodic and intermittent flows. The choice of form is determined by the conditions and requirements for the individual cases.

Compressor installation and costs and other factors in the selection of equipment are discussed.

Present practice in the various regions of the world is given consideration in the article. The dynamic state of this phase of the industry warrants further study for those intimately concerned.

—L. H. C.

Geomorphology of the Ruby-East Humboldt Range, Nevada. By Robert P. Sharp. Bull. of the Geol. Soc. of Amer., vol. 51, no. 3, March 1, 1940, p. 338.

A middle or late Pliocene open-valley stage in the Ruby-East Humboldt Range is recognized and described. The anomalous position of the drainage divide in places seat of the range crest is explained in terms of the geomorphic evolution of the range. Pediments and terraces on the range flanks and in the adjoining basins are described, and those on the west side formed under a regime of through-flowing drainage are compared with those on the east side formed on the borders of hydrographically closed basins.

Seven surfaces, the two highest being pediments and the others partial pediments and terraces, are recognized on the west flank of the range. The dissection of these surfaces is shown to be related to successive rejuvenations of the Humboldt River drainage. The exposure and dissection of surfaces on the east flank of the range are attributed chiefly to relative uplift of the range between the middle Pleistocene and Recent.

The origin of pediments under contrasting conditions is considered, and the conclusion is reached that different geologic, climatic, and topographic conditions impose a difference in the efficacy of processes of pedimentation. In this region lateral planation is dominant in areas of permanent streams and soft rocks; and rill wash, rain wash, and weathering are dominant in areas of hard rocks, ephemeral streams, and low mountain masses.

Lateral erosion by streams accounts for approximately 40 per cent of the retreat of the mountain front, and approximately 60 per cent is due to weathering and various types of wash.

"Petroleum for Germany at War," Dr. Benjamin T. Brooks, Industrial and Engineering Chemistry, Nov. 1939.

Predictions of an early end to the present war on account of a petroleum shortage in Germany are not justified by the facts. Many careless statements have been made regarding Germany's vulnerability on account of lack of adequate petroleum products such as Diesel oil, motor fuel and lubricants.

"The whole matter may be roughly summarized by stating that if Germany gets all the Polish production, about 3½ million barrels, maintains her own domestic production of 4½ million barrels, manufactures 9 million barrels from coal, continues to get only 25% of Rumania's production, and gets none from Russia, then her total available oil of all kinds, including motor fuel, will amount only to 28 million barrels or about one-third of her present wartime requirement.

"However, the picture is vastly changed if Germany gets all Rumania's surplus for export, about 33 million barrels, and an equal amount from Russia; then her total available oil will be about 84 million barrels, sufficient for her to maintain the war indefinitely so far as petroleum, motor fuel, Diesel oil and aviation gasoline are concerned.

"It is evident that the vital factors in this situation are altogether uncertain. It is just as unwarranted to assume that Germany will not get all Rumania's available surplus and will not get any oil whatever from Russia as it is to assume that she will be able to import all she needs or desires."

Germany starts this war much better off with respect to petroleum and motor fuel than she was in 1914.

"Since the World war, Germany has built up a certain production of synthetic motor fuel by synthesis from coal by the Fischer and Bergius processes, and during the last five years has imported surplus petroleum which has been accumulated as a war reserve. Also a large but uncertain proportion of Rumania's oils which were closed to her in 1914 is now available.

"Imports from Russia are also possible and no one can say how much petroleum will be imported into Germany from Russia."—F. J. B.

Can Soviet Oil Supply German War Needs? World Petroleum, October, 1939, p. 31.

News of a trade agreement between the Soviet Union and Germany, followed by a treaty of unknown terms, has produced much speculation as to the results on the war. The most widely adopted conclusion is that Germany can get foodstuffs, raw materials, and petroleum products.

Russia has oil undoubtedly. She is second in production and has large resources undeveloped. But supplying it to Germany is another matter.

Russia produces 32,050,000 tons of oil per year, 90% of which is produced in the Caucasus. To ship oil from the Caucasus to Germany entails a long rail and water trip for which facilities are lacking, unless the oil can be shipped by way of the Black Sea and the Danube. But if Russia enters the war, she will need all her supplies herself.

About 27,000,000 tons of petroleum products are refined each year, of which in 1932, the peak year, 6,040,000 tons were exported. But in 1938 the export had fallen to 930,050 tons.

Soviet products for export are mainly fuel oil and kerosene. Germany needs gasoline and gas oil. Fuel oil could be converted, but neither Germany nor Russia have refining facilities sufficient enough.

In the past, Germany has imported little of Russia's production. It is a question whether Stalin will leave his well established markets to supply a relatively temporary desire of Germany, and whether Germany can pay in cash.

Recent reports from Russia show that the refining operations have declined in efficiency very strikingly. In Baku over 200 breakdowns were reported in the first half of the year.

In September, it was reported that German technicians were going to Russia. It remains to be seen if they can be more successful than others have been in that country.—J. B. W.

Flow Tank Vapors Saved by Economical System: The Oil Weekly, December 11, 1939, p. 19.

Operators in the Long Beach area have become flow tank vapor conscious. Since the practice of installing elevated traps is not general in that area, sufficient pressure must be maintained on the traps to force the oil thru the piping into the flow tank battery. This pressure is high enough to cause an appreciable quantity of gas to dissolve in the oil, which, if not saved, would be vented to the atmosphere and lost.

The systems consist mainly of providing each tank with a self-closing, spark-proof gauge and thief hole cover, and manifolding the vapor space of all the flow tanks in the battery into a common vapor balance line.

Various features are embodied in this equipment to insure close control, such as vacuum and pressure regulators, sensitive automatic valves, and internal flame snuffers.

The amount of vapors removed from a battery will vary according to conditions. One battery of four 250 barrel flow tanks handling the production from two 350 bbl/day wells passed an average of 60,000 cubic feet of one and one half gallons gas per day. On this basis the system paid for itself in nine months.

—E. B. W.

"Temperatures Affecting Crude Oil Production". By Michel T. Halbouty, Consulting Engineer, Oil Weekly, December 25, 1939, page 15.

The author describes temperatures affecting crude oil production and discusses the Geothermal Gradient present in the Gulf Coast oil fields.

Two classes of chemical compounds may be used for the removal of paraffin and the prevention of its deposition: Namely, those that generate heat, thus raising the temperature of the oil and melting the paraffin; also, those that act as a solvent to change the character of the wax so that it will not crystallize when the temperature is decreased below its original melting point.

A very efficient and practical method of eliminating paraffin deposits is found in equipping wells with steam coils; and at intervals, a small portable boiler, capable of supplying super-heated steam at a temperature above 500°F. and pressure of 1000 pounds can be set up at the well and operated until the accumulation has been dissolved and passed into the tanks. This method is especially applicable to large wells that produce through tubing and are readily plugged with paraffin.

Several other methods for the removal of paraffin are also discussed.

The use of bottom hole chokes in gas wells with high bottom hole temperatures has presented a new application, since their installation practically disposes of freezing difficulties by utilizing more efficiently the high subsurface temperatures.

A discussion of high pressure condensate and distillate wells is given. A pressure—temperature chart illustrates the procedure to be followed in designing a high pressure surface valve for distillate wells.

A short discussion of heat treating crude oil emulsions is given.

Charts and a table are given along with a discussion of the Geothermal Gradient present in the Gulf Coast oil fields.

—E. Y. P.

(Continued from page 335)

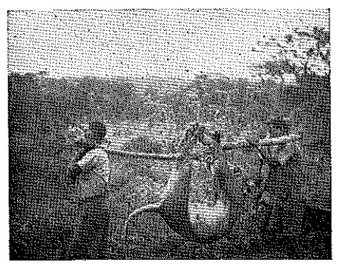
treated to some pretty scenery including native huts. Along the coast we saw many ships of all nations.

We arrived in Durban along with a heavy rain and were surprised with the beauty and size of the city which seemed to be a bit smaller than Denver. The flamboyant trees were in bloom and their red flowers added much to the visual aspect of the city.

The port of Durban is pretentious and complete in all respects and could be easily compared with any of the large ports of the world. In tonnage handled it is but 16th down the line, so it is a busy place. We were in Durban six days, after which we left for the port of Lourenco Marques in Portugese East Africa, which is the main terminus for much of South Africa's imports and exports.

The American Consul in Lourenco Marques was very cordial and showed the captain and myself the town and the sights. Here we saw cashew nuts growing much the same as English walnuts and not as ground nuts as we had imagined. The next port was Beira, also in Portugese East Africa but under different government. In Beira the Mozambique Charter Company has control of practically everything, including the land, mineral rights, post office, police, and even the currency. The day before getting into Beira we saw the hulk of the "Africa Shell" which had been shelled and put down by the "Graf Spee." It had been run ashore before it sank and was clearly visible in the surf.

The final port of my journey was Dar-Es-Salaam where I disembarked after I had been on board for 55 days. From here I was to continue my trip inland to the mine but as the trains do not run every day it was necessary for me to spend Christmas day here. Dar-Es-Salaam has a wonderful harbor with a very narrow entrance in which the German sank a big steel dry dock just at the entrance during the last war and narrowly missed blocking it. The trip from Dar-Es-Salaam to Itiga, a distance of 300 miles was rather monotonous. The last 250 miles to the mine was made over bumpy roads by car, and so after nearly 13,000 miles and 64 days of travel I finally arrived at my destination in Southern Tanganyika, roughly between Lake Nyassa and Lake Tanganyika.



▼ Man Eater Meets His Finish.

It is very nice at the mine but it was a bit of a shock to have a man eating lion shot on the outskirts of the camp within a week after I arrived. It took a native boy the first night and returned and took a dog off a truck near one of the staff houses. I visualized lions, elephants and almost everything else coming into camp every week but it is not as bad as that. We are fifty miles from the nearest town, two hundred and fifty miles from the railroad and ninety miles from an airport.

New Saza Mine, Chunya, Tanganyika Territory, British East Africa.

NEW EQUIPMENT PAGE PROVES VALUABLE

From WARD T. GRAHAM, Ex-'26

I noted on the "New Equipment" page of the March "Mines Magazine," the article about the Minnesota Mining and Manufacturing Company's offering in this line. We are enclosing a Ten Dollar money order, for which we would like to receive the "Scotch Edger" and as much tape supply as possible with this amount of money . . . please bill us for the additional amount required or send a C.O.D. for the balance . . . we will appreciate very much your securing this for us or passing on our request to the manufacturer.

Note: We are glad to render this service. Ed.

General Superintendent, Baguio Gold Mining Company, Baguio, Philippine Islands.

ENJOYS THE MAGAZINE

From MERLE L. GILBREATH, '33

I enjoy the Mines Magazine and believe that each issue is better than the last, with the April issue the best. . . . I liked the questions and answers given in the "Man of Minerals," wish more of them could have been given in the magazine.

P. O. Box 17, Angleton, Texas.

FOOTBALL PICTURES BRING MUCH PLEASURE

From HARRY J. WOLF, '03

Needless to say, they were viewed with great satisfaction. It was obvious that Mines had a good team. The photography for the most part was excellent. The whole performance was thoroughly enjoyed . . . obviously these pictures would be of greatest interest to men who actually saw the games. This same interest could be inspired if one had not seen the games, if he could be constantly informed as to what was going on. In other words, the

(Continued on page 377)

Patent Service

Recent Patents Relating to the Mineral Industries, edited by James Atkins, registered patent attorney, Munsey Building, Washington, D. C. Inquiries with reference to this subject or to any patents appearing in this department should be addressed to Mr. Atkins.

ELECTRICAL APPARATUS AND METHOD FOR LOCATING MINERALS. Patent No. 2,201,256, issued May 21, 1940, to William M. Barret, Shreveport, La., assignor to Engineering Research Corporation, Shreveport, La.

APPARATUS FOR ALLAYING DUST FROM ROCK DRILLS. Patent No. 2,201,270, issued May 21, 1940, to John Taylor McIntyre, Johannesburg, Transvaal, Union of South Africa.

EQUALIZING VALVE ARRANGEMENT FOR PACKERS. Patent No. 2,201,281, issued May 21, 1940, to Harry B. Ziegler, Odessa, Tex., assignor to Halliburton Oil Well Cementing Co., Duncan, Okla.

METHOD AND MEANS FOR PERFORATING WELL CASINGS. Patent No. 2,201,290, issued May 21, 1940, to Haskell M. Greene, Whittier, Calif.

APPARATUS FOR INDICATING THE POSITION OF DEVICES IN PIPES. Patent No. 2,201,311, issued May 21, 1940, to Erle P. Halliburton, Los Angeles, Calif., assignor to Halliburton Oil Well Cementing Co., Duncan, Okla.

DRILL BIT. Patent No. 2,201,379, issued May 21, 1940, to John F. Shaw, Los Angeles, Calif., assignor to Reed Roller Bit Co., Houston, Tex., a corporation of Texas.

FLUID TAKING TOOL FOR OIL WELLS OR THE LIKE. Patent No. 2,201,447, issued May 21, 1940, to Samuel A. Mullins, Beaumont, Texas.

WELL SWAB. Patent No. 2,201,451, issued May 21, 1940, to Benjamin E. Parrish, Dallas, Tex.

METALLIC REDUCTION PROCESS. Patent No. 2,201,460, issued May 21, 1940, to Russel H. Varian, Stanford University, Calif.

COMPACT ROLLER DRILLING BIT. Patent No. 2,201,569, issued May 21, 1940, to John A. Zublin, Los Angeles, Calif.

ROTARY EARTH BORING BIT. Patent No. 2,201,570, issued May 21, 1940, to John A. Zublin, Los Angeles, Calif.

ROTARY DRILLING MACHINE. Patent No. 2,201,673, issued May 21, 1940, to Tracy S. Park, Houston, Tex., assignor to Arthur J. Penick and Kirby T. Penick, Harris County, Tex.

DEVICE FOR LAYING PIPE AT AN OIL RIGGING. Patent No. 2,201,813, issued May 21, 1940, to Charles A. Doud, Alta Loma, Texas.

WELL HEATER. Patent No. 2,202,034, issued May 28, 1940, to William K. Thomas, La Porte, Tex.

WELL CEMENTING DEVICE. Patent No. 2,202,173, issued May 28, 1940, to Alvin L. Straub, Houston, Tex.

CASING-HEAD STRUCTURE. Patent No. 2,202,192, issued May 28, 1940, to Hugh F. Cypher, Borger, Tex., assignor of one-half to Kenneth M. Axelrod, Borger, Tex.

METHOD AND MEANS FOR REGULATING TEMPERATURE IN ORE ROASTING FURNACES. Patent No. 2,202,245, issued May 28, 1940, to David Leo Cramp, Kirkland Lake, Ontario, Canada, assignor to Lake Shore Mines, Limited, Kirkland Lake, Ontario, Canada.

APPARATUS FOR DETERMINING HORIZON PRODUCTIVITY OF WELLS. Patent No. 2,202,404, issued May 28, 1940, to Will S. Sease, Tulsa, Okla., assignor to Stanolind Oil and Gas Co., Tulsa, Okla., a corporation of Delaware.

FLOTATION APPARATUS. Patent No. 2,202,484, issued May 28, 1940, to Augustus Bachelder Emery, Messina, Transvaal, Union of South Africa, assignor to Messina Development Co., Limited, a corporation of Great Britain.

DEVICE FOR CONTROLLING THE TRANSMISSION OF POWER TO PUMPS. Patent No. 2,202,504, issued May 28, 1940, to John C. Myers, Sperry, Okla., assignor of one-half to J. W. Scott Drilling Co., Tulsa, Okla., a corporation of Texas.

THERMOCOUPLE WELL ASSEMBLY. Patent No. 2,202,533, issued May 28, 1940, to Morris Mason, Wood River, Ill., assignor to Standard Oil Co., Chicago, Ill., a corporation of Indiana.

MINING APPARATUS. Patent No. 2,202,584, issued May 28, 1940, to Morris P. Holmes, Claremont, N. H., assignor to Sullivan Machinery Co., a corporation of Massachusetts.

FLOTATION REAGENT. Patent No. 2,202,601, issued May 28, 1940, to Robert C. Ried, West Conshohocken, Pa., assignor to Separation Process Co., a corporation of Delaware.

WELL-LOGGING ELECTRODE. Patent No. 2,202,656, issued May 28, 1940, to Cecil J. Haynes, Houston, Tex., assignor to Standard Oil Development Co., a corporation of Delaware.

APPARATUS FOR GEOPHYSICAL EXPLORATION. Patent No. 2,202,885, issued June 4, 1940, to Theodor Zuschlag, West Englewood, N. J., assignor to Hans T. F. Lundberg, Montreal, Quebec, Canada.

WELL CASING PERFORATOR. Patent No. 2,202,887, issued June 4, 1940, to Millio F. Aloi, Maywood, Calif.

OIL WELL PUMP. Patent No. 2,202,970, issued June 4, 1940, to Francis E. Steele, Shreveport, La., assignor to Phillips Petroleum Co., a corporation of Delaware.

UNDERREAMER. Patent No. 2,203,246, issued June 4, 1940, to Emil H. Zum-Berge, Dallas, Tex., assignor, by mesne assignments, to Estate of Emil H. Zum-Berge and George Klein, both of Dallas, Tex.

PERFORATING GUN FOR OIL WELLS. Patent No. 2,203,265, issued June 4, 1940, to Frank C. Kniss, Eldorado, Ark.

APPARATUS FOR DETERMINING SEISMIC VELOCITIES. Patent No. 2,203,272, issued June 4, 1940, to Neil R. Sparks, Tulsa, Okla., assignor to Stanolind Oil and Gas Co., Tulsa, Okla., a corporation of Del.

MEANS FOR MEASURING AND CONTROLLING FLUID PRESSURES. Patent No. 2,203,577, issued June 4, 1940, to Frank E. O'Neill, Glendale, and Rowland G. Whealton, Altadena, Calif., assignors to Mordica O. Johnston, Glendale, Calif.

DEVICE FOR USE IN WELLS. Patent No. 2,203,595, issued June 4, 1940, to Elwin B. Hall, Los Angeles, and Arthur L. Armentrout, Santa Maria, Calif., assignors, by direct and mesne assignments, to Security Engineering Co. Inc., a corporation of California.

APPARATUS FOR DETECTING WATER INTRUSION IN BOREHOLES. Patent No. 2,203,720, issued June 11, 1940, to Clarence R. Dale, Los Angeles, Calif., assignor, by direct and mesne assignments, to Dale Service Corporation, Los Angeles, Calif., a corporation of California.

METHOD AND APPARATUS FOR USE IN DETERMINING THE GEOLOGIC NATURE AND CHARACTERISTICS OF A FORMATION TRAVERSED BY A BOREHOLE. Patent No. 2,203,729, issued June 11, 1940, to John Jay Jakosky and Patrick B. Lyons, Los Angeles, Calif., assignors, by direct and mesne assignments, to Schlumberger Well Surveying Corp., Houston, Tex., a corporation of Del.

METHOD AND APPARATUS FOR DETERMINING THE STRIKE AND DIP OF SUBSURFACE STRATA. Patent No. 2,203,730, issued June 11, 1940, to Curtis H. Johnson, Santa Monica, Calif.

FLOTATION REAGENT. Patent No. 2,203,739, issued June 11, 1940, to Emil Ott, Elsmere, Del., assignor to Hercules Powder Co., Wilmington, Del., a corporation of Delaware.

METHOD FOR THE FLOTATION OF ORES. Patent No. 2,203,740, issued June 11, 1940, to Emil Ott, New Castle, Del., assignor to Hercules Powder Co., Wilmington, Del., a corporation of Delaware.

LAMINATED DISK DRILL BIT. Patent No. 2,203,747, issued June 11, 1940, to Harvey D. Sandstone, Los Angeles, Calif.

PUMP VALVE WITH GAS CHAMBER IN CAGE. Patent No. 2,203,759, issued June 11, 1940, to Elmer G. Ware, Bakersfield, Calif.

METHOD AND MEANS OF PERFORATING WELL CASING AND THE LIKE. Patent No. 2,203,796, issued June 11, 1940, to Frank E. O'Neill, Glendale, Calif., assignor to Edith L. O'Neill, Glendale, Calif.

DRILL. Patent No. 2,203,846, issued June 11, 1940, to Thomas H. Stancliff, Houston, Tex., assignor to Reed Roller Bit Co., Houston, Tex., a corporation of Texas.

FEEDING MECHANISM FOR ROCK DRILLS. Patent No. 2,203,953, issued June 11, 1940, to Albert Feucht, Garfield Heights, Ohio, assignor to The Cleveland Rock Drill Co., Cleveland, Ohio, a corporation of Ohio.

ROCK DRILL. Patent No. 2,203,954, issued June 11, 1940, to Albert Feucht, Garfield Heights, Ohio, assignor to The Cleveland Rock Drill Co., Cleveland, Ohio, a corporation of Ohio.

SCRAPING DEVICE. Patent No. 2,203,966, issued June 11, 1940, to Herbert C. Otis, Dallas, Texas.

EXPANSION BIT AND REAMER. Patent No. 2,203,998, issued June 11, 1940, to Daniel J. O'Grady, Los Angeles, Calif., assignor to H. John Eastman, Long Beach, Calif.

APPARATUS FOR RECOVERING PRECIOUS METALS. Patent No. 2,204,018, issued June 11, 1940, to Errol F. Kingsley, Portland, Oregon.

INSIDE PIPE CUTTER. Patent No. 2,204,091, issued June 11, 1940, to George A. Lowrey, Houston, Tex.

ROD COUPLING. Patent No. 2,204,103, issued June 11, 1940, to Elbert H. Lampkin, Tulsa, Okla., assignor of one-fourth to George H. Dickinson, one-fourth to Wilfred Dickinson, and one-fourth to James T. Forster, all of Tulsa, Okla.

METHOD OF TREATING OIL AND GAS WELLS. Patent No. 2,204,223, issued June 11, 1940, to Howard C. Lawton and Albert G. Loomis, Berkeley, Calif., assignors to Shell Development Co., San Francisco, Calif., a corporation of Delaware.

PROCESS FOR TREATING OIL WELLS. Patent No. 2,204,224, issued June 11, 1940, to Donald A. Limerick and Howard C. Lawton, Berkeley, Calif., assignors to Shell Development Co., San Francisco, Calif., a corporation of Del.

RELEASABLE FLOATING VALVE. Patent No. 2,204,340, issued June 11, 1940, to John R. Bradshaw, Duncan, Okla., assignor to Halliburton Oil Well Cementing Co., Duncan, Okla.

OPEN HOLE PACKER. Patent No. 2,204,378, issued June 11, 1940, to Roland E. O'Donnell, Midland, Tex., assignor to Halliburton Oil Well Cementing Co., Duncan, Okla.

JARRING TOOL. Patent No. 2,204,458, issued June 11, 1940, to Harry P. Wickersham, Huntington Park, Calif., assignor of one-half to Erwin Burns, Los Angeles, Calif.

(Continued from page 375)

pictures could be dramatized. This brings up the idea that it would be good publicity for the School to prepare a general film about the school, the buildings, typical classes of instruction, equipment, personages, etc. . . .
475 Fifth Avenue, New York.

MORE ABOUT MINES MAGAZINE AND NEWS CLIPPINGS

From WILLIAM J. RUPNIK, '29

Enclosed is an article appearing in the Long Beach Press Telegram quoting from Max Ball's ('06) book, Fascinating Oil. . . . The last two Mines Magazines were exceptionally good. . . . I certainly did think the plan of getting up a collection for Coach Mason was Super excellent . . . the convenience that the card board slot offered . . . seems that it would be an excellent plan to raise an athletic loan fund for Mines. . . .

Note: We are always especially glad to get clippings telling of Mines men. Ed.
2011 Pine Ave., Long Beach, Calif.

ADVERTISERS LISTINGS

AINSWORTH & SONS, INC., WM. .....
Denver, Colo., 2151 Lawrence St.
AJAX FLEXIBLE COUPLING COMPANY .....
Westfield, N. Y., 135 English St.
Denver, Colo., 1501 Wynkoop St.
APACHE EXPLORATION COMPANY .....
Houston, Texas, P. O. Box 1711.
APACHE POWDER COMPANY .....
Benson, Arizona.
Los Angeles, Calif., 411 W. 5th St.
BUELL & CO., T. H. .....
Denver, 14th & Stout Sts.
CAPABILITY EXCHANGE .....
Denver, Colo., 734 Cooper Building.
CARD IRON WORKS COMPANY, C. S. 375
Denver, Colo., 2501 West 16th Ave.
CARNIE-GOODWIN-PENDLETON COMPANY .....
Fresno, Calif., 2126 Inyo St.
Sacramento, Calif., 515 L St.
CHIKSAN OIL TOOL COMPANY, LTD. .....
Fullerton, California.
Houston, Texas, Shell Building.
CLIMAX MOLYBDENUM COMPANY .....
New York, N. Y., 500 Fifth Ave.
CLINTON & HELD COMPANY .....
Denver, Colo., 1637 Wazee Street.
COCKS-CLARK ENGRAVING CO. 336
Denver, Colo., 2200 Arapahoe St.
COLORADO B. P. & SUPPLY CO. 369
Denver, Colo., 1340 Glenarm Place.
COLORADO CENTRAL POWER COMPANY. .....
Golden, Colo.
COLORADO FUEL & IRON CORPORATION 338
Amarillo, Texas, 711 Oliver Eakle Bldg.
Butte, Mont., 508 Metal Bank Bldg.
Chicago, Ill., 309 Railway Exch. Bldg.
Denver, Colo., Continental Oil Bldg.
El Paso, Texas, 801 Basset Tower Bldg.
Ft. Worth, Tex., 1503 Ft. Wth. Nat'l Bk. Bldg.
Kansas City, Mo., 415 R. A. Long Bldg.
Lincoln, Nebr., 330 N. 8th St.
Los Angeles, Calif., 739 E. 60th St.
Okla. City, Okla., 906 Colcord Bldg.
Portland, Oregon, 902 Porter Bldg.
Salt Lake City, Utah, 604 Walker Bk. Bldg.
San Francisco, Calif., 1245 Howard St.
Spokane, Wash., 727 Old Nat'l Bk. Bldg.
Wichita, Kans., 420 S. Commerce St.
COLORADO IRON WORKS COMPANY 380
Denver, Colo., 1624 Seventeenth St.
Kingston, Ontario, Can., Canadian Loco. Wks. Co.
Vancouver, B. C., Can., Vancouver Iron Wks., Ltd.
Manila, P. I., Marsman Trading Corp.
Johannesburg, So. Africa, Head, Wrightson & Co.
Stockton on Tees, Eng., Head, Wrightson & Co.
Granville, N. S. W., The Clyde Eng. Co., Ltd.
COLORADO NATIONAL BANK .....
Denver, Colo., 17th St. at Champa.
COLORADO SOCIETY OF ENGINEERS .....
Denver, 525 Cooper Bldg.
COLORADO TRANSCRIPT .....
Golden, Colo.
COORS PORCELAIN COMPANY .....
Golden, Colo.
CROW, WILLIAM 369
DEISTER CONCENTRATOR COMPANY .....
Fort Wayne, Ind., 911 Glasgow Ave.
New York, N. Y., 104 Pearl St.
Nesquehoning, Pa., 231 E. Catawissa St.
Hibbing, Minnesota, P. O. Box 777.
Birmingham, Alabama, 930 2nd Ave. North.
DENVER EQUIPMENT COMPANY 336
Denver, Colo., 1400-1418 17th Street.
New York City, 50 Church St.
Salt Lake City, Ut., 725 McIntyre Bldg.
Mexico, D. F., Mexico, Boker Building.
Toronto, Ont., 45 Richmond St. West.
London, Eng., 840 Salisbury House, E. C. 2.
Johannesburg, So. Africa, 18 Bon Accord House.
DENVER FIRE CLAY COMPANY 379
Denver, Colo.
Salt Lake City, Utah, P. O. Box 836.
El Paso, Texas, 209 Mills Bldg.
DOLPH COMPANY, INC., THE .....
Newark, N. J., 168 Emmet St.
Denver, Colo., 1501 Wynkoop St.
DORR COMPANY, Inc., Engineers .....
New York, 570 Lexington Ave.
London, England, Dorr-Oliver Co., Ltd.
Melbourne, Australia, Crossle & Duff Pty., Ltd.
Buenos Aires, Argentina, Luis Fiore.
Rio de Janeiro, Brazil, Oscar Taves & Co.
Chicago, Ill., 221 N. LaSalle St.
Los Angeles, Calif., 811 W. Seventh St.
Denver, Colo., Cooper Building.

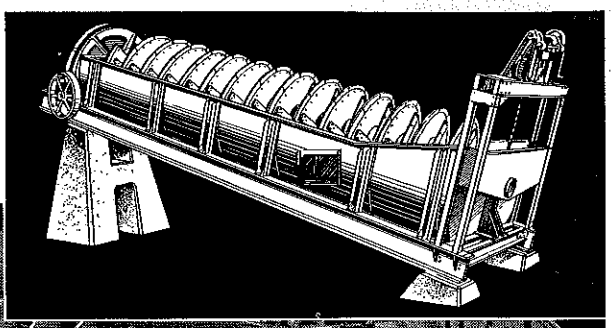
DUNLAP AND BRUMMETT .....
San Gabriel, Calif., 592 No. San Marino Ave.
DUPONT de NEMOURS & COMPANY, E. I. .....
Denver, Colo., 444 Seventeenth St.
Wilmington, Delaware.
San Francisco, Calif., 111 Sutter St.
DUVALL-DAVISON LUMBER COMPANY .....
Golden, Colorado.
EATON METAL PRODUCTS COMPANY 336
Denver, Colo., 4800 York St.
EIMCO CORPORATION, THE .....
Chicago, Ill., 333 No. Michigan Ave.
El Paso, Texas, Mills Bldg.
New York, N. Y., 330 W. 42nd St.
Sacramento, Calif., 1217 7th St.
Salt Lake City, Utah.
FLEXIBLE STEEL LACING CO. 335
Chicago, Ill., 4628 Lexington St.
FOSS DRUG COMPANY .....
Golden, Colorado.
FRANCO-WYOMING OIL COMPANY 337
Los Angeles, Calif., 601 Edison Bldg.
Paris, France, 17 Boulevard Malesherbes.
FROBES COMPANY, DANIEL C. .....
Salt Lake City, Utah, Dooly Bldg.
GARDNER-DENVER COMPANY .....
Quincy, Illinois.
Denver, Colorado.
Butte, Mont., 215 E. Park St.
El Paso, Texas, 301 San Francisco St.
Salt Lake City, Utah, 130 West 2nd South.
Los Angeles, Calif., 845 E. 61st St.
San Francisco, Calif., 811 Folsom St.
Seattle, Wash., 514 First South.
GATES RUBBER COMPANY .....
Chicago, Ill., 1524 South Western Ave.
Denver, Colo., 999 South Broadway.
Hoboken, N. J., Terminal Building.
Dallas, Texas, 2213 Griffin St.
Birmingham, Ala., 1631 1st Ave. S.
Portland, Ore., 1231 N. W. Hoyt St.
Los Angeles, Calif., 741 Warehouse St.
San Francisco, Calif., 2700 16th St.
GENERAL ELECTRIC COMPANY .....
Schenectady, New York.
GOLDEN CYCLE CORPORATION 337
Colorado Springs, Colo., P. O. Box 86.
GOLDEN FIRE BRICK COMPANY 337
Golden, Colorado.
Denver, Colo., Interstate Trust Bldg.
GOODMAN MANUFACTURING COMPANY .....
Birmingham, Ala., 1600 2nd Ave. S.
Chicago, Ill., Halsted St. at 48th.
Denver, Colo., 704 Denver Natl. Bldg.
Huntington, West Va., 831 2nd Ave.
Pittsburgh, Pa., 1714 Liverpool St.
St. Louis, Mo., 322 Clark Ave.
Salt Lake City, Utah, 314 Dooly Bldg.
Wilkes-Barre, Pa., 35 New Bennett St.
GREAT WESTERN DIVISION, THE DOW CHEMICAL COMPANY .....
San Francisco, Calif., 9 Main St.
Pittsburg, Calif., Plant.
New York, 1775 Broadway.
El Paso, Texas, H. J. Barron Co.
GRIMES PIPE & SUPPLY COMPANY .....
Denver, Colo., 1300 Larimer St.
GULF OIL CORPORATION .....
Pittsburgh, Pa., Gulf Bldg.
HANNUM DRILLING COMPANY .....
Wichita, Kansas, Ellis Singleton Bldg.
HARDESTY MANUFACTURING COMPANY, THE R. .....
Denver, Colo., 3063 Blake St.
HEILAND RESEARCH CORPORATION .....
Denver, Colo., 700 Club Building.
HENDRIE & BOLTHOFF MFG. & SUPPLY COMPANY .....
Denver, Colo.
HERTEL CLOTHING CO. .....
Golden, Colo.
HuART COMPANY, THE .....
Peoria, Ill., 206 Parkside Drive.
INGERSOLL-RAND .....
Birmingham, Ala., 1700 Third Ave. So.
Butte, Mont., 845 S. Montana St.
Chicago, Ill., 400 W. Madison St.
Denver, Colo., 1637 Blake St.
El Paso, Texas, 1015 Texas St.
Kansas City, Mo., 1006 Grand Ave.
Los Angeles, Calif., 1460 E. 4th St.
Manila, P. I., Earnshaws Docks & Honolulu Iron Works.
New York, N. Y., 11 Broadway.
Pittsburgh, Pa., 706 Chamber of Commerce Bldg.
Salt Lake City, Utah, 144 S. W. Temple St.
San Francisco, Calif., 350 Brannan St.
Seattle, Wash., 526 First Ave. So.
Tulsa, Okla., 319 E. 5th St.
JEFFERSON COUNTY REPUBLICAN, THE .....
Golden, Colorado.
KENDRICK-BELLAMY COMPANY 337
Denver, Colo., 801 Sixteenth St.
KIDDE & COMPANY, WALTER .....
New York, N. Y., 140 Cedar St.
Denver, Colo., 1501 Wynkoop St.
KISTLER STATIONERY COMPANY 379
Denver, Colo.

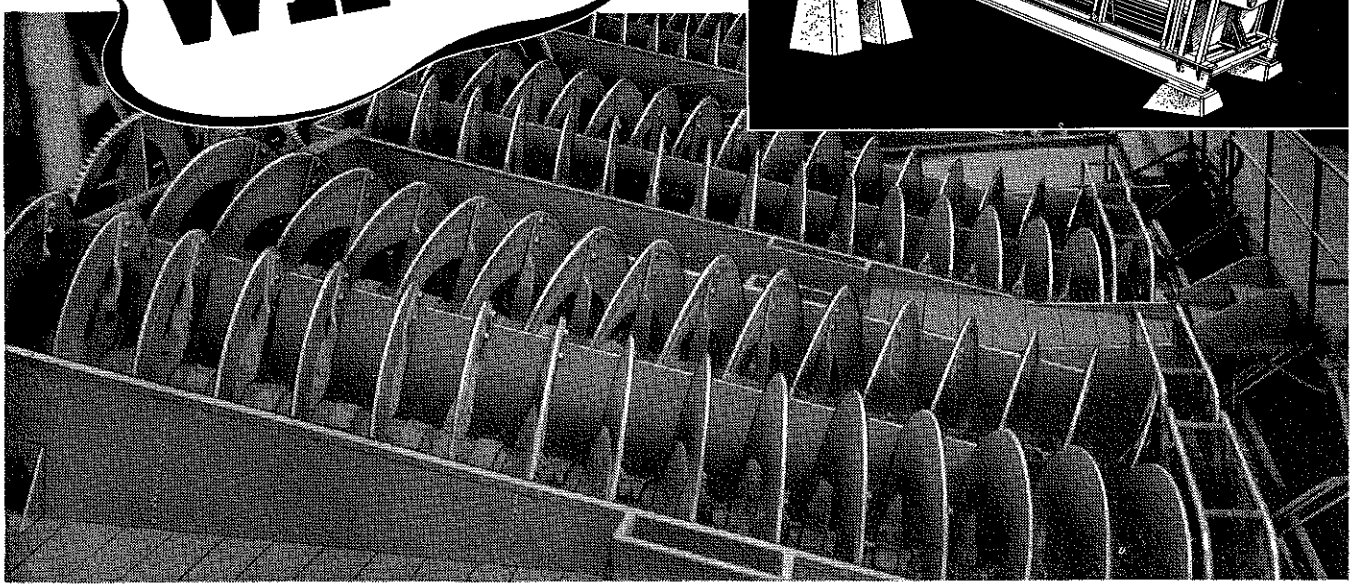
LETTER SHOP, INC. 337
Denver, Colo., 509 Railway Exch. Bldg.
LINK-BELT COMPANY 335
Chicago, Ill., 300 W. Pershing Rd.
Atlanta, Ga., 1116 Murphy Ave., S. W.
Indianapolis, Ind., 220 S. Belmont Ave.
San Francisco, Calif., 400 Paul Ave.
Philadelphia, Pa., 2045 W. Huntington Park Ave.
Denver, Colo., 521 Boston Bldg.
Toronto, Can., Eastern Ave. & Leslie St.
LUFKIN RULE COMPANY .....
Saginaw, Michigan.
New York, 106 Lafayette St.
Windsor, Ontario, Canada.
MARSMAN AND COMPANY, INC. .....
Manila, P. I., Marsman Bldg.
McFARLANE-EGGERS MCHY. CO. .....
Denver, Colo., 2763 Blake St.
MECO ASSAYERS .....
Los Angeles, Calif., 417 So. Hill St.
MERRICK SCALE MANUFACTURING COMPANY .....
Passaic, New Jersey.
MINE & SMELTER SUPPLY COMPANY 377
Denver, Colo.
Salt Lake City, Utah, 121 W. 2nd South.
El Paso, Texas, 410 San Francisco St.
San Francisco, Calif., 369 Pine St.
Seattle, Wash., 419 Ry. Exch. Bldg.
New York City, 1775 Broadway.
Montreal, Canada, Vickers, Ltd.
Manila, Philippines, Edw. J. Nell Co.
Santiago, Chile, W. R. Judson.
MINES REGISTER 334
MORSE BROS. MACHINERY COMPANY 334
Denver, Colo., 2900 Broadway, P. O. Box 1708.
New York City, 1775 Broadway.
MOUNTAIN STATES TELEPHONE & TELEGRAPH CO. .....
Denver, Colo., 14th & Curtis Sts.
NATIONAL FUSE & POWDER COMPANY 336
Denver, Colo.
NATIONAL TRAILWAYS SYSTEM 367
Denver, Colo., 501 17th Street.
OIL CENTER TOOL COMPANY .....
Houston, Texas.
New York, Val R. Wittich, Jr., 30 Rockefeller Plaza.
OXFORD HOTEL 366
Denver, Colo.
PARAMOUNT EQUIPMENT COMPANY .....
Tulsa, Okla., 911 East First St.
Denver, Colo., 1501 Wynkoop St.
PARKER & COMPANY, CHARLES O. 337
Denver, Colo., 1901 Lawrence St.
PHILIPPINE MINING YEAR BOOK .....
Manila, P. I., P. O. Box 297.
PICK PHOTOGRAPH & BLUE PRINT COMPANY .....
Denver, Colo., 1015 Seventeenth St.
PORTABLE LAMP & EQUIPMENT COMPANY .....
Pittsburgh, Penna., 72 First Ave.
Denver, Colo., 1501 Wynkoop St.
PRICE COMPANY, H. C. .....
Bartlesville, Okla.
Los Angeles, Calif.
San Francisco, Calif.
PROFESSIONAL CARDS 369
PUBLIC SERVICE COMPANY OF COLORADO .....
Denver, Colo., Gas & Electric Bldg.
ROBINS CONVEYING BELT COMPANY 377
New York, N. Y., 15 Park Row.
ROBINSON'S BOOK STORE .....
Golden, Colo.
ROEBLING'S SONS COMPANY, JOHN A. .....
Trenton, N. J.
RUTH COMPANY 336
Denver, Colo., Continental Oil Bldg.
SALT LAKE STAMP COMPANY .....
Salt Lake City, Utah, 65 W. Broadway.
SECURITY ENGINEERING COMPANY .....
Whittier, California.
Houston, Texas, 5525 Clinton Dr.
New Iberia, La., P. O. Box 121.
New York City, 420 Lexington Ave.
SOUTHERN COLORADO POWER CO. .....
Pueblo, Colo.
STEARNS-ROGER MFG. COMPANY .....
Denver, Colo., 1720 California St.
SWEENEY CONSTRUCTION COMPANY, EDWARD L. .....
Denver, Colo., United States Natl. Bldg.
TEXAS CO., THE .....
New York City, 135 E. 42nd St.
Denver, Colorado, University Bldg.
2229 Warehouses in principal cities.
UNITED GEOPHYSICAL COMPANY .....
Pasadena, Calif., 169 North Hill St.
URQUHART SERVICE .....
Denver, Colo., 1501 Wynkoop St.
VULCAN IRON WORKS .....
Denver, Colorado, 1223 Stout Street.
WESTERN MACHINERY COMPANY .....
Denver, Colorado, 1655 Blake Street
WILFLEY & SONS, A. R. 368
Denver, Colo., Denham Bldg.
New York City, 1775 Broadway.
WORTHINGTON PUMP & MACHINERY CORP. .....
Harrison, N. J.
Denver, Colo., 1725 California St.
YARNALL-WARING COMPANY .....
Philadelphia, Penna.
Denver, Colo., 1501 Wynkoop St.
YUBA MANUFACTURING COMPANY 375
San Francisco, Calif., 351 California St.

ADVERTISERS LISTINGS

AINSWORTH & SONS, INC., WM. .....
Denver, Colo., 2151 Lawrence St.
AJAX FLEXIBLE COUPLING COMPANY .....
Westfield, N. Y., 135 English St.
Denver, Colo., 1501 Wynkoop St.
APACHE EXPLORATION COMPANY .....
Houston, Texas, P. O. Box 1711.
APACHE POWDER COMPANY .....
Benson, Arizona.
Los Angeles, Calif., 411 W. 5th St.
BUELL & CO., T. H. .....
Denver, 14th & Stout Sts.
CAPABILITY EXCHANGE .....
Denver, Colo., 734 Cooper Building.
CARD IRON WORKS COMPANY, C. S. 375
Denver, Colo., 2501 West 16th Ave.
CARNIE-GOODWIN-PENDLETON COMPANY .....
Fresno, Calif., 2126 Inyo St.
Sacramento, Calif., 515 L St.
CHIKSAN OIL TOOL COMPANY, LTD. .....
Fullerton, California.
Houston, Texas, Shell Building.
CLIMAX MOLYBDENUM COMPANY .....
New York, N. Y., 500 Fifth Ave.
CLINTON & HELD COMPANY .....
Denver, Colo., 1637 Wazee Street.
COCKS-CLARK ENGRAVING CO. 336
Denver, Colo., 2200 Arapahoe St.
COLORADO B. P. & SUPPLY CO. 369
Denver, Colo., 1340 Glenarm Place.
COLORADO CENTRAL POWER COMPANY..
Golden, Colo.
COLORADO FUEL & IRON CORPORATION 338
Amarillo, Texas, 711 Oliver Eakle Bldg.
Butte, Mont., 508 Metal Bank Bldg.
Chicago, Ill., 309 Railway Exch. Bldg.
Denver, Colo., Continental Oil Bldg.
El Paso, Texas, 801 Basset Tower Bldg.
Ft. Worth, Tex., 1503 Ft. Wth. Nat'l Bk. Bldg.
Kansas City, Mo., 415 R. A. Long Bldg.
Lincoln, Nebr., 330 N. 8th St.
Los Angeles, Calif., 739 E. 60th St.
Okla. City, Okla., 906 Colcord Bldg.
Portland, Oregon, 902 Porter Bldg.
Salt Lake City, Utah, 604 Walker Bk. Bldg.
San Francisco, Calif., 1245 Howard St.
Spokane, Wash., 727 Old Nat'l Bk. Bldg.
Wichita, Kans., 420 S. Commerce St.
COLORADO IRON WORKS COMPANY 380
Denver, Colo., 1624 Seventeenth St.
Kingston, Ontario, Can., Canadian Loco. Wks. Co.
Vancouver, B. C., Can., Vancouver Iron Wks., Ltd.
Manila, P. I., Marsman Trading Corp.
Johannesburg, So. Africa, Head, Wrightson & Co.
Stockton on Tees, Eng., Head, Wrightson & Co.
Granville, N. S. W., The Clyde Eng. Co., Ltd.
COLORADO NATIONAL BANK .....
Denver, Colo., 17th St. at Champa.
COLORADO SOCIETY OF ENGINEERS.....
Denver, 525 Cooper Bldg.
COLORADO TRANSCRIPT .....
Golden, Colo.
COORS PORCELAIN COMPANY .....
Golden, Colo.
CROW, WILLIAM 369
DEISTER CONCENTRATOR COMPANY .....
Fort Wayne, Ind., 911 Glasgow Ave.
New York, N. Y., 104 Pearl St.
Nesquehoning, Pa., 231 E. Catawissa St.
Hibbing, Minnesota, P. O. Box 777.
Birmingham, Alabama, 930 2nd Ave. North.
DENVER EQUIPMENT COMPANY 336
Denver, Colo., 1400-1418 17th Street.
New York City, 50 Church St.
Salt Lake City, Ut., 725 McIntyre Bldg.
Mexico, D. F., Mexico, Boker Building.
Toronto, Ont., 45 Richmond St. West.
London, Eng., 840 Salisbury House, E. C. 2.
Johannesburg, So. Africa, 18 Bon Accord House.
DENVER FIRE CLAY COMPANY 379
Denver, Colo.
Salt Lake City, Utah, P. O. Box 836.
El Paso, Texas, 209 Mills Bldg.
DOLPH COMPANY, INC., THE .....
Newark, N. J., 168 Emmet St.
Denver, Colo., 1501 Wynkoop St.
DORR COMPANY, Inc., Engineers .....
New York, 570 Lexington Ave.
London, England, Dorr-Oliver Co., Ltd.
Melbourne, Australia, Crossle & Duff Pty., Ltd.
Buenos Aires, Argentina, Luis Fiore.
Rio de Janeiro, Brazil, Oscar Taves & Co.
Chicago, Ill., 221 N. LaSalle St.
Los Angeles, Calif., 811 W. Seventh St.
Denver, Colo., Cooper Building.
DUNLAP AND BRUMMETT .....
San Gabriel, Calif., 592 No. San Marino Ave.
DUPONT de NEMOURS & COMPANY, E. I......
Denver, Colo., 444 Seventeenth St.
Wilmington, Delaware.
San Francisco, Calif., 111 Sutter St.
DUVALL-DAVISON LUMBER COMPANY .....
Golden, Colorado.
EATON METAL PRODUCTS COMPANY 336
Denver, Colo., 4800 York St.
EIMCO CORPORATION, THE .....
Chicago, Ill., 333 No. Michigan Ave.
El Paso, Texas, Mills Bldg.
New York, N. Y., 330 W. 42nd St.
Sacramento, Calif., 1217 7th St.
Salt Lake City, Utah.
FLEXIBLE STEEL LACING CO. 335
Chicago, Ill., 4628 Lexington St.
FOSS DRUG COMPANY .....
Golden, Colorado.
FRANCO-WYOMING OIL COMPANY 337
Los Angeles, Calif., 601 Edison Bldg.
Paris, France, 17 Boulevard Maiesherbes.
FROBES COMPANY, DANIEL C. .....
Salt Lake City, Utah, Dooly Bldg.
GARDNER-DENVER COMPANY .....
Quincy, Illinois.
Denver, Colorado.
Butte, Mont., 215 E. Park St.
El Paso, Texas, 301 San Francisco St.
Salt Lake City, Utah, 130 West 2nd South.
Los Angeles, Calif., 845 E. 61st St.
San Francisco, Calif., 811 Folsom St.
Seattle, Wash., 514 First South.
GATES RUBBGER COMPANY .....
Chicago, Ill., 1524 South Western Ave.
Denver, Colo., 999 South Broadway.
Hoboken, N. J., Terminal Building.
Dallas, Texas, 2213 Griffin St.
Birmingham, Ala., 1631 1st Ave. S.
Portland, Ore., 1231 N. W. Hoyt St.
Los Angeles, Calif., 741 Warehouse St.
San Francisco, Calif., 2700 16th St.
GENERAL ELECTRIC COMPANY .....
Schenectady, New York.
GOLDEN CYCLE CORPORATION 337
Colorado Springs, Colo., P. O. Box 86.
GOLDEN FIRE BRICK COMPANY 337
Golden, Colorado.
Denver, Colo., Interstate Trust Bldg.
GOODMAN MANUFACTURING COMPANY .....
Birmingham, Ala., 1600 2nd Ave. S.
Chicago, Ill., Halsted St. at 48th.
Denver, Colo., 704 Denver Natl. Bldg.
Huntington, West Va., 831 2nd Ave.
Pittsburgh, Pa., 1714 Liverpool St.
St. Louis, Mo., 322 Clark Ave.
Salt Lake City, Utah, 314 Dooly Bldg.
Wilkes-Barre, Pa., 35 New Bennett St.
GREAT WESTERN DIVISION, THE DOW CHEMICAL COMPANY .....
San Francisco, Calif., 9 Main St.
Pittsburg, Calif., Plant.
New York, 1775 Broadway.
El Paso, Texas, H. J. Barron Co.
GRIMES PIPE & SUPPLY COMPANY .....
Denver, Colo., 1300 Larimer St.
GULF OIL CORPORATION .....
Pittsburgh, Pa., Gulf Bldg.
HANNUM DRILLING COMPANY .....
Wichita, Kansas, Ellis Singleton Bldg.
HARDESTY MANUFACTURING COMPANY, THE R. .....
Denver, Colo., 3063 Blake St.
HEILAND RESEARCH CORPORATION .....
Denver, Colo., 700 Club Building.
HENDRIE & BOLTHOFF MFG. & SUPPLY COMPANY .....
Denver, Colo.
HERTEL CLOTHING CO. .....
Golden, Colo.
HuART COMPANY, THE .....
Peoria, Ill., 206 Parkside Drive.
INGERSOLL-RAND .....
Birmingham, Ala., 1700 Third Ave. So.
Butte, Mont., 845 S. Montana St.
Chicago, Ill., 400 W. Madison St.
Denver, Colo., 1637 Blake St.
El Paso, Texas, 1015 Texas St.
Kansas City, Mo., 1006 Grand Ave.
Los Angeles, Calif., 1460 E. 4th St.
Manila, P. I., Earnshaws Docks & Honolulu Iron Works.
New York, N. Y., 11 Broadway.
Pittsburgh, Pa., 706 Chamber of Commerce Bldg.
Salt Lake City, Utah, 144 S. W. Temple St.
San Francisco, Calif., 350 Brannan St.
Seattle, Wash., 526 First Ave. So.
Tulsa, Okla., 319 E. 5th St.
JEFFERSON COUNTY REPUBLICAN, THE.....
Golden, Colorado.
KENDRICK-BELLAMY COMPANY 337
Denver, Colo., 801 Sixteenth St.
KIDDE & COMPANY, WALTER .....
New York, N. Y., 140 Cedar St.
Denver, Colo., 1501 Wynkoop St.
KISTLER STATIONERY COMPANY 379
Denver, Colo.
LETTER SHOP, INC. 337
Denver, Colo., 509 Railway Exch. Bldg.
LINK-BELT COMPANY 335
Chicago, Ill., 300 W. Pershing Rd.
Atlanta, Ga., 1116 Murphy Ave., S. W.
Indianapolis, Ind., 220 S. Belmont Ave.
San Francisco, Calif., 400 Paul Ave.
Philadelphia, Pa., 2045 W. Huntington Park Ave.
Denver, Colo., 521 Boston Bldg.
Toronto, Can., Eastern Ave. & Leslie St.
LUFKIN RULE COMPANY .....
Saginaw, Michigan.
New York, 106 Lafayette St.
Windsor, Ontario, Canada.
MARSMAN AND COMPANY, INC. .....
Manila, P. I., Marsman Bldg.
McFARLANE-EGGERS MCHY. CO. .....
Denver, Colo., 2763 Blake St.
MECO ASSAYERS .....
Los Angeles, Calif., 417 So. Hill St.
MERRICK SCALE MANUFACTURING COMPANY .....
Passaic, New Jersey.
MINE & SMELTER SUPPLY COMPANY 377
Denver, Colo.
Salt Lake City, Utah, 121 W. 2nd South.
El Paso, Texas, 410 San Francisco St.
San Francisco, Calif., 369 Pine St.
Seattle, Wash., 419 Ry. Exch. Bldg.
New York City, 1775 Broadway.
Montreal, Canada, Vickers, Ltd.
Manila, Philippines, Edw. J. Nell Co.
Santiago, Chile, W. R. Judson.
MINES REGISTER 334
MORSE BROS. MACHINERY COMPANY 334
Denver, Colo., 2900 Broadway, P. O. Box 1708.
New York City, 1775 Broadway.
MOUNTAIN STATES TELEPHONE & TELEGRAPH CO. .....
Denver, Colo., 14th & Curtis Sts.
NATIONAL FUSE & POWDER COMPANY.... 336
Denver, Colo.
NATIONAL TRAILWAYS SYSTEM 367
Denver, Colo., 501 17th Street.
OIL CENTER TOOL COMPANY .....
Houston, Texas.
New York, Val R. Wittich, Jr., 30 Rockefeller Plaza.
OXFORD HOTEL 366
Denver, Colo.
PARAMOUNT EQUIPMENT COMPANY .....
Tulsa, Okla., 911 East First St.
Denver, Colo., 1501 Wynkoop St.
PARKER & COMPANY, CHARLES O. 337
Denver, Colo., 1901 Lawrence St.
PHILIPPINE MINING YEAR BOOK.....
Manila, P. I., P. O. Box 297.
PICK PHOTOGRAPH & BLUE PRINT COMPANY .....
Denver, Colo., 1015 Seventeenth St.
PORTABLE LAMP & EQUIPMENT COMPANY .....
Pittsburgh, Penna., 72 First Ave.
Denver, Colo., 1501 Wynkoop St.
PRICE COMPANY, H. C. .....
Bartlesville, Okla.
Los Angeles, Calif.
San Francisco, Calif.
PROFESSIONAL CARDS 369
PUBLIC SERVICE COMPANY OF COLORADO .....
Denver, Colo., Gas & Electric Bldg.
ROBINS CONVEYING BELT COMPANY 377
New York, N. Y., 15 Park Row.
ROBINSON'S BOOK STORE .....
Golden, Colo.
ROEBLING'S SONS COMPANY, JOHN A......
Trenton, N. J.
RUTH COMPANY 336
Denver, Colo., Continental Oil Bldg.
SALT LAKE STAMP COMPANY .....
Salt Lake City, Utah, 65 W. Broadway.
SECURITY ENGINEERING COMPANY.....
Whittier, California.
Houston, Texas, 5525 Clinton Dr.
New Iberia, La., P. O. Box 121.
New York City, 420 Lexington Ave.
SOUTHERN COLORADO POWER CO. .....
Pueblo, Colo.
STEARNS-ROGER MFG. COMPANY .....
Denver, Colo., 1720 California St.
SWEENEY CONSTRUCTION COMPANY, EDWARD L. .....
Denver, Colo., United States Natl. Bldg.
TEXAS CO., THE .....
New York City, 135 E. 42nd St.
Denver, Colorado, University Bldg.
2229 Warehouses in principal cities.
UNITED GEOPHYSICAL COMPANY .....
Pasadena, Calif., 169 North Hill St.
URQUHART SERVICE .....
Denver, Colo., 1501 Wynkoop St.
VULCAN IRON WORKS .....
Denver, Colorado, 1223 Stout Street.
WESTERN MACHINERY COMPANY .....
Denver, Colorado, 1655 Blake Street
WILFLEY & SONS, A. R. 368
Denver, Colo., Denham Bldg.
New York City, 1775 Broadway.
WORTHINGTON PUMP & MACHINERY CORP. .....
Harrison, N. J.
Denver, Colo., 1725 California St.
YARNALL-WARING COMPANY .....
Philadelphia, Penna.
Denver, Colo., 1501 Wynkoop St.
YUBA MANUFACTURING COMPANY 375
San Francisco, Calif., 351 California St.

WHY?





Because

YOU GET STARTED QUICKER AFTER SHUTDOWNS

Can you start again immediately, when you want to start? You can if you are using AKINS Classifiers—because the AKINS will always start without unloading. It is never necessary to grind out the circuit before a shutdown. Furthermore, normal circulating sandload and normal density overflow are established immediately. With demand for all metals rapidly increasing, this big gain in operating time means money to you.

Other Advantages—Greater overflow capacity per foot width, with a big saving in floor space; operate at slope of 4″ to foot, without backslip or surge; ability to produce extremely fine overflow; efficiency at high density; more tonnage and improved metallurgy at lower power cost.

A Few Users of AKINS Classifiers:

Butler Brothers, Minnesota
Climax Molybdenum Co., Colorado
Combined Metals Reduction Co., Utah
Consolidated Mining & Smelting Co., B. C., Can.
Copper Range Co., Michigan
Cuban Mining Co., Cuba
Empire Zinc Co., N. Mex. and Colorado
The Fresnillo Co., Zac., Mex.
Golden Cycle Corp., Colo.
Hollinger Cons. Gold Mines, Ltd., Ontario
Lake George Mines, Ltd., N.S.W. Aus.
Little Long Lac Gold Mines, Ontario
Marievale Consol. Mines, Ltd., So. Africa
Nevada Consol. Copper Corp., (Chino) N. M.
Potash Co. of America, New Mexico
San Mauricio Mining Co., Philippine Islands
Sunshine Mining Company, Idaho
U. S. Smelting, Ref. & Mining Co., Utah
Van Dyk Consol. Mines, Ltd., So. Africa

● *Send for Bulletin 24-H*

Representatives Outside the U.S.A.

Canadian Locomotive Co., Ltd., Kingston, Ontario, Can.
Vancouver Iron Works, Ltd., Vancouver, B. C , Can.
Marsman Trading Corp., Manila, P. I.
Head, Wrightson & Co., (So. Africa) Ltd. Johannesburg
Head, Wrightson & Co-, Ltd., Stockton on Tees, Eng.
The Clyde Engineering Co., Ltd., Granville, N. S. W.

AKINS *Classifiers*

We also manufacture:
Lowden Dryers; Ball, Rod & Tube Mills; Diaphragm Pumps; Smelting Equipment; Crushers; Rolls.

COLORADO IRON WORKS CO., DENVER, COLO., U. S. A.