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WHICH T — THE PRINTER OR STENOGRAPHER

From JOSEPH S. IRWIN

I did not have an opportunity to see the printer's proof of my article published in your Petroleum Edition, therefore a sizeable error went through in the penultimate paragraph on page 392. My stenographer wrote "million" for "billion" in one instance, and your printer changed the other "billion" to "million." I think the figure "260" was my error—it should be 160.

The paragraph should read:

"Estimates of oil content in the Athabaska sands can be nothing more than suggestive. Max Ball, who has taken a leading part in the study and exploitation of the Athabaska sands, conservatively suggests a probable area of 20,000 square miles and an acre content of 11,000 barrels, which would result in a total content of 160 billion barrels. He warns, however, that probably only one billion barrels or so are accessible at present day prices."

In order to set the matter straight and to do as well as we can by our friends Max, I will appreciate it if you can make the correction in your next issue, giving it such prominence as you deem appropriate.

Consulting Geologist, 812 Lancaster Building, Calgary, Alberta.

BAGUIO, PHILIPPINE ISLANDS

From E. F. McDaniel, '32

Enclosed is a money order for five dollars ($5.00) to cover annual dues for membership in the Alumni Association. I received a letter some time ago stating this was the amount—if it is not correct, please let me know and I will send the rest.

This is something I have intended doing for quite a long time, but kept putting it off until I feel a bit ashamed about the fact.

I am very glad to say though that I did attend the Alumni meetings in Chapters in two different sections.

Chief Engineer & Geologist,

Bagnio Gold Mining Company, Bagnio, Philippine Islands.

WHERE CIPHERS COUNT

From Max W. Ball to J. S. Irwin

After commending your article in "Mines Magazine," which I still do, it has taken a letter from a friend in New York to call my attention to some errors in the part about which I know most. Either you or your stenographer or Frank Bowman, the editor, or the printer, or someone ran out of cipher or else wasn't New Dealish enough to talk in billions instead of millions. Moreover, the figure 260 should be 160. The next to the last paragraph on page 392 of the article should read:

"Estimates of oil content in the Athabaska sands can be nothing more than suggestive. Max Ball, who has taken a leading part in the study and exploitation of the Athabaska sands, conservatively suggests a probable area of 20,000 square miles and an acre content of 11,000 barrels, which would result in a total content of 160 billion barrels. He warns, however, that probably only one billion barrels or so are accessible at present day prices."

President, Abasand Oil, Ltd., Box 156, Edmonton, Alberta, Canada.

(Continued on page 566)
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MINING PROPERTIES OF THE WEST
COLORADO Forged Steel GRINDING BALLS

The Colorado Fuel and Iron Corporation
GENERAL OFFICE: DENVER, COLORADO
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Front Cover

Miners Ravine in Alien District, east of Roseville, California. 46-30 "Caterpillar" Diesel Electric Set furnishing electricity for motors on gold dredge. Producing 120 yards gold-bearing gravel per hour. Former power cost $6.00 per 14-hour shift for fuel—the 46-30, 80 cents.

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DENVER CONTINUOUS TESTING PLANT

Use this continuous test plant. Here is what a large mining company wrote us:

"The Company's engineers, upon their return to our New York Office, have rendered an exceedingly favorable report as to the courteous and efficient services extended to them by your Company this past month, during which time they were testing ore in the Ore Testing Department of the Denver Equipment Company.

"The equipment available in your Continuous Testing Division was entirely adequate to meet our requirements and operated very satisfactorily during the entire period. We obtained the information which we were seeking and are well pleased to have had the opportunity to conduct this test in your new plant."

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PERSONAL NOTES

James A. Appleton, '37 has accepted a position with the Goodman Manufacturing Company and is now being addressed in care of the company, 46th & Halsted Streets, Chicago.

Daniel L. Beck, '12, has been promoted by the Dodge Brothers Corporation and transferred to St. Louis, Missouri. He is now Regional Manager of the St. Louis region. His office address is 1908 Continental Life Building, 3615 Olive Street.

David Billing, '32, C. C. C. officer, has been transferred from El Paso, Texas, to Van Wert, Ohio, where his mailing address is 227 South Avenue.

P. N. Bosco, '35, returned to the States several months ago from exploration work in Chile. He is taking graduate work at Mines this year and receives mail at his home in Denver, 2166 South Washington Street.

Samuel G. Bousman, '38, is employed as Engineer for the Aluminum Ore Company with mailing address Box 276, Rosiclare, Illinois.

Willard S. Brico, '30, in the Advertising department of Bethlehem Steel Company, has a change of address to Box 11, Springtown, Penna.

Gordon T. Brown, '39, sailed for South America last month to take over duties of Junior Mining Engineer for the Cerro de Pasco Copper Corporation at Morococha, Peru.

E. J. Bruderlin, '10, Superintendent of the Amarillo plant of the A. S. & R. Company, has as mailing address Box 1111, Amarillo, Texas.

Francis A. Cappa, '33, is Transitman for the Aluminum Company of America and receives mail at 3711 S. E. Taylor Street, Portland, Oregon.


William A. Clair, '40, Engineer Trainee with the Carter Oil Company, has a change of address to 1430 So. Quaker St., Tulsa, Okla.

Louis E. Cotulla, Geologist for the Stanendell Oil & Gas Company, is now located in Tulsa, with post office address Box 591.

S. del Río, '28, has returned to the States from a trip to South America and has a new residence address, 54 Fox Boulevard, Merzick L. I., New York. He is Manager of the Foreign department of the Colonial Trust Company.

Ira J. Dilts, Jr., '39, is assistant in the department of Drawing and Machine Design, College of Engineering, Colorado University, and working for his Bachelor's degree in Electrical Engineering. His address in Boulder is 1024 University Avenue.

Fan W. Donohoo, '39, Computer for the Phillips Petroleum Company, is now being addressed at Houma, Louisiana.

Melvin Evans, '37, Research Engineer for Phillips Petroleum Company, has joined the Army for one year's service. He has been assigned to the 2nd Engineers Battalion at Fort Sam Houston. His mailing address is 431 Mistletoe Street, San Antonio, Texas.

Glen E. Faison, '29, has gone to South America where he is Assistant Manager of the Andaray Gold Mines Company. His mailing address is Casilla 1825, Lima, Peru.

Willis H. Freeman, '36, has a change of address to Box 201, Gulfport, Mississippi. He is employed by the Brown Gravity Meter Corporation of Houston.

Wendell W. Fertig, Ex-'24, has been promoted to General Superintendent of the Samar Mining Company. The com-
company, managed by Elizalde & Company, operates the second largest iron mine in the Philippines. Production this year will reach 350,000 tons of high-grade iron ore, assaying 60% Fe with negligible phosphorus and sulphur. All ore is loaded on steamers for Japan. Loading is accomplished by means of the longest conveyor belt installation in the Orient. An average rate of 200 tons per hour has been maintained.

His address is Box 119, Tacloban, Leyte, P. I.

Sam S. Ringert, '36, is Chief Chemist for the O'Keeffe Copper Company, Ltd., Nabiabep, Namaqualand, South Africa. Harold L. Gardner, '27, has returned to the States from the Philippines and is now associated with the Union Potash & Chemical Company at Carlsbad, New Mexico. His post office address is Box 1006.

Hial Gernert, '30, Field Superintendent for the Texas Company, is now being addressed at Hamilton, Colorado.

Robert L. Gibson, '30, is Exploitation Engineer for Shell Oil Company, Inc. with post office address Box 2699, Houston, Texas.

T. E. Giggy, '34, Salesman for Ingersoll-Rand Company, resides at 225 Arizona Avenue, Prescott, Arizona.

Das Griewold, '30, Assistant Agricultural Engineer for the Soil Conservation Service, has completed his work in Utah and returned to Albuquerque, New Mexico, where he is being addressed at 1500 Los Lomas Road.


James T. Harvey, Jr., '34, recently accepted position of Assistant Mill Superintendent for the Condor Mine at Wau­haw, No. Carolina.

O. G. Hesselson, Jr., '40, has registered at Duke University for graduate work this year. His address is Box 4958, Duke Station, Durham, North Carolina.

Eugene M. Howell, '30, Assistant Sanitary Engineer, Farm Security Administration, has been transferred from Denver to San Francisco, where his office address is 85 2nd Street. He will travel throughout four western states, inspecting sanitary conditions.

B. W. Knowles, '08, who has been in Canada for some years has returned to the States and will be located at Colorado Springs, Colorado, as Consulting Mining Engineer. His address there is 1524 Mesa Avenue.

M. A. Lagergren, '33, has a change of address to Livengood, Alaska, where he is Engineer for the Livengood Placers, Inc.

D. I. Lambree, '34, is Assistant Engineer for the St. Joseph Lead Company at Sheepranch, Calif.

John A. Lewis, Ex-26, Chief Geologist for the Wilshire Oil Company, moved his residence recently to 4225 Shaw Street, Long Beach, California.

Arthur M. Motton, '37, after a year's treatment at Craig Colony, Denver, for tuberculosis, is recovered and able to resume work. He is now at his home in Denver, 4216 Umatilla Street.

James R. Needham, '31, is Resident Manager for North Camarines Gold Mining Company, Paracale, C. N., Philippine Islands.

Joseph A. O'Keefe, Ex-36, in the Sales Department, Standard Oil Company (Ind.) resides at 1526 Turlington Ave., Harvey, Ill.

(Continued on page 558)
PETROLEUM INSPECTION TRIP
Colorado School of Mines—May 1940

By MARVIN YOCHE, NICK SHIFTER, LINCOLN ELKINS, DOUGLAS CLARK, WILLIAM CLAIR

Introduction
The annual Senior Petroleum Inspection trip for 1940 was arranged by Clark F. Barb, head of the Petroleum Engineering Department and was begun on May 4 and extended through May 20, when most groups returned to school. In this year's class there were 28 students, accompanied by Professor James O. Ball of the petroleum department and J. C. Reed of the mechanical engineering department. The entire trip was made by cars, the mileage registered on each one ranging from 3,500 to 4,400 miles.

In general the itinerary included fields in west Texas near Hobbs, Denver City, and Midland, the Texas Gulf Sulphur Plant at New Gulf, refineries and fields around Houston, the Lufkin Foundry and other places of interest at Lufkin, and finishing up with the International Oil Exposition at Tulsa.

The Hobbs Field
In the evening of May 6 the party arrived at Hobbs, New Mexico. A meeting was held in the Humble camp near Hobbs during which Mr. Staley, proration umpire for the State of New Mexico, lead a discussion on proration methods in New Mexico. He gave a brief history of petroleum development in the state. The first discovery was the Brown well in 1909. Early laws required casing and proper abandonment of wells.

Until 1929 oil was classified as a fugitive mineral after which time mutual agreements between operators were made to provide for a more equitable distribution of production. In the year 1935 the present conservation and proration laws were enacted. Production figures of the U. S. Bureau of Mines are being used as a basis for proration. The state quota thus determined is prorated in certain pools on the basis of productive acreage only. All pools except Hobbs and Monument are prorated on the basis of 40 acre tracts containing at least one well, the number of wells over one on a tract not affecting the allowable.

In the Hobbs pool proration is figured 60% on potential and 40% on bottom hole pressure declines. Forty acre spacing is used in this field. The maximum allowable gas-oil ratio in Hobbs is 4,000 cubic feet per barrel and penalties are applied for anything higher than this ratio. It was estimated that operating costs were lowered by 30% owing to proration and affected the use of less storage space and smaller tubing.

Denver City, Texas
The Wasson Pool
On May 7 the party visited the Shell Oil Co. gasoline plant and surrounding field at Denver City, Texas. The maximum capacity of the plant is 23,000,000 cubic feet per day and it was built at a cost of $1,250,000 with an approximate 5 year pay out.

The plant was running at a little over 90% capacity at the time we were there. It is an absorption type plant operating at 180 psi. with a maximum operating pressure of 200 psi. The gas, which contains 1.3 gallons per 1,000 cubic feet of gas, is collected in a 112 mile gathering sys-
The residue gas is used for firing the boilers and for drilling operations since there is no market for it. The royalty paid to lease owners is 10% of the gasoline content of the gas. The high pressure gas taken from the absorbers is used as prime mover in all the steam pumps in the plant thus eliminating two additional boilers.

The absorption oil is pre-saturated with propane to give an increased efficiency of extraction of the heavier fractions in the wet gas. 5,000 gallons of absorber oil are required each month. The vapor pressure of the raw gasoline at 100° F. is 90 psi. and is stabilized to 38 psi. at 100° by removing the propane. Excess propane is burned in flares and the gasoline is shipped directly with the crude oil in pipe lines.

The party also visited the Wesson field itself which produces from line at 5,000 feet. Wells are drilled in 15 days on the average. A widely used completion program here is to drill in the final stretch under oil using reverse circulation. Later the wells are acid treated in three stages, using 1,500, 3,500 and then 5,000 gallons of 15% HCl.

There is one separator tank battery for each group of four wells, the pressure in the separators never exceeding 2 psi.

**Midland, Texas**

**Goldsmith Field**

On May 8 the party visited the Goldsmith Field near Midland. Various gauge testers and bottom hole pressure bombs were inspected at a field laboratory. Bottom hole pressure contour maps showing the change of bottom hole pressure with time were shown. The field method of taking pressures was observed.

Later in the day the field Baroid Well Logging equipment was observed in operation on a drilling well owned by the Gulf Oil Corporation. Drill cuttings, salt, and gas detection are referred to the proper depth by a running log of bit penetration and the number of strokes on the mud pumps. The well logging equipment including complete core analysis equipment is housed in a trailer which permits easy accessibility to wells for field measurement. The cost of Baroid service in this region is $100 per day for equipment and men or $1,000 per month for leasing the equipment.

**MacElroy Field**

The group visited the Gulf Oil Corporation camp at the MacElroy field in Texas on the afternoon of May 8. Mr. E. A. Crites, the engineer in charge, gave pertinent facts about the field. This field was divided into two parts, nearly equal, the Gulf Oil Corporation producing one half as a unit and the other half being produced on a competitive basis by small operators. The Gulf half was produced on 20-acre spacing and most of their wells are still flowing. All wells on the other half are pumping, and drilling has ceased. Production is from line at about 2,800 feet.

Mr. Crites showed the group a standard cable rig on which they were swabbing and a semi-portable cable rig which has a derrick of two uprights similar to a gin-pole. The crude in this area is so corrosive that only wooden storage tanks can be used. All drilling done by Gulf in this field is with cable tools.

The Phillips Petroleum Company has built a gas plant in this field and puts the gas back into the different leases and the gasoline into the crude pipe lines. The latter procedure is advantageous in several ways—first by reducing the viscosity of the crude without greatly increasing the volume and second by reducing storage and haulage costs.

**Yates Pool**

The Yates field is lime production on the east flank of the Central Basin Uplift in the Permian Basin, West Texas. Production is from cavernous limestone varying in thickness from 4' to 400' at a depth of from 900' to 1,700' depending on topographic well location.

The field was drilled with standard tools in most cases although some wells in the gas cap area were completed with rotary tools drilling in with oil. The main difficulty in drilling is gas trouble. There are 556 producing wells on 20,000 acres. As the field has been produced under pro-ration and as a semi-unit operations, a large majority of the wells are flowing and will remain so for the life of the field. Drilling time from location to location is 30 days with an average cost of $12,000 to $15,000 a well.

The production from the field to date is 250,000,000 barrels with a pressure drop of 165 pounds. This is about 2,000,000 barrels per pound. The present total potential of the field is 4,000,000 barrels per day with one well having an open flow capacity of 204,000 barrels per day, the largest in the U.S.

The present allowable in the field is 22,500 barrels per day. A minimum of 25 barrels per day per 100 acre unit is allowed with the remainder being prorated with potential as a basis. The Yates Pool is the only area in the U.S. where oil has been mined successfully. Due to a sus-
These are plotted on a bar type graph against well depth. From this graph the experienced laboratory man is able to predict these horizons of interest to the driller.

The above work is the newest duty of this laboratory. Its more established service is the analysis of top soil for corrosion and other properties.

Humble Refinery

Mr. Washer, graduate of Mines '26, conducted a quick tour through the refinery and then invited the entire group to his home for lunch. An enjoyable time was reported by all.

Sinclair Refinery

The Sinclair Refinery at Houston was inspected in the morning of May 13. The party was divided into groups of 4 or 5 men each and conducted by different plant supervisors and technicians.

Characteristic of this plant is its old-type stills and other refinery equipment. Though more or less out of date, the equipment is still used because it is cheaper to maintain it than to stand the expense of new. This plant is the largest in the region and employs from 1,200 to 1,300 men.

It might be said here that this plant is quite different from the Humble Plant just visited in that it is extremely unionized while the Humble Plant has no union and the men employed there do not seem to want one.

When the refinery was first built it obtained all crude from East Texas. Now, however, about 35% comes from the West Texas fields through pipelines. This crude brought with it many corrosion difficulties which are still not overcome. Several stills built only 3 years ago must now be replaced because of this corrosion.

Previous to the war in Europe much gasoline was shipped abroad. This market is now closed for the most part and the only ship trade to speak of is coastwise up to New York and New Jersey.

Old Ocean Field

The Old Ocean field is a pool on a deep-seated salt dome on the Gulf Coast. It is being developed by the Abercrombie-Harrison Co. Production is obtained at 10,000 feet. The bottom hole pressure is 3,000 pounds per square inch. There is a centralized production system which brings all the distillate to separators which reduce the pressure to 1,250 pounds and thence to separators which reduce the pressure to 500 pounds, thence to separators which reduce the pressure to 60 pounds and thence to a vacuum separator. Most of the gas is taken from the first stage and compressed to 3,400 pounds for injection to maintain reservoir pressure.

The field produces 60,000,000 cubic feet of gas per day, 97% of which is put back into the formation.

The formation was discovered by geophysical methods, and the discovery well was drilled in 1934. Drilling time averages 60 days. Three casing strings are used and the tubing is packed into the casing. Separators are protected by a shear release which shears a nail at a specified pressure. The men working in this field are more or less experimenting to find the correct development procedure.

Lufkin, Texas

Lufkin Foundry & Machine Company

On Wednesday, May 15, the party arrived in Lufkin. The plant of the Lufkin Foundry & Machine Co. was first visited. This plant was originally built to manufacture saw-mill equipment. With the depletion of the forests in the vicinity the company turned to the manufacture of oil well pumping equipment. The first pumping units were equipped with worm gear drives but at present the units are made with herring-bone drives. From a small manufacturer of saw-mill equipment this company has grown to be the largest manufacturer of pumping equipment in the world.

Starting with pig iron, the company produces practically everything in its own plants. The electric motors and bearings are obtained from other companies. Besides manufacturing beam pumping units and central power units, the company has just completed a new building in which automobile trailers will be made.

Of particular interest were the beam pumping units being made for a company in California. These units are supposed to be the largest of their kind in the world.

Aside from the manufacturing divisions the company has laboratories for the design and testing of the units produced. At present the company is operating at about 20% capacity.

This was the first group of Mines students to visit the plant and upon the completion of the tour through the foundry the entire group was treated to an excellent lunch given by Mr. W. C. Trout, President of the company.

Texas Malleable Iron Company

After lunch the malleable iron plant located in Lufkin was visited. This plant has only been in operation for 15 months. The labor personnel was drawn entirely from the population in or near Lufkin. Many problems were encountered in training the laborers and in distributing them according to race.

The company takes grey cast iron and melts it with the proper amounts of scrap iron and coke to get a malleable casting. Stove parts and many other products are manufactured which compare favorably with similar products in other locations. This is the only plant of its kind in the south with the exception of those located in Birmingham, Alabama.

The solutions of many interesting problems of technique and management were demonstrated here.

Southland Newsprint Company

The last plant inspected in Lufkin was this paper mill. This plant is less than a year old. It furnishes newsprint paper for 40% of the newspapers in Texas and some of the newspapers in Oklahoma and Arkansas. The pulp used is 80% mechanical pulp and 20% chemical, which is obtained from Houston.

The main feature of this plant is its utilization of southern pine, which formerly had been thought useless for the manufacture of paper. The capacity of the mill is 150 tons per day, but at present it manufactures only 130 tons of paper each day. Aside from a slightly different chemical treatment of the pulp, the mechanical processes in the paper manufacture are not different from other plants in the north.

Tulsa, Oklahoma

International Petroleum Exposition

The International Petroleum Exposition opened at Tulsa, Oklahoma on May 18 at 10:00 A. M. There were exhibits of the equipment used in developing, producing, and refining petroleum. The various supply companies put in these displays.

The Vickers Company exhibited a hydraulic pumping unit with a ten-foot stroke. The L. C. Moore Co. exhibited the largest rotary rig in the world; the lifting capacity of this derrick being 300 tons. The Franks Company exhibited a portable rotary capable of drilling to 4,500 feet. The Baroid Company exhibited one of their well logging trucks. A hydraulic-drive draw-works was shown by the Worthington Pump Co. The Lane-Wells Co. displayed their electrical logging truck and one of their gun perforator units. The Reda Pump Company exhibited an actual pump and also a miniature working model.

Several companies were demonstrating portable rotary and cable tool units. Each of these units was for the same work, but there were nearly as many ways of accomplishing the work as there were different units.

Great crowds of people attended the exhibition during its opening days and showed signs of increasing each day. The brief time spent there by this student group was really far too short to gain the full benefit from observation of the latest equipment on the market.
By
KENNETH E. HICKOK, '26
Instructor, Department of Metallurgy
Colorado School of Mines

Part V—Sulphur and Pyrites

Sulphur, one of the most widely used of the Non-Metallic Minerals, has two things in common with Uncle Sam's deeply-buried, carefully-guarded hoard. It is yellow in color and occurs in the native state; however the similarity ends at this point and it would be stretching the bounds of credulity to believe that anyone would confuse a lump of sulphur for a lump of gold.

Pyrites, or iron pyrites, is the naturally occurring sulphide of iron and so frequently fooled the tenderfoot miner that it is commonly called "Fools Gold." It is not, however, valuable for its yellowish, golden luster but because it is a source of sulphur dioxide when burned in air. This sulphur dioxide produced from pyrites is the same as that produced by the burning of native sulphur so pyrites is considered a source of sulphur.

The chief deposits of native sulphur in the United States are along the Gulf Coast of Louisiana and Texas. These deposits are in salt domes, far underground and in some cases under the ocean. The sulphur occurs in the limestone capping of the salt which occupies the major portion of the domes.1

The mining methods used in the exploitation of these native sulphur deposits of the Gulf Coast are unique, to say the least. The process developed for this particular type of mining is called the Frasch Process and is based upon the melting point of native sulphur which is very low compared to the enclosing rock.

The Frasch Process2, 3, 4 in its simplest terms amounts to boring a well into the sulphur bearing formation and putting in a heavy casing. Inside the casing is placed a slightly smaller pipe and inside this pipe is placed a small air line.

Steam is pumped into the well in the ring between the casing and the inside pipe. The steam enters the sulphur formation and melts the sulphur while the steam is converted into superheated water. The liquid sulphur and superheated water flow back into the well, enter the main pipe and air from the air line lifts it to the surface on the air-lift principle.

Upon reaching the surface the sulphur and water flow into large tanks where the sulphur settles to the bottom of the tank, cools and solidifies. After the sulphur has solidified the water is drained off, the side of the tank torn down and the sulphur loaded into railroad cars by means of a power shovel.

This simple, low cost, mining operation has put the sulphur produced in the world. In general, the development of the Frasch Process for mining the sulphur of the Gulf Coast Salt Domes was a serious blow to the sulphur producers of the whole world. Now the U. S. A. is not only the largest producer of sulphur in the world but virtually supplies the whole world with this very important Non-Metallic Mineral Product.

Pyrites are produced by a number of metal mines as a by-product of the mining and treatment of other metals such as, copper, zinc, and lead. In a few places the pyrite occurs massive and of sufficient purity so that it can be mined as such, and with little or no beneficiation it is shipped to the market for use in making sulphuric acid.

Many smelting plants are utilizing the sulphur dioxide produced in the roasters treating base metal sulphides for the production of sulphuric acid. This not only gets rid of the troublesome sulphur fumes but also gives a salable product. The smelter at Trail, B. C., Canada not only makes sulphuric acid but is also producing elemental sulphur from their roaster fume.5

Mining operations for the production of pyrites consists of the usual underground methods or may be by open pit methods, depending on the deposit. Most of the pyrite produced as a by-product of base metal production is the result of selective flotation; the base metal is floated first, then the pyrite, and the gangue is eliminated as tailing. One coal washing plant in Southeast Kansas is making by-product pyrite with jigs in their washing plant. The jigs produce a clean coal, a

---

1 References are at the end of article.
Massive Pyrite, Colorado.

Sulphur and pyrites have a multitude of industrial uses. Sulphuric acid accounts for about half of the consumption and the balance is divided up as follows: Fertilizers, insecticides, pulp and paper, explosives, dyes, coal tar products, petroleum refining, chemicals, iron and steel, rubber products, paint and pigments, metallurgical, textiles, food products and many other miscellaneous uses.

Sulphuric acid is so widely used in industrial processes that it is hard to find any major industry that does not use considerable quantities of this acid which is of course made from sulphur or pyrites. The list of uses for sulphuric acid would be so long that it would be boring rather than instructive. Any book on industrial chemistry will point out the extremely important part played by sulphuric acid in the world of today.

Specifications for sulphur and pyrites are quite rigid especially concerning the amount of sulphur, the impurities present, and the materials present which might prevent combustion.

Sulphur produced by the Frasch Process is unusually pure and free from impurities. In general, it is free from arsenic and selenium and contains from 99.5 to 99.8 percent sulphur. Materials which might prevent combustion are entirely lacking.

Pyrite, however, is not so fortunate as the native sulphur. Pyrite frequently contains arsenic, selenium, tellurium, copper, lead and zinc as harmful impurities. Also the sulphur content of pyrite is relatively less than that of native sulphur so the consumer must balance the unit cost of the available sulphur present in pyrites against the unit cost of the sulphur in native sulphur. Disposal of the burned calcine is also an expense where pyrite is used because it is worthless as an iron ore and the metallic minerals present are in such small quantities as to make it uneconomic to smelt the sinter.

Geographic distribution of sulphur is not world wide by any means, in commercial deposits. The U. S. A. produces about five-sixths of the world’s consumption and Italy supplies most of the balance. Japan, Chile, and the Netherland East Indies produce smaller amounts in that order but not enough to be serious competitors in the world market although they do supply part of their domestic requirements.

Pyrites are almost world wide in occurrence and few consumer nations do not produce some pyrite. However, the pyrite production does not near meet the sulphur requirements of the major industrial nations.

Political control of the sulphur production of Italy, Japan and Chile is an established thing with heavy governmental subsidies and tariffs aiding the producers. In the U. S. A. no political control is evident except that which might be exercised as a Neutrality Embargo.

The year 1938 showed a falling off of consumption of sulphur and pyrites compared to 1937 which was not a very prosperous year for most industries. Notwithstanding the slacking off in consumption the U. S. A. produced and sold almost 1,700,000 tons of sulphur which had a value of $27,-300,000. Production of pyrites amounted to about 600,000 tons valued at twelve to thirteen dollars per ton or a total value of about $7,-200,000.

The thirty-four million dollar production of sulphur and pyrites puts these Non-Metallic Minerals right up near the head of the list and let us all offer up a heartfelt prayer that political control may never strangle this industry which is so important to our industrial life.

6. Conversation with C. B. Carpenter—Prof. of Met., Colorado School of Mines, 1939.
The present war in Europe, like the World War of 1914-1918, began as a siege of Germany. The Allied nations hemmed Germany in: Great Britain and France on the west, Poland on the east. With the crushing of Poland, and the westward advance of a more or less friendly Russia to the new German frontier and to the Baltic, Germany proclaimed that the siege was broken.

So it might well appear at first sight. On the north is neutral Denmark, while Germany and Russia, in uncertain alliance, control the Baltic Sea, across which they can bring supplies from neutral Norway and Sweden. On the east Russia controls the little Baltic States and extends her vast bulk across eastern Europe and all of Asia to the Pacific. She is thus able to draw supplies from all quarters of the world and ship them, together with her own products, into Germany. On the south are the neutral states Hungary, Yugoslavia, and Switzerland, as well as Germany's axis partner, Italy. Through Hungary flows the Danube, one of the major waterways of Europe, on which supplies from the Balkan States and the Near East may be brought upstream into Germany; while Yugoslavia and particularly Italy tap more directly trade routes converging from all parts of the world to pass through the Mediterranean. On the west British control of the North Sea hampers Germany toward the northwest, while France blocks the way toward the southwest. But between these extremes lie neutral Holland, Belgium and Luxembourg, the first two with sea gates open to world commerce. If Germany can draw supplies from more than a dozen neutral countries bordering on her frontiers, and can through them receive supplies from most of the rest of the world, how can it be said that she is today besieged?

Germany is Besieged

Yet it is fair to say that Germany is besieged, and it seems not improbable that in the end the siege will either cause her capitulation or drive her to military efforts to break the siege, which efforts are most likely to end in defeat. The explanation of this apparent contradiction lies, in last analysis, in the preponderant role of sea power as a determining factor in war. Let us analyze Germany's situation a little more closely.

It is not sufficient for a besieged nation to border on friendly or neutral countries in order to draw supplies from them or through them. These countries must first of all feed, clothe, and house their own people and supply their own armies with necessary materials of war in view of the possibility that they may at any moment become involved. Only in case her friendly or neutral neighbors have an exportable surplus of things Germany needs can she hope to get aid from them. Even then she cannot hope to get all the exportable surplus, because friendly and neutral nations alike must use much of that surplus for buying in world markets other vitally important materials in which they themselves are deficient. This enormously reduces the surplus available for purchase by Germany. But Germany cannot get even this greatly reduced surplus unless she has money or materials to offer in exchange. Credit may be extended in limited amounts for a limited time, but credit is cut off as soon as the creditor nation feels that the debt is becoming so large, or Germany's position so precarious, that the debt may not be paid. Already some of the neighboring states are refusing credit to Germany, and she is being forced to provide money or materials to purchase what she wants.

Since Germany lacks sufficient funds with which to purchase the limited surplus her neighbors have to sell, she is forced to fall back on direct exchange of her products for the surplus products of her neighbors. But two factors interfere with such exchange: her neighbors do not want many of Germany's surplus products; and were Germany to withdraw from her military reserves the great numbers of men required to manufacture things her neighbors do want, she would face a shortage of raw materials, and her military power would be dangerously impaired. Germany is too busy on the war front to build up a great new manufacturing industry to meet the situation created by the war.

There remains the possibility of bringing from the outside world, through friendly or neutral territory, the supplies of which Germany stands in such pressing need. This immediately involves cost of transport she is unable to pay in her present condition. It involves providing ships, river barges, and railroad cars in quantities simply not available. Even if these difficulties could be overcome, there is another even more formidable. The role of sea power comes into play. Because of British control of the sea, Germany cannot ship her products abroad either to get funds for purchases elsewhere or for direct exchange with overseas countries. Even if these countries were willing to extend indefinite credit to a nation likely to be defeated and hence to default on her debts, they cannot get the needed materials to Germany. If they attempt it, even in neutral ships, the ships are stopped by the British navy, and the cargoes are confiscated.

Perhaps you are wondering why Italy or Holland or Sweden could not sell their own supplies to Germany and then make good the loss by importing equivalent supplies from abroad. The explanation is two-fold: First, these countries are not going to pay for foreign goods, and then sell to Germany on credit, especially when years of military preparation and un-

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* Reprinted from The Geological Society of America who originally presented this essay in March 1940.
wise trade policies have already placed Germany in a serious financial plight, a plight destined to become tragic if Germany is defeated. In the second place, sea power once more comes into play. France and Britain will not permit neutral countries to supply Germany in this indirect way. Trade statistics for normal imports of all countries are available, and the Allied blockade will not pass vessels carrying new and unusual imports to Germany's neighbors, or unusual quantities of material formerly imported. Allied sea power actually rationed Germany's neighbors, neutral though they be, permitting them to import only those materials, and those quantities of them, essential to the neutrals' own urgent needs.

Strategy of the Siege

Thus it appears that Germany is clearly besieged, despite the fact that she is nearly surrounded by neutral or supposedly friendly nations. But, you may ask, what has all this to do with geology and the strategy of the war? In reply let me say that the influence of geology is in part dependent on the nature of the war as a gigantic siege of a nation now numbering perhaps a hundred million people. We had to establish the fact of siege, and the way it operates, before we could fully understand the influence of geology upon the strategy employed by both sides.

There are, of course, many factors besides geology, which help to determine German and Allied strategy. But we shall confine our further discussion to the geological factors alone. These geological factors affect strategy in a variety of ways. Again we shall limit discussion, giving consideration to two geological factors of exceptionally high importance: First, the economic geology of affected areas, by which we mean the results of geologic processes in producing accumulations of oil, metals, and other materials of value; and second, the physiographic geology, or topography of the affected areas, which is the result of geologic forces operating for certain periods of geologic time, upon a great variety of geologic deposits and structures.

Strategic Aspects of Oil

As an illustration of what economic geology can mean to a besieged nation, let us take the case of oil and its derivatives. One of the most remarkable developments in modern warfare is the mechanization and motorization of armies. Not only do modern navies and air fleets depend upon fuel oil and its derivatives, but for armies also fuel oil is the vital life blood without which they are incapable of effective action. Artillery is often drawn by motor tractors. Motorized tanks replace the cavalry. Even the infantry is shifted swiftly from place to place by motor transport. When fuel oil fails, it is impossible to fall back upon the military equipment of the horse and buggy days. The transformation to mechanized and motorized equipment has been too vast and too complete. Today an army seriously deficient in fuel oil supplies is an army facing defeat.

Germany is one of the world's great consumers of fuel oil even in peace times. In war her consumption necessarily advances by leaps and bounds. Unfortunately, her geology has not been kind to her in the matter of providing oil supplies. Among the world's producers she ranks very low. In an attempt to make good her critical deficiency she has been developing synthetic production from coal but has succeeded in meeting less than 40 per cent of her needs in this way, while the resulting fuel is not of the best grade, and its cost in money and man power is high. It has been estimated by one of our petroleum experts that 15 to 20 divisions of the German army would be required to produce from coal all the oil Germany needs. Even then her aviation service, requiring the highest grade of fuel, would be at serious disadvantage as compared with that of the Allies, since the latter have free access to large supplies of the best product. The extent of stored reserves in Germany is unknown, but experts on petroleum estimate it can scarcely exceed six months' requirements. Hence Germany faces an enormous deficiency in one of the most vitally necessary of military supplies, a deficiency that must be made good from outside sources.

Germany hoped to gain the Galician oil fields by her conquest of Poland. But the oil production of Poland is small, less than 4 million barrels in 1938; and Russia secured the lion's share (or perhaps we should say the bear's share) of this, a proportion variously estimated from 65 to 78 per cent of the total. The nearest practicable source is Roumania, a small country normally producing a little over 50 million barrels of crude oil annually. If all of this were shipped into Germany, it would by no means make good the latter's war-time deficiency. But Roumania must first provide for her own consumption. She must further supply certain of her Balkan neighbors. Anglo-Dutch and French interests control approximately 60 per cent of Roumania's petroleum industry and, supported by the Allied governments, work constantly to restrict exports to Germany. The former cheap water route via the Dardanelles, Mediterranean, and Atlantic is blocked by the Allied navy. Transportation by barges up the Danube against the current is too costly, and transportation by rail is both high in cost and inadequate in quantity. Manifestly Germany must look farther afield for the life blood of her mechanized and motorized army, navy, and air force.

Russia, with an annual output of some 200 million barrels in recent years, is the source most frequently mentioned. But even in peace time Russia consumes nearly all the oil it produces. The exportable surplus has, for several years amounted to but one or two million barrels annually, a mere drop in the bucket compared to Germany's needs. And Russia is no longer at peace. Her motorized army, navy, and air forces are making unusual demands on her oil resources in the campaign against Finland. Whatever Stalin's future plans, they certainly provide for the conservation of Russia's oil resources to meet the needs of new aggressions against his neighbors or defensive measures in case Russia herself is attacked.

Even if Stalin should think it good insurance to penalize his own people in order to aid Hitler with some of Russia's oil, he would find it impossible to ship adequate quantities at a cost within Germany's reach. It is over 400 miles by land plus 600 miles by water from Baku to the mouth of the Danube. Then comes the problem of shipping the oil by barges up the river against the current for another 1500 miles or more. Adequate fleets of barges are not available, and the cost of such upstream transportation is prohibitive. Again, the old cheap route by the Dardanelles, Mediterranean, and Atlantic is blocked by the Allied navy; and even the passage across the Black Sea to the Danube is precarious, since Turkey may at any time become an active partner of the Allies and give the latter control of the Black Sea highway. To ship adequate quantities of oil from Russia to Germany by rail would require, it has been estimated, 57,000 tank cars with necessary locomotives running constantly day and night all the way from Baku to German ports. Tank cars and locomotives in such enormous quantities are not available and could hardly be procured even if the cost of this method of transportation were not prohibitive. Look at it any way we may, it seems impossible to find in Russia any hope for a satisfactory solution of Germany's critical petroleum problem.
hundred million barrels annual production; Mexico with its forty million; Venezuela with its hundred and eighty million; the East Indies with their fifty million. But Allied control of the seas blocks the way to all these sources. With Germany effectively besieged, it seems doubtful whether there is any solution of her petroleum problem short of early and complete military defeat of her enemies. Unless she can accomplish that, her own lack of geological deposits rich in oil must ultimately cause her capitulation.

Strategic Aspects of Minerals

The story is much the same if we study the strategic implications of Germany's deficiency in copper, iron, and certain other minerals, due to the fact that her geological endowment provides less of these vitally important materials than she requires in peace time, far less than her war-time needs.

In the case of copper Germany's normal dependence is on the United States, a source cut off by the Allied blockade. For the same reason African supplies of copper cannot reach Germany. Yugoslavia, friendly to the Allies and distrustful of Germany's capacity to pay, is an uncertain as well as an inadequate source. Russia's pro-

Germany in preparation for war is a secret, but experts believe it is nothing like enough for a long conflict. In the World War, Germany's need for copper became desperate, and toward the end of that struggle the shells fired by her artillery lacked the copper bands required to render shell-fire accurate, while iron replaced copper in the brass shell cases. History is likely to repeat itself in this respect as well as in others.

Germany has been importing iron from North Africa, Spain and Sweden. The Allied blockade has shut off the two sources first named. The sea route from Narvik by which Germany imported most of her Swedish ore is available only so long as vessels follow the intricacies of the Norwegian coast to keep within the protection of Norway's territorial waters. The remaining Baltic route is blocked by ice in winter and is secure at other seasons only so long as Russia, now established upon that route, remains friendly to Germany. The seizure of Austria gained for Germany only 10 per cent of her former needs in iron ore, and the seizure of Poland little more. Czecho-Slovakia had to import iron ore, and according to our distinguished expert on mineral resources, C. K. Leith (on whose authority most of the data on metals here cited was based) the smallness of the quantities arising from Germany's inadequate deposits of iron ore. For its own needs, and perhaps to reduce Swedish exports of ore to Germany, the British government has purchased one-third of Sweden's normal production—a measure against which Germany protested so vigorously that Sweden raised her export limit. Thus the struggle over Germany's only practicable source of iron imports is acute, with the ultimate result uncertain. If the Allies remain united and retain control of the sea, Germany's deficiencies in minerals vital to the prosecution of war may alone be sufficient to bring about her ultimate capitulation, providing no other factor causes an earlier break in her resistance.

Let us now turn our attention to the second aspect of the effect of geology on warfare.

Topography and Strategy

The World War of 1914-1918 taught us that the topography of Europe exerted a profound influence upon the strategy and tactics of the opposing armies, determining the best routes of invasion, the best defensive positions, and even the outcome of battles in some instances. One may have been tempted to believe that guns which hurl high explosive shells...
with marvelous accuracy over lofty mountain ridges and across the widest river valleys, airplane service which permits more extended observation than can be secured from the most favorably situated topographic eminences, and modern engineering devices which refuse to be daunted by the deepest stream or steepest cliff have eliminated the surface features of the land as an important factor in military calculations. But long study of this problem on topographic maps and on the ground during the World War, and many conferences with generals along the battlefront, convinced the writer that today, more than ever before, topography must be counted a major factor in warfare. This is in part because airplane observation of enemy troop movements and control of artillery fire upon enemy territory become imperfect or fail entirely when anti-aircraft guns force planes too high, when lowlying clouds or mist obscure vision, and when concentration of enemy aircraft drives observation planes from the field. Protected observation posts on the ground are more permanent and more secure, and can often operate when planes are useless or unavailable. As Field Marshal Haig told the writer in 1918: "It would be no exaggeration to say that the whole War has been a struggle for topographic positions." This being the case, it is obvious that some knowledge of major elements of the terrain is essential to a proper understanding of the present war.

**Topographic Belts of Europe**

Let us first get clearly in mind the broadest features of European topography (Fig. 1). Later we shall make more detailed examination as required. Across the north-central part of Europe there stretches a low and nearly level plain, reaching from northeastern Russia across northern Poland and northern Germany, through Holland and Belgium, thence southwestward across western France to the Pyrenees on the Spanish border. Over this plain one may travel all the way from northeastern Russia to the base of the Pyrenees Mountains without passing through a single tunnel, and without ever rising as much as 600 feet above sea level. Much of this plain is fertile and highly cultivated, and supports a dense population. Forests have been largely removed, and railroads, highways, rivers, and canals form a dense network of transportation lines. It should be evident that the richness of the country, the absence of high mountains or plateaus, and the abundance of communication routes make of this plain a natural pathway across north-central Europe in time of peace. In time of war this pathway presents four military advantages of prime importance: (1) It is interrupted by no topographic barrier of serious magnitude; (2) it is supplied with numerous parallel roads and railways by means of which several columns of troops may advance simultaneously; (3) it is productive enough to supply food for the sustenance of large armies for long period of time; and (4) it passes close to important coal and iron deposits in the borders of the Ardennes and has, indeed, important coal fields lying immediately below its level surface.

South of the plain country stretches an irregular belt of low mountains and plateaus, deeply trenched by occasional large river valleys and cut into a maze of hills and ridges by minor tributary streams. At places fairly broad and level lowlands interrupt the mountains or plateau uplands, but in the main this is a region of rough country, locally wooded, relatively poor in agricultural resources, and difficult to traverse except along the main rivers. Within this belt are included the Podolian plateau of southern Poland, the belt of mountains encircling the Bohemian plain, the uplands of central and southwestern Germany including the Black Forest region and the Ardennes Mountains of southern Belgium, the Vosges Mountains and the plateau regions of the Paris Basin and
Still farther south is a broad belt composed of rugged and in some cases high mountains, interrupted by broad, low basins or plains. The Carpathian Mountains, the Transylvanian Alps, the Hungarian plain, and the high Alps of southern Germany (formerly Austria), northern Italy, and Switzerland are in this third belt. More rugged and wild, and far more difficult to traverse than either of the other belts, the mountain barriers of this southern region are among the greatest obstacles to military activity found in Europe. Troop movements are usually practicable only at certain passes, often far apart and easily defended by a handful of men against greatly superior numbers.

So much for the three major topographic belts which will inevitably influence the siege of Germany by the Allied armies. We must next consider how these three belts will affect the desire of Germany to break the siege by issuing from her own territory and attacking the besieging armies; and how they will affect the desire of the Allied armies to enter Germany and gain a decision by defeating the German military machine on its own soil.

The opening battle of the new world war was fought and won by Germany, without a shot being fired, when Hitler defied the Allies and broke the Treaty of Versailles by entering the Rhineland with his military forces. (Compare Figures 2 and 3). This gave him possession of an important part of the natural defensive barrier of the Slate Mountains and other areas of the low mountain and plateau belt, thus greatly strengthening Germany's defenses on the southwest. The rugged terrain, always a military obstacle of serious proportions, was promptly rendered almost impregnable by elaborate fortifications forming part of the Westwall or so-called Siegfried Line.

The second battle of the war was also won by Germany when her massed military forces poured across the frontier to prevent Austria from deciding by plebiscite that she did not want to join Germany. By forcibly annexing Austria, again in defiance of the Allies and in contravention of the Treaty of Versailles, Germany gained the magnificent defensive barrier of the high Alps (compare Figures 2 and 3), placed her armies on the strategic Brenner Pass to hold her uncertain ally Italy in awe, and surrounded on the western part of Czecho-Slovakia. Thus Germany at one blow protected her southern front against attack and prepared the way to win a third great victory.

This victory she won at Munich, again without firing a shot. With mighty armies massed on the north, west, and south of the mountain-girt bastion of Bohemia, long recognized as one of the greatest natural military strongholds of central Europe, Hitler offered the Czechs and their French and British allies the choice of surrender or a bloody fight. The French and British decided to surrender rather than plunge Europe into an orgy of bloodshed; and the Czechs, deserted by their allies, had no choice but to follow suit.

It must be remembered that war is not the actual firing of guns, but the utilization of armed force to impose one's will upon an enemy. Munich was a battle, and Mr. Chamberlain took back to London, not the "peace for our time" which he fondly hoped, but the record of a major military defeat. This defeat robbed the democracies of a million and a half of the finest soldiers in Europe and took from their control a great natural fortification reinforced by artificial defense works similar to those of the

![Figure 3.—Greater Germany after remilitarization of the Rhineland and seizure of Austria, Czecho-Slovakia, and Poland. Topographic base after A. K. Lobeck. Approximate scale 1 inch = 250 miles.](image_url)
famed Maginot Line of eastern France. The whole defensive system protecting the Bohemian plain was handed over to the German army, and the fate of Czecho-Slovakia sealed. In a few weeks the remainder of the country was seized, and Germany was now well protected by mountain barriers on the southeast as well as on the south. (Compare Figures 2 and 3.)

**Battle of the Eastern Plain**

But the level plain of the north stretched unbroken across northern Poland and on into Russia (Fig. 1). The Allies, finally awakened to the fact that they had lost three major battles without offering resistance to Germany's armed might, were striving to align Russia on their side. They wanted to forestall what they well knew would be Germany's next step in her war of conquest, the seizure of Poland. Germany saw in the open plain an easy pathway from Russia direct to Berlin. To block that pathway by a buffer Polish state under German control, and thus to bring her own armies to the border of the Russian Ukraine with its rich harvests, and to the border of Roumania with its valuable oil fields, Poland must be conquered. This could probably be effected without bloodshed, as in the case of Austria and Czecho-Slovakia. If the Poles should resist, German armies would sweep across the level plain at lightning speed, with no important topographic barrier to be crossed save the Vistula and its branches, already outflanked by German forces in East Prussia on the north and in the newly seized Slovakia on the south.

So the battle of the eastern plain was launched. But Poland resisted. Great Britain and France declared war on Germany. Von Ribbentrop was wrong in saying that nothing could make the Allies fight, and Hitler had blundered into a first-class European war, when all he wanted was a one-sided and bloodless German war against weak neighbors. The situation was desperate. If Russia joined the Allies, nothing could stop the Russian steam roller from rumbling over the level plain into Germany, while one part of the German army was holding off the Allies in the west, and other parts were holding the Austrians and Czecho-Slovens under control. The topographic gateway to Berlin was wide open, without natural or artificial defenses of any consequence to help German troops defend it.

A desperate situation called for a desperate remedy. If the Alps had bordered Germany on the east, the fateful bargain with Stalin need not have been made. But when Hitler looked across the level plain where the Russian bear was raising his head above the eastern horizon, and when he thought of fighting simultaneously on two fronts with the eastern front undefended by topographic obstacles, he determined to buy off the bear. So Hitler sold his reputation as the idealistic defender of Europe against Bolshevism, his control of the strategic Baltic Sea, the independence of his friendly neighbors Finland and the lesser Baltic States, half of the Poland he had coveted for himself, and his projected seizure of the Ukraine, together with possible territory in the Balkans and Scandinavia, according to a Satanic bargain not yet wholly revealed, all to buy the Russian bear not to enter any farther along the topographic gateway leading into the heart of Germany. The price was appalling, but the open plain made the danger perilous.

Strengthened, for the moment at least, by his costly bargain, Hitler rushed the war in the east to a speedy conclusion. Sweeping southward, eastward and northward over the level plain, the German armies closed in on the brave but poorly directed and quickly disorganized Polish forces. Where Russian forces had, during the World War, held the Germans at bay along rivers and marshes, the Poles were too weak to take much advantage of these minor topographic barriers. Even in the higher and rougher country of the Podolian Plateau in southern Poland the delay in the German advance was not notable. Then Russia walked in and occupied her allotted portion of the prostrate country, including the famous Pripet Marshes where otherwise the retreating Poles might have made a final defensive stand. In a few weeks Poland was wiped out of existence. The open plain and a poorly organized defense had combined to make the German onslaught swift and irresistible. (Compare Figures 2 and 3.)

**Eastern Gateway Still Open**

But Germany's anxiety over her exposed eastern frontier on the level plain is not yet ended. She knows that this plain is occupied by millions of Poles, bitterly hostile to their German conqueror and eager for revenge. She knows that a Russian army not blocked by a German army, could sweep across this plain to the gates of Berlin without encountering a single topographic obstacle of major importance. It would require a large German army, without the aid of topographic barriers, to hold such a Russian attack in check. And Germany dreads nothing so much as having to fight on two or more fronts simultaneously.

Russia in her turn looks anxiously to the future. For the moment she has no cause to fear Germany, busy on the western front, and busy elsewhere holding Czechs, Austrians, and Poles in submission. But suppose Germany wins the war and builds up a vast central European empire determined to regain control of the Baltic and other traditional German interests sacrificed to Stalin in a desperate emergency? Or suppose Germany, convinced of defeat, overthrows the Hitler regime, restores Austria and Czecho-Slovakia, and agrees to joint German-Allied military action for the restoration of Poland on condition that Russia be driven back to her prewar frontiers? In either case the level plain forms a topographically defended pathway from Germany straight to the interior of Russia (Fig. 1). No wonder Russia is hastily building artificial fortifications along her new western frontier and feverishly seeking to dominate Germany on the north by seizing control of the Baltic through military occupation of Finland and the smaller Baltic States.

**Battle of the Finnish Lakeland**

We may close this part of our discussion with a glance at the Russo-Finnish front (Fig. 4). The world has been astounded at the wholly unexpected resistance of Finland against assault by an enemy fifty times her size. The explanation of this remarkable phenomenon is apparently two-fold: (1) The inherent weakness of the Russian military machine, never efficiently organized and now purged of its competent officers, and (2) the topography and climate of the Russo-Finnish combat area. We are concerned with the last factor only.

Finland and adjacent parts of Russia were, during the ice age, overrun by the north European continental glacier. The vast sheet of ice disarranged river systems, scoured out depressions in soil and rock, and dropped accumulated debris in countless irregular hummocky morainal and other hilly deposits. The result was to transform the whole region into a bewildering maze of lakes, marshes, irregular hills, and wandering rivers. Cover this with a vast forest and you have the typical landscape of Finland, a country not unlike the lake and forest area of the wildest sections of Wisconsin and Minnesota. Blanket it with deep snow and bitter winter temperatures, and you have the physical aspects of the country into which the Russian army has been trying to force its way.
over the whole of Finland in a few days. This was what the world expected. But evidence accumulates that the supposed strength of the Russian army rested on Communist propaganda. Certainly the topography is in every way highly favorable to the defense. Trapped in the maze of lakes and wooded hills Russian units are annihilated piecemeal by skillfully concealed sharpshooters and machine gun nests. Tanks built to operate on the level Russian plain are bogged in Finnish snow and mud, and destroyed by Finnish artillery fire famed for its accuracy. Armies broken into minor units by numerous lakes lose contact with each other and are attacked when isolated from effective support. Planes are weighted down with accumulating ice, lost in blinding snowstorms, or grounded by mist and fog. Unused to arctic temperatures and poorly clad, Soviet troops are conquered as much by cold as by enemy fire.

How long these physical conditions can offset the vast superiority in numbers enjoyed by the Russians, no one can tell. The Finns say they can hold the Russian advance within reasonable limits all winter if they are adequately supplied with planes, arms, and munitions. If the Allies take full advantage of the favorable terrain on which the Finns are fighting and give them full support in men and materials, they may discover that the shortest and easiest route to Berlin is via Leningrad. Potential allies in such an advance may be found in the other Baltic States and a liberated Poland. Eventual Allied control of the whole Baltic Sea might then be in sight, and the siege of Germany could be tightened and strengthened.

**Arctic Front**

If adequate help is not extended to Finland, and the vast superiority of Russian man power ultimately enables her to overcome the formidable topographic obstacles of the little country, the strategic character of another frontier may become a matter of public interest. For the question which will then claim the world’s attention is whether Russian occupation of northern Norway to gain long-coveted Atlantic ports was part of the price Hitler paid Stalin in Hitler’s hour of need. If so, it scarcely seems probable that either Norway or Sweden can fail to resist Russia’s westward advance, and their armies, probably supplemented by retreating Finnish forces, may try to hold the Russians on the comparatively short line extending from the head of that part of the Baltic known as the Gulf of Bothnia northward to the Arctic Ocean, preferably east of the Finnish port Petsamo (Fig. 4). Such a line would be well protected on its right flank if the Gulf of Bothnia, blocked at its southern end by the strategic Aland Islands and by the mine fields strewn on either side of the islands by Finland and Sweden, remained securely in Finno-Swedish control. British control of the sea would render the left flank secure. The heavily glaciated terrain crossed by this hypothetical battle front would favor the defense, as would the further fact that the defenders are more accustomed to operating in this bleak northern region than are Russian troops. Rail connection from the southern end of this battle front to supply bases in Norwegian ports, and control of the Arctic Highway running along the rear of the supposed battle front all the way from the railhead at Rovaniemi to the Arctic Ocean at Petsamo, if secured by the Scandinavian allies, would give them enormous advantages not possessed by the Russian enemy. Under such circumstances it seems doubtful whether the Russian forces, vastly superior in numbers but apparently inferior in leadership, training, equipment, and morale, could break through to the Atlantic. During the World War the Russian colossus ventured into the maze of a glacial terrain in East Prussia and was soundly beaten by an enemy not only inferior in numbers but forced to fight on two fronts simultaneously. In Finland we have seen similar results. In the far north of Scandinavia history may once again repeat itself.

Let us next examine the topography of Germany’s western front, to see what routes are available for sorties of the besieged German armies into Allied territory and for offensive drives by the Allies into German lands.
Topography of the Western Front

From neutral Switzerland to neutral Luxembourg, German territory borders directly on that of France (Fig. 3). Here Germany, without violating neutral lands, could attempt to break her siege by pouring a mighty army into France. But the topography is highly unfavorable to any such attempt. The whole of the Franco-German frontier lies in the upland belt of mountains and plateaus. A short distance west of the southern part of the frontier rise the rugged Vosges Mountains, presenting their steep rocky face toward Germany and their gentle backslope toward France. The rocky escarpment is heavily wooded and difficult to ascend. Important troop movements are necessarily restricted to a few favorable passes. During the World War it was reported that a commander of German forces at Mulhausen, ordered to lead his men across the Vosges Mountains into France, made three futile attempts to carry the heights of the range in the face of French artillery. Then came an urgent message from the Kaiser: “The crest of the Vosges must be carried at any cost.” A fourth desperate assault by the intrepid commander ended in his defeat. Retiring to his quarters the unhappy general, according to the story, committed suicide, first sending to his Kaiser this message: “The Vosges cannot be crossed. Come and try it yourself.”

One may hesitate to vouch for the truth of the story, but it serves to illustrate the peculiar surface features of the Vosges which render their ascent comparatively easy from the French side but very difficult from the German side. This is the key to the significant fact that during the first three years of the World War the only place where the German troops were unable to expel French forces from German soil was on the steep eastern face of the Vosges Mountains.

Belfort Gateway

It is true that between the southern end of the Vosges Mountains and the foothills of the Jura Mountains in neutral Switzerland there is a very low gap some 10 to 15 miles wide. This is the famous “Belfort Gateway” (Be, Fig. 5). Entrance to France by this route is easy so far as physical features alone are concerned, and from earliest history the gateway has played an important role in the migration of peoples and in commercial intercourse. But under modern conditions of warfare the opening is too narrow for an attacking army to maneuver effectively. Defensive forces would enjoy the advantage arising from the fact that their left flank would be well protected by the rugged Vosges and their right flank by the Jura Mountains and the neutrality of Switzerland. In the War of 1870, and again in 1914, German armies attacked at the Belfort Gateway in vain. It seems highly improbable that today, with the famous Maginot fortifications extended over the Vosges and across the gateway, Germany will attempt the dangerous and costly maneuver of launching a major offensive at this opening into France.

Swiss Corridor

Consideration must be given to the possibility that Germany may attempt to outflank the defenses of Belfort by passing south of the gateway through Swiss territory. If such a movement were made through the “Swiss Corridor” (SC, Fig. 5), the low belt of country between the Jura Mountains and the lofty Alps, there would still be a rugged barrier where the Jura folds curve southward to meet the Alps at the western end of that lowland, while beyond would rise the east-facing escarpments leading up to the dissected plateaus of central and northern France. Because Switzerland has a capable and determined army already mobilized to defend the neutrality of the country against all comers, because violation of the neutrality of this liberty-loving land would cause a new world-wide eruption of sentiment against Germany, and because of the physical obstacles to be overcome, it seems doubtful whether Hitler will attempt to raise the siege of his own country by an invasion of his small but brave neighbor. Yet a flank attack on France through the Swiss Corridor is a possibility which cannot be excluded.

Lorraine Gateway

From Germany the chief approach to this part of the frontier is up the valley of the Moselle River, which served as the main supply line of one of the German armies during the World War. Toward the upper part of the Moselle valley the upland breaks down to a broad belt of rolling country in France and Luxembourg known as the Lorraine Gateway (L, Fig. 5). Far broader than the Belfort Gateway, and connecting with a broad lowland stretching northwestward to join the low plain of northern France, the Lorraine Gateway has long been a favorite route of invasion. It was by this gateway that the Prussian armies entered to overwhelm France in the War of 1870. It was one of the routes of invasion in 1914.

But for very good topographic reasons the Lorraine Gateway was not chosen as the chief route of invasion by the German armies of 1914, when France was far stronger than in 1870 and a speedy capture of Paris offered the only chance of victory. The flatlying rocks of the Paris basin are tilted upward toward the north, northeast, and east in a succession of plateaus separated by broad lowlands through some of which pass natural moats formed by the rivers Moselle, Meuse, and Marne. These “natural defenses of Paris,” as they have well been called, face squarely toward the Lorraine Gateway. The outermost rampart stands almost in the gateway itself, a plateau with steep escarpment toward Germany and a gentle backslope toward Paris. Where the Moselle cuts a gap through the escarp lies the famous fortified camp of Metz. West of this plateau stretches a broad marshy plain, dominated in turn by a second plateau escarpment. The only practicable gateways through this second escarp are guarded by the great fortified camps of Verdun and Toul. Beyond to the west the same unfavorable topography is repeated again and again: always a steep scarp toward Germany, commanding a plain over which the invading troops must advance; always a gentle backslope down which the defending armies may retreat to the next scarp if too severely pressed, while rear guards on the formerly occupied crest hold the invaders temporarily at bay. If victorious along one plateau scarp, the invading armies would be checked at the next and compelled to fight the battle anew.

In 1914 the German high command fully realized that no rapid advance on Paris was possible by this route, so the chief armies of invasion were directed elsewhere. Later the Crown
the plateau barrier at Verdun. Today the easternmost members of this group of natural topographic barriers have been rendered wellnigh impregnable by vast underground fortresses constituting part of the broad fortified belt commonly called the Maginot Line. It seems highly improbable that Germany will ever again try to force her way into France by the Lorraine Gateway.

Northwest of the Lorraine Gateway the Ardennes Mountains of southern Belgium continue the topographic barrier of the mountain-plateau belt. The Meuse River cuts a deep narrow trench entirely across this belt. But while this would serve well as a supply line for a German army operating in France, the Albert Canal defenses and the rough uplands on either side of the gorge would first have to be conquered.

The recently constructed Albert Canal, deep and steep-sided, is as much a defensive work as it is a commercial project. It connects with the much larger deep and steep-sided gorge of the Meuse to form a V-shaped moat outlining a defensive bastion with its eastward-projecting point near the German frontier, the northwestern arm of the V connecting with an embayment of the sea at Antwerp, and the southwestern arm reaching to the French border. This bastion, strength-

the key to the new defensive system of Belgium. That system must be destroyed before the gorge of the Meuse can be utilized as a route for the invasion of France. Furthermore, for a German army to advance by the Meuse valley the neutrality of Belgium would have to be violated, and, if world opinion is to be outraged by a second German assault on brave little Belgium, there is another route through the country topographically far better suited to serve as the main pathway of the invading army.

Flanders Gateway

This favorable pathway is the belt of low plain (Fig. 1) earlier described as extending from northeastern Russia to the foot of the Pyrenees. It passes across northern Belgium, and that part of it called the Flanders Gateway (F, Fig. 5) has long been recognized as Europe’s easiest entrance into France. The pathway is broad as well as level, and presents no topographic obstacles. It is a route which enables an invader to take in the flank the entire series of mountain and plateau barriers farther east. Roads and railways are excellent and numerous, permitting the rapid simultaneous advance of different columns of troops. The country is fertile and highly productive, providing sustenance for large armies. With the occupation of importance to the invaders. Back of the invading armies would be a broad network of first-class lines of communication and supply. Assuredly, of the possible routes of invasion this is the one incomparably the best so far as its physical characteristics are concerned. The lowest land near the sea is traversed by numerous canals and can be flooded, but there remains an ample breadth of dry land on which to maneuver a large army advancing in parallel columns.

Such was the route chosen by the German high command for its major thrust at France in 1914, despite the fact that utilization of this route involved the violation of Belgian neutrality, thereby bringing the Belgian army and the British army and navy into the war against Germany. Surely the choice of an invasion through Belgium must have been dictated by some very compelling reason to justify it in the minds of the German General Staff. That reason is to be found in the topographic features of western Europe which rendered a swift advance on Paris impossible from the east, but comparatively simple from the north over the broad pathway of the Belgian plain. "He who is menaced as we are can only consider the one and best way to strike," said the German Chancellor. "Belgian neutrality had to be violated by Ger-
man on strategic grounds," cabled the Kaiser to President Wilson.

When the siege of Germany in the present war brings the German people nearer the breaking point, the Hitler government may in desperation attempt to raise that siege by another invasion of France by way of the Belgian plain. Hitler may well believe that the topography of all that region stretching from southern Belgium to and including Switzerland is so favorable to the defense as to make a German irruption across any part of it impossible. And he may therefore decide, as did the Kaiser, that political considerations must yield to topographic considerations when victory or defeat depends upon the choice.

The Low Countries

The plain of northern Europe passes through Holland as well as through northern Belgium, and German armies could operate more freely if they were to cross the Dutch portion of the plain as well as the Belgian portion. In 1914 the German armies were seriously hampered by the long southern arm of Dutch territory which reaches far southward to the border of the rougher country of the Ardennes Mountains. This and other considerations may eventually dictate violation of both Belgian and Dutch neutrality. German airplanes now experience difficulty in their operations against Britain because of the great distance they must carry bombs from the German coast to objectives in England and certain portions of the North Sea. Air bases on the coasts of Holland and Belgium would enormously facilitate Germany's aerial warfare. Submarine bases on these coasts would similarly facilitate her undersea warfare against the British blockade, and her own submarine blockade of Britain. Invasion of Holland alone might secure these last advantages, and without danger of serious punishment if Belgium remained neutral and thus prevented the French and British armies from coming to Holland's aid. Recent heavy concentrations of German troops along the Dutch frontier were interpreted by many as presaging such an invasion of Holland. It was reported, but not officially confirmed, that the plan was abandoned by Germany when Belgium notified the German Government that she would open her territory to the Allied armies the moment German armies crossed the Dutch frontier.

Much of Holland's plain lies near or below sea level and can be flooded from the elaborate system of canals forming part of the defensive system of that little country. Partial flooding was carried out during the recent German threat, ostensibly as a precautionary practice measure but perhaps equally as a warning to Germany of the artificial obstacles an invasion would encounter. For the present the danger seems averted. But neither Holland nor Belgium, lying as they do on the natural topographic highway to the North Sea ports and northern France, will feel secure until German military power is controlled or destroyed.

Thus far we have looked at the topography of the western front from the standpoint of a possible German attempt to raise the siege of her country by sallying forth to attack her enemies. How does the topography appear to the Allied high command, considering a possible invasion of German territory as the best means of bringing the war to an end?

Starting near the southern end of the Franco-German frontier we find opposite the Vosges Mountains its twin topographic form, the Black Forest Mountains. This mountain block has a steep western face toward France, a gentle backslope toward the interior of Germany. It is rugged and heavily forested. Obviously any Allied attack on Germany in this direction would encounter precisely the same topographic difficulties as a German attempt to cross the Vosges. The topographic obstacles have been made doubly formidable by a broad belt of fortifications intended to make the southern part of the Siegfried Line or Westwall a counterpart of the French Maginot Line.

Basel Gateway

Between the southern end of the Black Forest and the Swiss frontier there is the counterpart of the Belfort Gateway, a gap leading eastward into southern Germany which we may call the Basel Gateway (Ba, Fig. 5). This gateway, like that of Belfort, has great historic importance, because it lies near the head of the Danube valley, a major natural corridor through southeastern Europe to the Near East. Along this easy pathway waves of migrations and contending armies have moved since time immemorial. For the Allied armies this gateway has significance today because it forms a natural approach to Austria and Czecho-Slovakia, two of the countries which France and Britain will doubtless seek to free from German domination, and on whose help they may count for the shattering of Hitler's empire from within when the strain of the siege begins to break German morale.

But under present conditions the Basel Gateway, protected by fortifications of the Siegfried Line, is difficult to attack. It is narrower than the Belfort Gateway. Its defenders can rest their right flank securely on the Black Forest Mountains, their left flank on the neutral territory of Switzerland. As the Allies are fighting to re-establish the sanctity of treaties, and to destroy the system of ruthless assaults on small nations, they cannot consider any attempt to out-flank defenders of this German gateway by passing through Swiss territory.

Rhine Corridor

Between the Black Forest and the Vosges Mountains lies the broad flat-floored valley of the Rhine, roughly bisected longitudinally by the river which forms the Franco-German frontier to a point opposite the northern end of the Black Forest range. This vast natural corridor, 20 miles broad in places, continues northward, for another 80 miles wholly in German territory, giving easy access to the very heart of the western half of the country. It is a topographic route of invasion of capital importance and has been followed by French armies in earlier conflicts with the German people. The French are already firmly established in the western half of the southern part of this broad corridor, which is French territory. It may confidently be predicted that an Allied advance northward down the Rhine valley will figure in future Allied military plans if and when the invasion of western Germany becomes a practical possibility.

At present, however, the cost in blood of such an advance would be prohibitive. No material progress northward down the broad corridor is possible so long as German armies remain firmly entrenched in the Black Forest Mountains on the east and in the rough plateau country on the west. These formidable topographic barriers must be conquered before the easy pathway of the corridor can be utilized. And it is precisely these topographic barriers that give the so-called Siegfried Line its greatest strength. Germany's first move in her undeclared war on the Allies was remilitarization of the country west of the Rhine, where a hastily constructed belt of fortifications, cleverly adapted to the rugged hill and valley country of the plateau-like mountain upland, has rendered that terrain impassable except at an enormous sacrifice in men. As a result of this remilitarization, permitted by France and Britain in defiance of the Treaty of Versailles, the great natural corridor into western Germany is reasonably secure against Allied attack.
War of Siege

It would thus seem that the formidable topography of the belt of low mountains and plateaus traversed by the western frontier of Germany, skillfully utilized in development of the vast zones of fortifications known as the Maginot and Siegfried lines, has imposed a war of siege rather than a war of movement on the Franco-German front. The uninformed may call this a "phony war." But those familiar with the topographic features of this region, and cognizant of the decisive effects of siege warfare on many past conflicts in the world's history, will recognize present conditions on the western front as a normal and even necessary phase of a war that is being pressed in deadly earnest by both sides. When internal conditions force Germany to attempt a sortie, a war of movement may develop across the lowland plain or through the Swiss corridor.

The well-advised student of war despatches will not waste one moment of his valuable time in reading the daily official communiques respecting land operations on the western front. They have no significance whatever and will have none until some radical change in conditions transforms the war of siege into a war of movement. Communiqués respecting major aerial combats may be scanned for evidence that the Allies are gaining supremacy in the air. If and when such supremacy becomes decisive it will be a fact of the very highest importance and may well presage a profound transformation in the character of the struggle. For overwhelming supremacy in the air may, during favorable weather, so reduce the advantages of topographic position as to permit a war of movement to replace the war of siege on more favorable portions of the front.

Before leaving the western front we should note the radical change in conditions which would result were either Holland or Belgium, or both of them, to abandon neutrality for any reason and throw their present neutral territory open to Allied military operations. Instantly the broad route of the industrial heart of Hitler's empire would be encountered in a sweep across northern Germany, and there is no evidence that the northward extension of the Siegfried Line is comparable in strength with its southern part. We should be on the alert, therefore, to watch any developments that might alter the neutral status of either Holland or Belgium. The dangers for Germany inherent in any such alteration might well give Hitler food for thought and may explain the sudden lessening of tension on the Dutch and Belgian frontiers a short time ago.

Topography of the Southern Front

On Germany's southern frontier the formidable barrier of the Swiss Alps and the neutrality of Switzerland, both capable of being ably defended by her army, make it doubtful whether any major military operations will be attempted by either side across Swiss territory.

Eastward from Switzerland, the German frontier borders Italy. Seizure of Austria gave Germany an almost imperceptible topographic defense in this region. The Alps consist of a complex system of rocks intensely folded and broken, and deeply dissected by swift flowing streams. The difficulties were increased a hundred fold when ice streams of the glacial period flowed down the valleys, cutting them much deeper, steepening the valley walls into rocky precipices, leaving side valleys hanging many hundreds of feet above the floors of over-deepened main valleys, sharpening the inter-valley ridges into knife-edge aretes, and carving the dome-shaped peaks into jagged needles and horns. The resulting topography is one of indescribable ruggedness, in which precipitous cliffs, inaccessible peaks, steep-sided divides, and hanging valleys present to the engineer almost insurmountable difficulties. Roads and railways are for the most part restricted to the bottoms of glacial troughs and to the few passes across intervening ridges. Where they are forced against the rocky wall by a lake occupying the trough floor, or lead upward over dissected mountain slopes, tunnels and bridges are numerous. Military movements through such a country must of necessity be slow; the lines of advance are few and narrow, and easily blocked by the destruction of bridges and tunnels; they are dominated by command and control of bridges, streams, and tunnels; they are disembarked on command by peaks, which are only slowly and painfully advanced over the most rugged and precipitous terrain, and important passes must be wrested from the control of the enemy.

From the foregoing description of the topography it would appear that any major military operations on the Italo-German frontier are improbable. If Italy remains neutral, the frontier will be outside the zone of warfare. If Italy decides Germany can win with her help, and becomes an active partner again, the fighting will be elsewhere. If Italy decides the Allies will win, and joins the winning side, she can tighten the blockade of Germany and hold a certain number of German troops immobile at the Alpine passes. But it is difficult to see how any offensive on either side can succeed on this difficult terrain until the morale of the troops on one side or the other is definitely shattered. We must, therefore, anticipate relative quiet on this front until the breaking point of morale is reached and the end of the war becomes visible.

Eastward from Italy, Germany has a common frontier with Yugoslavia as far as the border of Hungary. Here also the seizure of Austria gave Germany a southern frontier defended by the eastern Alps. For reasons fully set forth above in connection with the Italo-German frontier, we must expect an inactive sector even should Yugoslavia eventually join the Allies. Accession of her support to the Allied cause would still further tighten the siege of Germany and hold an additional number of troops immobile at the Alpine passes. But any war of action must be anticipated on some different terrain.

Manifestly the whole picture on the German-Italian and German Yugoslavia fronts would be radically altered were Austria to revolt against the Hitler regime and attack German defenders of the Alpine passes from the rear. Once the defending troops were conquered, the way to the broad Danube Valley and Czechoslovakia would be wide open to an Allied thrust from Italy and Yugoslavia. A revolt of the Czechs would complete the debacle, and the end of the Hitler regime would be in sight. The Siegfried Line would be exposed to attack from the rear, and all northern Germany would lie at the mercy of the invaders. It is wholly within the realm of the possible that the end of the war will come from this southern direction and in the manner described. But this cannot happen until German resistance is so far weakened as to encourage the Austrians and Czechs to strike a decisive blow for their independence.

Hungarian Gateway

A long sector of Germany's southeastern frontier borders on Hungary.
This little country is for the most part an open plain drained by the great Danube River and its tributaries. Strategically the plain is of capital importance. It is the granary of a large section of Europe. For the Germans it is the broad highway to the Balkans and the Near East, to the oil fields of Roumania and southern Russia, to Yugoslavia, and the trade routes of the Mediterranean. It is a vital link in the old German scheme of a mighty empire stretching across the Balkans to Asia Minor. For the Allies it is a broad back door to Czecho-Slovakia, and through that friendly land direct to the heart of Germany. It is likewise the back door to Austria and all southern Germany. For between the Carpathian Mountains and the Alps there is a broad, low gap long known to geographers as the Hungarian Gateway (H, Fig. 5). Armies passing through this broad opening would find themselves within striking distance of three other gateways, narrower than the Hungarian Gate but of great historical and strategic importance. (1) To the west opens the Vienna Gateway (V, Fig. 5), by which one may enter the broad Danube lowland leading westward to all southern Germany. (2) To the northwest past Brunn (Br, Fig. 5) one may enter the Bohemian plain of western Czecho-Slovakia, the political and military center of that former republic, whence the Elbe Gateway (E, Fig. 5) opens north to central Germany and Berlin. (3) To the north lies the famous Moravian Gateway (M, Fig. 5), the historic opening from southeastern Europe into eastern Germany. When it is remembered that these three topographic openings through mountain barriers lie in Austria and Czecho-Slovakia, both victims of German aggression and strongly disaffected toward their conqueror, the strategic importance of the gateways takes on added significance.

Roumania, already under protection of the Allies, borders the Hungarian plain on the east. Yugoslavia, friendly to the Allies, borders the plain on the south. Greece and Turkey, closely bound to the Allies, are not far away. The alliance with Turkey was a victory of the very highest importance for Britain and France, since it placed within Allied control the two partially submerged and easily defended gorges forming the Dardanelles and Bosphorus, blocked Russian seizure of these straits, kept the sea route to Roumania open, placed Bulgaria and Russia under threat of invasion if they take action hostile to Allied interests, confronted Italy with the possibility of complete Allied control of the Mediterranean, and immeasurably strengthened Allied influence in the Balkans. As a result of this situation the strategic potentialities of the Hungarian plain and its gateways into Germany are greatly enhanced.

Small wonder then that Russian, German and Allied diplomacy have been feverishly at work in the Balkans. And small wonder that Hungary finds herself in one of the hottest spots in Europe, with the necessity of steering skillfully a very difficult course. With Russia, Germany and the Allies having widely conflicting interests in this critical sector of southeastern Europe, it is evident that any major diplomatic or military move involving this country is bound to have far-reaching repercussions difficult to foresee.

Balkan Problems

With so many combinations possible it is not practicable to predict the role of topography in that part of the struggle hidden in the mists of the future. Should Yugoslavia ultimately enter the war on the side of the Allies, she in combination with Roumania, Greece and Turkey should be able to bring Bulgaria promptly to terms and make it possible to pour Allied armies across the Hungarian plain and through the northwestern gateways into Austria and Czecho-Slovakia. If Hungary sided with the Allies the procedure would be rendered much easier. If she sided with Germany the ultimate result could be the same, but at greatly increased cost in men and
It should be pointed out that the possible future invasions of Germany postulated in the foregoing discussion do not actually have to take place in order to bring the conflict to an end. It is quite probable that in the present war, as in the last, the Germans will give up the struggle if and when the military situation becomes such that invasion will be inevitable in case the war is further prolonged. The defeat of Germany could conceivably be decisive without the Allies having any actual foothold on her soil.

One could go on indefinitely weighing the effects of this or that combination in the highly unstable Balkan situation, but further speculation would hardly be profitable. All we can say with reasonable assurance is this: It will pay to keep a watchful eye on the broadly open back door to southeastern Germany, for it is the strategic key to military action which may conceivably end the present conflict.

Should the Allies find it possible to over-run the country south of the Caucasus, and to establish themselves in the few passes of that lofty range and across the narrow lowlands separating either end from the Black and Caspian Seas, they might be satisfied to hold those easily defended positions while the loss of Russian oil centers exerted its crippling effect upon both German and Russian military operations. Or if strong enough, they might push northward around the eastern end of the Caucasus range, progressively outflanking the Russian defenders of the passes until the secondary oil center of Grozny, near the northern base of the range, fell into Allied hands. With Baku gone, Russia's plight would be serious and Germany's well-nigh desperate.

OIl a Major Strategic Prize

France and Britain are believed to have assembled an army of half a million men in the Near East (the most reliable figures range from 470,000 to 570,000). When these are added to the excellent fighting forces of Turkey, a formidable concentration of manpower is available for military operations in this remote region. Allied control of the Black Sea is seemingly assured by Turkey's hold on the Dardanelles and Bosporus. A very short advance from the Turkish frontier to Batum, aided by naval operations off the coast, would cut the three major streams of oil products flowing westward, and place the chief oil port of the Near East in Allied hands. A moderate advance from the Persian frontier would again cut railway and pipe lines, and if pushed to Baku would put Russia's chief oil producing area at the mercy of the Allies. Both advances could be made across

barriers of serious importance.

A few months ago the railway system of western and central Turkey was connected with the line running from Erzurum in eastern Turkey across the Russian border into the upper Kura valley at Tiflis and thence to Batum and Baku, as well as into northeastern Persia (Fig. 6). Along the most direct route from the Turkish frontier to Batum rail connections are lacking; but from near the Persian frontier a railway nearly or quite completed now runs in fairly direct line to Baku. The Russians would enjoy the great advantage of a railway paralleling their entire front, located some distance to the rear in the Rion-Kura lowland and sending off occasional branch lines to points along that front. They would have the added advantage of much rough country south of the main portion of the lowland, a terrain difficult for an enemy to conquer and which, if held by the Russians would seem seriously to threaten any Allied advance on either flank toward Batum and Baku. Allied munitions and other supplies coming overland would have to pass through the bottleneck of a single railway line, except in so far as supplemented by motor transport and by sea. Whether Allied fighting power, taking advantage of the inherent weakness of the Russian military machine, could overcome these disadvantages is a question which may be answered before the war is ended.
Taylor Remote Pneumatic Transmission Systems

A simple and economical means of indicating, recording or controlling process variables remote from the point of measurement is offered by the new Taylor Remote Pneumatic Transmission Systems. This new system is particularly advantageous where it is desirable to indicate temperature, pressure, flow or liquid level data on a centralized panel or in a control room.

Taylor Indicating Transmitter.

The system utilizes standard Taylor instruments. It may consist of one or two transmitters connected to a receiver; or one or more receiving instruments, not necessarily near each other, and as far as 1,000 feet from the transmitter. Transmitters or receivers may be indicating, recording or controlling types. Air pressure is the transmitting medium, with 3/8" O.D. copper tubing as the means of connection.

Taylor Remote Pneumatic Transmission Systems are highly accurate—well within ±1⁄2% of the scale range when properly installed. The speed of response of the receiver to changes in output air pressure from the transmitter is largely dependent upon distance—the maximum lag being 1 second per hundred feet of connecting tubing.

New Lightweight Scraper Hoist

Ingersoll-Rand Company announces a new scraper hoist. Claimed by the manufacturer to be the lightest and most compact double-drum scraper hoist ever built, the unit weighs only 250 lbs. (without cable guides). Its compactness will allow it to be passed through an opening 15"x15".

Lightweight Double-Drum Scraper Hoist

The hoist was designed especially for small scraping jobs in thin, narrow veins or stope, irregular veins, cross cuts, for spreading wastes, for development work, etc. It has a cable pull of 650 to 1,000 lbs. and a cable speed of 125 to 150 ft. per minute. Either Air or Electric Drive is available.

Superfinish for Hancock Valves

“Once again we have borrowed a page from the automotive industry in order to produce better valves,” announces the Hancock Valve Division of Manning, Maxwell & Moore, Inc., Bridgeport, Connecticut. The makers claim that through the use of the revolutionary development, Superfinishing, the life of valve seats and discs in Hancock “600 Brilliant” Valves is increased twelvefold. Friction causes wear in automobile engines and friction also causes wear in valves. It is stated by the manufacturers that Superfinishing produces a highly polished wearing surface by "honing" (actually rubbing and scrub-
Special Superfinish Machines have been developed expressly for Hancock. Close-up of one such machine applying Superfinish to a Hancock valve disc is shown in the insert at the upper left of this picture. The makers say that every Hancock “500 Brinell” Valve is now being equipped with Superfinished seats and discs at no increase in price.

The makers also give credit to the automotive industry for the development of the Diamond Boring Machine whose adaptation enabled Hancock to build the first commercial valve with stainless steel seats and discs of “500 Brinell” hardness.

A most interesting new bulletin describing Superfinished Hancock “500 Brinell” Valves is just off the press; a copy may be had by writing the manufacturers.

New Jackhammer Jackleg

A new and novel air-feed rock drill mounting which is known as the Jackleg, has just been announced by the Ingersoll-Rand Company. It is designed for use with Ingersoll-Rand Jackhamers. This mounting helps to support the drill, absorb the recoil and feed it forward as the hole is drilled into the rock.

The larger and faster drilling Jackhamers can now be used on horizontal holes. Instead of the operator holding up the drill by hand and pushing it forward as it drills into the rock, he uses the Jackleg and only has to exert a slight downward pull on the handle of the Jackhammer to balance the lifting force that is exerted by the pneumatic feed of the Jackleg. The manufacturer of this Jackleg reports that it increases drilling footage in some cases, as much as 59%. Also, the miners are less tired at the end of the shift and accidents are thereby reduced. Further claims are that rock drill upkeep costs are reduced, because there is less wear on the chuck bushings and fronthead parts.

The Jackleg weighs only 55 pounds and can be easily regulated by a conveniently located pressure throttle.

For additional information, an illustrated folder, Form 2690, is available from Ingersoll-Rand Company, 11 Broadway, New York City, or any of its branch offices.

No More "Nibs" and "Nervous" Lines!

Draftsmen will welcome news of the Johnson Contour Pen Holder that Kistler's Engineering Supply Department offers you. By holding the pen in correct position at all times the Johnson instrument eliminates broken lines and allows pen to turn true. It holds the pen handle at the proper elevation, and a free floating action assures even pressure and even density. And the Johnson automatic pen raising feature eliminates the nibs or enlarged ends that occur when the pen is raised by hand.

These new pen holders will be a big help to experts and almost indispensable to the beginner.

You can get full information and prices by writing or seeing Kistler's in Denver.
commercially in seven minutes. The addition of this equipment to the laboratories of the school, therefore, makes it possible for the expansion of the mineral industries in this region.

New Motor and Generator for E. E. Department

Prof. Payntor of the Electrical Engineering department announced that a new generator and a three phase synchronous motor have been added to the E. E. laboratory.

The 1700 pound machine was installed this summer and is "completely modern," according to Prof. Payntor. It is Westinghouse equipment and more than forty experiments can be done with it.

He also announced that the E. E. laboratory has been totally reconditioned and painted. The laboratory manual has been rewritten, and a large number of new meters have been purchased.

The motor is rated at 15 horsepower and is directly connected to a compound-wound 125 volt generator. It is arranged so that the DC generator can be driven by the synchronous motor. The DC generator can be run as a motor driving the three phase synchronous motor as a generator. The machines can be operated together or separately.

Publications Building Remodeled

Student labor did a first-class job in housecleaning and "interior decorating" during vacation and spic and span offices greeted the staffs of The Ore-digger and Prospector when they reported for duty this fall.

The Ore-digger is now occupying two rooms on the second floor, with the Prospector in the other room.

Professor Crain, Director of Publications, has the first floor offices, one room of which he has equipped with a multigraph duplicator, a wide carriage typewriter with carbon paper attachment, a paper cutter and a wire stitcher.

Professor Johnson Secures Fossils

Several hundred unusually well preserved fossils were added to Mines' museum this month by Professor J. Harlan Johnson, who collected them in southern Tennessee this summer. They are Cretaceous in age and still show the original shell which is very unusual for fossils occurring in that period.

Professor Johnson also spent several weeks collecting algal limestone from Kansas. He is interested in this collection for study with respect to fossils and organisms responsible for forming this type of limestone.

Fred Eyer Deceased

Mines students will be missing "Fred" this year from the chemistry laboratory where for 25 years he has been stock clerk. His death occurred in August following a heart attack.

He always had time to chat with the boys and cheer up the fresh and sophs when they were discouraged with the results they were obtaining in their laboratory work or when they had broken a desiccator or platinum crucible.

Semi-Micro Qualitative Course Continued

The chemistry department is again offering the course in semi-micro qualitative analysis which was successfully tried out on a special section last semester.

At present, the number of men taking this course is sixty-seven, more than double the number in the original class. Many new improvements have been instituted this semester. No longer do the students have to walk to reagent shelves for supplies. Each individual has at his desk a complete tray of fifty reagents, an increase over last semester's tray which contained only thirty-six reagents. In addition, two new centrifuges, each with a capacity of eight centrifuges, have been obtained. The text used is the same one employed last semester.

Dean Morgan's Honor Roll

A total of 61 students made the honor roll for the second semester 1939-40, was announced last month by Dean Morgan, an increase of three over the first semester.

The seniors again headed the list with 23 men, one less than the first semester. The sophomores came next with 17 men, six more than the preceding semester. The juniors were third on the list with 15 men, four more than the first semester. The freshmen totaled 6 men, only half the number they placed on the roll the first term.

To be eligible for the honor roll a student must have not less than 45 credits and must have an "A" average with no grade less than a "B." Also he must have no incompletes at the end of the semester.

Argentinian Geologist at Mines

Dr. Abel Herrero Dulex, geological engineer for the Yacimientos Petrolifero Fiscales, a government owned oil company of Argentina, enrolled at Mines last month in special petroleum geology courses. He is particularly interested in the observation of current drilling, refining and geological techniques.

Dr. Dulex is a graduate of the University of La Plata in La Plata, Argentina.

Appointments to Publications Board

Dean Thompson and Clay Creager were recently appointed to the Board.

(Continued on page 560)

IN MEMORIAM

John M. Weller

John M. Weller, '26, was killed instantly in an automobile collision near Tonopah, Nevada on August 28. A coroner's jury rendered the verdict that death was caused by the side-sweeping of his car by the driver of the other car who was on the wrong side of the road. Mr. Weller's wife and seven-year old daughter were with him but were uninjured.

Mr. Weller was a native of Pineville, Kentucky where he lived until entering Mines in 1922. Upon his graduation four years later he accepted a position with the Mazapil Copper Company in Mexico but soon after transferred to the Mexican Gulf Oil Company as geologist. He was employed by them until September 1927 when he returned to Mines for graduate work in geology. The following year, he became associated with the Gypsum Oil Company as geophysicist and assistant party chief. In September 1929 he accepted a position with Norrie and Tower, Consulting Engineers, and served as their geologist for four years, making mine examinations, doing prospecting and initial development. Since January 1933 he had been an independent geologist, specializing in diamond drill work in Texas, Oklahoma, California and Nevada. At the time of his death he and his family resided in Tonopah, Nevada.

Mr. Weller was a member of the Goldfield, Nevada, lodge of Elks which conducted services in Goldfield before the body was taken to Pineville, Kentucky for burial.

Besides his wife and daughter he is survived by his mother, Mrs. M. J. Weller, three brothers and four sisters all of Pineville.

Benjamin A. Rusman

Benjamin A Rusman died at his home in Los Angeles on August 27, after an illness of four years.

A native of Kansas City, Missouri, Mr. Rusman was brought to Denver when a young boy where he received his elementary education. Upon his graduation from high school he entered the Colorado School of Mines where he received degree, Engineer of Mines, in 1913.

He was employed by the International Smelting Company at Tooele, Utah, until 1929 when he moved to Los Angeles and became associated with the Beverly Hills Carpet Works of which he became the owner.

He was married in Tooele to Miss Faye Lodge who, with a daughter, Betty Jane, survives.

He was a member of the Masonic lodge, Shrine, and also of the Elks.
Miners Trim Greeley in a Thriller

Victory cheers were heard again on Mines' campus October 12 when the Orediggers scored twice to defeat the Greeley Bears in a thrill-packed battle by a 12-7 score. The lead sawed back and forth and only when the final gun had sounded was the winner decided.

The Miners took an early lead by scoring right after the opening kickoff and held it until the second quarter when the Teachers came back to score one and kick the extra point which put them out in front 7-6 at half time. The Miners kept fighting, and late in the third quarter scored the decisive touchdown on a deceptive pass play to take a 12-7 lead.

Coach Mason was pleased with the outcome but said that although the defensive play was much improved the offense still needed working on.

No alibis were offered by Coach Hancock of Greeley. He only said his boys had keyed themselves up too much for this game and did not loosen up until after the first quarter.

The Miners presented a much stronger defense than they showed in the Colorado State game, but still looked a little ragged in the ball carrying department. Three times they were inside the Greeley Teachers' twenty yard line and were unable to score. The blocking and tackling had noticeably improved and with this improvement the Orediggers served notice that they intended to keep on going towards a conference championship.

One of the outstanding Mines' backs was little Nobby Tashiro, the 145 pounder who took over the fullback duties when DeLaHittre was hurt. Late in the third quarter he and Berta set the stage for the winning touchdown and then again in the last part of the game he broke loose on the Mines' 27 and raced down the field to the Greeley 44 where he was finally brought down. Tashiro also starred on the defense where he broke up several passes that probably would have gone for Greeley scores.

In the Mines' line Moe was showing the Teachers the brand of play that made him all-conference last year as a Sophomore. He was in most of the plays and a thorn in the side of the Bear backs. Spieles looked good at guard and is credited with breaking up many Greeley plays. Captain Lou DeGoes played his usual fine game and recovered several fumbles. Hutchinson and Eden played great games and both were in there backing up the line so that the 'Teachers' runners seldom got far if they did get through the line.

Greeley had several players who proved to be disturbing influences to the Miners. Cumley and Hicks at left tackle and left guard respectively often slipped thru the Mines' line and smeared plays before they got well started. The 'Teachers' passing combination of Fleiger to Campbell gave the Mines' secondary much trouble and set up the Greeley touchdown. Brelsford proved to be a real

(Continued on page 561)
FROM THE Local Sections

BAGUIO

L. W. Lennox, '05, President; Frank Dalehunty, '25, Vice-President; T. J. Lawson, '16, Secretary-Treasurer. Box 252, Baguio, P. I. Monthly dinner meeting third Wednesday each month.

BIRMINGHAM

Tenney C. DeSollar, '04, President; W. C. Chase, Ex-'03, Vice-President; Hubert F. Risser, '37, Secretary, Flat Creek, Alabama.

BAY CITIES

Ronald S. Coulter, '19, President; R. P. Obrecht, '34, Vice-President; Leslie E. Wilson, '27, Secretary-Treasurer, 215-7th Avenue, San Mateo, Calif. Four meetings per year, 2nd Monday, March, June, September and December.

BUTTE

E. S. McGlone, President; H. M. Stock, '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.

HOUSTON

Clark W. Moore, '32, President; R. J. Schiltz, '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, September 13, at 6:00 p. m. in the cafeteria of the Lamar Hotel in Houston.

Those present were:


Mr. Paul Weaver, who is a geologist and geophysicist with the Gulf Oil Corporation, was our guest and gave an interesting talk illustrated with moving pictures on the modern field operations and equipment involved in geophysical prospecting, particularly in the marsh and coastal water areas here on the Gulf. Mr. Weaver's talk was enjoyed thoroughly by all.

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.

An enthusiastic group of Miners and their guests met at "Lucky" Baldwin's ranch, Santa Anita, California, Saturday afternoon, September 21, 1940, and thoroughly enjoyed themselves.

Those present were:


The picnic started off with a bang, the first comers trying out their skill at horseshoes. Needless to say, the boys from Long Beach could ring anything at will, except the third finger of a lady's left hand. Leonard White, one of the early arrivals, seemed to have a strange knack of persuading Mr. Romero to produce "wimpys" by the stack! He said something to Romero that sounded like a guy in distress, and believe it or not, it worked miracles. They say it was Romero's excellent command of Spanish. Well, it sure sounded funny to us as we wouldn't dare try it upon our wives! How about it, White? Anyhow, the general opinion is: No White, no Wimpys!

Miners soon found out why Mexicans can earn as much as $2.00 per day! Most of our contestants were perfect—that is, they hit the LOG every time! Ed Brook scored almost 100%; the log got in his way and spoiled his chances of a perfect score.

That magic beverage that contains every vitamin from A to P; and makes guys want to stand on their heads and play ball! The donor of the beer was the Pacific Smelting Company, Torrance, California. In Memoriam, let's all think of "Spike" Lannon, '07, former President of the Pacific Smelting Company, a Miner man forever!

The highlight of the picnic was the "hawkeye" game. Sides were chosen, so think the ultimate result was the "Hardrocks" vs. the "Leatherheads."

The "Hardrocks" The "Leatherheads"

"H" Turner c "Heady" Gouldin
"F" Turner e "Heady" Gouldin
"T" Turner p "Whiffer" Peet
"S" Turner m "Swifty" Brook
"E" Adams 2b "Evie" Adams
"F" Browell ss "Pipper" Armstrong
"T" Treadwell 1b "Bump" Dugan
"R" Runyon 3b "Bull" Runyon
"M" Miller rf "Heffy" Pack
"M" Miller cf "Pickle" Brines

Never before has such a tight "pitcher's battle" been seen on the Pacific Coast! That long "gangling" imported pitcher of the Hardrocks, "Skinny" Manke vs. that dynamic muscle-bound "Whiffer" Peet! Yes sir! They hit the bat every time! A duel—you said it! The only guy who managed to escape this vicious pitcher's assault was "Whiffer" Peet. Smart guy, that fellow—he managed to get his bat out of the way every time! "Bump" Dugan also turned in an excellent "Field" day, in fact, one could survey the horizon of weeds and everywhere was Dugan! Us "Westerners" almost forgot what a Kansas sunflower should look like—we'll swear they're simply Dugans on stems. The game was called because of darkness; final score: Hardrocks 19—Leatherheads 19. The umpiring was a bit rare. Here again "Bump" Dugan shone like a red rose. After failing to catch his second wind in the field, due to the efforts of "Evie" Adams, "Bump" Dugan decided that his spot should be "Umps" Dugan.

After the game the fellows sat down to an excellent barbecue dinner. Those who missed out on that delicious steak dinner surely missed a
The boys busied themselves talking over old times. Many had not seen each other for years. Bill Zulch, '14, of San Bernardino, and Joe Shanley of Long Beach, '15, hadn't seen each other since their graduation 26 years ago!

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

NEW YORK CITY
C. L. French, '13, President; Ben W. Goddes, '37, Secretary, 1112 University Terrace, Linden, N. J. Meetings held at the Western Universities Club, 4 West 43rd St., New York City, the second Tuesday of each month. Visiting miners please note.

A special meeting of the New York section was held on August 27th at the Western Universities Club. The meeting was called in view of the urgent need for funds in the Alumni Loan Fund.

It was decided that the money for the Alumni Loan Fund would be raised by individual contributions. The possibility of transferring a portion of our local loan fund was also considered, but was voted down by the group. Thus, we are going ahead with our contributions and expect to surpass our quota as set up by the Alumni Association.

It was further decided at this meeting to transfer the administration of the New York Section Loan Fund of about $1,300.00 to the school loan fund committee. This section has always been reluctant to do this because we wanted to stimulate interest in the formation of similar loan funds by other local sections. For that reason we have always restricted the use of our loan fund to students from the eastern part of the United States. However, the fund has been in existence for about 10 years and has not failed to stimulate a similar interest in other sections, but also it has not been used to any appreciable extent. Now, we want to take this opportunity to challenge the other local sections to equal us with other local section loan funds.

Ted Carter presented a discussion of his efforts to get some of the World's Fair exhibits for the School. It is believed that a number of fine exhibits will be obtained and many thanks are due Carter for his work.

Those present were:
- Harry Wolf, '03
- C. L. French, '13
- Jack Bonardi, '21
- Frank McKinless, '23

Two meetings in year, second Saturday in April and October. T. E. Giggy, '34, President; A. F. Halley, '09; Percy Jones, '27.

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

On the evening of August 31st the Utah Section of Mines Alumni Assn. held a meeting at the Newhouse Hotel. President Otto Herres gave a short talk which was followed by a moving picture of the Mines-Colorado College football game.

The committee in charge of arrangements consisted of Nevin Wetzell, Chairman; Dan Frobes and Frank Harris. We all appreciate the work of this committee and were especially pleased that they were able to show us the football picture which was enjoyed by all.

The meeting was well attended in spite of the fact that it was held on the Saturday before Labor Day when several of the members were out of town.

The following Alumni were present:
- Otto Herres, '11
- James Ballard, '36
- S. W. Johnson, '32
- D. H. Mullen, '25
- Dan Frobes, '24
- George E. Zelenkoff, '36
- T. P. Turchan, '35
- H. J. Van Der Veer, '30
- P. A. Pelton, '35
- Robert Brown, '39
- N. E. Sears, '24
- H. W. Heck, '36
- N. F. Wetzell, '14
- R. L. Christie, '24

The desirability and practibility of holding quarterly meetings at the various mining towns of Arizona, rather than the semi-annual meetings at Phoenix, was discussed. Most members seemed to be in favor of that idea. Definite decisions as to where and when were left open, pending reports from Alumni as to possibilities in their respective districts.

Alenius gave an interesting talk on Jerome during the lively times of the early twenties.

It was largely a social meeting and a pleasant one.

PHOENIX
Two meetings in year, second Saturday in April and October. T. E. Giggy, '34, President; A. F. Halley, '09; Percy Jones, '27.

Twelve alumni of the Arizona section met for dinner on the evening of October 19th at the Adams Hotel in Phoenix. They were:
- T. E. Giggy, '34
- Peter Geshel, '29
- J. F. Frost, '25
- Geo. D. Middleton, '31
- E. J. Eisenach, '39
- C. A. Davis, '27
- A. Z. Dimatroff, '19
- Percy Jones, '35
- E. M. J. Aienius, '23
- Geo. Jenkins, '39

Their guests were:
- J. L. Weaver of Ohio State University, Palmer Sae and M. S. Woodle, both of the South Dakota School of Mines.

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It was largely a social meeting and a pleasant one.

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

TULSA
John R. Evans, '23; President; D. H. Peaker, '32, Sec'y-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.
Personal Notes
(Continued from page 531)

Clyde Osborn, '33, who has been in the Philippines since his graduation, has just returned to the States and is receiving mail in care of A. H. Johnson, Morrison, Colorado.

Robert Paterson, '39, is now being addressed at Box 587, Phillip, South Dakota, where he is doing geophysical work for the Carter Oil Company.

John Peteraki, '36, has been promoted to Mine Foreman for the United States Fuel Company at Hiawatha, Utah. His post office address is Box 94.

Basil O. Pracott, '33, is Assistant Seismologist for the Shell Oil Company with address Box 476, Centralia, Illinois.

Charles E. Prior, '13, Consulting Engineer, is now being addressed at Alhambra, California, in care of Geo. N. Montereyat.


Robley F. Sopris, '26, who recently moved from New York to California, is Vice-President of the National Postal Meter Company, 142-154 West Slauson Avenue, Los Angeles.


Lincoln A. Stewart, '15, Engineer for the U. S. Bureau of Reclamation, receives mail at Box 64, Parker Dam, Calif.

Thomas L. Wells, '29, Consulting Engineer has moved from Toronto, Canada, to New York City, where his address is 50 East 72nd Street.

James Werner, '36, has a change of address to French Creek, Idaho, having accepted a position with the Golden Anchor Mine.

George Whitaker, '38, Sales Engineer for Ingersoll-Rand Company, resides at 117 West Chippewa, Buffalo, N. Y.

William Zohn, '35, who entered the army for a year of duty and has been stationed at Camp Ord, California, has been transferred to the Army Engineers' School, Fort Belvoir, Virginia. He holds the rank of First Lieutenant.

WEDDINGS
Stuart-Kitchel

Herbert Z. Stuart and Miss Katherine Kitchel, daughter of Mr. and Mrs. D. S. Kitchel of Bisbee, Arizona, were married on August 18, 1940, in the Covenant Presbyterian church at Bisbee.

The bride, a graduate of the Arizona Teachers college, served as teacher the past two years at Miami and Bisbee, Arizona. Mr. Stuart who graduated in 1936 is stope engineer for the Phelps Dodge Corporation at Bisbee.
Hugh E. Templeton and Miss Eleanor Robertson were united in marriage the afternoon of September 2 in St. Luke’s Episcopal church of Fort Collins, Colorado. Wallace Templeton of Denver was his brother’s best man and the bride’s attendant was Mrs. Warren Jarrard Jones of Cody, Wyoming.

Mrs. Templeton is the daughter of Mrs. Charles Clark of Otto, Wyoming. She is a graduate of Colorado State College where she was prominent in the various campus activities, her senior year being president of the Pi Gamma Mu, honorary sorority. The groom, of the class of ’36, is process engineer for the Standard Oil Company of Louisiana. The couple are now at home at 2229 Ovid Street, Baton Rouge, La.

Templeton-Robertson

George D. Volk and Miss Hannah Marie Wormington exchanged marriage vows Wednesday afternoon, September 6, at an informal ceremony in St. Martin’s chapel of St. John’s Episcopal cathedral of Denver.

The bride, daughter of Mrs. Charles Wormington, is a graduate of Denver University where she was a member of Alpha Gamma Delta sorority. She afterwards spent a year at Radcliffe and took graduate work in France and England. For the past several years she has been curator of archeology at the Colorado Museum of Natural History and has made many distinguished contributions to the museum’s records by her expeditions, during one of which she uncovered remains of a prehistoric civilization hitherto unknown.

Mr. Volk graduated from Mines in 1935. He is petroleum engineer for the Brown-Willard Oil Company with offices at 301 Hoke Building, Hutchinson, Kansas.

Volk-Wormington

William W. Stephens and Miss Nellie Louise Jones were also married in St. Martin’s chapel of St. John’s cathedral of Denver, the date being September 14. Harry Turts, a classmate of the groom, served as best man.

The bride is the daughter of Fred Jones, Jr., of Denver, the date being September 14. Harry Turts, a classmate of the groom, served as best man.

The bride is the daughter of Fred Jones, Jr., of Denver, the date being September 14. Harry Turts, a classmate of the groom, served as best man.

The bride is the daughter of Fred Jones, Jr., of Denver, the date being September 14. Harry Turts, a classmate of the groom, served as best man.

The bride is the daughter of Fred Jones, Jr., of Denver, the date being September 14. Harry Turts, a classmate of the groom, served as best man.

Robertson-Walbridge

George O. Argall, Jr. was united in marriage to Miss Patricia Haley in “Junglewood” the country home of the bride’s parents, Mr. and Mrs. Ora Ben Haley, the evening of September 16.

The groom of the class of ’39 is chemist for the American Smelting & Refining Company at their Globe Smelter in Denver. Mr. and Mrs. Stephens are residing at 1000 So. Logan Street.

Argall-Haley

Harlay D. Phelps, ‘10
Mining Engineer
U. S. Mineral Surveyor
Prescott, Arizona

W. C. Douglass, ’11
Mining Engineer
Hedley, British Columbia

Harlay D. Phelps, ‘10
Mining Engineer
U. S. Mineral Surveyor
Prescott, Arizona

W. C. Douglass, ’11
Mining Engineer
Hedley, British Columbia

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Mines Magazine + October 1940

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Weddings
(Continued from page 559)
Miss Wadlund attended schools at Hartford and is employed by the Traveler's Insurance Company.

BIRTHS
Mr. and Mrs. Kenneth R. Fenwick welcomed a second child into their home on August 21, a baby daughter weighing 10 pounds.

Mr. and Mrs. A. S. MacArthur are the proud parents of a daughter who arrived the morning of September 18. She tipped the scales at 3 pounds 1 ounce. Name chosen for her is Mary Roberts.

Mr. MacArthur is mining engineer for the Continental Mining Corp. The family home is 1565 Lafayette St., Denver.

Mr. and Mrs. C. K. Viland announce the arrival of their second daughter, Judith Ann, at the Martinez, California, Community hospital on September 22.

C. K. Viland, '29, is employed by the Tidewater Associated Oil Company as research engineer.

NEW MEMBERS
SEPTEMBER, 1940
Alumni
WALTER R. BROWN, '10 - Oakland, Calif.
THOMAS A. HORK, '36 - Denver, Colo.
SHERMAN W. JOHNSON, '32 - Murray, Utah
NORMAN E. SEARS, '24
MINES vs. MONTANA STATE
KICK-OFF 2:00 P.M.

COMPLIMENTARY SUPPER
MINES' FACULTY THE HOSTS
IMMEDIATELY FOLLOWING GAME

"M" CLUB DANCE—GUGGENHEIM HALL
9:30 P.M.

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or
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TRAILWAYS
Passenger Traffic Department
DENVER UNION BUS DEPOT KE. 2291
501 17TH STREET, DENVER, COLO.
Trade Publications—

(Continued from page 555)


[117] MOLYBDENUM STEELS. The September number of "The MOLY matrix" by Climax Molybdenum Co., 500-5th Ave., New York, is devoted to description of Chromium-Molybdenum and Nickel-Molybdenum Steels used for valves and radial drill parts. Analysis and physical properties are given of the steel described.

[118] NICKEL CAST IRON. The September issue of Nickel News published by the International Nickel Co., 97 Wall St., New York, contains many interesting illustrations and short articles on the advantages of using nickel cast iron as a highly resistant material for equipment used in the mineral industry. One very interesting article in this issue shows the important role played by nickel alloy cast iron in internal combustion engines.

Sports March—

(Continued from page 555)

The first touchdown was scored by the Miners in the first few minutes of play. The game opened with Greeley kicking-off. Berta took the ball on his own fifty and galloped up the field behind marvelous interference to the Greeley sixteen. Rogers and DeLalette then hurdled at the Greeley line and a few plays later Rogers took the ball across for a touchdown.

In the second quarter the Teachers forged ahead. A kick by Rogers was partially blocked and Greeley gained possession of the ball on the Mines’ 47 and marched goalward paced by Fleiger. A kick by Rogers was partially blocked and Greeley gained possession of the ball on the Mines’ 19. Fleiger faked back and tossed a pass to Sears who crossed over to tie the score at 6-6. Sears converted from a placement and Greeley was leading 7-6.

The Mines scored the winning touchdown in the last part of the third period on a beautifully executed pass. To start the drive Berta received a kick from his own thirty and ran back to the 48 yard line before being tackled. Then on second down he went off tackle and raced down the field to the Bears’ 25 where he lateraled to Tashiro who went on however, ruled that he stepped out of bounds on the 23 where the ball was put in play. Then on fourth down with the ball on the Bears’ 22, Campbell came in for Berta. The ball was snapped to Hallman who gave it to Campbell on a reverse. Hallman continued running and out in the clear near the goal received a perfect pass from Campbell and stepped across for the winning points. Hallman’s dropkick for an extra point was wide and Mines led 12-7 with which score the game ended.

The lineups:

Greeley State 
Colorado Mines
Brown, 1. e. ........................................ Greger, 1. e. 
Cunaley, t. ......................................... Mon, t. e. 
Hicks, l. g. .......................................... Spieles, l. g. 
Long, c. ............................................. Hutchinson, c. 
Kruse, r. g. ......................................... Volpi, r. g. 
Lahr, r. t. ........................................... Muley, r. t. 
Campbell, r. e. .................................... DeGates, r. e. 
Carlson, q. b. ....................................... Edwards, q. b. 
Fleiger, l. b. ......................................... Berra, l. b. 
Sears, r. h. .......................................... Rogers, r. h. 
Brelsford, f. b. ..................................... DeLalette, f. b.

Score by periods:

Mines ................................. 0 6 0 6—12
Greeley State ................................. 0 7 0 7—0


Substitutions—Mines: End, Blair; tackles, Stockmar, McKinney; guards, Gargan, Pruess; center, Eden; backs, Campbell, Hallman, Tashiro. Greeley State: Ends, Carson, Guthrie; Brown; tackles, Sutherland, Briggs; guards, Lucero, Rosario; Fair; center, Hutt; backs, Collier, Welch, Suitak; Green.

Officials—Referee, McDougall; umpire, Voiter; linesman, Gitmen. 

First downs .................................. 16
Net yards rushing ......................... 184
Yards lost .................................. 68
Net yards forwards ....................... 42
Forwards attempted .................... 19
Forwards completed .................... 11
Intercepted by .............................. 1
Yards interception .......................... 19
Punts (number) .............................. 10
Returned by ................................. 0
Average yards ............................ 39.7
Kicks returned ............................. 176
Punts ......................................... 68
Kickoffs ....................................... 108
Fumbles ....................................... 4
Recovered .................................... 3

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THE MINES MAGAZINE • OCTOBER 1940

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The article discusses the statistical data given.—D. W.


Fundamental controls of the gravity anomalies observed in Virginia are noted as thickness and lateral extent of low-density sediments; variations in the thickness and configuration of acidic upper crust. The writer presents all data used in the interpretations of the geologic picture; namely, seismic, gravitational and geologic. Such topics as basement configuration; basement lithology; density distribution; continental shelf area are treated. The gravity field in Virginia which is similar to that observed in other areas of the Eastern seaboard is believed to reflect three different conditions, namely: surface or near surface mass-density; distribution from lithologica1 variation; a lack of isostatic equilibrium.—D. W.


Gravimeters capable of measuring the value of gravity at a station of 0.1 of a milligal or less have been developed. The paper brings out the necessity of making accurate terrain corrections if precise gravity surveys are desired in hilly country. The terrain correction is considered as consisting of two parts, viz.: the "Bouguer correction" which treats the material beneath the station as a slab and the terrain correction itself which takes into account the undulations of the terrain around the gravity station. Both parts of the subject are fully treated and terrain correction tables with which the effect of terrain may be evaluated to the required accuracy are given. The formulas for the two tables are based are developed.—D. W.


A method is described for determining the value of density to be used in calculating the Bouguer correction for elevation of a gravimeter station. If incorrect density is assumed for the slab material between the station point and the base level to which stations are corrected, which is accounted for by the Bouguer correction, an appreciable error may be introduced into the measured values of gravity. The procedure makes use of the gravimeter itself in finding density by running a special traverse of stations across a topographic feature which is to be corrected for and reducing these stations for different densities. The density value for which the reduced curve has a minimum correlation with topography is the correct one. In effect the gravimeter is used to weigh the topography and overcomes the weakness of isostatic equilibrium. Examples are given. —D. W.

Seismic Methods:


Two examples of dip reflection surveys on faults in the Gulf Coast area are presented and discussed in detail. They represent limiting cases as it is pointed out that no sharp line can be drawn on one side of which mislabeled dips of a dip traverse can be interpreted as representing faulting and on the other side of which mislabeling can be attributed to observational error.

In one example a large fault is clearly shown by the geophysical data which in the other geological assistance was required to prove a small fault that did not appear from the geophysical information alone. The article adds to the none too extensive list of published examples of geophysical results.—D. W.


In the section on submarine seismology it is noted that advances in this type of exploration have depended on: (1) The use of rubber rubbershells for depth bombs (or shots) and (2) the use of marine balloons instead of cables for lowering and raising apparatus. Bombs of T.N.T. are described which have been successfully exploded on the ocean bottom at depths up to 2500 fathoms. Marine balloons are described by which seismic recording units can be placed on the ocean floor, take their recordings and float to the surface which eliminates the need for lowering such equipment by cables from the surface.

The article covers new techniques developed for deep sea geophysical prospecting.—D. W.

Refraction Type Seismic Prospecting Apparatus. E. and M. J. 140(7) 84, July 1939.

A picture and brief description of a lightweight portable refraction seismic apparatus manufactured by the Geophysical Equipment Company, Washington, D. C. It is reported one man can operate the entire apparatus.—D. W.


A brief description of the seismic method of prospecting with special attention to the reflection procedure. The article covers particularly the equipment used by the D'Arcy Exploration Co. for seismic exploration in the Mississippi Delta. Detectors, filters, amplifiers, and other phases are described. A sketch of the equipment in the "van" (Recording truck for Americans) is given. Some seismic programs are attached which show outstanding reflections.—D. W.

WILLIAMS, NEIL. Marsh Buggy for Geophysical Crew. Oil and Gas Jnl. 38(34)-58, August 17, 1939.

A description and picture of a "Marsh Buggy" developed by the McCollum Exploration Co. for geophysical work in
An investigation of the nature of the wave motions produced by a dynamite blast as recorded on a 3 component seismograph. It was concluded that the con-
centration of energy at the source, divided into principal wave types. These separate
wave motions produced by a dynamite blast may have remained in some places several hundred feet or more of the section. The value of reflection wave velocity used in a depth calculation is present if applied to a point where less thickness of section occurs would lead to an incorrect depth determination. Under such conditions resulting contour maps may in some cases show evidence of surface topography.

The procedure described takes into consideration the effect of the velocity in the eroded part of the section. The wave path is divided into two portions as indicated by the local geologic conditions. This treatment is also of aid in correcting measurement of intervals between two reflecting horizons.—D. W.

General:


In this article the costs of geophysical exploration and other forms of exploration such as core drilling, trenching and actual prospecting are critically compared. Field methods of exploration cost drilling history; diamond drilling costs are treated. Tables and discussion on costs at Huntier Hill and Sullivan, the Tarpatch area at Mineville and the United Verde Mine are presented. Geophysics as applied to placer deposits and briefly in petroleum exploration are included. The author notes a want of good exploration cost data and concludes with the thought that substantial savings are possible by the use of geophysics in both mining and petroleum exploration. Much of the pertinent data on the subject is gathered in this article which includes a bibliography of 16 items.—D. W.


Descriptive and biographical sketch of the late Donald C. Barton one of the leaders in the development of Exploration Geophysics in the United States. —D. W.


has been largely economic and in the fields of petroleum and mining. In the solution of larger, regional and semi-regional geo-

physics problems not only in the United States but also in parts of the world other countries have not been much used. Their possibilities in this latter field are dis-
cussed. Examples of such work in which the joint efforts of various governmen-
tal and state surveys and educational and scientific organizations are involved are considered. The manifest advantage of such programs are clearly shown.—D. W.

De Golyer, E. Notes on the Early His-
tory of Applied Geophysics in the Petro-

Beginning with the summer of 1914, when the author first became interested in the possibilities of geophysical instruments, the outstanding events and interf-
crating high lights in the early history of geophysical exploration are given. The first halting steps in the application of the torsion balance, the refraction seismic method, and the reflection technique are traced through to the time of their general recognition. Individuals, companies, and places of interest in this growth are con-
sidered.—D. W.


The writer points to the future of mine geophysics as playing a wider role than at present, namely, in its possibilities of geophysical interpretation, as well as minor structural features, such as probable loci of mineral deposition as a guide to the development of a mining district. The article contains a discussion of the self potential, the magnetic, the potential drop-
ratio and resistivity methods of prospecting. These are illustrated by maps of survey results including descriptions of the geological setting and geophysical findings. Many of the examples come from surveys by the author in Canada and elsewhere and others from exploration work in various mining districts throughout the world.

There is here given an outstanding ex-
hibit of examples of what exploration geophysics accomplished in its applica-
tion to mining problems on a basis of what it has done.—D. W.

KANENSTORF, F. M. The Relations-
ships of Geophysics to Geology. Geo-
physic 4(3), 149-154, July 1939.

Using geology to mean petroleum geology and geophysics to mean petroleum geophysical methods, the writer discusses that ever since the development of the structural theory geologists have been mapping the attitude of sedimentary beds in searching for oil and gas. Geophysics came as an answer to the need for better methods of doing this mapping. The place and basis of the different geophysical methods in such work it reviewed, as well as the ability of existing methods to locate fields associated with faulting, as shown by re-
dent discoveries, and to outline low relief structures which have been the subject of much discussion. The true stratigraphic trap is still 2 to 1. The article surveys the mat-
ter of the discovery of reserves interest-
ingly.—D. W.


In evaluating the contribution of geo-
physical prospecting to mining charts the unit prices of a barrel of oil, of copper, of lead, and of silver since 1918 and of the annual production of these min-
erals for a like period are given. A valu-
able table showing date, method, location, and results of electrical prospecting methods applied to mining going back to 1932 and a like table for magnetic, gravity, and geothermal methods with a first entry 1760 is given.

The accompanying discussion and tables depict results for the past two decades in the United States. Oil exploration is not here considered.—D. W.


Part one of this report (previous pub-
lish Crude Oil Weekly) treats the effect of temperatures on oil well drilling. Part two, here reviewed, cov-
ers the effect of temperatures on oil pro-
duction, and discusses the geothermal gradient present in oil fields of the Gulf Coast.

This latter topic, is of geophysical in-
terest. The writer presents a table of sub-
surface maximum temperature, depth, geothermal gradient in 73 Texas and Louisiana fields in connection with other data on the subject. Cross sections show-
ing relation of isogeo thermal surfaces and the north side of the Humble Salt Dome and across the Gulf of Mexico are given. A bibliography accompanies the article.—D. W.

This is a well-written, modernized edition of the late Professor James Furman Kemp's standard work on the megascopic identification of rocks. The revision was carried out by Frank F. Grout, Professor of Geology and Mineralogy at the University of Minnesota.

Incorporating many recent advances in the science and many teaching advantages, this new edition retains all the merits of its predecessors. It remains an outstanding guide to the study of rocks as to origin, and identification in the field and laboratory. It is designed to follow general courses in geological science, but not to require advanced optical and microscopie equipment.

Among the new features there is included much research published since the last edition; data on fusion and crystallization of rocks, on weathering, on methods of study of rocks in connection with exploration for petroleum, and on the mechanism of development of metamorphic rocks. A new emphasis has been placed on the origin of rocks, making it easy to understand how variable the formation of rocks can be and, consequently, what variety is to be expected in the result. Sample descriptions of different rocks are provided for the student's work and, to help him further, there are numerous practical calculations to be made by application of the general statements and laws.

Simplification of terminology is accomplished by the use of easily understood prefixes before the common fundamental names. Care has been taken to avoid the use of names based on little known localities. The chemistry of rocks is taught based upon general statements about composition, but these calculations may conveniently be assigned whenever the teacher wishes. This constitutes a method of presentation that possesses many advantages over the mere use of tables of analyses. This text has ample material for the usual one-semester course, having a total of six hours a week in class and laboratory; it may, however, be readily adapted to shorter courses.

There are several distinctive features of this book including:

1. A list of rare names and their general meaning.
2. Criteria for distinguishing the main classes of rocks.
3. Notes on methods of correlation of sedimentary rocks, used by oil-field geologists.
4. Notes on keeping a log of drilled wells.
5. Sample descriptions of various rocks.
6. Variation diagrams of rock series.
7. Summation of interest in several classes of rocks.
8. Many details of Professor Kemp's own studies of rocks and ores formed at the contact of limestones and igneous rocks.

—J. C. F.


The Searchlight district in Clark County near the southern tip of Nevada has produced over 50,000,000 gold, silver, copper and lead valued at over $5,400,000. The shipment via the Union Pacific Railroad is Nipton, 22 miles to the west, but the district is reached by roads from Las Vegas, Nev., and Needles, Calif.

The district, discovered in 1897, included an outlying group of low hills on the east side of the valley and on the west side of a low range of mountains that slopes more than 3,000 feet to the Colorado River. Gently sloping surfaces adjacent to the low hills are upstope pediments or slopes of bedrock with a thin mantle of alluvium. Many of the mines and prospects are in the pediments.

The oldest rock in the district is a granite exposed in the southern part of the district near the Quartzette mine. It is overlain by a group of andesite flows and breccias that have been largely converted to hornfels. These rocks were intruded in a most complex manner by ankerite porphyry, but both the andesite porphyry and the earlier rocks subsequently were intruded by a large body of quartz monzonite. The intrusion of the veins followed the invasion of the quartz monzonite. Extrusion of another series of volcanic rocks, exposed chiefly in the northwestern part of the district, followed a period of erosion. The ages of the different rocks are unknown, though the gneiss is judged to be pre-Cambrian, and the later rocks are considered to be early and late Tertiary. Warping and faulting followed the accumulation of the last group of volcanic rocks.

The veins are distributed in an en echelon pattern along the western and southern margins of the quartz monzonite body. Most of the veins have a westerly strike and dip moderately to the south. A few strike nearly north and dip to the west. The depth of the largest veins were about 1,000 feet long. Ore shoots were mined to a maximum depth of about 900 feet down the dip, but many veins were stopped only near the surface. The ore shoots consist of breccias of country rock cemented with vuggy quartz and, in the most productive veins, with the sedimentation of sulphide minerals. A peculiar ore shoot at the Blossom mine was saucer-shaped and nearly flat.

The principal product of all the mines was gold; silver was a minor product in terms of value except in a very few veins. Considerable quantities of copper came from the Quartzette mine and the Duplex mine yielded copper and lead in addition to gold and silver. With the exception of residual lumps of galena in the Duplex mine and some complex sulphide ore in the Big Casino mine, vein materials have been weathered. Original copper-bearing sulphides have changed to copper carbonates, carbonates, and sulphates. Cerussite is the principal mineral, and hemimorphite (calamine) accounts for minor amounts of zinc. Gold is visible in some of the rich ores, but no silver mineral was seen. The dominant gangue mineral throughout the district, but adularia and calcite become prominent in the northern part. Hematite is present in the Quartzette vein.

The wall rock of the veins in the southern part of the district has been little modified by the vein-forming solution, but in the northern part of the wall rock there has been a great variation of quartz and adularia with remnants of earlier minerals. The regional variation in alteration of wall rocks together with a corresponding change in ore deposits indicates a zonal distribution of the deposits. The higher-temperature type of deposit is represented by the Quartzette vein at the south, whereas the lower-temperature, outer zone type, is represented by the Pompeii and J. E. T. mines to the north. This distribution is not radial with respect to the outcrop of the quartz monzonite.

Of the 16 mines and prospects described, the Quartzette and the Duplex have had far the largest production of gold and silver and also account for nearly the entire output of lead and copper. Explorations in the vicinity of some of the larger veins are expected to result in a continued small production from the district.—Author's Abstract.


Aerobic as well as anoaerobic bacteria are found in marine bottom deposits. They are most abundant in the topmost few centimeters of sediment below which both types of bacteria decrease in number with depth. A statistical treatment of the data on their vertical distribution suggests that aerobes are active to a depth of only 5-10 centimeters whereas anaerobes are active to depths of 40-50 centimeters below which they seem to be slowly dying off. However, microbiological processes may continue at considerably greater depths, owing to the activity of bacteria that accumulate in the sediments. The organic content is the chief factor which influences the number and kinds of bacteria found in the sediments.

Bacteria lower the oxidation-reduction (O/R) potential of the sediments. Vertical sections reveal that the reducing intensity of the sediments increases with depth, but the muds have a reducing capacity near the surface. Three different types of oxygen absorption by the reduced muds are described, namely: chemical, enzymatic, and respiratory.

Bacteria that decompose or transform proteins, lipins, celluloses, starch, chitin and other organic complexes occur in marine sediments. These bacteria tend to reduce the organic matter content of the sediments to a state of composition more closely resembling petroleum although methane is the only hydrocarbon known to be produced by the decay of the decapitation or solution of calcium carbonate as well as certain other minerals is influenced by microbiological processes that affect the hydrogen-carbon ratio. Other bacterial processes influence the sulphur cycle and the state of iron in the sediments. The possible role of bacteria in the generation of petroleum is discussed.

—Author's Abstract.


Transportation affects sedimentary particles both by abrasion and by progressive sorting. The latter factor has not received the attention it deserves, and probably is more important than abrasion under some conditions. The effects of abrasion and...
Our knowledge of the effects of transport, and especially of the causes of these effects is far from complete. We know that most sediments show a progressive decrease in mean grain size in the direction of transport. Though this effect has often been considered to be due almost entirely to abrasion, it may equally well result from sorting on the basis of size. Stream and beach gravels appear to become progressively rounder with transport, but this might be partly the result of sorting according to shape, at least under some conditions, rather than being entirely an effect of abrasion. The predominance of flat pebbles on beaches has also been ascribed both to abrasion and to sorting according to shape.

The concept that streams round their transported sands does not appear to be generally true; the available data indicate that stream sands usually remain angular or become more angular than some of what rounded previously. Theoretically, stream sands would be rounded if little or no coarse material were present and conditions were gentle, but the writer does not know of a published description of such a case. The rounding of sand grains appears to occur chiefly in areas of sand transportation, that is, in dunes on beaches. The evidence, however, is not sufficient to prove whether wind or wave action is most effective in rounding sand. Dune sands appear to show the best rounding, on the average, of any type of sediment but this is not valid evidence in favor of the effectiveness of wind abrasion alone. Some dune sands indicate that the roundness of dune sands is a property largely inherited from beach sands, the higher mean roundness of dune sands resulting from transportation of previously rounded grains. Regardless of which agent is most effective, experiments show that grains of sand size are rounded so slowly that it would take hundreds or thousands of years for the rounded grains probably have been subjected to more than one period of rounding.

Progressive changes in the mineral composition of sediments in the direction of transport seem to result from the interaction of a number of factors, beside the addition of material from new sources of supply. These are abrasion and sorting according to size, shape, and specific gravity. Of these, abrasion appears to be one of the least important with sand-sized grains, but probably becomes increasingly significant with progressively larger particles.

Evidently only a few of the commonly accepted concepts regarding the effects of transportation on sedimentary particles can be considered as definitely proved. Some appear to be false; others, though possibly true, have not been firmly established by sufficient evidence. Further research is needed on almost all phases of this problem before positive conclusions will be justified. —Author's Abstract.


The data for this study are derived from 8 traverses across the continental shelf, from Cape Cod to Cape Canaveral, and 3 from the Gulf of Maine. Samples were taken in 2 miles apart.

The source of the present-day sediment is largely reworked glacial debris for the northern lines, and for those outside the limits of ice advance, reworked Coastal Plain deposits. Although the distribution of sediments appears very diverse when the shelf is considered in small areas, certain uniformities in their arrangement appear when regions. This distribution indicates that the bottom deposits are becoming adjusted to present sea-level, and that the differences are largely dependent on source of supply.

Calcareous carbonate is present in significant amounts north of Cape Hatteras. South of this cape, however, it is a main constituent of the bottom deposits, often reaching 50-90 percent. It is derived from the skeletons of various organisms which have been comminuted to the same sizes as the inorganic particles, and also from silts. Some of the lime is undoubtedly derived from the reworking of older deposits.

The Gulf Stream is the only one of the currents making win the main circulation system of the ocean that has any effect on the continental shelf. South of Cape Hatteras, the continental slope is, for the most part, swept bare of unconsolidated material by this current. A combination of wave action and tidal currents is sorting the bottom deposits in water shallower than 60 to 70 meters and occasionally to greater depths. These methods are exceptionally strong. Wave action is known to extend to the bottom all over the shelf in winter but is not effective in agitating the sediments below the depths given above.

A profile of equilibrium has been developed on the inner halves of the northern lines and is best exemplified on the Marthas Vineyard traverse. The traverses south of Cape Hatteras represent profiles that are still far above wave base.

South of New England is a large area in which quartz sand grains, exhibiting a very high degree of rounding, are found in abundance. Most of these grains have a mat surface unless it has been secondarily removed. They are thought to be the remnants of dunes formed during the lower sands of the sea during the Pleistocene. Many sediments on the break in slope are coarser than those immediately inshore. They are also considered to be residual from a lowered sea-level.

The grade size does not decrease uniformly in an offshore direction. However, the bottom deposits, by their very diversity, are merely a modern illustration of conditions that have been in operation throughout the whole history of Coastal Plain sediments. Settling out along the margins of a major ocean must not be considered typical of an inland sea.

—Author's Abstr.
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WHAT'S IN A NAME?

J. H. J.

THE LAW OF RIVERS

The conditions of transport of detritus by moving water constitute one of the most vital problems confronting students of sedimentation. This article by Hjulstrom summarizes the main aspects of present knowledge of the problem as applied to rivers. Many of the relations for river water apply to ocean water; but the sea differs from rivers in at least three ways: the large masses of water involved; the slowness with which the water moves; and the effect of tides. Notwithstanding the fact that these three phenomena modify the picture as portrayed by Hjulstrom for rivers the information he presents is of great value to students of oceanography.

The laws governing the different kinds of transportation are complicated. For particles larger than sand (0.5 millimeter) the size of particles that can be put in motion increases as the velocity of the water becomes greater; but for smaller particles the minimum velocity that is required in order to bring them into suspension does not decrease as the particles become smaller; instead it increases. Thus it is easier to move sand off the bottom than silt. Once a particle is in motion it continues to be transporting velocity for particles of sand size or larger seems to be about 30 per cent less than the velocity needed to remove the particles; but the sea differs from rivers in at least three ways: the large masses of water involved; the slowness with which the water moves; and the effect of tides. Notwithstanding the fact that these three phenomena modify the picture as portrayed by Hjulstrom for rivers the information he presents is of great value to students of oceanography.

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—Author's Abstract.
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