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PERSONAL NOTES

Haskell R. Collins, '39, Computer for the Seismograph Service Corporation, is being addressed at Box 334, Kingsville, Texas, at the present time.

H. M. Cronin, '13, Superintendent, National Fuse & Powder Company, has a change of residence address to 1681 Madison Street, Denver.

Evans Ferris, '18, has received a promotion from The Gates Rubber Company as their representative in Phoenix, Arizona. His address there is 1205 West Jefferson Street.

George Gebhardt, '40, who is doing seismograph work for the Stanolind Oil & Gas Company, is receiving mail thru Box 3565, Edna, Texas.

Ardis Has, '36, is Party Chief, Seismograph Division, Phillips Petroleum Company, and is now being addressed at Ardmore, Oklahoma.

Robert L. Halley, '05, is Chief Chemist for the National Lead Company, 111 Broadway, New York City.

Francis E. Healey, '15, Consulting Geologist and Geophysicist, makes his home at the Elks Club, San Antonio, Texas, where he receives mail.

Herbert W. Hecht, '34, is now Junior Engineer for the Silver King Coalition Mines Company at Park City, Utah. His address there is Box 57, Park City, Utah.

Arthur J. Hietz, '12, is Staff Engineer for the Public Service Company of Colorado, residing at 1340 Garfield Street, Denver.

Harold M. Holkestad, '24, District Manager for E. D. Bullard Company, makes his offices at 411 Atlas Building, Salt Lake City, Utah.

Paul M. Hopkins, '39, is Pushman in the Coke Plant of the East St. Louis Refinery of the Socony-Vacuum Oil Company. His mailing address is 1704 Winstanley Street, East St. Louis, Illinois.

Alfred C. Howell, '35, Manager of Alfred C. Howell Transportes Fluviales de Petroleo, has mailing address of Apartado No. 369, Tampico, Tamps, Mexico.

Walter C. Huntington, '12, is Engineer for Phillips Dodge Corporation at Clarkdale, Arizona.

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Fred D. Kay, '21, is Assistant Superintendent, American Rutile Corporation, Roseland, Nelson County, Virginia.

A. M. Keenan, '35, Chemist, Preparation Department, Pittsburgh Coke Company, has a change of postoffice address to Box 33, West Newton, Pa.

William C. Lang, '39, is Chemist for the Sun Oil Company and resides at 123 W. 2nd Street, Mesa, Arizona.

William R. Lewis, '40, resigned his position with Ingersoll-Rand Company and returned to Denver where he has become associated with Crane O'Fallon Company as Engineer. His mailing address is 1722 Gilpin Street, Denver.

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Texas Company, is now being addressed Engineer, with mailing address 2213 Terrace, Linden, N. J.; A. G. Hoel, Jr., Broadway, New York City; Kirk C. '36, Engineer, Letvis H. Boyd, '36, Party Chief, Brown E. L duPont de Nemours & Co., 1110 Engineer. Tropical Division. His position is that of the Braden Copper Company. His present position of Chief Engineer for the Baguio about six miles out of Portland, Maine. McKinley Island, Maine. The island is at Box 361, Brenham, Texas.

Allan P. Nesbitt, Jr., '38, is returning from Chile where he was employed by the Braden Copper Company, his present address is 1121 Dodge Court, Cheyenne, Wyoming.

Thomas E. Northrop, '32, is being addressed in care of the Seismograph Service Corporation, Hotel Jardin, Maracay, Venezuela, which is the head office of the Tropical Division. His position is that of Engineer.

Robert Wm. Price, '35, who returned from the New York & Honduras Rosario Mining Company in Honduras last spring is now Night Mine Foreman for the Summer Mines, Ltd., at Fallon, Nevada. His address is 338 West Center Street, Fallon.

William J. Rudig, '34, is Engineer for the Puthers Coal Company and resides at 1321 Illinois Avenue, Pittsburgh (16) Petna.

Horace A. Tanner, '21, Geologist and Field Engineer for Cia. Minera Tie Penaoles, S. A., makes his headquarters at Monterrey, N. L., Mexico.

Thomas P. Turcan, '35, is Mine Shift Boss for the Combined Metals Reduction Company with mailing address 326 E. 1st South Street, Salt Lake City, Utah.

C. A. Weitzel, '27, Geologist, Stanolind Oil & Gas Company, has a change of residence address to 142 Goadrich Street, Lexington, Kentucky.

Rees A. Wofford, '28, is now located at Cartersville, Georgia, Box 370, where he is Mining Engineer for the New Riverside Ochre Company.

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Front Cover

Rubber tracks for tank tracks. U. S. Army light tank maneuvering. Contracts for manufacture of rubber track blocks for a large number of combat tanks for the national defense (similar to tank in Acme News photo) have been awarded to The Goodyear Tire & Rubber Company by two foundries and a federal arsenal engaged in the production of armored vehicles of war. The orders, issued on a sub-contract basis, call for approximately 130,000 units, which will be vulcanized to metal plates and furnished with necessary bushings and accessories at Goodyear's mechanical goods plant in Akron and must be completed by March 1, 1941.

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Official Organ of the Colorado School of Mines Alumni Association, Inc. Copyright 1940. Entered as Second Class Matter at the Postoffice at Denver, Colorado, under the Act of Congress of March 3, 1879. Subscription price $3.00 a year. Single copies 50 cents. No additional charge for foreign subscription. Published every month in the year by the Colorado School of Mines Alumni Association, Inc. Address all correspondence to Frank C. Bowman, Editor, 934 Cooper Building, Denver, Colo.
Honduras is a Spanish word meaning great hollows. When one flies over the country and looks down upon it from a height he sees before him a country of great hollows. The mountain ranges, instead of running in a general north and south direction like they do in North America, have a general east and west trend. The maximum altitudes are gained on the peaks at about 10,000 feet, but the general elevations of the highest part of the mountains are from 6000 to 8000 feet. The hillsides are very precipitous. There are several large rivers and those that flow into the Caribbean Sea along the north coast of Honduras flow through wide and fertile valleys.

In the highlands between the mountain ranges are high plateaus. The uplands are forested with several varieties of hard wood and pine trees. The lowlands are jungles of tropical plants of various kinds. The plateaus in the uplands vary in elevation from 2000 to 4000 feet. The climate in the uplands is almost ideal. During the dry season the temperature rarely exceeds 80° to 85° and rarely goes below 50°; there are few rains, but plenty of rainfall to mature crops of rice, corn, beans, grains, etc. Any of the temperate zone crops can be raised on the uplands. During the wet season there is an abundance of rainfall.

In the lowlands the climate becomes very hot and humid with temperatures of about 85° to 95°. During the dry season in the lowlands, the days and nights are warm and delightful. The principal crop in the lowlands is bananas. There is plenty of rainfall during the wet season, in fact, too much rainfall, so drainage ditches must be built to drain off the excess water from the banana plants, but during the dry season the banana plants must be irrigated for a considerable part of the time.

During the wet season all of the streams in Honduras run full of water and at times part of the country is flooded, but during the dry season the streams become small and some of them dry up. The Rosario Mine has three hydro-electric plants which furnish it with an abundance of power for all purposes during most of the year, but during two or three months the streams dry up to such an extent that the company gets only a part of the power that is needed. Therefore, the company installed a diesel power plant to give it the necessary power at those seasons of the year when the hydro-electric plants could not furnish the requisite amount. Owing to the precipitous nature of the country there are many places where hydro-electric plants can be built, but these plants would have the disadvantage of furnishing a surplus amount of power during certain seasons of the year and an inadequate amount during a small part of the year.

The traveller in passing through the country is impressed with the beauty of the scenery. In every section there are unusual scenes where the mountains, the rivers and vegetation combine to add to the beauty of the landscape. The beauties of the country are not available to the usual traveller. There are few roads in Honduras. The two or three improved roads are not as good as those usually built by the detestable engineer named "de-tour." It is difficult to travel over the best roads by automobile because they are narrow and rough and there are very few bridges crossing the streams. Most of the travel is done on the backs of mules. Throughout the country are numerous trails that have come into being through centuries of travel. These trails are worn down so that after a rain they are filled with pools of water. The hoofs of the mules very quickly make these pools into bogholes of mud, so that the modern traveller, who is used to paved roads and fast low-hung automobiles would rather forego the pleasures of viewing the scenery. One of the great needs of Honduras is good roads but on account of the precipitous nature of the
Honduras has an area of 46,332 square miles, about the size of the state of Pennsylvania. The population is about 1,000,000. The largest city is Tegucigalpa, the capital, with a population of about 45,000 people. It is located in the west interior of the country at an elevation of 3,200 feet. The climate in Tegucigalpa is delightful throughout the year. The city has few modern improvements. It has a sewage system, electric lights, water system, telephone and telegraph. The streets are narrow and paved with cobblestones.

Tegucigalpa is reached through the port of Amapala in the Gulf of Fonseca on the Pacific side. From Amapala, which is on an island, the traveller takes a launch to San Lorenzo then by automobile he travels for 5 hours over an 80 mile tortuous mountain highway to Tegucigalpa. Busses, trucks, ox carts and mules travel this highway quite extensively. Another route which is from the Atlantic side, is to take the National Railroad at Puerto Cortes on the Caribbean Sea, and travel by rail for 66 miles to Potrerillos then by truck to Lake Yojoa which is crossed by ferry then continue by truck over a rough road up through Comayagua to Tegucigalpa. The easiest way to reach Tegucigalpa is by plane from Amapala on the Pacific side or from any of the ports on the Atlantic side.

Tegucigalpa is one of the oldest cities in the western hemisphere. It was an Indian village before the Spaniards made a city of it several hundred years ago. The narrow streets and quaint Spanish buildings make of it an unusual and attractive center for the tourists, but the city enjoys practically no tourist trade. It is difficult for the tourist to reach the city and it takes much time for him to search out the points of interest after getting there.

The second largest city in Honduras is San Pedro Sula. It has a population of about 17,500 and is located in the heart of the Ulua Valley. It is in the lowlands, in the banana country. It is also quaint but its streets are wider than those of Tegucigalpa. It has an electric light plant, a water system, telephone and telegraph, but practically no other modern conveniences.

The third largest city is La Ceiba which is the principal port on the Caribbean Sea. It has a population of about 10,800 people.

The other ports of consequence are Tela, Puerto Cortés and Trujillo, all on the Caribbean Sea. Tela is a modern and up-to-date town built by the United Fruit Company and is the principal port from which they ship bananas. The United Fruit Company also ships bananas from Puerto Cortés. The Standard Fruit Company have their docks located at La Ceiba. All of these towns located on the north coast and in the lowlands of the north coast are connected by railroad.

The accommodations for travellers in all the Honduranian cities are poor except in two of the United Fruit Company towns, which are Tela and La Lema. Both of these towns are modern with beautiful little homes for the staff of the United Fruit Company and well built homes for the workmen. Outside of these cities and Progreso which is another United Fruit town, there is very little sanitation in Honduras.

The population of Honduras is mostly Indian with a little mixture of Negro blood. The better class of people are Spanish or a mixture of Spanish and Indian. The great mass of people live in the interior of the country. They are a kindly, likeable people who seem to be very happy in their way; their wants amount to practically nothing. They will do anything they can for the visitor, but the majority of the people in the country are illiterate. They have no newspapers or contact with the outside world so they know nothing about what is going on except in their own neighborhood. Of course they have heard of Tegucigalpa and they have probably heard about a war somewhere in Europe, but have little idea of where Europe is located and they know nothing about the nations involved in the conflict.

These people live in thatch houses which can be built in two or three days. The only tool they need for putting up such a house is a machete, which is the one instrument used by the native Honduranian for almost all purposes. With his machete he will cut the poles for the frame work of his house. These poles are tied together with faggots. The walls are usually made of poles tied closely together with faggots and the roof is covered with thatch. Over in the corner or just outside under a porch is his native stove which is built up from the ground with rocks with a hearth of clay. With an open fire on this hearth he cooks his meals. Occasionally a native will build a dutch oven which is also made of clay and used for baking bread. These huts protect the occupant from the rains and in their construction there is no need for him to buy anything. His food consists of beans and corn, chickens, pigs, etc. Almost all of the natives have chickens and pigs. They are never fed, they browse about the place getting what food they can find. The natives gather the eggs, kill the chickens and slaughter the pigs for their own use. The ordinary native does not produce anything for the market, although there is a large amount of trading with his neighbor. One of the neighbors will trade a part of a pig for some corn or beans, etc. Throughout the country there is an abundance of fruit such as oranges, grapefruit, tangerines, bananas, etc., that grow and yield...
An abandoned and wrecked Chilean mill in foreground and arrastre in background. The arrastre is used quite extensively by natives in crushing gold ore.

Abundant crops without any care whatever. All of this fruit is practically free to the natives just for the asking, so it is unnecessary for the native of Honduras to work to live. He can live comfortably by loafing around. The women folks do practically all the work. They do the cooking and they do the washing. It is unnecessary for the native to wear very much clothing because of the warm climate. Therefore, his wardrobe is not very expensive. Children as a rule run naked until they are about 4 or 5 years old. So this is the life of the majority of the people of Honduras.

But the country must not be entirely judged from the native peon. There are cattle ranches in Honduras owned by natives in which the owner of the cattle ranch will have several families of natives working for him. Of course, he pays them very little, but allows them plenty of food and some clothing. Likewise there are plantations owned by the higher class natives that are brought up to a high degree of productivity and the crops are harvested and marketed. The aristocracy is made up of well educated people some of whom have command of several languages; they are delightful people to meet and know. During the time of the Spanish occupation all of the people of Honduras were practically slaves of the conquering Spaniards.

During the Spanish reign there was a great development of the country. Nearly all of the present native cities were built under the Spanish rule. When the Spaniards were driven out the people had difficulty in creating for themselves an economic system which would develop the country. The lower class of people were content to live a semi-civilized life and the higher class of people had difficulty in organizing a government that they would all support. Therefore, the country has been handicapped with frequent revolutions, the last revolution occurring about 10 years ago. The country is now enjoying a stable government and is making steady progress. The present ruling officials are extremely anxious to develop the country and improve the conditions of the people, but even the higher class of people in Honduras are not industrially inclined. Although there are many artisans in the country who display unusual skill, yet there isn't the initiative and the cooperative spirit necessary for real development. Time means very little to the natives, so left to themselves the progress would be extraordinarily slow.

Honduras is a country of great natural resources. It is a country that could be developed into one of the most prosperous and highly developed areas on earth. During the Spanish occupation Honduras was an empire rivaling in production that of Mexico and Peru. There were gold and silver mines developed which poured wealth into the laps of the Spanish noblemen, but when the Spanish were driven out all of this enterprise and development slumped and it hasn't yet started to move again. Honduras is dependent upon the initiative and enterprise of the foreigner.

Another great handicap to Honduras is the fact that it is a country. All small nations are at a disadvantage in the world of today. A small nation must maintain all the governmental departments such as a post office, banking system and custom house staffs just the same as larger nations. It also tries to support a diplomatic staff and an army. With an economic system limited to the export of only a few commodities the small nation is unable to maintain a national government comparable with that of the larger nations. The result is that a small nation like Honduras is usually in poor financial condition and the common people are in various stages of poverty. There is no abundant life or high standard of living as enjoyed by a larger nation with a larger and varied economy.
ness of only about eleven million dollars a year, (based largely on export of bananas) yet it has almost no public debt and with difficulty has kept its lempira (worth 50c) on par with the United States dollar.

The greatest development in the country and the one that has done the country the most good has been the entry of the United Fruit Company and the Standard Fruit Company in building up the banana business. These two companies have furnished an outlet for a valuable commodity, they have given work to a large number of natives and they have given to the government a steady and dependable income. They have also been very solicitous in helping the government to build the country and to improve the native population. Honduras is the largest banana growing country in the world. About 80% of its exports to the United States are bananas, which is a cash crop in demand throughout the entire year.

The next most important development is that of the Rosario Mine which is owned by the New York and Honduras Rosario Mining Company. This company is a steady producer of silver and gold and is marketed in the United States. It gives to the government a steady income and is as solicitous as the two fruit companies in helping to build up the country and its population. But the initiative in all these enterprises is from citizens of the United States. The future of Honduras as well as the other Central American Republics depends upon their linking their economy more closely to that of the United States. Although Honduras is a republic with the constitution copied almost bodily from that of the United States, yet very few of the people have enough knowledge to vote or to exercise suffrage or to otherwise fulfill their obligations as a free and independent people. If Honduras had the same support that the Philippine Islands receive from the United States it would become almost overnight a country of opportunity, prosperity and wealth. If the people could be educated, if the country could be opened with new roads and with better farms and factories, the population itself would give a ready market for almost everything that could be manufactured in the country. The United States will always furnish a splendid market for most of the fruits and all of the metal and mineral products that the country can produce.

Another development in Honduras of unusual significance is that of air-plane transportation. The Denver Post in its edition of September 29, 1940, carried an article telling about the development of airplane transportation in Central America under the following heading: "Honduras Has World's Most Successful Air-line." "It carried 43,350 passengers and 12,533,500 lbs. of freight during the first 6 months of 1940." This company which is known as TACA, the abbreviation for Transportes Aereos Centro Americanos, was developed by Lowell Yerex, a New Zealander, who was educated in the United States at Valparaiso University in Indiana. He served in the Royal Air Force in the World War No. 1 and became an expert pilot. About 10 years ago he went to Tegucigalpa with a Stinson Junior Plane powered with a 200 h.p. motor and went to work hazing freight and passengers from one part of Honduras to another. Shortly after his arrival in Honduras the country was disturbed with a revolution. Mr. Yerex volunteered his services to General Tibucio Carrión Andino, who was the leader of the conservative element of the country. In one of the engagements Mr. Yerex lost an eye but on account of his skill as an aviator and his nerve

(Continued on page 610)
PETROLEUM FOR WAR

By

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Introduction

October 12, 1940, marks the 407th day of the Second World War in Europe, a war which is vastly different to that which we knew in 1917-18. The fate of the French Republic during the past few months shows to us very vividly the advantage under the present-day conditions of using all possible motorized equipment both for attack and defense. Trucks and armed automobiles for transporting troops and materials; tanks as offensive or defensive weapons; mobile field artillery and anti-aircraft guns, these are all primary factors in the efficient operation of land forces. All of this motorized equipment depends upon liquid fuel, either gasoline or Diesel fuel oil, and an indication of the growth of this fuel requirement is indicated by the fact that the horsepower employed by a mechanized division today is fifty times as great as was the case with the so-called mechanized division of the First World War.

By way of radio and newspaper we get twenty-four hour reports of the continued air raids and counter-raids on the belligerent nations in Europe. The success of these raids depends upon the use of many airplanes by the invaders, and the defense of the invaded country's industries depends upon their use of many planes with which to repulse the invader. Recent reports from Britain relate that at least 1,000 planes, mostly large bombers, are used almost every day by Germany in her attack on Britain. All countries involved in this war are mechanizing their armies at the most rapid rate possible, and all are building or buying all the airplanes they possibly can. Recent reports show that the lubricating oil consumption of large bombers, similar to those Germany has been using in her raids on Britain, consume approximately eight gallons of lubricating oil per flying hour, and that the gasoline consumption of 100 of the bombers per eight hours of flying is approximately the load of one oil tanker (about 80,000 bbls.).

The foregoing figures are very general, but serve to show us that a vast amount of petroleum products is required to carry on modern warfare.

World Distribution of Petroleum

Mother Nature was very generous with the western hemisphere when she distributed the wealth of crude oil throughout the world (based on known production and reserve). Within a radius, shorter than 3,000 miles, of New Orleans, Louisiana, there is 76% of the world's crude oil supply and known reserves. This figure includes the petroleum of North America, and of South America, with the exception of the unimportant production of Bolivia and Argentina. This total area produces all of its own requirements, and in addition is the most important source of supply, both in quality and in quantity, for the rest of the world.

As the war and the international situation become more and more critical, this concentrated supply of crude oil in the United States or under the protection of its Monroe Doctrine takes on more and more significance. Since the remaining 24% of world crude oil supply is not sufficient to run the non-belligerent countries and at the same time carry on the European war, this vast store of crude oil may be the controlling factor in the destinies of the belligerent nations.

The daily averages of crude oil production, in barrels, are listed below. (Courtesy World Petroleum, page 72, August, 1940)

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From the above table we see that Russia is the world's second largest producer of crude oil, and her average daily production was slightly greater in 1939 than over the same period of 1940. Her total production for the month of July, 1939, was slightly over 18,000,000 barrels. Though these figures do not indicate it, her annual crude oil production is increasing slightly, but not nearly rapidly enough to counteract her increase in domestic consumption. Whether the Soviets can step up production in amounts sufficient for war needs is a matter for speculation. It has been pointed out by G. D. Holson of the Imperial College of Science and Technology in London that in spite of the frenzied Russian search for oil in many parts of that large country, the Caucasian region still remains the principal region of Soviet production. Moreover, the inference has been made that Russia is sadly deficient in crude oil that will yield high-grade lubricants or high-octane gasoline in quantities sufficient for war-time needs.

Germany released an official statement in February that large quantities of both lubricating oil and gasoline were being shipped her by the Russians. The amount claimed to have been transported was twenty trains per month with a total of 410 tank cars. The total could not have exceeded 102,500 barrels per month (250 bbls./car), an amount which German economists claim was insignificant. This statement from Germany was made following contentions in neutral and anti-Nazi nations that Russia was not assisting Germany as Germany had expected after the signing of agreements with the Soviet Union.

More recent developments in the Balkans indicate that Germany seems very angry at Russia for gaining nearly as much territory as Germany has gained from all her labors, while Russia has hardly fired a shell. Therefore, authorities are of the opinion that in all likelihood Russia is giving very little if any aid to Germany in the form of crude petroleum or petroleum derivatives.
Korea out of the distinction of second place. Venezuela produces approximately 80% of the total of all oil produced in South America, and Colombia has 10% of the total. The remaining 10% is widely distributed over the rest of the South American countries. Refining facilities in the producing countries are inadequate to process their production; therefore, 82% of the Venezuelan and 42% of the Colombia production is exported to the Netherlands, West Indies, where it is processed in refineries of the Standard Oil of New Jersey and of Royal Dutch Shell. Here on this little South Atlantic Island the home offices of the Royal Dutch Shell Oil Co. have been set up since the invasion of Holland and attack on England by the Germans.

Germany proper (old Reich) has a total average daily production of crude oil of only about 12,393 barrels, while her total accumulative production from Ostmark, Moravia, Poland, and Slovakia bring her daily supply up to only about 25,312 barrels. If Russia is transporting oil to Germany at the rate Germany claimed, this would amount, approximately, to only 3,500 barrels a day, raising the total to 28,812 barrels per day.

Just how much oil Germany is obtaining from Roumania is a matter of much conjecture, but official estimates seem to indicate that this quantity is approximately 67,000 barrels per day. However, let us give Germany the benefit of the doubt and assume that she is importing 100,000 barrels per day, of crude oil from Roumania, a figure which would leave a scant 29,124 barrels per day on which to operate Roumania, domestically. This would boost Germany's total daily petroleum resources to 128,812 barrels per day. Besides this crude oil source of fuel, Germany is reputed to have developed her synthetic fuel manufacture to approximately 65,000 barrels per day. It has been estimated that 10 barrels of the crude oil which Germany is able to get are required to produce one barrel of the high-octane gasoline sufficient for combat purposes. According to that figure, Germany's total aviation gasoline output per day from crude oil would be approximately 12,880 barrels, with the additional 65,000 barrels of synthetic gasoline manufactured by pyrolysis of coal and coke. This would give her a total daily gasoline supply of approximately 78,000 barrels. Authorities on the subject have brought to light the fact that approximately 1/3 of all Germany's planes are powered by Diesel motors which will effectively burn hydrocarbon fuel.

Since the provinces of Bessarabia and Transylvania were taken from Roumania by Russia and Hungary respectively, there is some speculation as to just how much of the oil production of these countries will still find its way into German refineries. The Hungarian seizure was evidently engineered by Germany, but the Russian occupation of Bessarabia was something Hitler had not counted upon. One thing is certain, Hitler has many more pieces of war machinery than he has the fuel to operate at present. This is a defect in his economic setup which will have to be altered before he can hope to win the war. If Japan, Russia, Britain, Germany and Italy all become involved in this war, there is not enough petroleum available outside the western hemisphere for carrying it on. This is a matter to which the United States, who swears to uphold the Monroe Doctrine, should give much thought.

Great Britain's production (outraying possessions) is sufficiently large enough to supply most of her demands, if she could get these oil supplies to England and her Atlantic ports without going all the way around Africa. Since Italy's entrance into the war, and the defeat of France, however, it has been impractical to attempt the transfer of these supplies through the Suez Canal and the Straits of Gibraltar. As a result, all of Britain's production in India, Arabia, and the East Indies has been far removed from the home ports. The total production of Britain, including Iraq, Burma, Canada, Balh Hein, Iran, British India (beside Burma), Saudi Arabia, Sarawak and Egypt, amounts to some 372,725 barrels per day. Egypt affords an available source of fuel for the Mediterranean fleet of Great Britain, and probably supplies of Arabian oil are also available, though these supplies can hardly be transported to London under existing conditions. As a result, Britain is obtaining much of her petroleum supplies from the Netherlands' West Indies refineries, of which there are some available, the above figure could be greatly increased. Besides the above source of supply, the Dominion of Canada produces approximately 19,400 barrels per day, and there is some talk of increasing this somewhat in the near future. Mexican exports at present are sold almost totally to Britain and Japan. So long as Britain maintains the supremacy of the Atlantic Ocean, she will be able to get sufficient supplies of oil and oil products.

Japanese total production amounts to only 7,249 barrels of crude oil daily, with no promise of increasing this amount. In fact, her present production is below that of 1939, though her domestic and war requirements are rapidly increasing. Japan is probably foremost, at the present time, in the conversion of domestic vehicles to the burning of wood, coal and peat, or such other available fuels. The President's recent ban on the exports of aviation fuels or lubricants, tetra-ethyl lead or scrap-iron was no doubt aimed at crippling the Japanese war efforts, and to cut down on the shipments of these supplies to the Axis powers through Spain and Portugal. These two countries are the only European nations to which U. S. ships were allowed to transport oil since Italy's entrance into the war. Indications were that this oil was going either to Germany or Italy, and as a consequence Britain, with the aid of President Roosevelt, took the necessary steps to stop it.

The United States and Britain jointly control 90% of all the oil tankers in the world. Of this total 60% are controlled by London, while approximately 40% are under the jurisdiction of Washington, D. C. Of the remaining tanker tonnage there are left to roam the seas only a few Swedish and Japanese tankers, and the operations of these vessels are restricted to travel in certain trade routes.

The British blockade of Europe is certainly effective, despite denials of this fact by the Axis powers. This fact is well borne out in the South American and Mexican exports of oil to these countries, which have ceased altogether since Italy's entrance into the war. This blockade cut off a 30,000 to 40,000 barrel per day crude oil market of Mexico to Italy and Germany. At the present time these two countries owe Mexico approximately $4,000,000 for oil, which they promised to pay for with tankers and other goods, but which have not been delivered. This is some of the petro-
MINERAL CONTENT 
OF THE 
BEVIER COAL 
SEAM*

BOONE COUNTY 
MISSOURI

By

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Instructor, Department of Mining
Colorado School of Mines

Introduction

The purpose of this paper is to present the results of a study of the minerals associated with the Bevier coal in Boone County, Missouri. The minerals present will be described, their paragenetic relations to each other and to the coal determined, and deductions made as to their possible origin.

The Bevier coal seam is a member of the Cherokee formation, which is the basal formation of the Des Moines group of Lower Pennsylvania age. The coal seam underlies approximately the northern half of Boone County, Missouri.

The Cherokee formation was laid down on the old land surface formed by the Mississippian rocks, which had been eroded to a mature topography. Deposition continued until the wash from surrounding land surfaces filled the shallow seas, converting them into swamps in which the materials for the Bevier and other coal seams grew and accumulated. At intervals the swamps were submerged and buried under a load of sediment, which accumulated until swamps again covered the area. Thus in the Cherokee there are a series of coal beds separated by shales, limestones and sandstones. (Fig. 1).

The second coal bed deposited was the Bevier\(^1\) coal seam which averages about three feet in thickness, but varies from 28 inches to 4 feet. This variance is probably due to differences in the length of time parts of the swamp were in existence.

There are two rather persistent partings in the coal seam itself; one about ten inches from the roof consisting mainly of marcasite and/or pyrite with subordinate amounts of clay, and the other occurring about twelve inches from the floor consisting of clay. These partings vary from one-half inch to three inches in thickness, the lower one being the thicker.

The following tables give the results of proximate and ultimate analyses together with the heating values from four different samples taken in Boone County, Missouri.

An inspection of the Bevier coal seam will readily show the cause of the high ash and sulfur content. The calcite and gypsum together with the inherent clay particles and iron from the sulfides make up the ash of the burned coal. The actual sulfur content is much larger than the analyses show, as the sulfide parting and lenticular masses are discarded in the actual mining of the coal. Careful washing of the coal removes about half of the ash content and about a third of the sulfur content.

Beneath the Bevier coal is a bed of plastic clay that varies from 6 inches to 2 feet in thickness. Below the clay is one to six feet of a blue gray limestone. The Bevier coal is capped with a series of shales called the Lagonda shales. This shale series contains thin

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*Thesis submitted in partial fulfillment of the requirement for the degree of Master of Arts, at the University of Missouri, 1938.

\(^1\)The name Bevier was first used by McGee in 1885 from its occurrence at Bevier in Macon County, Missouri.

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**Table I**

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<th>Sample No.</th>
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<th>Ultimate</th>
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**Table II**

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</table>
The Bevier coal seam is cut by a number of small faults and by numerous clay slips or rolls especially near the present outcrops of the seam. The coal itself breaks into blocks due to the numerous joints that are normal to the stratification. In addition to the above there are small gash veins, less than one inch long, that are true gash veins.

There are a smaller number of open fissure joints, not infrequently 3 or 4 inches wide in the coal, some of which penetrate the overlying strata. There has been little or no vertical movement along these fissures. Locally the movement has been entirely lateral where the under clay has been forced into these open fissures. These open fissure joints tend to change to feather joints where the actual openings cease.

**Mineralogy of the Coal**

*Introduction*

The minerals positively identified as being present in the Bevier coal seam are: pyrite, calcite, gypsum and sphalerite. Traces of copper have been found associated with some of the pyrite, suggesting the presence of chalcopyrite. The minerals occur as veins, lenses, partings, and disseminations throughout the coal seam. They occur separately and associated with each other. Marcasite, the low temperature form of iron sulfide has not been positively identified, although its presence is suspected.

**Iron Sulfides**

Pyrite is one of the most dominant minerals present in the coal seam. It occurs as horizontal partings or bands, as vertical veins, as lenticular masses parallel to the stratification of the coal seam, and as disseminated particles throughout the coal seam.

The pyrite in the veins occurs as crystals which have a dense granular structure. The crystals where visible are cubes and pyritohedrons modified by octahedrons. These veins vary in width from less than a millimeter to a centimeter, and from 5 to 25 centimeters in length. (Fig. 2). The lenticular masses of pyrite are all finely granular, which when polished, show the typical pale brass-yellow color. These lenses are thin (less than 4 centimeters) concretions, that are rounded or elliptical in plan. (Fig. 3).

Calcite

Another of the dominant minerals present in the Bevier coal seam is calcite. There are at least two distinct forms of calcite present: crystalline and fibrous. The crystalline material occurs as perfect rhombohedral crystals, as thin scales and as scaly vein material. The fibrous variety is present only in veins. The crystalline form present in the veins is transparent, and shows the typical rhombohedral cleavage of calcite. The fibrous variety is easily distinguishable from the crystalline variety in the veins.

All the calcite veins in the coal are normal to the stratification. (Fig. 4). Most of these veins are from one to five millimeters in width. The calcite present between the stratified layers of the coal is of the transparent crystalline variety, and it appears to be a continuation of the veins that have spread laterally. These horizontal layers are thin, one millimeter or less in thickness, and of a small lateral extent. Perfect rhombohedral crystals of calcite are found only in the vugs or cavities in the vertical joints in the coal seam. Here the crystals occur on top of the pyrite crystals lining the vugs and project towards the center with horizontal partings or bands. This extensive alteration of the sulfide in the partings or dull layers would seem to indicate that it was composed of marcasite. No marcasite occurs in aggregates large enough to permit positive identifications, but it is reasonable to assume that a portion of the finely divided iron sulfide that is disseminated in the layers of the coal, is the orthorhombic iron sulfide. The evidence suggests that the waters of the swamp must have been at least neutral or slightly acid at times, as marcasite is deposited only from acid solutions at temperatures between 450° C, and 120° C. Pyrite of course, can be precipitated from solutions through a wide range of temperatures, as it is stable under practically all conditions.

**Calcite**

The iron sulfides oxidize very readily to the iron sulfate, melanterite, which is bluish-green in the hydrate form, but on loss of water turns white and later yellow through oxidation. The parting or band that occurs about ten inches from the top of the coal seam has been altered to melanterite throughout its entire exposure. Where the parting has been exposed over a long period of time the depth of alteration is from 4 to 6 inches back of the coal face.

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Figure 4. A view showing the blocky nature of the Bevier coal, caused by the presence of vertical veins of calcite. Arrows indicate the calcite veins. (2X)

Figure 5. Cavity in a vertical vein in the coal, showing calcite crystals deposited on pyrite crystals. (1X)

Figure 6. Gash veins in coal filled with gypsum. (2X)

no definite arrangement. In some of the vugs the calcite crystals make up the lining directly next to the coal, with pyrite crystals being deposited on the calcite. (Fig. 5).

**Gypsum**

Gypsum, the hydrous calcium sulfate, is present only in small quantities in the veins normal to the stratification of the coal, and as the alteration product of the transparent calcite. The vein gypsum is opaque, fine-grained and white in color. There does not appear to be any gypsum present in the horizontal partings of the coal. The gypsum was differentiated from the calcite by immersing it in a dilute solution of hydrochloric acid. The calcite effervesced while the gypsum does not. The gypsum present all appears to be of the same relative age. (Fig. 6).

**Sphalerite**

Sphalerite, zinc sulfide, is present in limited quantities and is closely associated with the clay slips or rolls. The sphalerite occurs as veins in the coal normal to the stratification of the coal seam, (Fig. 7), and as brecciated particles, (Fig. 8), and as isolated crystals in the clay slips, (Fig. 9). It is a coarsely crystalline variety breaking along the cleavage planes. It has a resinous luster, commonly brown to yellow in color. The veins have a maximum width of one centimeter. No evidence of sphalerite has been found in the partings that parallel the stratification of the coal. The brecciated fragments of sphalerite in the clay slips together with the clay and adjacent coal are striated.

**Structure of the Coal**

A coal seam after consolidation is almost impervious to solutions. If solutions have entered the coal seam some means of ingress must be provided. During the consolidation of the Bevier coal seam certain stresses were set up in the coal and overlying rocks. The first set of joints produced were probably the result of shrinkage and consolidation of the coal itself. This system of joints tends to give the coal its blocky appearance. (Fig. 4).

The second set of joints to appear were gash veins. (Fig. 6). These gash veins represent the first reaction to tension set up in the coal seam and overlying rocks due to the differential compaction in the coal seam, warping of the underlying sediments, work of solutions in the sediments below the coal seam as evidenced by the presence of stylolitic seams in the Mississippian and older sediments, and regional diastrophism. The tension in the coal seam increased gradually to the point of actual rupture and the separation of the walls formed an open fissure. These fissures were the widest where tension was greatest and die out at either end in a series of tiny cracks that resemble a feather. Further tension produced a large number of strong open fissures that extend into the overlying rocks. These openings provided ready passage for the solutions to enter the Bevier coal seam.

At some time after the formation of the gash veins, the large fissure veins were formed by further tensional stresses in the coal seam and overlying rocks. These large fissure veins may represent an original series of gash veins, as gypsum is found in the center of these veins, having the same general outline as that in the gash veins. (Fig. 11).

Stronger tensional stresses in the coal seam caused these large fissure veins to widen still farther, producing openings that vary from less than a millimeter to more than three inches. Feather joints were produced during this stage of relief to the tensional stresses in the coal. (Fig. 12). The feather joints appear more common at the lower extremities of the large fissure veins, but they are also present at the upper ends of the fissures and in some cases extend along the entire length of the fissures.

Mineral Relations

Introduction

From the study made of the minerals present in the Bevier coal seam, there appears to be a definite time sequence. The only syngeneic minerals found in the coal seam are the iron sulfides that appear in the horizontal partings and disseminations of the coal. The pyrite concretions were deposited sometime after the coal forming material was laid down and before final consolidation of the coal seam and are therefore thought to be peno-contemporaneous. The other minerals are all epigenetic. The first of these epigenetic minerals was transparent scaly calcite, followed by gypsum, and then a second period of scaly calcite. This carbonate and sulfate period of deposition was followed by a period of sulfide deposition, with pyrite and sphalerite being deposited. The last period of mineralization deposited the fibrous calcite.

Syngeneic Minerals

Iron Sulfides

There is little doubt that the iron sulfides present in the Bevier coal seam are largely syngeneic, that is, developed or deposited at the time the coal forming material was accumulating. The pyrite and/or marcasite that is found disseminated throughout the coal seam is thought to be of this origin. The material is microscopically crystalline and is present in all the specimens studied.

The massive fine grained marcasite and/or pyrite parting or band that is quite continuous over the entire area studied is also thought to be syngeneic in origin. Henry Hinds,6 in his report on the “Coal Measures of Missouri,” lists this stratigraphic band in the Bevier coal seam in almost every locality in which the coal seam occurs in Missouri. This feature appears to be definitely related to the accumulation of the coal forming materials, as its wide spread occurrence and thickness represents a great homogeneity of conditions. There are two possible alternatives concerning its origin: (1) does it represent chemical deposition during the period of accumulation of the coal forming materials, or (2) does it represent a later replacement of some other mineral or material? The replacement theory does not seem probable because no trace of any other mineral has been noted in the parting. Generally during replacement some evidence of the host mineral or material is left behind, especially where the replacement covers such a large area. The iron sulfide is so finely divided and granular, that its form suggests a colloidal origin. Chemical deposition of this type is frequently associated with bacterial action.7 Bacteria of the sulfate reducing types have the power to reduce sulfates, sulfites and thiosulfates in the presence of decaying organic matter. In the process of reducing the sulfates, hydrogen sulfide is liberated. Certain other bacteria reduce free sulfur present in organic matter to hydrogen sulfide. If iron salts are present in solution, ferrous sulfide (FeS) is formed directly and precipitated. The hydrogen sulfide formed will also react with the iron salts in solution to form ferrous sulfide. Later free sulfur reacts with the ferrous sulfide to form the disulfide (FeS2). The change from ferrous sulfide to marcasite or pyrite is not very well known, but B. Doss8 in explaining the origin of sedimentary deposits of iron sulfide, outlines the successive steps as follows:

“Iron dissolved from iron bearing solutions and carried as soluble ferrous carbonate as surface waters to enclosed bays or lagoons in which decaying organic matter is abundant. Here the iron is precipitated, either directly as black colloidal hydrated ferrous sulfide by reaction with hydrogen sulfide liberated by bacteria from decaying organic matter, or as ferric hydroxide by iron bacteria. Ferric hydroxide under reducing conditions and in the presence of hydrogen sulfide is changed to hydrated ferrous sulfide. By loss of water and the addition of sulfur, which occurs as free sulfur in the mud, the hydrated ferrous sulfide is changed to melnikovite. The melnikovite alters to pyrite gradually and the enclosing mud becomes hardened and cemented to clay and shales.”

While the above explanation is for sedimentary deposits of iron sulfide, the explanation holds also for the marcasite and/or pyrite contained in the parting or band present in the Bevier coal seam.

Peno-Contemporaneous Minerals

Iron Sulfides

The lenticular, finely grained masses of pyrite found in the Bevier coal seam, evidently represent replacement. The term replacement as used here does not imply an epigenetic origin, but a peno-contemporaneous origin. By peno-contemporaneous is meant, that period between the actual

---

deposition of the concretionary material and before final consolidation of the coal seam. The original concretion was probably highly calcareous, with calcium carbonate the main constituent. The calcium carbonate, calcite, is the mineral replaced with pyrite. The chemistry of replacement of carbonate by pyrite is as follows: iron salts in solution would react with the hydrogen sulfide produced by the action of bacteria on decaying organic matter, or by the action of bacteria on sulfates, sulfites or thiosulfates, giving rise to the ferrous sulfide (FeS), which would change to pyrite on the addition of free sulfur, the free sulfur being derived from organic matter by sulfur bacteria. Melnikovite might be precipitated directly, in place of the ferrous sulfide, but it would also alter to pyrite. The iron salts in solution were probably the bicarbonate, or at least as a soluble carbonate, and their reactions with hydrogen sulfide would result in the release of carbon dioxide. Calcium carbonate in the presence of an excess of carbon dioxide will tend to go into solution. Thus with the solution of the calcium carbonate, pyrite was deposited in its place.

The evidence of replacement is best shown in the polished sections made of the lenticular masses or concretions of pyrite. (Fig. 10). Here fusain or mineral charcoal is included in the concretion, showing replacement of the delicate cellular structure with pyrite. The calcareous material of the concretions has been entirely replaced, leaving behind the unreplaced clay particles. These clay particles have been pushed aside and concentrated so that they form layers surrounding the pyrite concretions. In some instances the line of contact between the clay layers and pyrite is quite sharp while in others the clay and pyrite appear to grade into each other. The surface of these clay layers on the concretions show definite evidence of movements. The striations on the upper surface are stronger than those on the under side, which seems to point to the fact that the surrounding coal slid over it in the process of consolidation. The coal surrounding the concretion is arched over it, and small stringers of coal are included in the lateral edges of the concretions. Included in the small stringers of coal are tiny vertical veins of gypsum. This gypsum does not show any evidence of replacement and thus must be later than the replacing pyrite. There is a fine network of calcite veins present on the striated clay surface, and where these veins cut the coal stringers the calcite has been converted to gypsum. The gypsum first mentioned may be, and probably is the converted calcite. The calcite veins are definitely later than the final consolidation of the concretion as the veins cut the striations and show no relative movement. In places the calcite has spread out to form a layer that parallels the coal and clay layers. Here the calcite has the appearance of a cockscomb, with fine blunt shaped crystals pointing away from the supplying vein.

The latest period of mineralization of the concretions consists of small radiating veins of pyrite. These veins cut or transcend the clay layers and coal stringers, and penetrate the massive pyrite in the center of the concretion. The veins probably represent the final contraction of the concretion producing tension cracks that are radial to the concretion.

Epigenetic Minerals
Calcite
Calcite was deposited in the first set of joints formed, hence is found on the sides of the joint blocks of the coal, as thin scales. (Fig. 4). Its scaly form and transparent character distinguish this calcite from the other forms occurring in the coal. (Continued on page 611)
Conjugate functions are not used by engineers as much as they might be. The subject is usually dealt with in the mathematical courses which form part of the training of engineers at universities and technical schools, but it is infrequent that the student takes to heart the instruction he receives and makes himself familiar with the conformal transformations. One of the reasons for this is that the pure mathematician is often content with the rigid accuracy of his conceptions and often does not see the advantage of making his abstract methods appeal to the type of engineer who prefers to understand things by means of mechanisms and models.

In order to show the application of the bipolar transformation in the determination of the quantity of seepage water which will enter a tunnel, it will be necessary to review briefly the fundamental concepts involved in the flow of water through soil.

Potential Theory of Slow Viscous Flow

Darcy's law may be assumed to hold. This law states that the velocity is equal to a constant times the gradient of the potential \( \phi \). With the \( Y \)-axis positive downward, \( \phi = p - y + C_1 \) \( (1) \), where the constant \( C_1 \) is arbitrary. The mathematical expressions for the velocity in three orthogonal coordinate directions, \( X, Y, \) and \( Z \), are

\[
\begin{align*}
u &= -K \frac{\partial \phi}{\partial x} \\
u &= -K \frac{\partial \phi}{\partial y}
\end{align*}
\]

\( (2) \)

where \( \mathcal{K} \) is the percolation factor defined as the quantity of water flowing across a unit area in unit time with a unit gradient of \( \phi \).

Velocities may also be defined in terms of the stream function, \( \psi \):

\[
\begin{align*}
\psi &= x - y \\
\frac{\partial \psi}{\partial x} &= \psi \\
\frac{\partial \psi}{\partial y} = 0
\end{align*}
\]

or, in Gibb's vector notation

\[
\nabla \psi = 0
\]

which states that the potential \( \psi \) must satisfy Laplace's equation.

Bipolar Transformation

Consider the analytic function

\[
W = \alpha + i\beta = C \log \frac{z + ia}{z - ia}
\]

where \( z = x + iy \).

Define

\[
\begin{align*}
\theta_1 &= z + ia = x + i(y + a) \\
\theta_2 &= z - ia = x + i(y - a)
\end{align*}
\]

Equation (7) may then be written

\[
W = \alpha + i\beta = C \log \frac{\theta_1}{\theta_2}
\]

where \( \alpha \) and \( \beta \) are the real and imaginary parts of any analytic function \( W \) of a complex variable \( \theta = \alpha + i\beta \).

It is known that the real and imaginary parts of any analytic function \( W \) of a complex variable \( \theta \) are solutions of Laplace's equation. Further, if \( \phi \) is the real part of such a function, it can be shown that \( \psi \) is the imaginary part of the same function, or vice versa.

Bipolar Transformation

Consider the analytic function

\[
W = \alpha + i\beta = C \log \frac{z + ia}{z - ia}
\]

where \( z = x + iy \).

Define

\[
\begin{align*}
\theta_1 &= z + ia = x + i(y + a) \\
\theta_2 &= z - ia = x + i(y - a)
\end{align*}
\]

Equation (7) may then be written

\[
W = \alpha + i\beta = C \log \frac{\theta_1}{\theta_2}
\]
\[ r_1 = C \log \frac{r_1}{r_2} + i(\theta_1 - \theta_2). \]  

\[ \text{Whence, equating the real and imaginary parts of the above equation, we have} \]

\[ \alpha = C \log \frac{r_1}{r_2} \]

and

\[ \beta = C (\theta_1 - \theta_2). \]

By definition \( r_1 \) and \( r_2 \) are the radii of any point in the \( XY \)-plane from the poles and \( \theta_1, \theta_2 \) are the angles which these radii make with the \( X \)-axis.

If \( \alpha \) is held constant and \( \beta \) allowed to vary, it will be noted that a family of curves can be developed of radius \( \alpha \) such which have the poles as limiting points, that is, all the circles will pass between the \( X \)-axis for which \( \alpha = 0 \) and the pole, for which \( \alpha = \infty \). The centers of this group of circles will all lie on the \( Y \)-axis.

Again, if \( \beta \) is held constant, and \( \alpha \) allowed to vary, a second family of circles will be developed which have centers on the \( X \)-axis and which pass through both of the poles. The development so obtained is, if plotted, known as a bipolar coordinate system such as is shown in figure 1.

**Theory**

If the equi-potential lines are chosen as the \( \alpha = \text{constant} \) curves of figure 1, and the stream lines as the \( \beta = \text{constant} \) curves, the lower half of this flow system is seen to correspond to the case of a circular tunnel in the ground into which water is percolating from the free water surface or ground water table.

Assume now that the water surface is \( h \) above the ground surface, the liquid pressure \( p \) at the elevation of the ground surface is then \( h \) measured in “head” of water.

Place the potential, \( \phi \), defined in equation (1), equal to \( \alpha \), that is:

\[ \phi = p - y + C_t = \alpha \]  

(9) 

Also place

\[ \psi = K \beta \]

(9a)

where \( K \) is the percolation factor defined above.

The boundary conditions: \( \alpha = 0, \ y = 0, \ p = h \) installed in (9) determine the value of the constant \( C_t = -h \).

If radius \( b \) of the tunnel is small compared to \( a \), it will be sufficiently accurate for practical purposes to place the value of \( \alpha \) at the tunnel equal to \( C \log \frac{2d}{b} \), and replace \( a \) by \( d \) in (7).

The conditions at the tunnel then become:

\[ p = 0, \ y_{\text{average}} = d, \ \alpha_{\text{average}} = C \log \frac{2d}{b} \]

which by substitution in (9) gives

\[ \frac{2d}{b} C \log \frac{2d}{b} = (d + h) \]

or

\[ C = \frac{d + h}{2d} \log \frac{2d}{b} \]  

(10)

Therefore function (7) becomes:

\[ W = \frac{d + h}{2d} \log \frac{2d}{b} = \alpha + i\beta = \phi + i\psi \]  

(11)

The quantity of water entering the tunnel on each side will be given by the difference in the value of the stream function (the imaginary part of \( W \) when \( \alpha = \alpha_0 \)) \( \psi_0 \) at the bottom and \( \psi_1 \) at the top of the tunnel. In figure 1, it can be seen that the numerical difference in the \( \beta \)-values at these points is \( \pi \) with \( C = 1 \), hence with the value of \( C \) given by (10) the numerical difference \( \psi_0 - \psi_1 \) by definition (9a) becomes

\[ \frac{\pi K (d + h)}{2d} \log \frac{2d}{b} \]

This quantity of fluid will enter both on the right half of the tunnel and on the left half. The difference in sign of the quantity \( \psi_0 - \psi_1 \) on the two sides merely expresses that the directions of flow are opposite.

Hence the total quantity of water entering the tunnel will be

\[ Q = \frac{2\pi K (d + h)}{2d} \log \frac{2d}{b} \]  

(12)

where \( K \) is the percolation factor of the soil in question.

If there is no water load on the foundation, \( h \) is placed equal to zero. The quantity \( d \) in equation (12) then must be placed equal to the average depth of the tunnel below the ground water table and the \( Y \)-ordinates are measured from the same level.

It is often of importance to know the liquid pressures \( p \) (uplift), which exist in the pores of the surrounding rock. In case the tunnel is unlined or, if lined, equipped with seepage drains, the pore pressures are obtained by equation (1):

\[ p = \phi + y - C_t \]  

(13)

where

\[ C_t = -h. \]

\( y = \text{depth below ground surface (or below water table if } h = 0) \), and \( \phi \) is found from equation (11) as the real part of \( W \):

\[ \phi = \frac{d + h}{2d} \log \frac{2d}{b} \left( \sqrt{x^2 + (y + d)^2} - \sqrt{x^2 + (y - d)^2} \right) \]
In the stability analysis of a foundation the contact stresses \((\alpha - p)\) multiplied by the coefficient of friction govern the available shear resistance in the critical slip planes in accordance with Mohr's criterion of failure or Henney's shear-friction factor. The stresses \(\alpha\) depend on the loading and can be computed by the methods described elsewhere. (See reference 5). The pore pressure \(p\) can be obtained from equation (14). When the tunnel is lined and without seepage drains the pore pressures become hydrostatic and equal to the unreduced head of \(y + h\). The lining must then be designed to withstand these external pressures. It is of course necessary to convert \(\alpha\) and \(p\) into consistent units. In computing \(\alpha\) and \(p\) for stability analysis, it should also be borne in mind that, if \(h\) is subject to fluctuations, \(\alpha\) may have to be based on a minimum value of \(h\), whereas the simultaneous pore pressures \(p\) should be based on the maximum value of \(h\) on account of the pressure lag in highly impervious materials in the transient state of percolation.

Attention is also called to the fact that even if the percolation factor \(K\) is uncertain, so that the quantity of seepage becomes a guess, more or less, still the pore pressures \(p\) can be relied upon to a much greater degree of accuracy. In a quasi-homogeneous foundation, the pore pressures are practically independent of \(K\).

**Application to Masonry Dams**

The above theory leads directly to still another application: namely, the case of numerous vertical drains near the upstream face of a dam. In this case all flow is horizontal so that the gravitational potential need no longer be taken into account. The disturbance due to the drains simply has to be superimposed onto the pore pressures which exist without drains.

The effect of the vertical drains is easily understood to be a function of the location of the drains with respect to the upstream face and with respect to each other, and the size of the drains.

The steady state of pore pressures across any horizontal section of a triangular dam without vertical drains varies linearly from full hydrostatic head at the upstream face to zero at the downstream face. It will be sufficient for practical purposes to know the approximate mean pore pressures when vertical drains exist, and these can be accurately enough represented by two straight lines as shown in figure 2. The average ordinate at the center line of drains should be

\[
P = h - \frac{2}{3} \log_e \left[ (1 + \frac{4}{9} \omega) (1 + \frac{4}{9} \omega_1) \right]
\]

(15)

where \(h\) is the uplift at the centerline of the drains if no drains existed.

The parameters \(\omega\) and \(\omega_1\) are defined as follows

\[
\omega = \left( \frac{2d}{c} \right)^2
\]

(16)

\[
\omega_1 = \frac{2d}{b}
\]

d is the distance from the upstream face to the centerline of drains

c is the spacing of the drains

For practical reasons the radius \(b\) should not be less than four inches and preferably larger. The drains should of course not be allowed to clog so as to keep down the entrance head loss.

The average pore pressure is a function of the parameters \(\omega\) and \(\omega_1\) and of the time-average hydrostatic pressure on the upstream face.

There is some question as to the reliability of this drainage system due to the clogging of the pores around the drain. 1

It is interesting to note that the bipolar transformation is also extremely useful in obtaining the stresses in certain elastic problems such as stress distributions around an eccentric circular hole in a circular cylinder, stress distributions around a tunnel, etc. For treatment of these problems the reader is referred to the following publications:


**Practical Application to Drainage Galleries**

Let it be required to determine the average uplift pressure in a triangular dam 500 feet high with a downstream slope of 0.8, if 5 inch diameter vertical drains are placed 13 feet from the upstream face on 10 foot centers.

Referring to figure 2, (X-D-2776) we have

\[
b = 2.5\text{ inches}
\]

\[
c = 10x12 = 120\text{ inches}
\]

\[
d = 13x12 = 156\text{ inches}
\]

\[
H = 500x62.5 \times 1 \times 31250 \times \frac{1}{144} \times \frac{1}{144} = 217,014 \text{ pounds per square inch.}
\]

If no drains exist the pressure \(H\) is assumed to diminish as a straight line, hence it is possible to determine the pressure \(h\) at the centerline of the drains to be installed by means of the ratio

\[
\frac{H}{400} = \frac{h}{400 - 13}
\]

Wherein

\[
h = 0.9675 \quad H = 209,061 \text{ pounds per square inch.}
\]

The parameters \(\omega\) and \(\omega_1\) are found to be

\[
\omega = \left( \frac{2d}{c} \right)^2 = (2.6)^2 = 6.76
\]

\[
\omega_1 = \frac{2d}{b} = 124.8
\]

The average uplift pressure is now determined by inserting the numerical values computed above into the formula given in the theory. This gives:

\[
p = 113.850 \text{ pounds per square inch.}
\]

1 "An Investigation of the Permeability of Masonry with Particular Reference to Boulder Dam" by Ruettgers, Vidal, and Wing, American Concrete Institute, March-April, 1939.
In general, mining is carried on underground, that is, in confined places where it is difficult to obtain adequate lighting and frequently in rock strata requiring much care to prevent caving. Moreover, explosives must be used in mining with the numerous hazards associated with them, and some mines give off explosive or irrespirable gases; also machinery must be used, usually under conditions much more hazardous than on the surface. These and many other considerations cause mining to be probably the most hazardous occupation in which large numbers of people are employed.

Prevention of accidents in the mining industry is far more complicated than in surface industrial work because the different elements that enter into possible accident occurrence are ascertained more readily above ground and suitable action can be taken against them; furthermore, errors in connection with prevention of accidents in surface industrial work usually affect only one or possibly a few persons, while in mines one human error may cause an explosion or other untoward occurrence resulting in the death of scores or even hundreds of persons.

This difficulty in the prevention of accidents in and around mines is well known, and most countries and states have regulations to guard the safety and, to a much smaller extent, the health of workers in mining and allied industries. In general, the state laws are merely an outline of some more or less fundamental minimum requirements regarding the welfare of mine workers. Unquestionably there is a great need for a closer correlation of the laws and regulations of the various states with regard to safety in the mining industry, and while mining conditions vary far too much for a standardized mine safety law applicable to all of the states, on the other hand there are numerous standard and fairly, fundamental safety provisions which apply to all mines and which should be embodied in the mining codes of all the States.

For many years progressive mining companies in the United States have not been satisfied to operate only within the meager safety requirements of the state laws and have adopted additional and far more effective safety procedure of their own. As a result of this forward looking policy, many of these companies have made astonishing progress in the reduction of accidents. This is true of coal mines, metal mines and non-metallic mines, as well as milling, smelting and metallurgical plants. Some mines have worked twenty-five or more years without a fatal accident; others have worked a considerable number of men a year or more without a lost time accident.

During the five year period 1906-10 inclusive, 13,288 persons were killed in the coal mines of the United States from all causes, or an average of 5.89 persons killed per million tons of coal produced. In 1933 this figure was reduced to 2.78.

In the metal mines the accident rate of killed and injured averaged 224.36 per 1000 workers from 1911-20 inclusive. This figure was not lowered very much until 1930 when it was 170.78 per 1000. Since 1930 it has been slowly decreasing.

Cost of Accidents

While obviously everyone should regard safety from the humanitarian standpoint, human nature is so constituted that it is regarded more often from a dollars and cents standpoint. Executives as a rule, are willing to spend money for safety work only when these expenditures show a monetary return.

The figures published by the compensation commissions of various states do not conform to any set standard or type, and it is practically impossible to correlate the various compensation costs. In some states the cost includes hospital and medical expenses, while in others only the compensation outlay is given and compensation for any given type of injury varies from state to state. The cost of temporary disabilities in mining ranges from $15 in New York to $108 for bituminous coal mines in Pennsylvania. Permanent partial disabilities range in cost from $506 in Arizona to $3,686 for disabilities of more than 18 months in Pennsylvania. Permanent total disabilities have the highest average cost, ranging from $6,526 in Pennsylvania to $15,484 in...
years later and the hospitalization alone aggregated more than $43,000. It is believed that $100 is a conservative average for the cost of all non-fatal accidents in mining in the United States. No lost time accidents cost the employer from $4 to $12 average.

The maximum compensation benefits for fatal accidents that may be obtained under the various state compensation laws range from $3,000 to $5,600 for a person who leaves no dependents.

It is believed that $100 is a conservative average for the cost of all non-fatal accidents in mining in the United States. No lost time accidents cost the employer from $4 to $12 average.

### Compensation Cost of Accidents in Seven States

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In 1924 the basic or stock company rate in the metal mining group was $4.57 while the Colorado State Fund rate was $3.88 per $100 of payroll. Increased compensation and medical benefits, and a more liberal interpretation of the Workmen’s Compensation Act by the courts have made it necessary to increase these rates from time to time, so that for the year 1937, the stock company rate was $9.73, while the Colorado State Fund rate was $6.81 per $100 of payroll. These rates are formulated from actual accident experience furnished by the National Council on Compensation Insurance each year. The rates are regulated entirely by the factors which raise the rates and outside of the ever-present humanitarian interest in employees, it is necessary to evidence interest in reducing accidents, and more especially the more serious accidents, as these are the factors which raise the rates and make it more difficult for the employers to carry insurance, and for employees to receive proper benefits.

The foregoing figures show that outside of the ever-present humanitarian interest in employees, it is necessary to evidence interest in reducing accidents, and more especially the more serious accidents, as these are the factors which raise the rates and make it more difficult for the employers to carry insurance, and for employees to receive proper benefits.

The maximum compensation until his death. In the ten year period from 1927 to 1936, in the metal mining industry in Colorado there have been 175 death cases which have totaled $515,802.04 in compensation benefits. Combining the permanent total disability cases and the death cases for the same ten year period, presents a total compensation payment in the metal mining industry alone of $746,174.13, for 191 accidents. During the same ten year period the state fund collected $4,170, all of which was set up by the state fund as a reserve to pay him maximum compensation until his death.

The direct cost of accidents in and around coal mines in the United States averaged 4c to 6c per ton of coal mined from 1931 to 1935. In metal and non-metallic mines the cost per $100 of payroll in 1933 and 1934 ranged from a low of $3.40 to as high as $15 and as high as $35 for tunneling.

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**WITH THE Manufacturers**

**EQUIPMENT NEWS**

"Vari-Stroke" Ore Feeder

Morse Silent "Vari-Stroke" Ore Feeders introduce an entirely new simple and positive mechanism that accurately governs the movement of the ore feeder belt. Silent operation is attained by means of a curved member parallel in curvature with the disc wheel that is rigidly attached to the head pulley shaft. The curved member provides a place of rest for a wedge roller when it is not engaged with the disc wheel; a hand wheel conveniently located governs position of the curved member.

When the cam follower arm engages the wedge roller, the disc wheel is then placed in contact with the wedge roller, thereby causing movement of the disc wheel, head pulley and belt. The amount of belt movement is controlled by the primary or rest position of the roller. The belt movement is, therefore, precisely controlled at all times. This exclusive design eliminates the use of noisy bumpers.

The framework is made of heavy channels that form a rugged understructure; the steel hopper is made low purposely to position the feeder up close under the ore bin; take-ups are conveniently located for belt adjustment and the belts are made endless and have rubber top and bottom on several plys of fabric. This is a new development of the Morse Bros. Machinery Company, Denver, Colorado.

Link-Belt "Friction Fighter"

Realizing the difficulties encountered in trying to distinguish between the series numbers assigned to the various types of anti-friction bearing units, Link-Belt Company, Indianapolis, is humanizing the presentation of its five types by comparing them with prize fighters and re-classifying them according to the various weights of fighters known to the ring.

The five different types are: Lightweight, Series 100; Welterweight, Series 400; Middleweight, Series 500; Heavyweight, Series 600; and Alternative Heavyweight, Series 7200.

The five different types of Link-Belt "Friction Fighter" bearings, since the term Friction Fighter so aptly describes a characteristic of the anti-friction bearing:

Transmitting power is essential to both the fight game and industry. A prize fighter can see his opponent, and transmit powerful punches in an attempt to bring him to the floor. But in industry, there is the invisible opponent Friction.

This invisible opponent fights wherever shafts go into their rounds, and no matter how badly he may be licked, he'll always make a comeback.

To obtain more detailed information on Link-Belt's Friction Fighter bearing units—descriptive matter, illustrations, dimensions, list prices, weights, engineering data—readers interested in the use of such bearings should send for a copy of a new 88-page Data Book No. 1775, giving all this information and classifying the five types of bearings as hereinbefore indicated. The book is free for the asking, and the request may be addressed to the nearest office of the company.

**Deep Well Turbine Pumps**

Worthington Deep Well Turbine Pumps, built by Worthington Pump and Machinery Corporation, Harrison, N. J., incorporate many years of experience in pump design and manufacture which guarantee high efficiency, continuous operation and low cost.

Some of the important features built into this pump are: oversize Ball Thrust Bearings with positive oil-flood lubricating system, fully controlled motor hollow shaft and weather proof hood, bronze shaft bearings every five feet, stainless steel impeller shaft, correctly designed and applied bronze impellers, stream lined water passages, discharge veins in impeller bowls, long sweep discharge elbow and others which insure smooth and efficient operation.

These pumps are built for any industry or class of service, exactly suited to the working condition. Write for bulletins covering your particular pumping requirements.

**Air-Bloc Hoist**

For hoisting light loads up to 700 pounds Ingersoll-Rand Company has just introduced the Air-Bloc. It is a flexible, welded, linkchain air hoist designed for use in machine shops, assembly lines, maintenance shops, shipping and receiving departments for light lifting jobs practically everywhere.

It is available in three sizes identified as LC-3, PC-3 and LC-7 which are designed to handle loads of 300, 500, and 700 pounds respectively.

The Air-Bloc weighs less than 75 pounds and can easily be moved from one job to another. An automatic up- and down-stop control prevents damage to the hoist from over-run of chain in either direction. Another safety feature prevents the load from dropping even if the air supply fails.

The motor which powers the Air-Bloc is a four cylinder, radial-type air motor which the manufacturer states cannot be injured by over-lubrication. Throttle control is sensitive, permitting easy and accurate spotting of the load.

An illustrated four-page folder, Form 2714, containing sectional views of the hoist is available from Ingersoll-Rand Company, 11 Broadway, New York, or any of their branch offices.

**New Multiple Leverage Punch**

The Gibraltar Equipment & Manufacturing Company of St. Louis, Mo., the manufacturers of a complete line of lightweight portable mining tools have recently perfected a new multiple leverage punch which promises to completely revolutionize the punching of rail. This labor saving device is the newest addition to their line of Gemco Tru Blu tools.

The multiple leverage unit features a system of links from the bar socket to the punch shaft thus multiplying the bar leverage by 3. The multiple leverage feature is combined with a new ratchet mechanism to secure a combination which is the last word in dependability, economy, safety, and efficiency. The punch shaft is drilled on one end to take the shank of the drill bit and a special thrust bearing made of "Gemloy" phosphorus-bronze to withstand the enormous pressures de-
of a die seat accurately machined into the punch frame. The die being held in place by means of a slight pressed fit.

The punch and die sets are furnished in any size desired from one eighth inch up to one inch diameters. The punch bit is held securely in the end of the punch shaft by means of two pins which are easily removed and replaced. Thus a punch and die set can be removed and replaced with a set of a different size in a couple of minutes and various sizes of holes can be punched in a minimum of time.

A handle made integral with the punch frame is provided for maximum ease of portability. The entire unit is designed to be as light in weight as possible without sacrificing strength and durability.

New Electrifugal Pump

Allis-Chalmers Mfg. Company, Milwaukee, Wisconsin, announces its new "Electrifugal" pump which is an all-in-one centrifugal pump especially designed as a complete pump and motor unit on one shaft and one housing. Instead of using standard motors having special end housings and shaft extensions, the "Electrifugal" pumping unit has a special motor with a one piece cast iron motor yoke and pump bracket. The feet are cast integral with the housing and bracket and extend under the entire unit instead of under the motor only.

The punch bit being used is held in perfect alignment with the punch bit by means of a die seat accurately machined into the punch frame. The die being held in place by means of a slight pressed fit.

The special motor design, with copper bearing steel cover, meets NEMA specifications for splash proof motors. Totally enclosed, fan cooled motors and explosion proof motors are also available in the "Electrifugal" type.

In splash proof construction the "Electrifugal" pump is now available in sizes from 1 h.p. to 10 h.p. inclusive at 1500 r.p.m. and from 3/4 h.p. to 7 1/2 h.p. inclusive at 1250 r.p.m. for heads up to 160 feet. Larger sizes of this type are in the process of design.

D-C Sectionalizing Switches for Mining Service

For reducing copper distribution losses, improving mining feeder voltage regulation during normal operation, and sectionalizing faulty sections of the feeder system during fault or overload conditions, a d-c sectionalizing switch for mining service has been developed by the Westinghouse Electric & Manufacturing Company. This unit is built in ratings up to 1600 amperes at either 275 or 550 volts d-c.

Mining bus often involves long feeders where short-circuits near the end of some of its branch circuits will not cause sufficient current to trip the feeder breaker at the substation. The sectionalizer is applied at the points where the branch circuits are taken from the main feeder. Trouble on one of these branches is quickly isolated so that normal service is undisturbed on the rest of the circuits. This reduces load outages and saves time in restoration of service after an outage.

A sectionalizer is housed in a substantial, drip-proof, steel box which can be locked up. Front and rear doors permit all parts to be easily inspected. The box is arranged for pole, wall, or floor mounting. The contactor is a proven circuit interrupter of strong and reliable construction and all parts are especially treated to withstand underground service.

For additional information write to Department 7-N-20, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

G-E Announces New High-Sensitivity Galvanometer

A new galvanometer, more than three times as sensitive as previous galvanometers, has been announced by the General Electric Company. The new instrument is suitable for many applications where small movements are required. Applications include testing instruments, material, and apparatus for production, where rapid readings and minimum fatigue to the operator are essential; and for bridges and other apparatus requiring an external galvanometer.

The extreme sensitivity of this instrument is largely obtained by an arrangement of two fixed mirrors mounted inside the case, one on each end, thus increasing the effective light beam length. This gain in sensitivity is obtained at no sacrifice in sturdiness.

The galvanometer element and optical system are mounted in an attractive case of cast-aluminum alloy. The scale, of translucent compound, is double-marked 50-050 and 0-100 in 1-mm divisions. The light source is provided by an automobile-type lamp, easily replaceable, which provides a high-intensity spot with hairline index, so that the scale can be used quickly, accurately, and with minimum eye fatigue. An external adjuster is provided for setting the element on zero. Alnico magnets are employed and the coils are of Formex wire, one of the latest products of G-E research.

When Hand Lettering Looks Like Printing . . . That's News!

There's a brand new line of lettering guides on the market, that's going to fill a long felt want among you technical men. They are Technygraph guides and they cover every style of lettering from simple sans-serif to the elaborate forms, meeting every need.
Ideal Rotary Connector

The wide acceptance and universal approval of operators using the Ideal Type DA-30 Rotary Connector on heavy duty rotary rigs has prompted the National Supply Company to develop their Type D-6 Connector for lighter rotary use.

Tungsten Carbide Tools

A straight tungsten carbide grade of Kennametal which is approximately 15% stronger than any other tungsten carbide of the same hardness, has just been placed on the market by McKenna Metals Co., 323 Lloyd Ave., Latrobe, Pa.

Known as Kennametal grade K4, this new carbide tool material has a hardness of 92.0 Rockwell A and strength of 223,000 lbs. per sq. in. (transverse rupture test), as compared to a hardness of 91.8 Rockwell A and a strength of 190,000 lbs. per sq. in. for a comparable competitive brand of tungsten carbide. The increased hardness and strength of Kennametal K4 is a result of the improved methods of carbide manufacture developed by the company for the production of the steel cutting grades of Kennametal.

Kennametal K4 has the same thermal conductivity as other tungsten carbide tool materials, namely, 0.19. Due to its high thermal conductivity, together with its unusually high wear-resistance, grade K4 is particularly applicable to the machining of hard, crumbly materials such as cast iron, "transite" pump, bakelite, porcelain, hard rubber, glass, casein—as well as silicon aluminum, hard bronze and other non-ferrous materials.

The increased strength of Kennametal grade K4 is particularly desirable when resistance and giving larger possible loads for expanded tractor effort. The second or front section of the bowl is then easily heaped high with the D8 tractor power.

A new apron design increases capacity, reduces overflow and facilitates loading by reducing entrance friction. Positive, wipe-out ejection tailgate gives accurate control of spread, eliminating the necessity for secondary spreading tools, and empties the bowl completely and quickly of the stickiest materials. Single dead-ended cable on either side of the bowl pulls the tailgate from the vertical load center, thus reducing friction and wear on tailgate rollers and cable.

To keep the sheaves entirely free from dirt, cable is dead ended on the apron and a sliding block sheave assembly mounted upon springpipe. A goose-neck or swan-neck yoke gives increased clearance for large single or dual tires when working over uneven ground.

Albanene—A New Tracing Paper

Albanene is made of 100% long fiber pure white rags treated with Albanite, a new crystal-clear, synthetic solid developed in the K & E laboratories. It is free from Oil and Wax—chemically and physically stable.

Albanene will not oxidize, turn yellow, become brittle or lose transparency with age.

Equally important, Albanene has excellent working qualities. It has a new drawing surface that takes ink or pencil smoothly and erases with ease. Because it is absolutely dry, Albanene does not pick up dust, helps you to keep your drawings unusually clean. The high fiber base stock gives it unprecedented strength. Because Albanene is permanent, it will retain all of these qualities indefinitely.

Try this improved tracing paper on your own drawing board, under actual working conditions. A sample will be sent upon request.

New Double Bucket Carryall

Designed to give increased yardage with D8 tractor power, R. G. LeTourneau, Inc. has introduced the Model LU Carryall cable-controlled Scraper with a strudy capacity of 15 cu. yds. and a heated capacity of 19 cu. yds.

Because of its large capacity and easy loading, the Model LU can be used behind the standard D8 tractor and loaded either with or without a pusher. An 8 ft. 6 in. blade width permits the moving of the Scraper over highways and its operation on narrow fills.

LeTourneau's patented double bucket feature incorporated in the Model LU gives the effect of loading two small Carryalls successively. After the first bucket is loaded to capacity, it is permitted to travel back on rollers instead of being forced, thus reducing loading taking rough cuts or interrupted cuts on hard materials. The illustration shows a tool tipped with Kennametal K4 on the stationary post of turret lathe, set in position for a rough cut across the face of a Pomona jet pump discharge head at the Pomona Pump Co., Pomona, Calif. Note that the cut is interrupted across the six holes on the face, yet the Kennametal tool took these "jump" cuts without being damaged in any way.

Plant News

New York Power Show, Grand Central Palace, New York, N. Y., December 2-7

Link-Belt Company plans to have a very active display in spaces 283-289-390, utilizing much of the operating equipment that attracted so much attention at its New York World's Fair exhibit.

This will include operating units of silent and roller chain drives and the Link-Belt P.L.V. Gear variable speed transmission.

To announce the newly designated line of "Friction Fighter" bearing units, there will be a multi-sided revolving display
P. M. Sheriger, '23, Takes Charge of Eimco's New Branch Office in New York City

The Eimco Corporation, of Salt Lake City, announces the transfer of its branch office in New York City, from 330 West 42nd Street to 120 Broadway. Coincident with this change to new and larger quarters, all Eimco sales in the eastern and southern states will be in charge of P. M. Sheriger. Mines '23, who has been moved to New York, as District Manager, from his former territory in Montana and Idaho.

Mr. Sheriger's wide experience in all phases of mining and tunneling, together with his intimate knowledge of Eimco products and manufacturing facilities, assures even better service than has heretofore been available to present and prospective users of Eimco Mine-Car Loaders, Continuous Vacuum Filters, Ball Mills, Crushers, Thickeners, and other improved equipment for the mining and chemical-process industries.

Eimco's New York representation has been strengthened by the appointment of Henry W. Erickson as District Engineer. Mr. Erickson's specialized experience in the manufacture and application of crushing and grinding equipment will permit eastern and southern mining companies to take fuller advantage of the "Super-Molychrome" ball-mill liners, crushing rolls, jaw-plates, etc., developed within recent years by the Eimco Corporation and its affiliated American Foundry and Machine Company.

Another forward step is the establishment in New York City, of a service department which will give any other necessary assistance to users of Eimco equipment throughout the eastern and southern states.

West Coast Mines, Inc. New Mill

The West Coast Mines, Inc., a California corporation, which operates a group of mines near Winnemucca, Nevada, has just contracted with the Western-Knapp Engineering Co., of San Francisco, to equip and install a modern milling plant.

The contract includes not only a complete crushing and milling unit, but also an 18 mile 40,000 volt power line; a 20,000 ft. water line with deep well and booster pump; water storage tank and other surface buildings, including an assay office, change room, shop office and office building.

Most buildings will be of steel frame construction to eliminate possible fire hazards. Winter weather conditions require that the mill building be heated.

Construction work was scheduled to start during the last week in October and the plant is expected to go into operation during the first few days of February, 1941.

Even Trademarks Are Modernized

Ashcroft, makers of quality pressure gauges since 1850, announce a new trade mark to appear on all Ashcroft Gauges in the future. The shield outline, so familiar to Ashcroft Gauge users is retained. However, the date (1850) when Ashcroft made the first gauges in this country, is now shown on the shield, together with the letters "Q. S. A." The name "Ashcroft" in white across the center makes it a most prominent trade mark.

In announcing their new trade mark, Ashcroft call attention to the complete Gauge catalog which will be furnished to anyone interested in writing the Ashcroft Gauge Division, Manning, Maxwell & Moore, Inc., Bridgeport, Connecticut.

Sullivan Appoints California Distributor

The Sullivan Machinery Company announces the appointment of The Bergstrom Steel Company, Ltd., of Los Angeles and Oakland, California, as distributors for their Detachable Rock Drill Bits. Bergstrom Steel were not only the first operators in the United States of a commercial drill steel conversion shop, but were the first detachable bit distributor as well.

The Bergstrom Steel Company will stock a complete line of bits in their warehouse at both Los Angeles and Oakland. They have a force of sales engineers experienced in the practical application of drill bits to all phases of rock drilling conditions.

They are fully equipped to make and supply Detachable Bit Rods and to resharpen bits.

Meehanite Research Institute

The twelfth annual meeting of the Meehanite Research Institute of America, Inc. was held in Milwaukee, October 30, 31, and November 1. The following officers were unanimously re-elected for 1941:

President—H. B. Hanley (American Laundry Machinery Co., Rochester, N. Y.)

Secretary-Treasurer—Frank M. Robbias (President, Ross-Meehan Foundries, Chattanooga, Tenn.)

Over eighty representatives of Meehanite foundries in the United States and Canada were present for the discussion and distribution of more than forty research papers which had been prepared during the year.

A feature of the meeting was the celebration of Mr. Smalley's birthday and the surprise presentation by the group of a large birthday cake.

A Call For More Procurement Inspectors

More procurement inspectors are needed at the Air Corps, Wright Field, Dayton, Ohio, for the following branches of inspection: Aircraft Instruments, parachutes, aircraft propellers, and tools and gages.

The Civil Service Commission has been seeking experienced men for these jobs but it announces that a new type of position has just been added to those to be filled—that of Junior Procurement Inspector, $1620 a year. The upper grades pay from $2000 to $2608 a year. (All salaries are subject to a 3 1/2 percent deduction for retirement annuity.)

For the junior grade, college graduation in engineering may be substituted for experience as follows: Graduates in aeronautical engineering will be eligible for aircraft, engine, instruments, and propellers; graduates in mechanical engineering will be eligible for engines, instruments, and tools and gages; graduates in electrical engineering will be eligible for instruments.

For the upper grades, mechanical experience, which may include apprenticeship, is required in the branch applied for except that the experience on engines, instruments, and tools and gages need not have been in aircraft work. In fact, for engines, mechanical experience on construction or machining of engines or as a machinist or toolmaker working to close tolerances using precision instruments or measuring devices will be acceptable. College courses in engineering may be substituted for a part of the experience for the upper grades.

Applicants will not be given a written test. They will be rated on their education and experience and the commission will determine the salaries and approval of the applications, subject to verification by the Commission.

This work is an important part of the National defense program. Apply for further details to the Secretary, Board of U. S. Civil Service Examiners, Wright Field, Dayton, Ohio; to any first- or second-class post office; to the U. S. Civil Service Commission, Washington, D. C. in their district offices.

(Continued on page 616)
FOR YOUR CONVENIENCE

Send your publications to Mines Magazine, 734 Cooper Building, Denver, Colorado. Readers may order publications from this office by giving index number.

(1176) ELECTRIC FLOW METERS. Catalog No. 3007 by Brown Instrument Co., Philadelphia, Pa., contains 28 pages of descriptive material and layout diagrams covering the complete line of Brown Electric Flow Meters for the measurement and control of steam, air, oil, water, chemicals and other fluids. Among those you may find an instrument that you can use to advantage in your plant.

(1177) OIL WELL DRILLING. Bulletin No. 284 by International Supply Co., Toledo, Ohio, describes and illustrates the new consolidated ideal rig type 27, showing the construction and many advantages of this new consolidated rig and economical oil well drilling.

(1178) CONCRETE HOSES. It is the title of a 32-page booklet published by Portland Cement Assn., Boston Bldg., Denver, Colo. This publication contains many illustrations and plans for attractive modern small homes.

(1179) V BELT DRIVES. "Industrial News" for November, published by Morse Bros., Moly, Co., Denver, Colorado, illustrates many new applications of V Belt Drives and especially an application of a V Belt Drive to the mine hoist which will be of interest to most of our readers. An application is also shown for dry line equipment.

(1180) CAPACITORS. Descriptive Data No. 49-302 by Westernhouse Mfg. Co., Cleveland, Ohio, contains 54 pages showing type FP Capacitor Bank and Switchgear Equipment for indoor or outdoor service. Pages of dimension and wiring diagrams are given.

(1181) TURBINE WELL PUMPS. Bulletin No. 405 by Reed Rollers Bldg, Co., Houston, Texas, describes a lump number of design of Reed Rollers waterwheel and describes the many applications of their drum specific rock foundations.


(1183) ELECTRIC DREDGES. Bulletin No. 14062 by Moore Bros. Moly, Co., Denver, Colo., illustrates and describes a complete line of machinery for both batch and continuous type mixers and especially describes many new applications of Y Belt Drive to the mine hoist which will be of interest to most of our readers. An application is also shown for dry line equipment.

(1184) AUTOMOBILE CONSTRUCTION. The story of the "What Is Take's To Make An Automobile" is told in a 30-page pamphlet published by Automobile Mfrs. Moly, Co., Denver, Colo., which illustrates and describes the Morse Continental Vacuum Filters, drum and disc types, and accessory equipment and table of capacities are given.


(1186) INSULATION. Armstrong Insulator for October. Published by Armstrong Cork Co., Lancaster, Pa., contains 12 pages showing the construction and operation of the Greentown heavy weight scrapers with capacities of 14 to 20 yd. up to 15,000 yd. Many other photographs are included showing the scrapers in operation. Bulletin No. 147 by Sauerman Bros., Inc., 438 So. Clinton St., Chicago, Ill., contains 12 pages showing the construction and operating the Greentown heavy weight scrapers with capacities of 14 to 20 yd. up to 15,000 yd. Many other photographs are included showing the scrapers in operation. Bulletin No. 147 by Sauerman Bros., Inc., 438 So. Clinton St., Chicago, Ill., contains 12 pages showing the construction and operating the Greentown heavy weight scrapers with capacities of 14 to 20 yd. up to 15,000 yd. Many other photographs are included showing the scrapers in operation.

(1187) RADIOACTIVITY WELL SURVEYS. Other interesting oil field notes are given in the December issue of the "West Virginia" published by Lane-Wells Co., everywhere.

(1188) SNOW FLOWS. Form No. 49021-1 by Mormor-Harrington Co., Indianapolis, Ind., contains 14 pages illustrating, specifications and many applications of Mormor-Harrington All-Wheel-Drive, heavy duty truck characteristics and especially for use in weather conditions and finishing, many models of snow handling equipment. Bulletin No. GEA-2758 by General Electric Co., Schenectady, N. Y., contains an illustration of Time Switches for many purposes. Descriptive data No. 40850 by Moore Bros. Moly, Co., Denver, Colo., describes and illustrates the Morse Continual Vacuum Filters, drum and disc types, and accessory equipment and table of capacities are given.

(1189) A PRACTICAL COURSE IN CONCRETE, in the form of a 64-page paper published by the Western Portland Assn., Boston Bldg., Denver, Colo. This is a very practical paper for the classroom and laboratory, written by Henry Game of the Iowa State College. Illustrations and descriptions and descriptions of methods which may be applied to almost every construction problem. Descriptive data No. 40850 by Moore Bros. Moly, Co., Denver, Colo., describes and illustrates the Morse Continental Vacuum Filter, and heavy-duty equipment. Pages of dimension and application are given.
Spectroscopy Course Popular

The course in spectroscopy is very popular with students and professors who “sit in” during the lecture and lab work. The course is open to seniors in Metallurgy. Dr. Phelps is in charge of the class.

The professors who outnumber the enrolled students are Carpenter, Ward, Aitkenhead, Schietz, Wichmann, Baxter, Howe, Hartkemeier, Jacobs, and LeBaron.

Professor Carpenter made this course possible by securing the proper equipment.

R. O. T. C. Commanders Appointed

Under a temporary General Orders, officers have been named to command the R. O. T. C. engineers unit at Mines. Nominated to fill the important posts of company commanders were Taylor, Berta, Talbott and Flynn. In order to assist these company commanders, Moore, DeGoes, Schiele and Wood were appointed as assistant company commanders. Other seniors were placed in the positions of platoon leaders in the various companies. Juniors taking advanced military training will serve in the important positions of first sergeants, line sergeants, guides and squad leaders. All of these appointments are tentative, and are subject to revision in the future.

This year, one hundred and two men reported for advanced military. Mines’ quota is eighty men, which shows a decided increase in interest in military life. This increase has been observed throughout the entire country, the general average being about twenty per cent greater than last year. The substantial rise has been attributed to two principal causes: namely, the uncertain condition resulting from the war in Europe, and the draft in our own country.

In former years, when the demand for advanced military was not as pronounced as this year, a deficiency in the quota at one school enabled another school to enlarge its quota. For example, if Mines had eighty-three applicants and a quota of only eighty, the military department would report this number to the corps area headquarters. Then, if some other school did not have a full quota, the Mines’ quota would be enlarged to accommodate the extra men. This year, however, all quotas have been filled, and hence the fate of the fourteen extra men is undecided. The Eighth Corps Area includes Colorado, Texas, New Mexico, Arizona, and Oklahoma.

In order to give a maximum number of men actual officer’s experience, the military department is working on a plan to have four companies of three platoons, each composed of three squads.

New Equipment for Metallurgy Department

Professor Carpenter has announced the arrival of new equipment for the Metallurgy department consisting of a densitometer and a logarithmic step-sector. The logarithmic step-sector will show the quantity of a substance under observation and the densitometer will show the density of the substance.

Course in Morse Code

Professor Pawley of the Geophysics department is again holding sessions for the study of the Morse Code every Monday and Thursday after school. The course began last year and resulted in one student getting an operator’s license.

After a short period of studying the code itself, the class takes down the messages Prof. Pawley sends by tapping on his desk. No previous knowledge is necessary and the course is entirely a voluntary one.

Changes in Curricula

Several important curricula changes to be included in the new catalogue have been announced by Dean Morgan. Of these, the change in graduation requirements, probation requirements, and registration in senior courses will affect the entire student body. The Mining and Geophysics options have the greatest number of changes in requirements.

All options will be affected by the change from 480 to 500 the number of credits required for graduation. One thousand quality points will be required instead of the present 760. Of these, 450 quality points must be earned in the junior and senior years, exclusive of the regular summer field courses. However no additional courses will be necessary to earn these additional 20 credits. Credit will be given for courses heretofore having no credits. These are: Senior trips, 8 credits; Junior trips, 4 credits; and First Aid, 2 credits. The remaining six credits will vary according to the department, but will consist of special work in geology, mining, metallurgy and petroleum.

A student will be placed on probation if he fails to earn 35 credits and a total of 60 quality points instead of the former 30 credits and 45 quality points. This will tend to increase the quality of the engineers graduating from Mines by weeding out those least fitted for engineering.

At the present time, only two options, Mining and Metallurgy, require undergraduates to have completed all junior courses before registering in senior professional courses. It was unanimously voted to change this to the following: “Students in all options must have completed all junior required courses before registering in any senior major course.” This will be effective for the present sophomore, the class of ‘43.

In the Geology department, Historical Geology 104 has been increased to a six credit course and Advanced Historical discontinued. This will be in effect after the present frosh class has passed the junior year. Thesis work will be continued thru both semesters of the senior year instead of one. A one hour course of seminar work has been added.

Partial Differential Equations and Mathematics for Geologists and Geophysicists have been discontinued. In their place G. P. 304-L, Principles...
of Electricity and Magnetism and G. P. 306, Introduction to Theoretical Physics will be taught by Professor Pawley. Other changes in the Geophysics department are Sedimentology in the place of Advanced Historical in the second semester junior year and in the senior year a new course, Industrial Rocks and Minerals, will replace Economic Geology. This course will be a study of the origin and occurrence of non-metallic mineral deposits of economic importance. It will be required in Geology, Geophysics and Mining Geology. Optical Mineralogy has been discontinued and Sedimentary Petrology added.

In the Mining department, a new option, Mining Geology, has been added. It places emphasis on the discovery and exploitation of mineral deposits instead of on exploitation and refining of the minerals after they are located. Graduates in this option will receive a mining degree.

No major changes were made in the Metallurgy, Fuel, or Petroleum departments.

Several new elective courses have been added. The Chemistry department, in cooperation with the Metallurgy department, will offer three new courses in Spectroscopy. They will cover the theory of the spectro-scope and practice in the use of it in quantitative and qualitative analysis of minerals. For this purpose a three-meter grating spectro-scope has been obtained. Corrosion of Metals will also be added. It will cover the theory, methods of testing, and prevention of corrosion. Powder Metallurgy covers production, use, properties, structures and fabricated articles from metallic powders. Mine Dust, the physiological and legal aspects of dust, and Dust Technology, dust and dust sampling with reference to mining operations were added to the Mining department.

New Cork-Borers

Professor Baxter and Mr. Hull have designed and built a set of eight cork-borers for the organic laboratory. They were built to facilitate the work in that laboratory. The borers have a fixed bit and all bits are of a different size. The machines are entirely new in design and are so constructed that they are self-cleaning.

Scientific Papers Given Mines

"Lett" LeRoy, '33, has donated three illustrated scientific papers to the Geology department for references in Geology courses.

Mr. LeRoy is one of the leading micro paleontologists in the world. He has been employed by the Standard Oil Company of California for several years to do research work on foraminifera from the late Tertiary of the Netherlands, East Indies. He has just returned to the East Indies to continue his work after a vacation spent in the States.

One of the outstanding features of the papers are the remarkable illustrations which were sketched by a native boy of the East Indies. He had to study the specimens with a microscope and then sketch them.

The papers deal with the foraminifera from the Sangscoelirang Bay area from the Siberacia Island off the west coast of Sumatra and from the Bantamien Substage.

All three papers will be included in the January issue of the Mines Quarterly, published by the Publication Department of the School.

Mines Receives Meteorite Collection

"The Colorado School of Mines is the first institution in the world to equip itself properly for acquainting geology students with meteorites," declared H. H. Nininger, director of the American Meteorite Laboratories in Denver.

A valuable collection of meteorites secured through Mr. Nininger has been presented to the School of Mines by three of its alumni, Charles O. Parker, Charles W. Henderson, and Orvil R. Whitaker, all of Denver. Parker graduated in 1923 and is president of Charles O. Parker Company in Denver. Henderson received an honorary doctor of science degree in 1930. He is supervising engineer of the Western Field office of the U. S. Bureau of Mines. Whitaker, who graduated in 1890, is a consulting engineer.

The collection will be used for teaching in the petrology course and will constitute the first collection of meteorites accessible to individual students. The collection will be analyzed by the students from lecture trays.

Meteorites range from pure nickel-iron alloys, siderites, to all types of a stony nature. More than 90 percent of all the meteorites that fall are of a stony nature. There are numerous intermediate types between these two classifications and they are called siderolites. When freshly fallen they have a thin layer of slaty, fusion crust which disappears after long exposure.

The specimens donated to the school represent three different falls, the Hugoton, Kansas meteorite; the Covxert, Kansas meteorite; and the Gladstone, New Mexico meteorite.

Some of the areas of life in which meteoritical research may prove of value are weather forecasting, lighting industry, mineral deposits, metallurgy, aeronautics and ballistics. A study of fallen meteorites enables a climatologist to get a brief understanding of the conditions in the upper atmosphere and of solar radiation. Meteoritical research is especially of value to metallurgists as meteorites are very resistant to rust and a great deal of study has been devoted to the field in connection with stainless alloys. Many geologists believe a number of nickel deposits are due to meteorite impacts.

Meteorites also give a means of studying air resistance to high velocities and markings from a hard impact.

In commenting on the gift, Dr. F. M. Van Tuyl, head of the department of geology and himself a collector of meteorites, said, "This collection is a valuable asset to the geology department and the school is greatly indebted to Messrs. Parker, Henderson, and Whitaker, inasmuch as the students having contact with meteorites during lectures will obtain better knowledge of them."

Mines Designated as Supervising Institution

The Colorado School of Mines at Golden has been designated by the United States Commissioner of Education as the supervising institution for Colorado and Wyoming for defense training on the engineering school level in the program for the training of national defense workers.

Dr. M. F. Coolbaugh, president of the Colorado School of Mines, has been named regional supervisor for the two states, which constitute region 19 of the national organization.

A regional organization has been set up in order to co-ordinate the training with the needs of industry. According to a communication from the United States office of Education to President Coolbaugh, "In each region there will be an adviser who will keep in close touch with the defense industries in his area to determine their needs for engineering specialists, and who will cooperate with the engineering schools of his region in utilizing their special facilities for special training."

A sum of $9,000,000 has been appropriated by Congress to the United States office of Education for national defense training on an engineering school level.

A meeting of the regional supervisors was held in Washington, Oct. 31 and Nov. 1 to work out the details of regional organization and procedure, which President Coolbaugh attended.
The champions take second. Preseason dope had it that the Miners would take the Rocky Mountain Conference banner for the second year in a row hands down. Only an unlucky day at Colorado Springs that gave Colorado College a 28 to 21 victory spoiled that prediction. It is the first RMC football title the Tigers have ever grabbed.

The feature of the month was the Orediggers seventeenth annual Homecoming, Saturday, Nov. 7, that pitted the Montana State Bobcats against the Blasters. When the final gun boomed, Colorado Mines was out in front by the score of 20 to 7, the same score they racked up against the Bobcats last year in Bozeman.

3,500 grads, students, and friends saw the Mines offense swing into action in the first period and strike three times in the first three minutes of the second quarter. The Bobcats threatened once and tallied once on a pass in the third stanza.

The first score came on the first play of the second period when Joe Berta crashed over the right side of the line from one yard line. A pass, Berta to Rogers, was good for the extra point. The Miners had threatened three times in the first period only to be stopped by fumbles and a stubborn Montana line. Hard driving of 190 pound fullback Carter De Laittre, and shifty running of Joe Berta and Harold Rogers piled up the yards for the Miners in that period.

The second touchdown was set up for the Miners right after the kickoff when a bad pass by the Bobcat center was recovered by Gene Volpi, Mines guard, on the Montana one. De Laittre smashed over for the touchdown.

Then with less than three minutes of the quarter gone, De Goes intercepted Vaughn's attempted lateral and scammed 35 yards for a touchdown. De Laittre placekicked for the extra point.

The Mines offense bogged down in the second half which was played on even terms.

By power plays the Miners amassed 241 yards from scrimmage to visitors 80. In first downs the edge was not so great for Mines had 11 to Montana's 8.

Western State

Defying the jinx that Western State has on visiting teams on their home field at Gunnison, the Miners rolled up a 12 to 0 win over the Mountain-
BAGUIO
L. W. Lennox, '05, President; Frank Delehunty, '25, Vice-President; T. J. Lawson, '36, Secretary-Treasurer, Box 252, Baguio, P. I. Monthly dinner meeting third Wednesday each month.

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

BAY CITIES
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.

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. Maloif, '37, Secretary-Treasurer, 9701 Lemont Ave., Cleveland, Ohio. Four meetings during year, 4th Friday, March, June, September and December.

DENVER
Paul Archibald, '35, President; Duane Gleghorn, '34, Vice-President; Earl Durbin, '36, Secretary-Treasurer, 3338 Gilpin St., Denver, Colo. Four eight meetings per year. July, October, January, April.

The Colorado Section of the Colorado School of Mines Alumni Association held its regular quarterly meeting at the Oxford Hotel on October 25, 1940. President Lay opened the meeting by announcing that we had received a challenge from the Southern California Section regarding the attendance and fulfilling of our quota for the Loan Fund by the Oxford Hotel by the October meeting.

Mr. Bruce LaFollette introduced coach Dox Neighbors who discussed the football team, the games to date and the prospects for the future. Mr. Neighbors said that the coaching staff has no alibi to offer for the showing of the team so far this season but they were too optimistic in expecting a team with only four starting men from last year's squad to come along in the time they had to practice for the games. Knee and ankle injuries have slowed the team up to a considerable extent for this year. Mr. Neighbors introduced Rex Flynn, a member of the Freshman coaching staff, and the following members of the team; Blair, Campbell, Rogers, and Eden.

Rut Volk assured coach Neighbors that the entire Alumni Association was behind the coaching staff at Mines and would continue to support them in their endeavors.

Mr. Mueller gave the financial report, which showed that Colorado Section was in good financial condition.

Mr. E. B. Watson, chairman of the nominating committee, submitted the following recommendations for officers for the coming year: Paul Archibald, President, Duane Gleghorn, Vice President, and Earl Durbin, Secretary-Treasurer. A motion was made and seconded to accept these men as the new officers. The motion was passed by the members present.

Mr. Archibald, the new president, assured Mr. Neighbors that the Colorado Section would continue to support the present coaching staff at Mines.

Mr. Neighbors then presented moving pictures of the C. C.-Mines football game. These pictures are used by the coaching staff to instruct the players regarding the mistakes that have been made.

These pictures show in detail the progress of the players as well as being very entertaining. Final Score C. C. 28—Mines 21.

The following members were present:


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

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.

The Southern California Section was melted down by some "unusual weather" on October 18 (97 degrees) and cupelled down to a button of 60 members who rolled into the Athletic Club for a fine dinner. The meeting night had been switched to Friday to enable some of the out-of-town men to attend. First timers at our meeting included C. E. Prior, '13; A. J. Dingeman, Ex-'08; E. S. Geary, '12; Wm. A. Perkins, '27. Prior has been out of the States so much of the last 27 years that he has been unable to vote at a single election since he left school.

After the dinner and roll call of members present, Ed Brook gave us some dope on this year's football team. Ray Dimmick and Geo. Johnson outlined the plans for a rooting section from here to go to Fresno on November 21 for Mines-Fresno State game. Indications are that there may be a couple of buses needed in addition to the men who will drive their own cars.

Arky Brown gave the results of the recent sweeptakes. Bill Boyle and Dimmick took a bow for the good work put in on the very successful barbecue held at Santa Anita Ranch, September 21.

After a short intermission, meeting was resumed with a color film made by the Columbia Steel Company, showing steel from the ore in the open cut on through all the mills and on to the various finished products. Mr. Wm. G. Austin of the Sales Promotion Division of the Columbia Steel was present to run the film off for us.

We are indebted again to Bill Boyle who was in charge of the program for the evening.

PHOENIX

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

TULSA

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

The Oklahoma Chapter of Mines Alumni Association, while silent as far as reporting, has been very active.

During the summer months several get togethers were held and a big beer party and barbecue for the Seniors on their annual trip.

During the month of July, the group received 100 tickets on the Hollywood Gold Cup Handicap race sweepstakes, selling over 40. Loyd Elkins was one of the heavy winners from Tulsa.

The meeting of September 13, 1940 was held in Hotel Tulsa. Fifteen Miners assembled and made plans for social and business meetings for the coming fall. President Evans announced that over $100,000 had been sent the Alumni Loan Fund.

The chapter has been very successful in holding a regular noon luncheon every Friday at Hotel Tulsa. A large number of old and new graduates get together and talk over the situation.

James Clark has Narrow Escape

James A. Clark, Manager of Standard Oil Co. of Venezuela, Caripito, Venezuela, had an exciting experience recently in the Gulf of Paria, off the east coast of Venezuela.

Mr. Clark, with five companions, was on a fishing trip when their motor boat struck a reef. They succeeded in building a raft from which they were picked up by the Venezuelan coast guard near Guaira, after a two-day search made for them by airplanes, boats, and Indian canoes.

Mr. Clark is a native of Colorado. He attended the Denver schools and studied two years at the University of Colorado before the World War. He went overseas with the A.E.F. and returned as a second lieutenant. He then entered the School of Mines from which he was graduated in 1921. After several years spent with petroleum companies in the States and in Mexico, he became associated with the Lago Petroleum Corporation of which, until recently, he was manager.
ALUMNI RETURN FOR HOMECOMING

Returning to their Alma Mater to review old campus haunts and to renew their friendships with members of the class of the “good old days,” Mines’ alumni joined students and faculty members, Friday and Saturday, in celebrating the seventeenth annual Homecoming, November 1 and 2.

Game-talk was apropos as Mines’ nineteen hundred and forty-one team was hailed by returning grads as a great eleven after winning the big event of the festivities. Other activities of the celebration included the annual rally, intramural contests, alumni buffet dinner and Homecoming dance.

Sigma Alpha Epsilon and Sigma Nu captured top honors in the house decoration contest and the intramural two mile run, respectively, while Bruce Tebbe, Beta Theta Pi, stamped himself as a “pie-face excellens” in winning the pie eating contest, and Dick Dirmeyer, Barb, showed his heels to the rest of the intramural runners in taking first place in the two mile run.

The events began Friday as the campus rolled out its welcome mats and Mines’ Spirit soared at a mammoth rally held in the field house.

“Mines’ Spirit” was the dominating theme of the pep talks given by coaches and prominent alumni. Talks were given by Charles Parker, S. Power “Pi” Warren, Frank Harris, Paul Archibald, alumni members, and John Mason and Adam Esslinger, Oredigger coaches.

The pie eating contest and crew race were held, with the Beta Theta Pi and Sigma Alpha Epsilon fraternities winning. The rally was concluded at a large bonfire which was the result of the freshman wood gathering activities.

House decoration judges, Professor W. A. Waldschmidt of the geology department, Mrs. O’Byrne of the Foss Drug Co., and Col. C. C. Gee of the military department awarded first prize to the S. A. E. exhibit. A cup was presented to the winning fraternity at the Homecoming dance. The Kappa Sigma fraternity has won first place for the past three years. The decision, committee members said, was a difficult one to make as there was little difference in the quality of the decorations.

The festivities were continued Saturday as the Montana and the Mines’ band joined together in an eighty-piece band in the flag raising ceremony. Half-time was taken by a demonstration by the Montana and Mines’ bands, the two-mile race and a skit. The snappy Montana State band performed for the fans spelling out Montana and Mines.

The class of 1915 was the honored class for the day and tickets to the game were supplied to this group of old grads. According to the registration of the alumni, only one man of the 1915 class was here, A. S. Walter of Socorro, New Mexico.

Immediately after the game a buffet dinner was given for the returning grads and their families. Over a hundred and fifty persons were served.

The “M” club dance Saturday night at Guggenheim climaxed the
The returning grads included:


Frosh Football

Holding a heavier Greeley Cub eleven scoreless until the last few minutes of the game, the Colorado Mines freshman team dropped a 21 to 0 contest to the Cubs.

The Teachers scored on a 70-yard drive and two intercepted passes.

Starring for the Mines freshmen were Bill Brown, tough blocking back and captain, and Joe Murphy, tailback who completed 11 out of 14 passes.

Soccer

Using a baffling passing attack the Mines soccer team conquered foes and lead the Denver league. The team is undefeated, but has two ties against Coors on its record. Captains Bill Roberts and Reggie Regelado are standouts.

Intramural Notes

In the annual cross-country run during the half of the homecoming game, Dick Dirmeyer, barb, captured first place in the two mile grind. The Sigma Nu's, however, gained the most points and their team took first.

Sig Ep reigned king of the touchball teams as they trounced Wheatridge, barb champs, in the final game, 9 to 0.

Bill Owens, flashy freshman, gained the finals of the intramural tennis meet by beating Bill Horlibt. Owens, a barb, will meet the winner of the Uzzel-Kellog match for the championship.
Professional CARDS
A. E. Anderson, '04
E. I. DuPont de Nemours & Co., Inc.
1110 Hoge Building
Saflia, Washington

Jack P. Bonardi, '21
New York Representative
The Mine & Smelter Supply Co.
1775 Broadway
New York City

George R. Brown, '22
Brown & Root, Inc.
Engineering Construction
Houston, Austin, Corpus Christi

G. Montague Butler, '02
Mining and Geological Engineer
Dean, College of Engineering,
University of Arizona, Tucson.
Examinations and tests are necessary for the character, and loss of ore.

C. Lorimer Colburn, '07
Mining Engineer
Cooper Bldg.
Denver, Colo.

Allan E. Craig, '14
Mercy Mill Division
The Mine & Smelter Supply Co.
Denver, Colo.

W. C. Douglass, '11
Mining Engineer
Harley
Great Sand Dunes, Box 415, Alamosa, Colo.

W. G. Swart, Hon. '17
Mining Engineer
916 Union Street
Alameda, California

Wm. D. Waltman, '99
Franco-Wyoming Oil Company
601 Edison Bldg., Los Angeles

Elmer R. Willey, '14
Willay Centrifugal Pumps
Denver, Colo.

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WILLIAM CROW
230 University Building
Denver, Colo.

(Continued from page 517)

Personal Notes—
Farm Security Administration, 85-2nd St.,
San Francisco, Calif.; Bruce H. Irwin,
'37, Mining Department, Allis-Chalmers
Mfg. Co., Milwaukee, Wis.; D. J. Lyons,
'36, Chemist, Tidewater Associated Oil
Co., 1719 Albamba Ave., Martinez,
Calif.; J. M. Maxwell, '30, Geophysicist,
General Petroleum Corp., Calil., 1481
E. Broadway, Glendale, Calif.; D. H.
MacKay, '29, Consulting Engineer, Steam-
boat Springs, Colo.; A. J. May, '22, Tazewell,
Va.; H. L. Mendenhall, '38, Computer,
Steinmetz and White Corporation, 709
University Bldg., Tulsa, Okla.;
Carl L. Morris, '36, Erection Engineer,
Allis-Chalmers Mfg. Co., 1205 So. 73rd
St., Milwaukee, Wis.; Raymond A.
Morgan, '29, Engineer, Stanolind Oil &
Gas Co., Elk Basin, Wyoming; E. F.
Petersen, Jr., '37, just returned from South
America, 721 So. 11th St., Muskogee,
Okla.; Howard S. Rines, '29, Project
Superintendent, Great Sand Dunes, Box
415, Alamosa, Colo.; William H. Spar,
'39, Sales Engineer, General Oil
and Gas Co., 11 Broadway, N. Y.; F. M.
Stephens, '13, Field Engineer, A. S. & R. Co., 813
Valley Bank Bldg., Tucson, Ariz.; Neil S.
Whitmore, '28, 714-11th Street, Grecely, Colo.;
Norman Whitmore, '26, Owers, Minerals
Engineering Co., 417 So. Hill St., Los
Angeles, Calif.; C. Ehr Wusch, '14,
Consulting Engineer, 417 So. Broadway,
Pittsburg, Kansas.

WEDDINGS
Bell-Pankow
Franklin A. Bell, Ex-'34, and Miss Mary Elizabeth Pankow, daughter of Mr. and Mrs. Charles J. Pankow of South Bend, Ind., were united in marriage in the St. James Episcopal church of South Bend, the evening of September 21.

The bride attended the University of Michigan and the University of Colorado and is affiliated with the Alpha Chi Omega sorority.

The groom was attended by his father, Charles N. Bell, '09.

The bride attended the University of Illinois, exchanged marriage vows on October 8 at St. Luke's Episcopal church, Champaign, Ills.

The couple are now at home.

(Continued on page 609)
IS IN YOUR HANDS

Before this child reaches maturity, Tuberculosis may be eradicated from the United States. But remember, she is growing up in a world where Tuberculosis still causes more fatalities between the ages of 15 and 19 than any other disease!

By buying and using Christmas Seals you will enable your Local Tuberculosis Association to continue a year-round fight that has helped to reduce the death rate from Tuberculosis by 75% during the last 33 years!

So protect this child—and every child in your community.

**BUY CHRISTMAS SEALS**
In listing Alumni for the new directory to be published next month the following names were found with addresses unknown. Every effort has been made to contact the men but all mail has been returned.

If anyone can furnish the addresses of one or more of these men the Alumni office will appreciate the information.

FRANK J. NAGEL, Secretary.

No changes of address or new listings will be accepted after December 10, 1940.

Petroleum For War—
(Continued from page 585)

Oil expropriated from oil companies of the United States operating in Mexico.

Mexico has proposed to build a pipe line from her oil fields to the port of Salina Cruz on the Pacific coast; and has asked many U. S. pipeline contractors for bids to build the line, but so far no contracts have been let. Such a line would remove the advantage the California oil market boasts for Japanese, Russian and other foreign countries over the tolls to pass through the Panama Canal and the longer trip to the Mexican ports on the Atlantic side.

Conclusions

At the present time it is impossible to predict the full significance of the part to be played in this war by petroleum products, but one thing we must all agree upon: all else being equal, the power having the greatest supply of fuels and lubricants has the better chance to win. That modern war machinery is essential to belligerents—and is now the President of Honduras. During the last 9 years under the expert supervision of Mr. Yerex, TACA has increased its business every year until in 1940 it has acquired 52 planes. An article recently in Time states that TACA has been bought by the American Export Lines, Inc., at a price of more than $2,200,000.00 and that Mr. Yerex has been retained as manager of the new company. This shows what a man with enterprise can do in Honduras if he knows his business and has the energy and perseverance to tackle a difficult job.

What Honduras needs most of all is more venture capital but the people of the country do not know how to secure the interest of those who can furnish the finances to develop the country. The government, nevertheless, is open to ideas and will do all it can to assist and encourage those who will help to build up the country. The taxes in Honduras are different from those in the United States, but they are reasonable and there is little trouble as soon as a newcomer is acquainted with the country and its policies.

Although Honduras was a major mineral producing country under the Spanish rule, yet its mining collapsed as soon as the Spaniards departed. For many years the Rosario Mine was the only mining operation in the country. This company has been steadily producing for the past 60 years and has paid over $16,000,000.00 in dividends.

It is a well managed and well operated company producing about $2,200,000.00 of mineral wealth per year. In 1939 it produced nearly 4,200,000 ounces of silver and 17,800 ounces of gold from ore that averages 23 ounces of silver and 1/10 of an ounce of gold per ton. The company owns about 25 square miles of mineral land and is located about 20 miles from Tegucigalpa. It has a 45 ton cyanide mill and over 100 miles of workings in its mine. It has ample reserves of ore and will probably be an important producer of silver and gold for many years to come.

A few years ago E. P. Halliburton of Los Angeles purchased the Agua Fria mine located near the town of Danli. This is a gold mine. The gold occurs associated with chalcopyrite, arsenopyrite and pyrite. A 100 ton flotation mill has been erected and this company is now the largest producer of gold in Honduras.

It has been the writer's pleasure to have made two trips to Honduras and while there he visited several min-

(Continued on page 616)
Calcite in places has been altered to gypsum. The source and deposition of this calcite is a problem that cannot be answered with any degree of certainty. Calcium carbonate can be deposited by a number of agencies. The calcite was probably deposited in these joints because of: (1) the super saturation of the meteoric waters with calcium bicarbonate; (2) common ion effect; (3) residual solutions in the coal seam losing carbon dioxide to the extent that calcium carbonate might be precipitated. The points listed above are thought to be the causes for deposition of this form of calcite, and the first and third causes are more probable than the second. The carbonate solutions probably had their source in the calcareous rocks both above and below the Bevier coal seam. The third point is listed as most probable as the removal of the carbon dioxide would result in the concentration of the remaining constituents and would tend to precipitate calcium carbonate. The loss of the extra carbon dioxide of the bicarbonate solution may have come about by temperature changes in the coal bed, a slight raising of the temperature being sufficient. The second point is mentioned, because, any other calcium or carbonate compounds present would tend to increase the common ion which would result in the precipitation of the common ion.

The alteration of the calcite to gypsum occurred later during the deposition of the sulfides. The gypsum is the result of the release of the sulfate radical during the oxidation of the iron sulfide, and its union with the calcium to form calcium sulfate, leaving as residual material the iron oxide, and liberating carbon dioxide. In some veins near the later generation of pyrite, pyrite occurs in gypsum, which has been formed from the calcite. This mode of occurrence strongly suggests a reaction with the hydrogen sulfide in the presence of iron carbonate with the resulting precipitation of iron sulfate and the oxidation of some sulfur to the sulfate, which reacted with the calcium carbonate to form gypsum. The absence of any iron oxide precludes oxidation of an iron sulfate as a source. The alteration to gypsum along these joints is not very extensive, and only a small portion of any one vein has been altered.

Gypsum

The second set of joints formed in the coal, the gash veins, were all filled with gypsum. (Fig. 6). Here the gypsum is thought to have been deposited directly, as calcite has not been found associated with it. The gypsum is definitely later than the preceding transparent scaly calcite, as the gypsum filled gash veins are found cutting the calcite filled joints. There is no evidence of alteration of the calcite at the intersection of the two veins. A probable source of the gypsum was its precipitation from a saturated solution of calcium sulfate which had formed in the ground water solution as a result of the oxidation of pyrite in the overlying shales and other coal beds. Gypsum is common along the joints in the shale above the coal, more common in fact than calcite. Another method of origin would be the precipitation of gypsum by sulfuric acid in the ground waters (formed during the oxidation of the pyrite, a common feature of the alteration of sulfide ore bodies) reacting with calcium bicar-

Bevier Coal Seam—

(Continued from page 590)
and the crystalline calcite of the cavities is of the same age. If they are of the same age, then, the fissures leading to the cavities must have been sealed off in some manner from the later solutions.

**Pyrite**

Pyrite was again deposited at the close of the second calcite period. (Fig. 2). This age of pyrite may be the same as that filling the radial cracks in the concretions. Solutions with no associated minerals (Fig. 7), with pyrite. Generally the sphalerite up the seam, or near the outcrops of after mining operations have opened not show signs of oxidation except fide. Since the Bevier coal seam does ably the result of oxidation of a sul­drogen sulfide in the waters is prob­sulfide content. The presence of hy­generally have a rather large hydrogen sulfide in any of the eroded beds. If iron salts are also acquired the hydrogen sulfide from the oxidation of iron sulfides in all cases. Where the veins were quite wide the calcite fibers do not touch in the cen­ter, leaving small vugs lined with cal­cite needles. This deposition took place from the walls of the veins to­wards the center. No evidence has been found to show that the trans­parent scaly calcite that lines the walls of some of the cavities, mentioned be­fore in connection with the next oldest generation of calcite, is of the same age as the fibrous calcite. If they are of the same age, then the problem appears as to why the transparent variety would be deposited in one place and the fibrous in another. This question is one that cannot be answered from the material available for study.

**Sphalerite**

Sphalerite, zinc sulfide, is found in these same veins, but not associated with pyrite. Generally the sphalerite occupies the entire width of the vein with no associated minerals (Fig. 7), but calcite has been found in small veins cutting the sphalerite in some instances. The origin of the sphalerite is a question that cannot be answered definitely. It is probably of the same origin as the sphalerite found in the lead and zinc deposits of the Missis­sippi Valley. Sphalerite has been found associated with the rocks of the Lower Coal Measures, all through the Mississippi Valley.

Pyrite and sphalerite also occupy the feather joints in association with the large fissure veins. In these feather joints the minerals are not associated with each other or any other mineral. (Fig. 12).

Somewhere near the close of the period of sulfide deposition the over­lying sediments had so compassed the coal seam, that the underlying plastic clay was forced up into the openings developed during the final differential compaction of the coal seam. These clay slabs or rolls generally show striations at the contact between the clay and the coal. The injection of these clay rolls, introduced compressive stresses in the coal seam. These comp­ressive forces produced a crushing effect in the coal seam in close proxim­ity to the injection. This is especially evidenced in the large fissure veins near the contacts. Here the coal has been almost powdered and recemented with calcite forming a dense gray mass like the filling in the vein.

In some of the material studied, sphalerite particles within the clay roll, show striations. The sphalerite particles having been breciated and recemented with the clay material. (Fig. 8). These particles of sphalerite were always found near the contact of the clay roll and the coal seam. The injected clay evidently tore off the sphalerite vein that lined the contact and incorporated it in the clay roll.

**Fibrous Calcite**

During the final period of mineral­ization of the Bevier coal seam the fibrous calcite was deposited. This form of calcite occupies the centers of the large fissure veins surrounding the included gypsum, and in places reaches a total width of one-half inch. (Fig. 11). This deposition of calcite did not fill the veins completely in all cases. Where the veins were quite wide the calcite fibers do not touch in the cen­ter, leaving small vugs lined with cal­cite needles. This deposition took place from the walls of the veins to­wards the center. No evidence has been found to show that the trans­parent scaly calcite that lines the walls of some of the cavities, mentioned be­fore in connection with the next oldest generation of calcite, is of the same age as the fibrous calcite. If they are of the same age, then the problem appears as to why the transparent variety would be deposited in one place and the fibrous in another. This question is one that cannot be answered from the material available for study.

**Conclusions**

The study of the mineral content of the Bevier coal seam has presented a number of interesting problems. The major problem considered in this report was: What event or sequence of events resulted in the mineral deposition? In the study of this problem, evidence was found to show that the minerals were deposited in a definite order, as follows:

**Syngenetic Minerals**

1. Marcasite and/or pyrite
2. Concretionary pyrite

**Epigenetic Minerals**

3. Transparent scaly calcite
4. Gypsum
5. Transparent scaly calcite
6. Pyrite
7. Sphalerite
8. Fibrous calcite

The different minerals and their varying periods of deposition were de­pendent upon the character of the de­positing solutions, which must have changed from time to time. The syngenetic minerals were doubtless controlled by the character of the original swamp solutions. The subsequent periods of mineralization were related to solutions derived from overlying or underlying formations; to the chemical changes produced by reac­tions with minerals in the coal; or to mingling with oxygen bearing solu­tions.

**Bibliography**

**Ground Water Seepage**

*(Continued from page 593)*

**Practical Application to Percolation Into a Tunnel**

If an unlined tunnel of radius 7 feet is driven at a depth of 25 feet below a river bed, the depth of the river being 10 feet, and the bed being so constituted that its percolation factor is 0.01 feet per year, let it be required to determine the quantity of water which will enter the tunnel in unit time. The quantity of water, as seen in the above theory, will be given by

\[
Q = \frac{2\pi K (d + h)}{\log \frac{2d}{b}}
\]

where

- \( h = 10' \) = elevation of water surface above the bed.
- \( b = 7' \) = radius of the tunnel.
- \( d = 25' \) = distance from river bed to centerline of tunnel.

\[
K = 0.01 = \text{percolation factor.}
\]

Hence

\[
Q = \frac{2\pi (0.01)(35)}{\log \frac{2(25)}{7}} = 9.799\pi (0.01)
\]

\[
= 0.308 \text{ cu. ft per year per linear foot of tunnel.}
\]

With this quantity of water known, a suitable drainage system for the tunnel could be easily provided.

**Acknowledgments**

All work in the Division of Dams of the Bureau of Reclamation is under the direction of K. B. Keener, Designing Engineer on dams. All design work is under the direction of J. L. Savage, Chief Designing Engineer. All engineering work is under the direction of S. O. Harper, Chief Engineer; and all activities of the Bureau are directed by Commissioner John C. Page with headquarters in Washington, D. C. To these, and to all who have helped in the preparation of this paper, the authors wish to extend their thanks.

(Continued from page 595)

c. Decreased volume of production from working places and machines of distracted employees.
d. Decreased production from machines operated by inexperienced employees replacing those injured.
e. Decreased productive ability of injured employee able to return to work directly after treatment.

Accidents cost money far beyond the medical bills, compensation and insurance premiums paid; in fact some authorities now maintain that the ultimate cost of accidents is four to five times the amount paid out in compensation, medical cost and insurance. The total cost of accidents is estimated to be about 20c per ton in coal mining and $20 to $25 per $100 of payroll in metal and non-metallic mines.

Examples of monetary savings possible through the adoption of a complete safety organization plan and institution of a determined, well-thought-out safety campaign are easily found and one will be given. In 1925 one mine with an average of 125 employees had three fatalities, 28 compensable disabling injuries, and 17 noncompensable disabling injuries resulting in 18,986 days lost time; in 1926 it had one fatal, one total permanent, one permanent partial, 38 compensable and 29 noncompensable disabling injuries, causing 14,991 days lost time; in 1927 it had 3 fatal accidents, 11 compensable and 15 noncompensable disabling injuries, causing a total loss of 18,705 days. In October 1927, through suggestions of a representative of the Safety Division of the United States Bureau of Mines, a safety organization plan was instituted, one permanent partial, 38 compensable disabling injuries, causing 14,991 days lost time; in 1928 it had 3 fatal accidents, 11 compensable and 15 noncompensable disabling injuries, causing a total loss of 18,705 days. In October 1927, through suggestions of a representative of the Safety Division of the United States Bureau of Mines, a safety organization plan was instituted.

No deaths have occurred since January 1, 1928, and no permanent disabilities are known to have occurred since that date. In 1928 there were 2 disabling accidents causing 1820 days lost time of which one was compensable. In 1929 there were 4 compensable and 7 noncompensable disabling accidents which resulted in 144 days lost time. During 1930, 5 compensable and 2 noncompensable disabling accidents caused 730 days lost time. On January 8, 1931, two miners received crushed fingers, and from then to May 25, 1933 there were no disabling accidents in the mine. The company was insured through a casualty insurance company, but after inaugurating the safety campaign the company became self-insuring. The cost of accidents in 1927 was $40,181.63. After the safety program was put into effect, the cost of accidents was reduced to $5,859.32 in 1928, $2,769.20 in 1929, $3,720 in 1930, $934.50 in 1931, $86.92 in 1932 and $601.16 in 1933. If the 1927 rate had been in effect from 1928 to 1933, accidents would have cost $241,089.78, hence the savings in six years may be estimated at $227,118.80. This company undoubtedly made a substantial saving by assuming full responsibility for accident occurrence and then trying to eliminate accidents.

Safety is, or at least should be, an operating problem, and executives who have adopted it as such and have given intelligent, well-directed effort to the work have returned safety dividends to their companies. Safety workers believe that supervision and discipline are the keynotes to accident reduction or elimination. An outstanding record was made by one mechanized coal mine. A safety engineer was hired in the spring of 1930. The accident cost was high during the first six months of the year, averaging 11c per ton of coal mined. In 1931 the average cost was reduced to 1.2c per ton, and the cost per lost time accident was $140. During 1932, 1933 and 1934 the costs were held below 1c per ton of coal mined.

The cost of maintaining adequate safety in a mining property is considerable but certain is not excessive, and the ultimate cost of neglecting safety is heavy not only on the operating company and its employees, but also on the entire community.

Data on the cost of accident prevention is far from complete due to the many conflicting elements entering into the cost of mining which pertain to safety, such as supervision, ventilation, timbering, haulage, and blasting, as well as first aid, safety organization, safety meetings, bonuses, rock dusting, etc.

Costs per ton, of accident prevention as given by a few mines are as follows:

<table>
<thead>
<tr>
<th>Mine</th>
<th>Cost per ton</th>
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<tr>
<td>A</td>
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The above costs include salaries of safety workers, first aid training and supplies, mine rescue training, first aid contests, safety meetings, bulletin boards and posters, bonuses and awards, and protective clothing furnished by the company.

As can be seen from these figures, the cost of accident prevention is decidedly less than the amount paid out for accidents after they have happened.

**THE MINES MAGAZINE • NOVEMBER 1940**
GEOPHYSICAL News and Review
Compiled by the Geophysics Department, Colorado School of Mines

General:


This book, by H. F. Elwood, who is principal of the Mining and Technical Institute, Leicester, England, contains a chapter on geophysical methods of investigating boreholes. II. gathers data on all important and accepted means of surveying the courses of deep boreholes.—D. W.


Reprinted from Physics of the Earth VII, Internal Constitution of the Earth, edited by B. Gutenberg, Chapter V.

Based on the thought that the crust and the interior of the earth are generally related, this book will yield information on the interior. To this end the writer treats extensively such topics as the composition of the crust; the basic layer, Meteorites; earth magnetism and radioactivity. The numerous subjects and phases covered under such a broad title and the conclusions drawn from them can only be hinted at in a brief abstract. The broad aspects of earth physics treated above have a bearing on exploration geophysics.—D. W.


A brief article with the first report of the A. I. M. E. Mineral Industry Education Division Committee on Geophysics Education. The report covers a survey on the work being taught in geophysics courses based on a questionnaire sent to 147 schools in the U. S. Plans for future work of the committee along this line are noted.—D. W.


A paper in the symposium on geophysical prospecting which covers briefly the development of the different geophysical methods in petroleum exploration. The present status of "The Exploratory Geophysical Arts" as now used in the search for oil fields, the magnitude of the costs involved, and the even greater importance in terms of oil discovered are treated.

Case examples for Illinois and California are given in presenting this summary on geophysical methods. The writer concludes with the sentence: "Applied geophysics in the petroleum industry is indeed 'big business'".—D. W.


The writer discusses the establishment of the geophysical section, its abstracting service, and its transfer from the U. S. Bureau of Mines to the U. S. G. S. in 1936. Magnetic work of the section, its seismic investigations and electrical and gravimetric field work and studies are treated. The article is illustrated and a list of some 150 references is attached. The paper shows the scope of governmental activity along this line.—D. W.

GABRIEL, V. Geophysical Prospecting in American Mining. E. and M. S. 140(7) 60, July 1939.

In a letter the writer brings out some points in the early history of the application of geophysical prospecting to mining in the U. S. which were pointed out to him by Sherman F. Kelly. Reference is made to an article on this subject by Gabriel in the April issue of this publication.—D. W.


In a previous paper the writer applied three principles of war: namely, that of the Offensive, Surprise and Security to Petroleum Exploration. The present one takes up the principle of the objective and that of the economy of force. The objective being stated as the discovery of oil under the most favorable conditions of time place and investment.

In considering the economy of force idea geophysical methods are discussed and divided into true structural methods as the drill and reflection seismograph—and pseudo-structural or stratigraphic prospecting methods—such as refraction, electrical, gravity, magnetic, and geochemical. The estimation of discovery costs for an orderly exploration campaign by the drill and reflection seismograph under the first class and by "Eltran" and "Eltran" plus gravimeter is given for an estimated 100 determinations being necessary for one discovery. One hundred wells cost three ($2 million) dollars, 100 reflection seismographs plus reflected detail, $290,000, and Eltran plus detail by Eltran and soil analyses and reflection seismograph and a test well, $75,000.

The conclusion reached is that it is less expensive to use stratigraphic methods for reconnaissance and true structural ones for detailing. Interesting examples of successful oil wells are given and the background material is presented.—D. W.

Magnetic Measurements:


A general discussion on the subject with particular reference to magnetic features of the oceanic basins. It is brought out that with improved knowledge of magnetic anomalies, their interrelations to gravity anomalies and deep focus earthquakes may be established. Numerous phases of this broad subject such as magnetic measurements on ocean-bottom cores, secular variation as related to regional geologic structure and the like are considered.—D. W.


The writers discuss the production of a highly uniform magnetic field in a rectangular box which is long compared to its width section by means of the coils of a rectangular coil on the ends of the box. The mathematics of the case presented is developed. It was found that a field comparing favorably in uniformity with that from Helmholz coils was produced.—D. W.


A soundly based discussion of the application of magnetic surveys to mining problems with the background idea that such work offers a method of securing additional data which to base deductions regarding structural and hence economic geology.

Examples are cited from the iron regions of Michigan, Wisconsin and Minnesota, from surveys in connection with Bauxite in Arkansas and the mapping of a rhyolite dike in Arizona. It is brought out that magnetic methods might save much money in the exploration of prospects. The author writes from a background of practical experience.—D. W.


The uniform magnetic field at the earth's surface that would arise from assumed pairs of poles within the earth is computed. This field which closely fits the existing earth magnetic field, is shown on maps of the U. S. by contours. These maps also carry the contours of the observed magnetic field of the earth with the discrepancy between these two sets of contours shaded. The problem considered by the author is to set up such a uniform hypothetical field and from it calculate the proper latitude and longitude corrections to apply to local field surveys. Tables for this correction values for different latitudes and longitudes are given in gammas per mile.

By the use of such values of the Lat. and Long, correction discrepancies found in tying together two surveys made from different base stations and possibly using different Latitude and Longitude corrections can be minimized.—D. W.


An investigation covering the theory and design of a new electromagnetic magnetometer, for measuring components of the earth's magnetic field, to establish a primary standard that is invariable. Because of the age (some 20 years) of many of this type of instruments a new primary standard was not feasible for keeping instruments in various laboratories functioning accurately.

This new instrument was made up of a Helmholz-Gaussain coil that sets upon a standard field opposed to that component of the earth's field measured a rotating coil used as a null detector measuring the current generated by it.

Principle of the measurement, computation of the coil constant; limit of detector sensitivity and errors are discussed in detail.—D. W.
The application of the Equipotential line on a mining property in Gilpin County field procedure used are covered, central City. The geology of the area and Colorado a few miles Southeast of Center, Ariz., 23(10), 2-4 and 14; October 15, 1939.

An answer to some questions. Mineral Jnl. Ariz., 23(10), 2-4 and 14; October 15, 1939.

A description of a geophysical survey on a mining property in Gilpin County Colorado a few miles Southeast of Central City. The geology of the area and of the mining worked are discussed. The application of the Equipotential line method using alternating current and the field procedure used are covered.

A conductive zone was mapped and recommendations for its exploration made.

The power supply described gives 2500 volts at 10 micro-amperes. This is suitable with Geiger-Muller counters. The supply weights 450 grams. A 175 gram output giving 90 volts is also treated.—D. W.

The details of a complete Geiger-Muller counter system with circuit diagrams are given. The system is A.C. operated and consists of a high voltage supply; coupling circuit and vacuum tube feeding a Geiger counter. Alternative methods and circuits are covered.—D. W.


Describing the practice in Illinois of locating the proper places to shoot and size of shots in low pressure horizons in the Chester sand. The Louden field is given as an example. Such procedure reduces the amount of water and increases the amount of oil.—D. W.


The article based on an illustrated talk given at the Annual Meeting of the A.I.M.E., Feb. 1939, brings out the overlap of the fields of geology and geophysics and that geology must be used as a starting point and as a constant check in all geophysical work. The importance of measurements of physical properties of rocks and formations in situ and the present possibilities of seismic and gravitacional methods in mining, geophysics are considered. Numerous pertinent points in the application of geophysics to mining and in relation to mining geology are discussed.—D. W.


A description of a geophysical survey on a mining property in Gilpin County Colorado a few miles Southeast of Central City. The geology of the area and of the mining worked are discussed. The application of the Equipotential line method using alternating current and the field procedure used are covered.

Conductive zone was mapped and recommendations for its exploration made.

The writer describes improvements in "Eltran" equipment such as a new mixing circuit and net work for producing waves of predetermined shape with which to match incoming waves in null measurements. A calibration scheme with which the feasibility of field equipment can be checked is discussed. A simplified method of subjecting a detected wave to the further distortion of a simple circuit, called the "Saw-Eran" is treated. The adjustment of this circuit necessary to bring the received wave to a standard value gives a measure of the time constant of the detected wave. The article gives much light on the electrical transient method.—D. W.


Conde maps showing a direct current resistivity survey with potential electrodes first 400 and 600 feet from current electrodes and second at distances of 900 and 1100 feet there; from an area of some one and one-half townships adjacent to the South Elton oil field are given. Profiles of the electrical survey for shallow, medium and deep penetration are critically compared with "Eltran" results along the same line.

It is concluded that the "Eltran" and resistivity data are in good general agreement qualitatively but that large observed variations in near surface resistivity—"can hardly be attributed to mineralization emanating upward over structure." Further that the number of anomalies found was so great that it was highly improbable that they were associated with structure. The article is controversial in nature.—D. W.


A discussion of the applicability of certain work by John R. Carson and others, in relation to D. C. transients. The investigations referred to dealt with the integral equation response of electrical net works and brought out some possibilities in regard to obtaining directly the derivative of voltage transients. It is suggested that a new experimental method might give more accurate measurements of the electrical earth responses than obtainable from suddenly applied D. C. transients.—D. W.


The writer treats a horizontally stratified soil whose electrical properties are characterized by a function expressing the relation of resistivity with depth. The apparent resistivity can be computed from earth resistivity measurements at the surface. The paper presents mathematical solution of the problem, which is more convenient for numerical calculations in interpretation of resistivity measurements than others advanced. The formula developed is calibrated by two examples, makes it possible the determination of apparent resistivity for different variations of resistivity with depth.

Instead of using the method of images a new procedure involving "lens-sources" is given. The method the type of resistivity curve to be derived from hypothetical arrangements of resistivity layers or variations of resistivity with depth can be calculated.—D. W.


Attention is called to the incorrect use of the expression for measured resistivity values in ohms per cubic unit. Motion presented that above assembly note that only the correct unit of ohms times cm. be employed; (ohms times a distance unit)”—D. W.

As the past history of geophysics has been concerned, the book is much more complete as possible, though some of the descriptive portions, and the treatment of mathematical and purely descriptive portions, and the treatment has been extended to cover recent developments. An endeavor has been made to present the art of Geophysical Prospecting from a systematic point of view, laying stress on fundamental concepts and descriptive instruments and procedures as completely as possible, though some of them may now be in predominant use. As the past history of geophysics has demonstrated, many methods developed at an early date and shelved because of lack of suitable instruments and interpretative techniques, have been revived later (and been patented in some cases).

In the four chapters referred to above, the treatment follows a uniform plan. It begins with a discussion of general principles; this is followed by a description of rock properties and methods and instruments for determining them. Instruments and instrument theory are treated next, after which a brief discussion is given of corrections to be made on observed data. Then follow the fundamentals of interpretation methods and a description of results obtained under varied geologic conditions. The treatment is mathematical where necessary, being as elementary as it could possibly be made without becoming too lengthy. A reader of average engineering background will be able to follow the discussions without having to skip portions because of unfamiliar mathematical procedure. At the same time, the geological phases of the subject have not been neglected. Geological factors are thoroughly discussed in their effect on physical rock properties; examples of geophysical surveys have been so selected as to illustrate as many different geologic situations as possible. The discussion of results has not been confined to cases where geophysics has been successful and geologic factors are externally emphasized limiting the application of a given method.

The main body of the book is preceded by six introductory chapters. These have been written for the benefit of individuals in executive and geologic advisory capacity who, without going into detail, wish to become familiar with geophysical exploration methods and their geologic possibilities and limitations. The first chapter explains the significance of geophysical exploration and sets forth that geophysics is primarily a tool for determining geologic structure, that mineral deposits can be located directly in but a few cases, and that the applications of geophysics are usually of an indirect nature. The second chapter contains a non-mathematical and elementary description of all geophysical methods, presented largely with the help of schematic diagrams. The third chapter discusses briefly the physical significance of quantities measured and procedures of measurements used in geophysical exploration. The fourth chapter is written for the oil geologist and explains to what type of geologic oil structures geophysical methods are applicable, pointing out the choice of method for reconnaissance, and detail. This is followed by a similar discussion of mining geophysics, based on a genetic classification of mineral deposits. The sixth chapter discusses both the geologic and non-geologic applications of geophysics in engineering, with particular reference to military uses.

Chapters seven to ten comprise the gravitational, magnetic, seismic and electrical methods, as was stated above. Chapter eleven deals with well-testing methods such as electrical logging, temperature measurements, seismic measurements, radioactivity logging, gas logging, photoelectric measurements and the like. The twelfth chapter contains a discussion of radioactivity methods, soil and gas analysis, dynamic soil testing and strain gauging. It is concluded with a discussion of the applications of acoustic methods in aerial, marine and submarine warfare.

Considerable attention has been given to the index. It is divided into two parts, the first including subject matter and the second names of authors and localities. The complete index covers 48 pages of fine double-column print. The reader should have no trouble finding what he wants.

Finally, what about the value of this book in view of the rapid development of geophysical technique? To begin with, I believe that we are now off the steep portion of the "asymtote" in geophysical development, as the mathematician would say. Most of the major procedures and instruments are fairly well crystallized at this time, as least as far as fundamental principles are concerned. Hence, an effort has been made to have this book retain its value for a number of years to come, by stressing fundamentals and arranging the material in systematic order. —C. A. H.

GUN TYPE WELL CASING PERFORATOR. Patent No. 2,216,151, issued Oct. 1, 1940, to Albert C. Princo, Los Angeles, Calif., assignor of one-half to George L. Ratcliffe, Los Angeles, Calif.


FISHING TOOL. Patent No. 2,218,267, issued Oct. 15, 1940, to Philip M. Ben, Oklahoma City, Okla.


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