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Published every month in the year, at Golden, Colo., by the Alumni Association of the Colorado School of Mines.

C. BRB WURNSCH, '14, EDITOR.
Advertising rates on application.
Subscription Price... $1.50 per annum Single Copies............... 25 cents

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VOL. X GOLDEN, COLO., SEPTEMBER, 1920 No. 9

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THE ALUMNI ASSOCIATION OF THE COLORADO SCHOOL OF MINES HAS A CAPABILITY EXCHANGE which renders efficient Employment Service; if you want a man or a new position wire them.
Gulf Coast Salt Domes
By Albert G. Wolf, '07.

The economic importance of Gulf Coast salt domes was first recognized when enormous workable salt deposits were discovered in some of them in Louisiana. Later, sulphur was discovered in a dome at Sulphur, La., and was first successfully extracted by the French process in 1894. The production of sulphur there soon became so great, and the cost so low, that the Sicilian sulphur mines, previously the largest producers of sulphur in the world, practically ceased to export to the United States. Now the Gulf Coast deposits supply the greater portion of the world’s sulphur. Neither of these discoveries, however, created any general public interest in salt domes. It remained for the completion of the Lucas gusher, by Capt. A. F. Lucas, on Spindlev Top, a salt dome near Beaumont, Texas, to bring these domes into the limelight. This gusher came in January 10, 1901, making 75,000 barrels of oil a day, and creating intense excitement in the oil world. As fast as rigs could be procured, all the more prominent domes were drilled, and many of them developed into large oil-producing fields.

At the present time, two of these domes supply us with considerable salt, and others have practically an inexhaustible supply for the future. Three others, one in Louisiana, and two in Texas, produce the majority of the world’s sulphur supply; many of the others are adding materially to the oil production of the United States. Undoubtedly many more domes are still to be discovered beneath the flat coastal plain.

In view of their economic importance, and despite the fact that much has been already written about these coastal domes, the writer believes that a general description of them, including their distribution, origin, structure, and mineral production, will be of interest to some of the readers of the Colorado School of Mines Magazine. The subject is so broad that only a brief treatment can be given to each subdivision. A bibliography, which, though quite incomplete, is appended for those who wish to make a detailed study of these peculiar structural formations.

Gulf Coast Topography and Distribution of Domes.

The domes here discussed lie within a belt not over 75 miles wide, extending inland from the Gulf of Mexico, in the states of Louisiana and Texas, and from west of the Mississippi River to the Rio Grande. The width of this belt is indicated in Fig. 1 by the distance between the Gulf shore and the arbitrarily drawn, heavy dot-and-dash line, and the portion of the belt shown contains all the important domes, at least those found to be of importance to date.

Most of this belt is an extremely flat coastal plain. Except where streams have cut down to an elevation approximating sea-level, forming banks, the untrained eye can scarcely distinguish any change in elevation. The river “valleys” are broad, and but slightly lower than the rest of the surface. These are called “bottom lands” or “river bottoms,” and are easily distinguished by a change in vegetation, especially an increased growth of Spanish moss on the oak and other trees.

It is no wonder, therefore, that, in a country so flat, more or less circular or elliptical, elevations 10 feet to, in one case, 85 feet, above the general surrounding level, should be called “mounds,” “ridges,” and “big hills.” These are the Gulf Coast salt domes, and are the chief topographic feature of the region.

After a number of domes had been discovered, it became evident that they were located along northeastern-southwestern lines roughly parallel with the Balcones fault and along intersecting parallel lines, as shown in Fig. 1. In this figure the broken lines are hypothetical fault lines, not exposed on the surface on account of the deposition of inter sediments, and believed to be formed by subsidence in the pitching trough of the Mississippi Embayment area. The round spots represent the principal salt domes. This regular distribution is now generally accepted as indicating some relation between the domes and the main structural features of the coastal belt.

One other topographical feature in this belt is the “wave ridges.” These are long, low, narrow elevations, more or less parallel to each other and the shore line, occurring from near the coast to many miles inland. They were formed by wave action along some former or the present shore line. Some “wildcatting” is done on ground where these occur by people not acquainted with their purely surficial character.
Surface Indications of Domes.

The chief surface indication, generally speaking, is the abrupt change in elevation. In an otherwise perfectly flat country, a dome, even if only eight or ten feet high, is quite noticeable to the trained eye if an unobstructed view can be had. The drainage, also, is a good indicator of high ground. Sometimes the bending of two streams or "bayous" around a certain area will indicate higher ground that might not otherwise be noticed. Radiating streams will also show this. The surface of any elevation is liable to be covered with sandy soil or yellow sandy clay in sharp distinction to the "black land" of the "bottoms." All salt domes, however, do not show an elevation on the surface. One in South Texas is indicated by a salt lake, the bottom of the lake being rock salt. The rapidity over one in Louisiana is a salt marsh. Where domes have been found under flat or marshy ground, some indication was usually given by gas or oil seepage, and subsequent drilling proved the existence of a dome.

Surface indications of domes, then, may be summarized as change in topography (a visible dome), arrangement of drainage, change in soil, salt lakes, and gas, oil, salt water and sulphur water geysers. Gas, oil, salt water, sulphur water, gypsum, salt, or native sulphur found in drilling wells are also indicators.

Structure of Domes.

The structural features may be divided into four parts: the salt core, the cap rock, the overlying sediments, and the abutting sediments. In a few cases the overlying sediments, or both the cap rock and overlying sediments are absent. Overlying sediments, for the most part, consist of unconsolidated Quaternary strata of sands, gumbos, (with or without builders), beds of marine shells, clays, etc., with some sandy shales and thin beds of harder clay shales or other rock called "shell" by the drillers (meaning a slice of rock, not a stratum of shells). Some of the Tertiary sediments may occur above the cap rock. All these strata are gently arched. The abutting Tertiary have been broken through by the salt core and bent upward at angles of 30 degrees to almost vertical.

The intruded salt core is more or less circular or elliptical in horizontal cross-section, with radii varying from one-eighth of a mile to one mile. Its top slopes in all directions, the dip increasing rapidly toward the flanks. The depth to which the salt extends is not known. In some domes, salt is known to extend below 3,000 feet, and at Humble one well penetrated salt to a depth of 5,410 feet before it was abandoned. In different domes the salt varies from a hard crystalline to a loose crumbly texture.

Immediately above the salt core, between it and the unconsolidated sediments, is the cap rock. This consists of any or all of the following: gypsum, anhydrite, dolomite, and limestone, the latter in places being altered to marble or calcite. Usually gypsum or anhydrite is next to the salt. This capping extends only a little or no distance beyond the top of the salt plug, and its formation must have been contemporaneous with or later than the salt-plug intrusion, as no equivalent strata in the series of original sediments of the Gulf Coast can be found. The depth at which the cap rock occurs varies from a few feet below the surface in some domes to 1,260 feet or more in others.

Origin.

The possible origin of these domes has been discussed at length by various geologists, and is still a moot-point. Most of the earlier theories were based on the idea that the salt deposits were formed contemporaneously with or just in advance of the building up of the sediments in which they occur, but, generally speaking, that was before the true structure of the domes was known. Now, almost all geologists, who have studied them, agree that these deposits are secondary to the surrounding sediments.

However, the thermal spring theory, advanced by Edward G. Norton (Trans. A. I. M. E., January, 1915), still has some adherents.

In arguing for or against any theory, two points must be taken into consideration—the cause of the uplift and the source of the salt. The uplift forming the domes is attributed variously to gas pressure from below, hydrostatic pressure, isostatic movements, growth of salt crystals, volcanic plug intrusion, doming of a salt stratum and overlying strata by a laccolith, and the intrusion of the salt itself either in a molten condition or a semi-plastic condition. The introduction of the salt is also variously ascribed to ascending magmatic waters, ascending artesian waters, and in the case of salt intrusions, to offshoots from deep-seated, underlying salt beds.

In selecting the most plausible theory, all the characteristics of the domes must be taken into consideration, namely, the arching of the overlying sediments, the puncturing and bending up of the now abutting sedimentary strata, the size and shape of the salt plug, the nature and location of the gas and oil seepage, and the presence of salt domes in the adjacent area.
extent of the cap rock, and the distribution of the domes in more or less regular lines along the coastal belt. In addition, it must be remembered that no igneous rock (except a little volcanic ash of unknown source) has ever been found in this coastal belt although hundreds of wells have been drilled to 5,000 feet deep and several over 4,000 feet with at least one over 3,000 feet.

The theory best conforming to the majority of these characteristics, I believe, is that of intrusion of salt in a semi-plastic condition from a salt bed at great depth, the impelling force being lateral or compressive thrust supplied by the weight of the sediments along an over-loaded sea coast. The lateral pressure is a result of the downward pressure. This theory is described at length by G. Sherburne Rogers under the title "Intrusive Origin of Gulf Coast Salt Domes," in Economic Geology, September, 1918 (printed by permission of the Director, United States Geological Survey). The distribution of the domes has already been discussed under that heading, but it may be added that the Balcones fault (Fig 4) is the most important structural feature of Central Texas. It extends from the Rio Grande to the Red River in a southwest-northeast direction, showing for hundreds of miles as a distinct escarpment. It was formed by the subsidence of the Gulf Coastal plains to the southeast of it.

Little progress has been made in evolving a satisfactory theory for the formation of the cap rock, which plainly does not belong to the series of unconsolidated sediments overlying and surrounding it. The suggestion has been made that the anhydrite may have been lifted with the salt, as anhydrite occurs with bedded salt deposits, but that would not account for the gypsum, calcite, limestone, dolomite, and sulphur, all or some of which occur in the capping of every salt dome, unless, of course, the salt core comes to the surface. If the formation of the salt is considered secondary compared to that of the surrounding sediments, then the formation of the cap rock may reasonably be considered Tertiary, and its deposition due to circulating solutions.

Oil.

Oil, when present, may occur in three different parts of the dome structure; in the cap rock, in the loose sands above the cap rock, or in the abutting strata below the level of the cap rock. In one dome it may occur in only one of these parts, while in another in all three. There is no regularity. In one instance, at Belle Isle, La. (A. F. Lucas, "Possible Existence of Deep-seated Oil on the Gulf Coast," Trans. A. I. M. E., September meeting, 1918), a small quantity of oil was found in the salt itself. In possibly one-half the present known salt domes on the Gulf Coast, no oil has been found.

On a new dome drilling for oil is usually done on the top, followed later by deeper holes on the flanks. The oil wells that are drilled to the oil-bearing strata, above the cap rock and in the cap rock, vary in depth from 500 feet to 1,200 feet. Some may be shallower. These on the flanks are from 1,200 to 3,500 feet. There are few, if any, producing oil wells on the Gulf Coast at the present time much deeper than that. The area in which oil is found also varies greatly. If oil is in or above the cap rock, the area may be restricted to a few hundred acres, while if found in the flanks, it may embrace several square miles. It, however, rarely extends a distance exceeding one or two miles from the center of the dome.

Oil in quantity in a coastal dome was first discovered by Anthony F. Lucas, when he completed the No. 2 Lucas well on Spindle Top, a few miles south of Beaumont, Texas, January 10, 1901. This oil was in the porous limestone capping. The well came in as a tremendous gusher from a depth of a little over 1,100 feet, and flowed at a rate estimated to be 75,000 barrels daily. Most of the salt-dome oil formations carry a heavy gas pressure, and the first well drilled, in some cases many of the wells, no matter what the life of the field may be, make a large initial production. The "gusher" is quite a phenomenon, and in a comparatively short time the wells must be pumped. After the Lucas gusher was brought in most of the easily recoverable oil was soon drilled. Several made good oil fields, producing millions of barrels each to date, while others are still being drilled in hope that oil will be found. The total oil production from the Gulf Coast, that is, the coastal salt domes of Louisiana and Texas, during the year 1919 was 54,297,630 barrels of 42 gallons. The coastal oil varies in specific gravity and analysis from place to place, but averages about 21° Bé. It has a high sulphur content, and an asphaltic base.

Sulphur.

Some sulphur is present in most of the Gulf Coast domes, but only in a few is it in commercial quantity. When present, it occurs in the cap rock of the salt. This cap rock, as already stated, may consist of any one of the following: limestone, calcite, gypsum, dolomite, or anhydrite. When the sulphur is present in large amounts it usually occurs as filling the very porous limestone or calcite, and with some of it scattered through the underlying gypsum or anhydrite. As the cap rock is limited in extent, it can readily be seen that the possible lateral extent of a sulphur field is more restricted than that of a dome oil-field. In thickness, the sulphur-bearing stratum varies in different domes and in the same dome from a few feet to over one hundred feet, and in grade from a fraction of 1 percent in the underlying gypsum, to 15 percent or more in the better part of the lime-sulphur stratum.

The origin of the sulphur is an unsolved problem. According to Lindgren ("Mineral Deposits"), sulphur is "undoubtedly derived from gypsum through the reducing action of organic matter, by way of calcium sulphide and hydrogen sulphide." This is in reference to sulphur deposits in general, and not to those in specific cases ("Possible Existence of Deep-seated Oil Deposits on the Gulf Coast," Trans. A. I. M. E., 1918), claims that the formation of sulphur from the reduction of gypsum at moderate temperatures can not be substantiated in the laboratory, where a temperature of many hundreds of degrees centigrade is necessary. He contends that the presence of hollow tubular, or worm-shaped, concretions of pyrite suggest their formation by hot, rising sulphur gases. Small quantities of galena, sphalerite, chalcopyrite, etc., found in some of the domes, indicate connections with igneous forces. Kennedy (Trans. A. E. E., 1919, p. 1456) suggests that instead of the sulphur being formed by reduction of the gypsum, it may be possible that the gypsum was formed by the alteration of limestone acid, and that the hydrogen having been found in some domes, and S0₂ being one of the most common volcanic emanations.

It is stated that sulphur was first discovered in the Coastal domes in wells drilled for oil at Sulphur, La., in 1869. Attempts were made to reach this sulphur deposit by shaft mining, but after some loss of life, died in hydrogen sulphide (and possibly carbon monoxide and dioxide) emanating from the sulphur zone, this was abandoned. Later, the process was adopted in another way by a chemist named Herman Frasch. This method consisted of melting the sulphur in the ground by hot water, and pumping the sulphur up in a liquid state. He got his patent applied for October 23, 1890, and the first sulphur was produced by his method in the autumn of 1894.

The process required a certain-boiler plant of 100,000 barrel capacity, say 1,000 hp. or more, together with superheaters, pumps and air compressors, and in addition, an enormous water supply is needed. Holes are drilled to the cap rock of the sulphur-bearing stratum by the rotary method, and from that point upward drilled by a steam heating. With the superheaters, and pumped into the drill-holes...
under pressure of about 100 pounds through a second line of pipes. The sul­fur melts and collects at the bottoms of the holes, from where it is raised to the surface by air lifts.

In the sulphur business the term “cap rock” does not mean the entire capping of limestone, gypsum, etc., above the salt, as has already been described, but only the barren rock between the unstable sediments and the sulphur-bearing stratum. A good cap rock is necessary to the economic production of sulphur by this process, for without it, the hot water will be dissipated throughout the loose sediments, and only a small part of its heat energy will be expended in melting sulphur.

On the surface, the sulphur is pumped into vats made of 2-inch plank, well braced, and built up as the level of the sulphur rises. These vats vary in size, but are usually quite large, being one hundred or more feet wide, several hundred feet long, and thirty to fifty feet high. When completed, a single vat may contain a quarter-million tons of sulphur in one solid block. After the sulphur is solidified, the vat walls are torn down, the sulphur is drilled, blasted with dynamite, and loaded onto railroad cars by steam shovels.

Only three companies have been equipped to produce sulphur by the Frasch process—the Union Sulphur Co., Sulphur, Calcasieu Parish, Louisiana; Freeport Sulphur Co., Freeport, Brazo­ria County, Texas; and the Texas Gulf Sulphur, Gulf, Matagorda County, Texas. On Fig. 1, Freeport is marked Bryan, and Gulf, Big Hill. I have no figures showing the total production for the year 1919, but a very rough estimate would be between 3,000 and 6,000 tons daily. At the present time the market quotation is $18 per ton domestic, and $20 export, so it can be seen that this is no insignifi­cant industry. While the value of the oil produced from coastal domes may exceed that of the sulphur, the sulphur produced is of much more importance to the United States than either the oil or salt because by far the larger percent of the production of both oil and salt in the United States is made from territory

other than coastal domes, while almost all the sulphur comes from these domes. It should be added here that none of the domes from which sulphur is being produced have made any great quantity of oil.

Salt.

The only salt being produced from coastal domes is mined as rock salt at Grande Cote (Weeks Island) and Petite Anne (Avery island), both in Louisiana. On these domes the salt cores are found at comparatively shallow depth, at 91 feet in one case, and 330 feet in the other.

The methods of mining have been described in other publications: “The Avery Island Salt Mines and the Joseph Jefferson Salt Deposit, Louisiana,” by A. F. Lucas, Engineering and Mining Journal, Vol. XII, pp. 463-464; 1898; and “Salt Mines of Avery Island,” by Henry Ro­}

A NEW TYPE OF AIR DRILL.

The development of pneumatic mining and quarrying tools has been so rapid, and their performance latterly so efficient, that it is now regarded as having reached such a point that their comparative tests conclusively prove these “Nine­ty” drills to be much superior, more powerful and more efficient, at all pressures, than other drills of their general type and weight, and express themselves as feeling gratified at being able to make such a substantial contribution to cost saving. The new type of pneumatic mining and quarrying drill which, it is claimed, marks a great advance in the progress of air drill manufacture that has been almost, if not entirely, equalled by any single achievement.

This new type of drill is built in three models, known respectively as Models NA-90, NR-33 and NR-95; the first named being a “dry” Auger Drill, especially designed for work in coal, iron and other soft formations; the second, a combination “wet” and “dry” Auger Drill efficiently serviceable in all kinds of rock and under all conditions, either above or below ground; and the last named, a “dry” rock drill particularly adapted to work in wet shales or where out-door conditions prevail.

All three drills are extremely light, so that they can be easily carried about, and each is operated by one man alone.

They are built throughout of the very best steels compounded and with the utmost precision.

While most Auger Drills are of the valveless type, the “Nineties” are equipped with an entirely new type of spool valve, having a positive action, which is exceedingly simple and efficient.

The rotating mechanism is of unusually strong design, and uses in both teeth and paws have been reduced to a minimum. Lubrication is effected by pulsations of air which gradually feed the oil from a reservoir at the side of the cylinder into all parts of the machine.

The manufacturers state that comparative tests conclusively prove these “Nine­ty” drills to be much superior, more powerful and more efficient, at all pressures, than other drills of their general type and weight, and express themselves as feeling gratified at being able to make such a substantial contribution to cost saving.

And yet, notwithstanding this popular notion, the Denver Rock Drill Manufacturing Company, which has for quite a number of years been amongst the foremost in rock drill progress, has recently developed a new type of light mining and quarrying drill which, it is claimed, marks a great advance in the progress of air drill manufacture that has been almost, if not entirely, equalled by any single achievement.

This new type of drill is built in three models, known respectively as Models NA-90, NR-33 and NR-95; the first named being a “dry” Auger Drill, especially designed for work in coal, iron and other soft formations; the second, a combination “wet” and “dry” Auger Drill efficiently serviceable in all kinds of rock and under all conditions, either above or below ground; and the last named, a “dry” rock drill particularly adapted to work in wet shales or where out-door conditions prevail.

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Investigation of the Fundamentals of Oil-Shale Retorting*

By Martin J. Gavin,† and Leslie H. Sharp.$

The oil-shale operators in this country who are sincerely attempting to make a real industry out of oil-shale developments, are anxious to obtain fundamental data on the retorting of oil-shale; and the Bureau of Mines, in the certain variable factors in the process of retorting, is almost to be considered a fundamental work in the scientific investigation of oil shales. A material is being dealt with regarding which little is known, both as to methods of treatment and its products. For these reasons the Bureau of Mines invites suggestions the value, and thoroughly studied before passing on to another.

Carefully conducted work along the lines above indicated should be of value in giving information on the following points:

1. Are oils of different qualities prepared from shale consecutively as their boiling points are reached, the so-called "fractional distillation theory," or does the shale yield a single mixture, more or less uniform crude oil throughout the course of the distillation?

2. If the fractionation above mentioned takes place, to what extent does it progress, and hence to what extent may economics be introduced in refining shales, if the various fractions are directly recoverable, and are in the same sequence at the point in order to avoid the introduction of unnecessary variable factors in the tests and to render results strictly comparable.

Effort will be made, as far as the equipment and capital at hand makes possible, to determine the effect of the particular variable factors in retorting on the quality and quantity of the products obtained from this shale:

1. Rate of heating to a definite final temperature.
2. Thickness of the shale layer in the retort.
3. Size of individual particles of shale.
4. Vacuum or retort pressure.
5. Various pressures above atmospheric.
6. Steam atmosphere at various pressures and temperatures.
7. Other atmospheres, such as carbon dioxide, carbon monoxide, hydrogen, illuminating gas, etc.
8. Actual temperature reached.

In each case the rate of formation of products and the total time necessary to bring the retorting process to completion will be determined.

It is doubtful whether all these determinations can be made satisfactorily with the limited personnel and equipment available for the work, but it is hoped that sufficient valuable data may be obtained to be a real contribution to the present knowledge regarding oil shales and to justify a continuation and expansion of the work. As far as possible the effect of each variable will be taken up by itself, and thoroughly studied before passing on to another.

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8. Actual temperature reached.

In each case the rate of formation of products and the total time necessary to bring the retorting process to completion will be determined.

It is doubtful whether all these determinations can be made satisfactorily with the limited personnel and equipment available for the work, but it is hoped that sufficient valuable data may be obtained to be a real contribution to the present knowledge regarding oil shales and to justify a continuation and expansion of the work. As far as possible the effect of each variable will be taken up by itself, and thoroughly studied before passing on to another.

Carefully conducted work along the lines above indicated should be of value in giving information on the following points:

1. Are oils of different qualities prepared from shale consecutively as their boiling points are reached, the so-called "fractional distillation theory," or does the shale yield a single mixture, more or less uniform crude oil throughout the course of the distillation?

2. If the fractionation above mentioned takes place, to what extent does it progress, and hence to what extent may economics be introduced in refining shales, if the various fractions are directly recoverable, and are in the same sequence at the point in order to avoid the introduction of unnecessary variable factors in the tests and to render results strictly comparable.

Effort will be made, as far as the equipment and capital at hand makes possible, to determine the effect of the particular variable factors in retorting on the quality and quantity of the products obtained from this shale:

1. Rate of heating to a definite final temperature.
2. Thickness of the shale layer in the retort.
3. Size of individual particles of shale.
4. Vacuum or retort pressure.
5. Various pressures above atmospheric.
6. Steam atmosphere at various pressures and temperatures.
7. Other atmospheres, such as carbon dioxide, carbon monoxide, hydrogen, illuminating gas, etc.
8. Actual temperature reached.

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Sulphur Dioxide as Factor in Salt Lake Smoke Problem. By G. St. John Barrett. (Salt Lake Mining Review, June 30, 1920.)

An average of one hundred and seven determinations during December and January showed 0.15 parts per million of sulphur dioxide; an average of 315 determinations during March showed 0.01 parts per million of sulphur dioxide. Tests up to three thousand feet above the city showed only a trace. The concentration is highest on smoky days, in the morning, and in the business district. The combustion of fuel in the city is in great part responsible for the sulphur dioxide present. J. A. H.

METALLURGY.

This paper is a preliminary report on a study of detonators being made at the University of California. The current enters the detonator through a copper wire and passes through a platinum-iridium filament having a resistance of 300 ohms per yard. They carry a current of 0.70 ampere without breaking. Oscillograms showed the time of detonation and the energy consumed. The variation of power required, and the decrease in power as the bridge wire heated. The temperature at detonation varied widely. The most important factor in choosing a treatment for an ore is the number of minerals present and their relation to each other. Free-milling ores may contain three or more phases, but there are easily separated from the gangue by reasonably coarse crushing. Complex ores are those in which the minerals are closely associated and finely disseminated through the gangue. Flotation was introduced into the United States in 1911, and has been used ever since for separating complex ores. Differential flotation takes advantage of the fact that some minerals will float under given conditions while others will not. J. A. H.


When the receiving and sending points are not fixed, the choice of a conveying system depends on the location of the load, and of the floor surface. If these points are fixed, the choice may depend on a variety of conditions. For conveying vertical, upward, some type of elevator or chain conveyor is used. For inclines of 20 degrees or more, bucket or chain elevators are preferable. If the incline is less than 20 degrees, belt conveyors are used. The best horizontal conveyors are buckets, vibrators, rubber belts, or screw conveyors. Conveying downwards may be done by a steep conveyor, a vibrating chute, or a hydraulic flume. The Wah-bana Iron Mine, at Bell Island, Newfoundland, disposed of ashes by loading them in the buckets of one hundred pounds, which were carried away to sea every spring. When the material is to be conveyed at varied inclinations in the same plane, the pre-existing systems may be used, with some limitations. To transport fine material under any combination of preceding conditions, a blower, and air tight pipe can be used. J. A. H.

MINING.

This paper is a preliminary report on the efficiency of electric detonators and their use in mines. The author discusses the accuracy of such detonators. The most important factor in choosing a treatment for an ore is the number of minerals present and their relation to each other. Free-milling ores may contain three or more phases, but they are easily separated from the gangue by reasonably coarse crushing. Complex ores are those in which the minerals are closely associated and finely disseminated through the gangue. Flotation was introduced into the United States in 1911, and has been used ever since for separating complex ores. Differential flotation takes advantage of the fact that some minerals will float under given conditions while others will not. J. A. H.


This article describes the construction of an inexpensive and satisfactory type of two-bucket aerial tramway. It is operated with a small hoist, fixed to the terminal, a flat-bottomed bin with loading chutes, another sheave at the discharge terminal, and a tripping device. The general load that these buckets are not moving by momentum when it reaches the lower terminal, as this increases the difficulty of damping. J. A. H.


At the Chief Consolidated Mine two thousand feet of the underground shaft was concreted, 100 feet in diameter, and 920 feet deep. The shaft is surrounded by sandstone. The ore occurs as a replacement of sandstone, and is about one hundred feet thick. The climate is desirable, the mountains being open for four or five months a year. The ore is worth a price of ten dollars per ton. J. A. H.


The efficiency of a ventilating fan is rated on the static head and on the velocity head it produces. Fans are tested by measuring the pressure and the velocity head and calculating the pressure and velocity of the air as it passes through an opening which may vary in size. The "equivalent orifice" of the opening and the fan determines the pressure which will produce a resistance equal to the friction which must be overcome in a given mine. The approximate opening of a regulator in a mine door is figured in the same way. Additional pressure must be supplied to make up for any increases in velocity which may take place. High-pressure fans are required to ventilate drifts and tunnels while they are being driven. J. A. H.


The writer hopes that an exposition of the area and the accessibility of carnitite will stimulate prospecting in this field. The volume is from $50 to $100 per ton, or equivalent to from 4 to 8 oz. of gold. The ore was discovered in 1895 and has been mined for one hundred feet. Large companies develop claims by diamond drill holes at regular intervals. One such claim was bought for $150 and has been producing $500,000 in ore. Carnotite was discovered in 1895 but was not considered valuable until two years later, when its radium content was discovered and valued at $1,000,000,000, and is used medicinally, and in the manufacture of luminous paint. Present indications are that the ore will increase in value. J. A. H.


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when the production was 85,200,000 barrels. The four oil fields of Baku, namely, Balakhan, Sabounch, Roman, and Bibi-Bibat, reached their maximum since. The Grossy oil fields have increased their production about five hundred per cent in the last twenty years. The Sara- khan oil field is the most productive of the new territories.

J. A. H.

The Oil Shale Industry

By Dr. Victor O. Alderson

Published by Frederick A. Stokes Co., New York. Illustrated, 162 pages. Price $4.00.

Cokes may be secured through the Colorado School of Mines Alumni Association.

This is the first book of its kind to appear in America relating to the oil shale industry considered in its numerous ramifications. The author has endeavored to present a non-technical language a general description of the oil shale industry as a whole so notifiable as to those interested in the true status of the American oil shale industry at the present time. He discusses the petroleum industry and includes numerous statistics to show in the neighborhood of some deposits prove the existence of deep-seated magmas.

J. A. H.

The Ore Deposits of Mexico—IV. By S. J. Lewis. (M. & S. P. July 3, 1920.)

The true contact deposits in which the igneous origin of cokes can be conclusively demonstrated are practically identical with those in which the igneous origin can be deduced only by analogy. This year in the book, there are numerous tables and figures illustrating the processes of ore formation of those ores. Hot mineral springs in the neighborhood of some deposits prove the existence of deep-seated magmas.

J. A. H.

The Ore Deposits of Mexico—V. By S. J. Lewis. (Min. & Scientific Press, September 11, 1920.)

In this article the author describes the ore deposits in igneous rocks. His introduction is, in the usual discussion and interpretation of the various physical-chemical phenomena involved in vein formation and ore-deposition. He then describes various mines in the Zacatecas District, and makes numerous references to specimens found, indicative of the various geologic phenomena of ore-deposition. There are numerous illus-

C. E. W.
keep up the standard of the Magazine as to enable us to assure advertisements, and therefore we must keep the technical articles rather than devote too much space to school news and local gossip.

I am aware that most of our members feel as you do regarding the technical matters in the Magazine. They enjoy the personal items best of all, but in order for the Magazine to be a credit to the school it must have some semblance of a journal becoming to a technical institution.

I trust that our members will enter this discussion so that the Association shall succeed in getting the support necessary to enable the objects set forth in its Constitution.

EDITOR.

PERSONALS

33. Mail addressed to William B. Milliken, 1314 Pershing, Denver, Colo., has been marked "addressed dead," Who can furnish us with further details?


36. Mr. and Mrs. Wm. F. Jones, of Cold Springs, Utah, have announced the birth of a baby girl on September 7 at Keota, Colo.

37. John H. Rabb, Jr., and Miss Dorothy Hicks, of Denver, were married on June 8 in Denver. They will reside at Annapolis, Md., where Rabb is associated in business with his father.

38. The school news.

REGISTRATION, SEPTEMBER 18, 1920.

Freshmen .................................. 150
Sophomore .................................. 123
Junior ...................................... 88
Senior ...................................... 53
Post Graduate ................................ 10
Total ......................................... 424

THE EDUCATIONAL AMENDMENT.

The following is the substance of the proposed educational amendment which is to provide for an additional assessment on each dollar of valuation may from time to time be authorized for the erection of additional buildings at, and for the use, benefit, maintenance, and support of the State Educational Institution.
The Colorado School of Mines Magazine.

ATHLETICS

By Ralph C. Maxwell, '23.

Mines Football Schedule for 1920.

October 16—Mines vs. Utah Aggies at Logan, Utah.
October 20—Mines vs. University of Wyoming at Denver.
November 6—Mines vs. Denver University at Denver.
November 11—Mines vs. University of Colorado at Denver.

FOOTBALL OUTLOOK.

Football practice at the School of Mines commenced September 8 and is being pushed as rapidly as possible, in order that the team may be in shape for the first game, which takes place October 16 at Logan, Utah, where the Ore Diggs will meet the Utah Aggies. The first conference game will be played against the Colorado Aggies at Fort Collins, October 23, at which time Mines will play its first game in Denver, November 6, where the team may be in shape for the first game in Denver.

The Jeffrey Manufacturing Company, of Columbus, Ohio, have recently issued the following new catalogs: "Mine Locomotives," No. 263. This new catalog fully illustrates and describes the Electrical and Mechanical features of their locomotives, including the "Armored" type of Main Haulage Locomotive. A similar position at the University of Kansas will be at least heard from.

At the meeting of the board of trustees of the School of Mines, held last Thursday, Harold W. Gardner was elected professor of mathematics, and to the head of the department of mathematics, in the University of Illinois and Kansas University, for some time he was in charge of civil engineering at Cooper Union, and professor of mathematics in the University of Illinois and Kansas University, for some time he was in charge of the mathematics department of Iowa Wesleyan College. G. W. Correll was elected professor of mathematics. He is a graduate of the Ohio Wesleyan and did post-graduate work at the University of Illinois and Kansas University. To some time he was head of the mathematics department of Iowa Wesleyan College. G. W. Correll was elected professor of mathematics. Professor Gardner is a graduate of the University of Illinois and is a post-graduate student at the University of Illinois.

The Jeffrey Manufacturing Company has been secured. The freshman athletic equipment has been secured. The freshman athletic equipment has been secured.

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PROFESSIONAL CARDS

SEELER, HENRY C.
Mining Engineer.
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Denver, Colo.

BURLINGAME, WALTER E.
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Phillipsburg, Mont.

TAYLOR, FRANK B.
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Reports and Investigations.
Box 255, Casper, Wyo.

LEONARD, W. D.
1216 First National Bank Bldg.,
Denver, Colo.
Phone Champa 6236.

DUGAN, WILLIAM P.
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Columbian National Life Insurance Company.
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If you will furnish us complete information regarding your conditions, our experienced engineers will be glad to suggest a mining system to be used in connection with the use of Jeffrey Pit Car Loaders, that will insure maximum output from a greatly reduced mining territory, at a great saving in Time, Labor and Expense.

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General Offices
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Colorado
School of Mines
Magazine

October, 1920
No. 10