The
COLORADO SCHOOL OF MINES MAGAZINE

Vol. I. — GOLDEN, COLO., SEPTEMBER, 1911. — No. 12

The Superficial Appearance and Alteration of Ore Deposits.

By George J. Bancroft.*

In order to approach this feature of the study of ore deposits in an intelligent manner, it is desirable to classify the outcrops in a manner entirely different from the classification given in my paper on the "Genesis of Ore Deposits." In that paper I classified them purely according to genesis. In this case the classification is more than a discussion-room convention, because the first step of an examining engineer is to settle in his own mind the class of deposits with which he is about to deal. Failure to do this simple and logical thing has led to some of the most ridiculous blunders in mining. I recall a case in Sonora that illustrates this point. There is a deposit about ten miles south of Saqui de Batuc called El Cobre Mina, which simply means The Copper Mine. This deposit consists of deposits of copper ore on the lower contact of a porphyry sill, lying in a limestone mountain. The porphyry and the lime-stone immediately overlying it weathered readily and hence were easily eroded. The underlying limestone was endurated near the contact, the result being that the "contact" formed a bench on the mountainside. The bodies of copper ore lay in bands or shoots trending from the mountain outward. Of course, they have little depth vertically, for they are contact bodies existing only in close proximity to the sill. At the best known part of the bench, called "copper flat," the porphyry and everything above it has been eroded, leaving the shoots of copper ore exposed on the surface. They look like huge crooked veins and were so considered by a group of experienced, but not well-informed American mining men from Minas Prietas. They sank two shafts about 200 feet deep on the so considered veins, then drove a tunnel under the flat. Then they dropped the prospect as no good.

The Mexican gambocinos did not know any more about geology than the Americans, but in the course of following the ore they burrowed under the bill along the contact. Then another group of Americans became interested and developed the mine with geological intelligence, opening up a large amount of ore, but the second bunch was, in reality, only a little more intelligent than the first, for the ore, when developed in large quantities, would not pay enough to warrant the expenditure for equipment necessary for production in such an inaccessible place.

The second lesson to be drawn from El Cobre, is, however, a side issue to the purport of this paper, as I will not attempt to go into the complexities of commercial conditions surrounding the development of mines, but shall stick to the geological side.

The first lesson to be drawn from El Cobre is that the examining engineer must first of all decide what class of ore deposit he is examining. As this question is apt to be purely a structural one, I will give a structural classification.

First—Fracture veins.
Second—Contact veins between non-eruptive rocks, i. e., stratified veins.
Third—Contact veins or ore bodies between eruptive and non-eruptive rocks.
Fourth—Impregnation deposits on porous strata.
Fifth—Impregnation deposits in crystalline rocks.
Sixth—Pipes and chimneys.
Seventh—Cement deposits.
Eighth—Deep leads.
Ninth—Stock-works.
Tenth—Mineralized dikes or batholiths of eruptive rock.
Eleventh—Segregation deposits in mineralized dikes or batholiths of eruptive rocks.
Twelfth—Cave deposits in quartzite or limestone.
Thirteenth—Fractured strata such as anticlinal and synclinal folds.
Fourteenth—Fractured eruptives, such as explosion vents, etc.

*Read at a meeting of the Colorado Scientific Society, April 21, 1911.

Fifteenth—Lenses in schist or slate.

The brief and incomplete enumeration given above will intimate what a variety of structural forms may be encountered in ore bodies, and I hope my illustration of El Cobre will emphasize the necessity of first determining the form of an ore body.

The engineer who is called upon to examine a prospect need not consider that it is work beneath his notice. Many engineers cover up their deficiencies by turning up their noses at prospects. As a matter of fact, the examination of prospects call for far more skill in all directions than the examination of developed mines. It stands to reason that after the form and structure of a deposit has been exposed by the diligent penetration of the miner and after working costs have been more or less determined by the operator, it is a much easier matter to make a reliable report on a property than when the same property is in the state of a raw prospect.

The engineer is often called upon to decide the future development of a prospect when there is nothing in sight but a ten-foot nole with ore in the bottom. I saw the great Combination Mine at Goldfield when it was in this condition. In that particular case the geology was so obscured by the superficial alteration of the eruptives that the true character of the deposit could not be determined, and was not determined until a depth of several hundred feet had been obtained. The only rule applicable was to follow the ore.

It may be said tnat the rule in any prospect is to follow the ore, but the application of intelligence comes in when the ore plays out. The Minas Priesta men followed the El Cobre ore down, but when it played out they did not have the intelligence to prospect the contact under the mountain.

Those two illustrations, I think, cover the extremes in cases of this kind. In the case of El Cobre, anyone with a trained eye could see the structural features of the deposit as plainly as though it were done in a glass model. At Goldfield, on the other, hand, a most diligent study of the formation gave no insight into the probable structure of the ore deposit. I will say, however, that the Goldfield deposit is the exception and not the rule in the semi-arid regions of the West. Where vegetation is rank, the difficulties of the examiner of prospects are many times increased.

When the immediate surroundings of an outcrop give no indication of its identity, it will very often be found instructive to walk clear around the prospect at a radius of a mile or so. The walls of canyons or gulches will often give a clue to the structure. A bold outcrop is often a remnant of an overlying stratum and the local dip of the formation can sometimes be picked up at its base, or the outcrop may be an intrusion of a fault-scrap, and in any event it is worth knowing what it is.

Of course, neighboring mines, if any such exist, should be visited and studied as thoroughly as the owners will permit.

One of the most perplexing class of prospects are those which occur in a flat or gentle rolling country. As luck will have it, this class embraces many good mines. Where acid waters are prevalent the rocks are softened and the hills take on a soft and rolling contour, while nearby mountains which contain no ore deposits may be very sharp and rugged. In such cases it will often be found useful to climb a neighboring hill and look down at, or over at, as the case may be, the hill of the prospect. At first no structural indications may be apparent, but it pays to make haste slowly in such cases. As the shadows change, the structural details may suddenly appear. Sometimes a certain bush or tree will have a fondness for a certain formation and a quiet half hour spent in studying the verdure will often reveal more of the hidden rock structure of a hill than days of digging would do. Thus a vein or porous stratum is apt to be a waterway and its outcrop is often marked by water-loving shrubs and bushes or by green grass. Slight shading in the soil may also become distinct under changing lights or cloud shadows.

Deep rooted trees are killed or stunted by acid waters, hence a hill barren of trees or containing many stunted trees, in a forested country, is always an object of interest to a mining man. The engineer can sometimes trace out the outlines of a large deposit of sulphide ore by the boundary of the injured timber.

In studying prospects it should be borne in mind that, as a rule, ore bodies do not make coarse pieces of float. I have seen very intelligent men looking in vain for "chunks" of float when the trend of the vein was painted as clear as a stripe on a zebra to the man who studied the finer particles in the soil. A common gold pan is very useful in studying the fines. One can count on the local prospector to have run down any clues of free gold, but the average prospector pays little attention to the black sands. A careful scrutiny of the black sands from a few pans of dirt will often lead to important discoveries.

Having given a rambling discussion of some of the features attending the examination of prospects, I will now take up the different classes as outlined above and try to give a few pointers that will help to distinguish them.

First—Fracture Veins—I use the word fracture in place of the word "fissure," because our highly respected courts have defined and redefined a fissure vein till the definition resembles a free trade bill that has been thoroughly amended by a Republican Congress.

A fracture vein is primarily formed by a dislocation of the country rock. As a rule, the vein is a fault fissure; that is, one wall

has moved with respect to the other wall. For this reason fracture veins are more or less like plane surfaces. The force which caused the faulting having had a definite direction, the lines of yielding also had a definite direction, and hence fracture veins are roughly tabular, in most cases.

It is difficult to conceive of a thing so hard and brittle as a rock, yielding in one place and not yielding in another place a few hundred yards away. I think it is an unreasoning feeling of this kind which prompts the prospector, who has discovered a vein, to trace the same, in his imagination, through several counties. I have frequently heard old mining men start with the Little Johnny vein at Leadville and trace its course through Lake County, Summit County, Clear Creek County and Gilpin County, winding up at some mine in Boulder County. Of course, each one followed a different path because each one wanted it to wind up at his particular prospect, but they all showed the instinctive idea that a fracture in our enduring granites must persist indefinitely. Unfortunately this is not true. A vein which marks a throw of several feet at one point may fade out entirely only a short half mile away.

This point is important in considering prospects. The engineer is often shown two ten-foot holes which disclose strong veins. The holes are a mile or so apart and the veins trend in the same direction. He is thereupon assured by the prospector that these two holes are on one and the same vein and that there is continuous ore from one hole to the other. If the engineers dare look a wee mite sceptical, the prospector proceeds to absolutely prove his assertion by the use of a divining rod.

However, if a vein gives evidence of a large throw and the country rock is hard it is safe to assume that the vein will persist in strike and depth for considerable distances, say a few thousand feet. If the country rock is soft and pliable, as, for example, clay shales, and the throw is small, it is not safe to assume much permanence to the vein in any direction. The vein's throw is shown by slickensides, gouge-streaks, etc. Occasionally one may find in an interrupted feature of the country rock on both walls of the vein which will accurately show the distance and direction of the throw. Such information is very useful when it can be obtained, but in prospects one can seldom get it.

As previously mentioned, fracture veins are roughly tabular in form, but it must be borne in mind that they are only very roughly so. In areas like the San Juan Range, Colorado, where the white quartz veins stand out very strongly and can often be seen extending for hundreds of yards, it will be noticed that they are far from planes. The outcrops are often as crooked as a twig. However, in examining an undeveloped prospect, it is often necessary to follow out the extension of the vein, and the only clue to its direction that we have is on the assumption that the vein is tabular. Having ascertained the dip of the vein, we may then imagine how a plane surface having that dip would cut the contour of the particular locality. In a rough country, it is surprising how crooked will be the outcrop of an inclined vein. Many a prospector has lost valuable property by failing to realize the rudiments of conic sections. If a vein dips into the hill and the outcrop crosses a gulch, the outcrop will extend up that gulch in a V-shape. The angularity depending, of course, on the degree of dip, the steepness of the hill and the depth of the gulch. Similarly, if the vein dip with the hill, the outcrop will extend down the gulch in a V-shape. These two illustrations are simple, but where we have crooked and slanting gulches, crooked veins and varying slopes, it is often very difficult to trace out the outcrop of a vein. A simple plan is to take a book or piece of board and holding it parallel in dip and strike with the vein, sight across it to the hill or gulch where the continuation is sought.

Fractures may occur on one of the bedding planes of a sedimentary series as the Durant Mine at Aspen, Colo. Such veins must not be confused with our next class (stratified veins). The difference lies in the fact that in the case of the fracture veins there has been movement and distinct fracture along the bedding plane while the statified vein results from percolation along the unfractured bedding plane.

Second—Contact Veins in Non-Eruptive Rocks, i. e., Stratified Veins—This class is generally very easy to identify. The fact of the un-faulted stratification paralleling the vein as a rule, settles the matter. There are, however, bodies of eruptive rock which have been given an apparent stratification by movement and pressure, and fracture veins in such rocks are often parallel to this schistosity or apparent stratification. This is particularly true of diorite areas. Then, again, fracture veins sometimes result from very little movement and make a very small angle with the stratification and may run absolutely parallel with it for some distance, so the engineer must not jump to conclusions. Stratified veins are not, as a class, highly thought of. It seems to be a rule that they are pockety and unreliable. The flats of the Black Hills are a notable exception to this rule. It sometimes happens, however, that a stratified vein may cross from one stratum to another and the system as a whole, may make a very valuable mine. This condition is very apt to be overlooked by the miner. He digs out the pocket that outcrops and abandons the mine, or, worse yet, blows in all his profits and more too, prospecting the stratum of the original ore body, whereas, had he closely observed the foot and hanging walls he might have

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SAFETY THE FIRST CONSIDERATION.

Methods Employed by the H. C. Frick Coke Co. for the Prevention of Accidents to Employes.

By Stephen L. Goodale, '04. *

Since about the 1st of January this legend has appeared on all letterheads, circulars of instruction to officers at the mines, blank forms to be filled out at the mines, and generally on all stationery of the H. C. Frick Coke Company. Up to the present time it has been mostly added in red ink with a rubber stamp, but whenever a new supply of stationery is needed the words are printed in red conspicuously as a part of the form.

For some years this company has conducted, under the able leadership and constant insistence of Mr. Thomas Lynch, president of the company, a strenuous campaign to make the mining of coal and other work about their properties as safe as possible. Four men were sent abroad to study what had been done in Europe and to get all assistance possible from countries which had been reported to have small numbers of accidents. This campaign is still in the course of development, but a very great deal has been already accomplished, and many improvements of the most vital importance have already been made. We can, therefore, describe now only the present state of development of a department that is showing the rapid growth of a healthy infant; but there is now so much to write about, and the subject of safety in the mine is of such great importance, that it can not receive too much attention from mining men and others who can assist.

The keynote of all this work is **prevention** of accidents. The means employed are firstly educational, and secondly a number of actual safety appliances and methods of work.

"Safety First" demanded above all a campaign of mutual education. "First we had to educate the steel corporation to the necessity of such work, then they had to educate us how to carry on the work, and now we have to educate our foremen and bosses and miners to carry out the regulations made and how to use the safety appliances provided," as one superintendent put the case—mutual education—a co-operative system among the leaders. That the company has been thoroughly convinced of the great need is proven by the money it has spent and is spending to make its mines and mining and surface works safe places to labor. A live interest and even keen rivalry exists among the superintendents and others at the different mines in furthering the movement for safety first. It took a good while to convince these men that the company was really in earnest, and that the movement was something more than a spasmodic interest, or a temporary spurt for appearances only; but, as one device after another was introduced for safety, and appropriations were made again and again for this purpose, the foremen and superintendents have not only been convinced of the good intentions of the management but have become very zealous assistants in the same cause themselves. These men are studying the problem of safety, both in their everyday work from the practical side and also to make it more effective from the theoretical side as well. Evening meetings and periodical conferences for study and discussion of mine and safety problems are so numerous for many of them that one is reminded of the engineer who said that to keep up with the procession in electrical engineering he had to work all day and study all night.

Of great value in this educational scheme are the signs which are posted everywhere about the properties. The miner who is seeking employment, or as they express it, "trying to catchee a job," is first confronted with the sign in big letters:

"To men seeking employment: Unless you are willing to be careful to avoid injury to yourself and fellow-workman do not ask for employment. We do not want careless men in our employ."

WARNING!

EMPLOYES WORKING AROUND ENGINES, MOVING OR REVOLVING MACHINERY, SHAFTING, ETC., ARE WARNED OF THE

DANGER

AND ARE PROHIBITED FROM WEARING TORN CLOTHING, LOOSE OR UNBUTTONED JACKETS, BLOUSES, SHIRTS, LONG NECKTIES AND LOOSE SLEEVES. ALWAYS WEAR THE OVER-ALL JACKETS TUCKED IN THE TROUSERS OR UNDER THE OVER-ALL BIB. NEVER FORGET TO EXAMINE YOUR CLOTHING BEFORE COMMENCING WORK.

H. C. F. C. Co.

Fig. 1

The sign, "Safety First," printed in five languages, is hung or to be hung in the superintendent's office, shop, boiler room, inside and outside engine room, power buildings, mine pump rooms, and all other machinery rooms, at the mine entrance—whether slope or shaft—at the shaft bottom, and everywhere around the plant where they will intrude themselves on the attention of the employes and the public. In addition, a "Safety First" illuminated sign is to be hung at each mine at a point where it will prove most conspicuous to men entering or leaving the mine, probably in the manway. "The sign will be double glass, showing the legend in two directions; it will be illuminated by electric lamps. It is also desired to place an additional illuminated sign on the surface near the entrance to the mine."

*Mines and Minerals, August, 1911.

The rules and regulations of the company, printed in five to seven different languages and comprising 28 articles, are conspicuously posted at all the mines in several places, and no one can be ignorant thereof who is employed at these mines. They are posted at such places as the lamp house, and the waiting rooms, at top and bottom of the shafts, etc., where they are not only conspicuous, but the men also have the best opportunity in the ordinary course of events to peruse them. These are given herewith in full:

Rules and Regulations of the H. C. Frick Coke Company.

1. Strict compliance with the Mining Laws of the State of Pennsylvania shall be the first duty of each and every employe, at all times and under all circumstances; and SAFETY must be the first consideration of superintendents, mine foremen, and all others exercising authority or charged with the direction of operations in every department; quality of product second; and, cost of production third.

2. Mines generating explosive gas must have, at the intake, not less than 500 cubic feet of air per minute per person employed in the mine, and so distributed that there will be sufficient volume in circulation in and around working places to give not less than 300 cubic feet per minute, per person employed in each "split." No mine shall have less than 300 cubic feet of air per minute, per person employed, at the intake, with sufficient volume in and around working places to give, at least, 150 cubic feet per minute, per person employed in each "split."

3. Dangerous accumulations of explosive gas must not be permitted in "gobs" or other parts of the mines; if the same can not be removed with the air-current, release it by means of bore holes from the surface.

4. In all mines where blasting of coal is permitted, all shot firing must be done with the consent, in the presence and under the supervision of the mine foremen, fire boss, or other competent person designated by the mine foreman; and the person designated by the mine foreman to supervise the blasting, or some other person designated by the mine foreman, must visit all the places where shots have been fired as soon as practicable after shots have been fired, to see that the roof is safe and that there is no fire or other danger.

5. Provide and maintain a system of pipes, and a supply of water with sufficient head, and all other necessary appliances, to thoroughly dampen the floor, sides, and roof of all places, in dry mines, where dust is a menace to safety; have the water head sufficiently strong to wash the dust from the roof and sides of these places, if need be, to make them safe, and have regular stated intervals for such watering or washing.

6. Employ steady, reliable, sober men only, in the capacity of mine foremen, fire boss, master mechanic, hoisting engineer, boiler and fan tenders, and stable boss; and the use of intoxiating liquors by any employe while on duty is absolutely forbidden.

7. Air-shafts must be kept open and free, at all times, from ice or other obstructions, and superintendents shall personally examine the air-shafts and stairways therein, and travel either up or down same at least once in each two weeks; he shall also see that the cages and safety catches are tested at least once in each two weeks, and that the hoisting ropes on cages used for lowering and hoisting men in and out of the mines are taken off as soon as they show any defect or weakness, from wear or other cause, but in no case shall ropes on such cages be kept in service longer than two years, even though apparently safe and in good condition.

8. Oils or explosives must not be stored in the mine, and no person shall be allowed to take more than one day's supply of oil or explosives into the mine at one time.

9. The best and safest oils that can be procured must be used for illuminating purposes in the mines and mine buildings above ground; and the best and safest explosives that can be procured must be used for blasting in the mines.

10. Engine rooms, pump rooms, power houses, boiler houses, and stables, both in the mine and above ground, must be well ventilated and kept neat and clean at all times. Provide cans in all these buildings for storing oils, oily waste, grease, etc. The use of open lights in any of these buildings, either under or above ground, is strictly prohibited. Hay and straw must be taken into the mines in bales—not loose.

11. All electric wiring, whether used for lighting or power, must be carefully installed in the most approved manner, and thoroughly examined by some competent person at least twice a year.

12. A system for checking men in and out must be maintained at all mines, which will show how many men, and who are in the mines at all times.

13. Fire hose of ample size and length must be maintained near the mine buildings, or some other convenient place at each plant; a sufficient number of ladders of proper length must be kept on the dwelling houses and mine buildings; barrels filled with water and salt, and fire buckets must be maintained on trestles, in tipples, engine and boiler houses, and other buildings where fire is likely to occur—all for use in case of fire only.

14. The use of safety lamps and open

lights must not be permitted in the same mine, except only upon the joint recommendation, in writing, of the mine foreman and the company's mine inspectors. Lights must be carried on the front and rear of all trains of cars "or trips" (including trips on slopes) controlled by motors, steam engines, or other mechanical means.

15. Finger boards must be maintained in all mines, which will plainly indicate to persons employed therein, the way out of the mine.

16. Each and every mine must be visited and thoroughly inspected by the company's mine inspector at least once in every sixty (60) days, who shall report condition of same, in writing, to the general superintendent.

17. The superintendent, mine foreman, fire boss, yard boss, master mechanic, hoisting engineer, stable boss, boss driver, boss roadman, and such other employes at each plant as the superintendent or mine foreman may designate, shall meet at least once every week, at the time and place designated by the superintendent, to exchange views, discuss the mine conditions and operations generally, and especially matters pertaining to the protection of the lives and health of the employes, and the care and safety of the property.

18. Mines in which safety lamps are used must be thoroughly examined by fire boss, or other competent person, on Sundays, holidays, and lay-off days, and all mines which have been idle for two or more consecutive days must be thoroughly examined by some competent person the day before operations are resumed.

19. No one will be permitted to interfere with the religious or political opinions of the workmen, and no superintendent, foreman, boss, or clerk will be allowed to solicit money or make collections from the workmen for any church, society, or association.

20. Any employe wishing to be absent from duty must, before going, apply to and receive permission from his immediate superior.

21. Superintendents and foremen shall see that the "turns" are fairly distributed among the workmen on contract or piece work, and that no more men are employed than are absolutely necessary to perform the required amount of work well and at the proper time.

22. All employes are requested to exercise care and economy in the use of materials and supplies, and any employe who through carelessness or malice wastes materials or destroys the property of this company, or is found stealing or carrying away the property of this company, will be discharged.

23. Any workman offering money, liquor, or valuables of any kind to a foreman, boss, or clerk will be subject to discharge, and any foreman, boss, or clerk accepting money, liquor or valuables of any kind from workmen will be summarily dismissed.

24. Superintendents must pay strict attention to the rights and privileges of all employes; hear and give prompt attention to any reasonable complaint or claim for redress made by any employe, and not allow any discrimination on account of nationality or creed.

25. Every salaried employe of this company is expected to devote his entire service to the work and interests of his employer, and while no restriction is sought to be placed upon employes in the matter of making investments, no salaried employe shall take active part in conducting the business in which an investment is made; nor will such employe be permitted to influence any other employe of this company to buy or in any way assist in the sale of the products of said business.

26. It shall be the duty of superintendents, foremen, bosses, and clerks to strictly comply with and rigidly enforce the above rules.

27. These rules are intended to supplement, not to supplant in any manner or form, any of the requirements or provisions

PLACE NO MORE LOAD THAN
9,000 LBS.
ON THIS CAGE.
—o—
HANG NO MORE LOAD THAN
15,000 LBS.
ON THE FREE ROPE.
—o—
IN EACH CASE, HOIST SLOWLY
AND WITHOUT JERK.
$1\frac{3}{8}$ ROPE

Fig. 2.

of the mining laws of the state of Pennsylvania, and printed copies of same in the English language, and other languages used by the workmen, must be kept posted in conspicuous places, at all mines, and the attention of all persons must be called to same, when hired, as well as to the printed special and general rules furnished by the State Mine Inspectors.

28. It shall be the duty of all employes to report any violation of the mining laws, or of these rules, to the superintendent of the plant where the offense is committed, and it shall be the duty of the superintendent to immediately report any violation of the mining laws, which may come to his notice, to the State Mine Inspector of the district and to the general superintendent; also, to report any violation of these rules to the general superintendent.

W. H. CLINGERMAN,
General Supt.

Approved:
THOMAS LYNCH, President.

The sign, Fig. 1, here reproduced in miniature, warning employes of the danger of torn clothing, is one which might well be posted

in all machine shops and places where rapidly-moving machinery is in use.

In addition, a small sign is used, directing that all machines considered dangerous to oil or wipe while running should be stopped to oil, wipe, or repair. The former sign is to be posted "in all power buildings, such as compressor, or electric stations, not less than two signs, one at each end of the room; in all shop buildings, at least two signs, one at each end of the room." The signs are to be placed also in any additional places which seem to require them. The latter sign is to be applied most conspicuously to all machinery, such as "hoisting engines and haulage engines (each side), to electric generators, to high-speed steam engines, to electric motors, to electric pumps, etc. It is not considered necessary to apply them to such slow-moving machinery as direct-acting steam or air-driven pumps." These two signs are made of sheet metal with white letters on a background of blue enamel.

The sign shown in Fig. 2 is placed as a framed placard under glass on the head frame at the ground landing, as instruction to the operatives for any weights that may have to be handled. This would apply to machinery parts, pumps, compressors, etc., or other unusual loads which are handled into the mine. There are many places where this idea might well be copied, such, for instance, as the cranes in industrial works.

Guide signs are placed at a sufficient number of points underground so that even a stranger in the mines could probably find his way out with no great difficulty. Besides this particular sign, dangerous workings are so marked to avoid men going into such dangerous places unnecessarily. The danger signs are white letters on a red background; the directional signs white letters on a black background.

But signs don't do much good unless they are read, understood, heeded, and obeyed. To make them read, they are put up in many prominent places; for understanding, they are translated into from four to six European languages, according to the nationality of the workers, who do not "versthey too much" English. As for attending to these instructions, and obedience on the part of the men, that is where the difficulty comes in. Many a man will take chances of danger to save himself a little inconvenience if he thinks the danger small, or he may even take Hamlet's view, "There's such divinity doth hedge a king." You can post a large sign on the main haulage way that no one is allowed to walk there, and in spite of the notice men—and especially those who ought to know better—will often walk that way if they can thereby save a longer walk. If such a man is killed in that kind of place, whom can you punish? He had a right to go by the manway, and was on the haluageway against strict orders. Every breach of discipline must be punished by appropriate means if this kind of thing is to be ended. The man who will not obey the regulations of the coal mines is just as much a menace to the lives of those in the mines as would be the railroad locomotive engineer who disobeyed his orders.

It is not ordinarily the ignorant immigrant fresh from steerage who takes these risks—he is warned by the signs in his native language, and by his older compatriots, and he obeys—he is too much afraid not to obey. Mr. Lynch states that in his own experience he has not known of any casualties to such men who have been less than two years in the mines. It is men who know of the dangers, but think—and have not made sure—they have provided for them, and who often go into places to which their duties do not call them; 66 per cent. of all the fatalities last year were of intelligent men who had had long experience in mining.

Perhaps the most important item in securing obedience to the rules and regulations is having the superintendents and foremen personally and vitally interested. And in this safety work Mr. Lynch, the moving spirit for safety, has certainly enlisted the active co-operation of his employes from superintendent down to the actual diggers of coal, the "mule-skinners," or even, we may also say, the unemployed miner who is trying to get employment. The willingness, interest, obedience, and co-operation of the employes, which is very marked at all the mines, is, therefore, even a more important factor than the numerous signs and notices of rules and regulations required to make "safety the first consideration."

The end sought in all this work is prevention of accidents. The oxygen helmets, the hospitals, the first-aid training, and all such, are at best, but a makeshift. They are like locking the door of the stable after the horse is stolen; but it is rather the constructive making the mines safe, making accidents impossible, toward which Mr. Lynch's efforts are directed. The company has, indeed, three rescue training stations, and has spent much money in training men. It has also hospitals at the various mines, but these are all thought of as of very secondary importance as compared to the prevention of accidents.

USEFUL.

Briggs—Have your daughters accomplished much in music?"

Griggs—Yes, their playing has rid us of two very undesirable neighbors.

No girl need fancy that she really knows a man before marriage, because a woman never knows any man until the first time she asks him for money.

Before marriage a man and woman look for perfection; after marriage they look for imperfections. And that's what causes all the travel to Reno.

The

Colorado School of Mines Magazine

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

Subscription price.....$1.25 per annum
Single copies.....25 cents
Advertising rates on application to the Manager

VOL. 1. SEPTEMBER, 1911. No. 12.

There is a surprisingly large number of the graduates who appear to be lacking in common courtesy. On behalf of the Magazine and the Alumni Association the former Assistant Secretary, Mr. Lonergan, and the present writer have sent the magazine since last October to every graduate of the School whose address we knew. The present writer has mailed to every graduate a ballot for Alumni choice for trustee and a ballot for Alumni officers and an invitation to attend the Alumni banquet and reunion to all members of the Association. Notices of dues for 1911 were sent to all members (not life members or those who had already paid) and to all non-members with a personal request to join the Association and help us out. To every Alumnus not already a subscriber a bill for the magazine was sent with a personal request to please subscribe or, if they were not interested in the magazine, to kindly let us know and we would stop sending it. Later, to all who did not respond to this appeal bills were again sent. And since June the writer has been sending personal letters to all still delinquent to please join or subscribe or both, as the case might be, and enclosing a stamped envelope for reply.

It is with regret that we find a considerable number who do not seem to have the courtesy to answer a personal letter from a fellow graduate, even when a stamped return envelope is enclosed. In a few cases, it is probable that the addresses we have are not correct, as we have found that the postoffice department is often very negligent about returning undeliverable mail matter, but in many cases we know the addresses are correct, as we sent out prepaid return postcards requesting the correct address and occupation and have received replies. These return postcards have Dr. Alderson's address on them and request the correct address so that the School may send them the quarterlies and other publications as published. Perhaps, they answer these requests, when they refuse to answer our personal letters, in the hope that they will receive some valuable publications without having to pay for them. We are curious to know whether they soak the stamps off our return envelopes and use them requesting free samples or valuable catalogs?

On the other hand, we are much pleased to note that more and more of the Alumni are beginning to realize that this is their magazine and are boosting it among the advertisers and in other ways.

REMEMBER!

We must have that football championship this year. Don't stand around explaining why we didn't get it last year, but get out on the field and work for it this year. At the request of the Alumni Association the schedule has been so shortened by reducing the time between lecture periods to five minutes that the old excuse "No time to practice" will not go this year.

HIT THE LINE HARD.

From all over the West you can hear the following chant:

I've a blister on me heel, and me beak's
begun to peal;
I've an ache for every bone that's in me
back.
I've a feeling I could eat rubber hose and
call it sweet,
And me hands is warped from lugging
bits of track;
Oh, me clothes they are tore, and me shoulder they are sore,
And I sometimes wish that I had died a
"borning;"
And me eye is full of dirt, and there's
gravel in me shirt,
But I'm going back to Golden in the
morning.

TO THE ALUMNI.

The all-important feature in connection with the opening of the school year 1911-12 is the return of Dr. Regis Chauvenet as a special lecturer in mining and metallurgy. He returns at the earnest solicitation of the trustees, the Alumni, and his friends at the School. His profound knowledge of chemistry and his wide acquaintance with mining and metallurgical subjects will make his lectures a distinct help in the work of instruction. His old pupils will be pleased to

VICTOR C. ALDERSON.

know that he has in press a new book on Stoichiometry, and that he will give much attention to this subject in his lectures.

Second only in importance to the return of Dr. Chauvenet is the selection of George W. Schneider, '94, as professor of mining; and Carl A. Allen, '05, as assistant professor of mining. In a distinct mining school the courses of mining should certainly be of the very best. The wide, practical experience of Schneider and Allen, together with their professional standing, makes one certain that the mining courses in the school will hereafter be second to none.

Owing to delay in payment of the State appropriations the testing plant will not be ready for use before spring, but it is confidently hoped that it will be ready by that time.

The revised course of study for the freshman, sophomore and junior classes will be in operation this year. The members of the present senior class will complete their year under the old plan. The revised course is arranged so that the first two years are prescribed for all students and include the fundamentals of an engineering course. In the junior and senior years four groups are offered: Metal mining, coal mining, metallurgy, and mining geology. A man selects one of these groups in which he may secure his degree of Engineer of Mines. A post-graduate year is also arranged for, in which a man, who has already secured the degree of E. M., may get the M. S. degree.

It is the settled policy of the trustees to make the school attractive to graduates who wish to return for advanced study. It is also their policy to place all the facilities of the school at their disposal for any research or experimental work they are interested in. Some of the Alumni have availed themselves of this privilege. It is hoped more will do so in the future.

It is merely justice to Orville Harrington to say that his work as Assistant Secretary has been persistent, faithful, and steadily productive of good results. All who see the Magazine recognize its steady improvement. If the Alumni will only "lend a hand" he will be able to accomplish much good for the Almuni and the school.

With the strengthening of the faculty, the revised course of study in operation, the completion of the testing plant, the magazine and Capability Exchange on a good foundation, the year 1911-12 will certainly mark an important era in the history of the school.

VICTOR C. ALDERSON.

ABSTRACTS AND COMMUNICATIONS.

Received your letter the other day at Valdez. I am now on my way to the Nickoli mine. It is about 200 miles in the interior on the Copper River and N. W. Railroad. Near to the Kennicott Bonanza mine. Don't know how long I will be at the Nickoli, possibly all winter. They are just developing the property. . . . Think I will like this country all right. It is very pleasant so far.

Respectfully,
EDWIN E. BUSSEY.

Kennicott P. O., Alaska,
Care Fagerberg Bros.

Bridgeport Land Company,
Bridgeport, Wash, Aug. 12, 1911.

Mr. Orville Harrington,
Golden, Colo.

Dear Sir—I am in receipt of your August edition of the C. S. M Magazine, and also your letter of June 23rd, which has been traveling around the country. Enclosed please find my check for $5 to apply for initiation fee 50 cents; 1911 dues, $1.50; subscription for C. S. M. Magazine, $1.25, and balance to help out the good cause. I am

very glad to have received the several copies sent me and have certainly perused them with the greatest interest. You are doing a work of a great deal of value, both to the School and the Alumni Association, simply by keeping the members of the latter in touch and interested in the School and its affairs.

In the past several years I have often wished for some such means of learning of the affairs and conditions at Golden. Not being able to do so and having a great many other things to keep our minds occupied, gradually results in the wider and wider separation of the Alumni from the C. S. M.

Wishing you the best of success and assuring you of my earnest wish to render all the help in my power. I remain,

Yours truly,
ALBERT BERRY.

PERSONAL.

'86.

Charles A. Gehrman, discoverer of the Stanley Mine, Colorado, and of the camp of Rawhide, Nevada, while in Denver recently, remarked that he would be ready to spring a brand new camp on the mining public in the near future. Somewhere in Colorado—the exact locality he did not care to mention at present—Colorado can stand another Cripple Creek or Leadville.

'92.

Mayor George K. Kimball, of Idaho Springs, was laid up for about two weeks early in August, suffering with a turned ankle. He was recently at Deadwood, S. D., for about ten days.

'94.

Prof. George W. Schneider, manager of the Conqueror mine at North Empire, and our new professor of mining, was in Mexico recently on an important mining transaction. He and his family will occupy one of J. L. Armstrong's residences in Golden this winter. Professor Schneider's 17-year-old son will enter the School of Mines this month.

'95.

W. S. Medell, who for some time has been instructor in chemistry at the School of Mines, has tendered his resignation, and will devote all his time to his interests with the Stanley Chemical Company.

'97.

Prof. W. J. Hazard has purchased the C. E. Smith residence.

'99.

Fred C. Steinhauer was appointed by the Denver Park Board to represent that city at the meeting of park commissioners and general superintendents of parks, held in Kansas City early in August.

Sidney B. Tyler has left Central City and is now superintendent of the Continental Mining Company, E. Stacion Monclora, Coahuila, Mexico.

'00.

Victor E. Kerr has accepted a government position in the Philippines.

'03.

We made several mistakes in the name and address of Grace C. U. McDermut (Mrs. Barry Mulligan) in the list of the Alumni, August Magazine. She is laboratory assistant, National Bureau of Standards, Washington, D. C. Address, 2244 Ontario Road, Washington, D. C.

'05.

J. B. Neville, Jr., is located in Denver now. Address, 836 Ogden Street.

E. E. Greve is with the Pyramid Oil Company, Mariposa, California, P. O. box, 92.

Prof. Carl A. Allen will occupy the other residence of J. L. Armstrong in Golden this winter. Mr. Armstrong will live in Denver.

Edward M. Rabb has returned to Denver after a six weeks' sojourn in the Southwest.

G. N. Pfeiffer is visiting his brother in Golden.

'07.

Ray B. Emens was in Golden with his wife for a visit the first of August. They are now located at Searchlight, Nev., where Mr. Emens is the mining and metallurgical engineer for the Walter M. Brown Engineering Company. "String Emens" has a host of friends in Golden, and many will remember him for his prowess on the football field.

C. A. Filteau was in Golden for several days, doing some experiment work. He has left for Aroroy, Masbate, P. I., as mill superintendent for the Colorado Mining Company. Clyde M. Eye, '95, is general superintendent for the Colorado Mining Company there.

'08.

M. M. Stuart and W. Val De Camp visited Golden during August, but failed to call on the Assistant Secretary. Some of their friends should persuade them to join the Association and subscribe for the Magazine.

William R. Chedsey called on the Assistant Secretary the last of July.

'08 and '10.

C. L. Brown and J. S. Bradford, '10, were leasing and operating the big Wood Mountain mill, which was destroyed by fire following an explosion at Wall Street, Colorado, July 29th. Mr. Brown and Mr. Bradford personally saw that everything was shipshape before closing the plant down that night. About midnight a terrific explosion rent the air and the mill buildings burst into flames. The explosion was in a part of the plant where no oil or explosives were stored. Investigation after the fire disclosed the fact that the chain and padlock which were used to lock the mill had been cut through. A big clean-up had just been made, nearly $2,000 worth of high grade was to have been shipped that week.

'08.

Jesse T. Boyd has left the Camp Bird Company, his permanent address is 1320 Detroit Street, Denver. He is on a six weeks' professional trip in the Paradox Valley, Colorado.

Arthur W. Buell was a Golden visitor early in August. Since leaving school he has been at Guayaquil, Equador, South America, and is now taking a few months' vacation.

'09.

O. R. Taggart called on the Assistant Secretary recently.

Mr. and Mrs. DeMont G. Miller and daughter, who have been visiting Mrs. Miller's parents, Mr. and Mrs. J. M. Johnson, returned to their home at Congress, Arizona.

A baby girl, Margaret Anne, was born August 11th, to Mr. and Mrs. William C. J. Rambo, at Denver.

John Hays Hammond, who recently returned to New York from his trip to Europe as special ambassador from the United States to attend the coronation of King George of England, has been appointed one of the consulting engineers for the United States Bureau of Mines.

'10.

Robert M. Keeney, who was recently elected instructor in metallurgy at the School of Mines, has tendered his resignation. Mr. Keeney is in Alaska as engineer for the British-Yukon Gold Mines Company, at Carcaross, Yukon, Canada. He will examine the mine property and bring ore to this country to be tested. He will then design, erect and operate a mill. He will have an article in the Magazine in the near future on the mining laboratories of the schools he visited a year ago at the request of the Board of Trustees.

'11.

The engagement of Edward J. Dittus and Miss Carolyn Wolfe, of Denver, has been announced. The wedding will take place in September. Mr. Dittus was recently appointed fellow in metallurgy at the C. S. M., and the young couple expect to occupy rooms with Dr. Garvin in Golden.

CHAUVENET TO BE SPECIAL LECTURER.

After a great deal of urging from the Board of Trustees, especially from our Alumni trustee, Fred Steinhauer, and from many of the Alumni and other friends of the school, Dr. Regis Chauvenet has consented to give one lecture a week at the School of Mines. At a meeting of the board, August 17, Dr. Chauvenet was officially retained as a special lecturer in mining and metallurgy. His first course will be on Stoichiometry, a subject upon which he is probably the best authority in the country. The Alumni will be pleased to know that he will soon publish a book on the subject.

Since severing his connection with the School of Mines as president, Dr. Chauvenet has been busy at his profession, practical mining engineering. With the changes that the years have brought in the science and the processes of mining he has kept pace. He has been a thinking leader, and has contributed not a little to the recent progress in mine development.

The wealth of new experience he has acquired will be placed at the disposal of the students. They will learn many things that students of former years could not learn so easily. The information that they will get from the weekly lectures will be the very latest there is.

At the same meeting of the trustees two new fellows were elected, Orville Harrington was made a fellow in mechanical engineering, and E. J. Dittus was chosen a fellow in metallurgy.

MISCELLANEOUS SCHOOL ITEMS.

Dr. Victor C. Alderson and Capt. James T. Smith have made several trips of inspection to the different mining districts during the past two months. In the Idaho Springs district they visited the numerous mills noting the various improvements in milling that have recently been installed, and visited the new mill being erected and furnished by the McKelvey process.

In the Leadville and Breckenridge districts they secured a number of rare and valuable specimens for the School of Mines collections.

Dr. Alderson reports that mining conditions and outlook in the San Juan district are much better and brighter, due in a large measure to the operation and proposed installation of modern methods of ore treatment.

A week was spent inspecting the mines and mills of Boulder county.

Prof. William G. Haldane returned from a visit of several weeks in Cleveland, Ohio, and then visited Leadville on business.

Prof. F. H. Traphagen has returned from a trip to the various mining districts of the northwest. He accompanied Dr. J. H. Holmes, head of the United States Bureau of Mines.

Prof. L. F. Miller visited Yellowstone Park this summer. He recently purchased the Curtis residence on Fifteenth Street and has moved there with his family.

Prof. C. R. Burger spent most of the summer on his farm near Steamboat Springs, and has returned with a good coat of tan.

Prof. Robert Otis and family went on a camping trip near Berthoud Pass.

Professor Patton and Professor Butler have been engaged on the State geological survey near Alma most of the summer.

Former Trustee Joseph Jaffa visited the school recently, accompanied by his brother, Dr. Perry Jaffa, of Trinidad.

William E. Johnson, the new athletic director, and his wife, expect to occupy rooms at Dr. Garvin's, in Golden, this winter.

Miss Mabel Shrum returned recently from

her three months' trip to Europe. She enjoyed the trip very much.

Prof. Arthur J. Hoskins has opened an office in the Commonwealth Building, Denver, and will move to Denver about the first of September.

While on his way to lunch after working half a shift in the Camp Bird mine near Ouray, William Peregrine, a junior at the School of Mines, had the misfortune to break his left thigh August 2nd. A telegram to his father stated he will be unable to return to school for six weeks.

Joe Morrill has been engaged by the trustees of the School of Mines as a special tutor for students who through force of circumstances have been unable to keep up with their studies. In many instances heretofore sickness or other causes have caused students to fall behind their classes, and in a number of cases they have been unable to hire a tutor. The new plan of the trustees will make it easy for the unfortunate ones to catch up. Mr. Morrill is a graduate of the University of Colorado and for some time has been an instructor in the electric engineering department. He is also to take an engineering course at the School of Mines.

A new schedule was put into effect recently on the Denver and Inter-Mountain, shortening the running time, which has been heretofore one hour between Golden and Denver. The new schedule provides that cars leave Denver on the even hour all day, including 6 p. m., after which they leave thirty minutes after the hour. The running time to Golden is 48 minutes, and the cars will lay over 12 minutes. The running time to Denver is 45 minutes, the cars remaining at the terminal 15 minutes.

J. B. Watson, the Y. M. C. A. general secretary, with his bride, who was Miss Marion L. Cook, will be at home to their many friends after September 15th. They have leased the lower floor of the new Baptist parsonage.

Andrew R. Brousseau, '14, was host at a hay-rack ride and beefsteak fry about the middle of August.

Charles F. Haselton, '14, and George K. Dale, '13, spent part of the summer in the Ouray district.

A wedding of interest in School of Mines circles occurred in Cheyenne recently, when Miss Ruth Grant and Thomas Skinner were united. The groom was a student of the School of Mines and was one of the best football players ever wearing the silver and blue. The couple will reside in Green River, Wyo., where Mr. Skinner is in business.

Complete tests have been made at the School of Mines recently of the chemical and assay laboratory supplies manufactured in Golden by the Herold pottery, with most gratifying results. The crucibles, evaporating dishes and all such ware have stood rigid tests almost as well as the expensive goods imported from Europe, and it is likely that a great deal of the ware of local manufacture will be used in the laboratories of the Mines and other Colorado institutions.

Golden and the School of Mines were honored in July by a visit from Dr. J. A. Holmes, director of the United States Bureau of Mines, who was here in the course of a trip through the West. Dr. Alderson and Professor Traphagen conducted the party, in which, besides Dr. Holmes, were State Mines Commissioner T. R. Henehan, John R. Wood, secretary of the Boulder County Metal Mining Association; Prof. J. C. Roberts, of the United States Mine rescue car; Prof. C. H. Fulton, of the Case School of Applied Science; George W. Schneider, mining engineer, and others.

All the buildings of the School of Mines were inspected, but the greatest interest centered in the new metallurgical plant, which is now approaching completion. Dr. Holmes remarked that the putting into operation of this plant can not help but prove a great help to the mining industry of the State, and in his opinion, it will, as soon as started, give impetus to the mining of low grade refractory ores, which are not now being taken out on account of inability to discover the right process for each particular ore.

Dr. Holmes was unable to make any statement as to whether the government will do anything now regarding a United States testing plant in this State, but the concensus of opinion among mining men is that in the no very distant future one or two plants for testing refractory ores will be built here. It is very likely that a small plant will be erected in the San Juan district, and there seems to be very little doubt but that the School of Mines, with its splendid equipment, will be made a United States experimental station.

Before coming to Golden Dr. Holmes was a guest at a luncheon given by the Denver Chamber of Commerce, at which about 150 of the State's most prominent men gathered, and there is no doubt but that the metal mining industry of the State has been given a forward boost.

At the luncheon President Alderson spoke in part as follows:

"Colorado knows what she wants, and she is going to ask the Federal government to co-operate with her. The matter of ore treatment is transcendental. We believe that the government should establish in this State a mine experimental plant, for there is no other State in which ore-treating problems are more complicated. If the government will take up and thresh out for us the problems that are too large for the individual, for the company, for mining districts, or for the State, we think it will be doing a good work, its duty, perhaps."—Golden Transcript.

A distinguished Golden visitor recently was Dr. M. Belonski, professor of geology at the University of Berlin. Dr. Belonski is in the United States for the purpose of examining the various geological and mineralogical collections. He was greatly interested in the magnificent collections at the School of Mines, which he pronounced inferior to none. He was especially interested in the magnificent specimens of zeolite and mesolite, which he said, are the very finest in the world. All these were obtained from the table mountains near Golden, and practically all the other fine collections in other institutions have been supplied with these wonderful formations from Golden.

REVIEW PROBLEMS.

Mathematics VI.

The above is the title of a pamphlet neatly bound in Manilla cardboard, containing 178 practical problems in mathematics, collected and arranged by Prof. C. R. Burger.

The problems are printed on one side of the sheet only, leaving the other side blank for the solutions and answers.

The preface thoroughly explains the pamphlet: "The following problems are selected and arranged for the Sophomore class of the Colorado School of Mines. They aim to cover the whole range of elementary mathematics through the calculus.

"Many of the problems were suggested by various departments of the School, and many are taken bodily from texts in engineering. No credit is claimed for originality. The main purpose is to review in a practical way the mathematics which the student has had and thereby encourage him to look upon it as an instrument of power and usefulness, ratner than one of mental development and culture."

We quote a few of the easiest problems taken at random to show the scope:

1. The parcels-post regulations give the maximum measurements of a parcel as length plus girth equals six feet. Find the dimensions of the greatest parcel which can be sent by mail, (1) if rectangular in section (2) if circular.

26. Two mining claims, each 300 feet wide, bear respectively N 83 degrees 17 minutes W, and S 79 degrees 16 minutes E. The northermost corner of the first coincides with the (center) discovery shaft of the second. Find the area in conflict.

89. A shaft 5 feet by 7 feet by 120 feet, is full of water. Find the work done in raising the water to the surface.

105. A wrought iron plate 1-inch thick, in the form of a sector of a circle, measures 4 feet 7 inches along each edge and the central angle is 54½ degrees. Calculate the weight of the plate, also center of gravity.

154. A cylindrical standpipe, open at the top, is to be erected at a minimum cost of material and is to hold 25,000 gallons of water. Find its dimensions.

This pamphlet may be obtained at Schall's Book Store, Golden; price, 50 cents.

POSITIONS VACANT.

Notices have been posted of two U. S. Civil Service examinations to fill vacancies in the Bureau of Mines, which may be of interest to some of the graduates. Notice No. 693, Metallurgical Chemist, September 23, 1911; to fill position in Bureau of Mines, salary, $3,000; must be graduate of at least five years' practical experience, as well as a graduate of a reputable school of mines. Notice No. 677, Physical Chemist, September 20, 1911; to fill positions in Bureau of Mines at Pittsburg, Pa. Salary, $2,400 to $3,000. College training necessary.

If interested, write to the U. S. Civil Service Commission, Washington, D. C., for a copy of the notice by title and number and form 304 and special form.

THE GENTLE ART OF APPRECIATION.

(By Mark R. Lamb, Milling and Cyaniding Engineer, Milwaukee, Wis.)

Much is written on the question of the honesty and the efficiency of metal-mine and reduction-works employees. Little is written on the honesty and the efficiency of managers, directors and metal-mining companies as displayed toward employees.

Company Honesty as Affecting Employees

If a miner is kept busy taking ore from a vein which he knows apexes in another property, what chance has his company of convincing him that it is wrong for him to pocket some of the ore? A story is told of a leaser in Goldfield who, after having worked for wages and "pickings," made a rich strike on a lease of his own. When he held up his mine crew at the point of a gun and compelled them to leave the "high-grade" in the mine, his argument was not based on high moral grounds. Such an argument, if attempted, would have left him (physically as well as figuratively) not a leg to stand on. Many mining companies are in no better standing, and the employees know it. When a smelting company—this is a true story—significantly asks an applicant for a position of ore sampler and buyer, "Can you 'make money' for the company?" what can they expect of the man they finally secure?

Blacklisted for Not Patronizing Company Saloon.

But omitting the comparatively uncommon, how much better feeling prevails when the man who represents the company takes an interest in and plays fair with the men. Not long ago one manager sent a blacklist to his mill foreman. This was a list of the amalgamators and helpers who had spent no money during that month in the company saloon! This same company operated a store. Employees taking a vacation (always without pay) were warned not to bring back "contraband" clothes, since it was their "duty" to buy at the company store. The

pet names for that store, such as "Robber's Roost" and "Swindle Shop," indicate the feeling entertained for it by the men. As a climax might be taken the warning to one man that he must prevent any shipment of express packages of fruit to him from his home in California. Such a company and manager are entitled to every consideration —and they get it.

Cheaper to Prevent Malaria Than to Have It.

An American company, operating in the "hot country" in Mexico, has great difficulty in keeping men, good or bad, on account of the discomforts of living, the lack of reasonable comforts and the ravages of malaria. The company is making money. It has cheap native labor, and the doctor is positive that he could reduce the fever cases 90 per cent. if given enough labor to clear off and drain the ground immediately around the camp. The marvelous record made on the canal zone justifies his statement. Many Mexican mines are cursed with fever, and the managers of these, as well as of other tropical countries, owe it to their companies as well as to their employees to know and to do the necessary work for preventing fever among their people.

When a mine manager must resort to having two men for each responsible position, must have a constant stream of contract labor on the road and is himself in bed part of the time drinking quinine solution, would it not be profitable to start a mosquito hunt? It would be an excellent way to show an appreciation of the value of the health, the lives even, of his men and their families. Almost anything in the way of sanitary policing is possible in the ordinary camp, as the mining company usually owns all the land and most of the houses.

Ice Plants Should Be More Common.

The matter of ice, particularly in hot or fever countries, is usually neglected; probably on account of the prevailing ignorance of the simplicity of the small plants. No mine should be without ice when having it means nothing but a few hundred dollars first cost, the operation and power costs being negligible. The traveling expenses of a few men to replace the fever-stricken will pay for the plant, and the ice is credited with saving the lives of many fever patients. A few coils of cold brine pipe in a lounging room in the tropics, by freezing out part of the moisture of the air, greatly reduces the difficulty of keeping employees satisfied, and the amount of power required is insignificant.

Company Store Often a Company Steal.

The company store is by some companies considered a legitimate source of income. Sometimes the per cent. of profit is high. What better way is there to tempt an amalgamator, a concentrator man or a precipitate man, whether Mexican, American, Englishman or Chinese, than to charge him $2 for a 50c pair of overalls? Is "foolish stealing" too hard a title for such a "sale"? To inquire why a man does not spend more in the company store, and even to insist on a minimum expenditure there, seems to be thrift gone mad.

A school rarely interests the manager of the small, isolated mine, which is notoriously unpleasant as compared to the large mines. The manager's children (and, alas! usually his wife also) are in the city. He can see no benefit to the company in a school for natives, or, in the case of American mines, for the children of common miners. There is no doubt that the majority of laborers have an ambition (admit that it is foolish) to educate their children, and even if it does the children no good, a school satisfies the parents and is to that extent a good investment for the company. The laborer gets the impression that his efforts and requirements are considered and appreciated.

Cheap Doctors the Companies' Desiderata.

Many companies provide a doctor grudgingly, usually a recently graduated student, who will work for a small salary and experience—the latter not furnished by the company—and who will keep the books and run the store. In other cases he is a dipsomaniac, a drug fiend, or a horse doctor available on account of his misfortunes and satisfactory on account of his being willing to work for low pay. A competent, normal physician is a most valuable asset to a company which wants to keep a desirable force of men. A married man may stay for a time at a camp not so provided, but only long enough to find another position, while the blind manager explains to the blind board of directors that the difficulty of keeping good men is due to the well-known restlessness of miners.

The boarding house is such a prolific source of dissatisfaction that it is entitled to a separate volume. The money usually spent on a poor table will supply a good one if proper attention is given it. The best of oil is none too good for the engine cylinder, but the eggs for the miner and the wine for the manager are usually of the same vintage. Instead of owning a saloon, an adequate amusement hall should be built by the company. Anyone in the business can look back to dreary months with little to brighten or relieve the deadly monotony of breakfast, the stope, cold lunch, supper and bed. Such monotony is directly responsible for and strengthens the feeling every man has that he is merely after a stake and will soon be in some other place or business. In commercial lines the employee owns his own home, has a feeling of ownership in his company and endeavors to give good satisfaction in order to hold his position, while in the mine the manager often has more trouble keeping his men than the men have in keeping their positions. There is no valid excuse for the encouragement of this feeling. From a purely profit point of view (since the directors' measure of mining success is money), it is an extravagant management which does not try to evade such conditions. Back of it all lies the resentment felt at undisguised robbery and imposition and lack of appreciation. Rarely does a rich mine afford such a luxury as dissatisfied and imposed-upon employees, and no other but a rich mine can afford it.

Men Should Be Kept Longer.

A manager complains of a department head and feels that there must be a better man for the position if he could be found. Instead of making frequent changes (the average life of a mining position is much short of a year, if one may judge by the changes of addresses of the members of the American Institute of Mining Engineers) it is much better to send department foremen to see other mines and plants. They are the best judges of points of practice which are applicable to the home mine, yet to suggest such a trip under pay and with expenses paid would superinduce heart failure for the manager. It is certainly true that a visit by any Mexican company's metallurgist to Pachuca, Guanajuato, El Oro and Aguascaliente would be worth much more than it would cost, yet how few make it except at their own expense. There are even camps where the half-dozen indispensable technical journals are not seen! There is one method of influencing employees which is little practised in precious-metal mines, which costs little or nothing and which pays enormous dividends. Put yourself in his place! It is an art the practice of which gains friends and partisans and which influences dividends as much in mining as in the manufacture of steel or in politics—the gentle art of showing appreciation.—Engineering and Mining Journal.

THE SUPERFICIAL APPEARANCE AND ALTERATION OF ORE DEPOSITS.

(Continued from Page 5.)

observed a little stringer that would have led him to another ore body. The Golden Cloud Mine in York Gulch, Montana, is a stratified deposit of this character. It consists of a series of flat stratified pockets connected by small quartz verticles.

Third—Contact Bodies Between Eruptive and Non-Eruptive Rocks—This class is very easy to distinguish and a very reliable class to prospect. It is true that the eruptive sometime extends out into the surrounding rocks in tongues of irregular shape, making it difficult to follow the contact, but as a rule, such conditions are very local. If a prospect shows good ore at one point on a contact and not elsewhere, a very close study of the local conditions should be made. It not infrequently happens that all the ore will make on the contact between the eruptive and a certain stratum or variety of the surrounding rocks. Thus, at Bisbee, Ariz., there is a mineralized contact between granite porphyry and bedded limestones, and all the ore is confined to that part of the contact where the porphyry and a certain bed of soft yellow limestone (carboniferous), comes together. As this particular horizon outcropped at only one point the early development of the camp was slow and marked by much exploration work which in the light of present knowledge looks very foolish.

Fourth—Impregnation Deposits in Porous Strata—This class is closely allied to stratified veins. The only real difference is that impregnation deposits generally extend out from some well marked contact or fracture vein while stratified veins are not so readily connected with any general system of mineralization. Impregnation deposits are usually the richer the closer to the channel of supply, and the leaner the farther away from it.

A granular or porous stratum is always more likely to be enriched than a dense one.

*At Clifton, Ariz., the granular paleozoic limestone beds are, in some instances, mineralized a distance of 2,000 feet from the nearest porphyry. It is probable, however, that more or less open veins aided in conveying the mineralized solutions so far away from the eruptives.

Fifth—Impregnation deposits in Crystalline Rocks—Such deposits are often hard to recognize in the prospect stage. Cripple Creek is a camp whose ore bodies are largely of this class, and we know it was scratched over quite a bit before its value was recognized.

The impregnation deposit, as a prospect, generally looks like a narrow vein with a reddish or brown discoloration of the rocks on both sides of the vein. As most all veins are accompanied by bands of discolored rock, I know of no way to be sure except to assay the discolored country rock alongside an ore body. For some reason the values of veins are generally confined strictly within the walls, but nevertheless it is the duty of the examining engineer to keep his eyes open for impregnation deposits.

Just the other day I saw a pretty example of crystalline limestone impregnated with pure resin zinc. The operators were throwing this ore over the dump when an experienced mine manager came along and told them that they better put that stuff containing the yellow crystals in the ore house.

Sixth—Pipes or Chimneys—It usually requires but little work to prove that a deposit is not a vein or contact, and then, of course, the only thing that will save it from the pocket class is that it be a pipe or chimney. Unfortunately, true pipes or chimneys are rare, while isolated pockets are many. There is no certain way to prove whether a prospect is a pocket or a pipe except to sink on it, but sometimes one can find scinter or onyx, or other evidence of geyser action, and it is supposed that most

*Waldemar Lindgren, p. 546, Vol. 35, Trans. Am. Inst.

pipes are the channels of extinct geysers. Where such evidences are found it is a fairly safe proposition to sink, in case the values are attractive.

Seventh—Cement Deposits—This class is easy enough to recognize, and presents no difficulties of examination or prospecting. They are superficial deposits and readily explored with churn drills or shallow shafts. They are formed in two ways. First—In desert regions the underlying gravels are generally cemented by calcite and alkalies. In case these gravels are rich enough in gold to work we have a cement deposit. Such are the cement deposits of Western Sonora and Western Australia. Second—The solutions issuing from a vein may make a mineralized cement in the soil. This may occur with primary or secondary solutions, but as a rule, the solutions are secondary, and hence gold is rarely found in such cement deposits because gold does not readily yield to secondary leaching. In the first class the deposit is prospected just like a placer channel and in the second class the deposits are generally soon traced to some strong vein which marks the origin and upper end. There are some cement copper deposits east of Hawthorne, Nevada.

Eighth—Deep Leads—This class is easily recognized because the ore is very evidently river gravel which has been buried under eruptive flows. Once the trend of the old river channel is determined they are readily followed. California and Victoria, Australia, are noted for their Deep Leads.

Ninth—Stock-Works—Stock-Works consist of a multitude of little veinlets crossing each other in all directions. In as much as the values are usually confined to the veinlets or some of them, and as the individual veinlets are too small to work, a stock-works suggests to the mind a large body of low grade ore. It is usually low grade, and unless it is large it is not interesting. Stock-works may be of any size and shape. Unless one can get some inkling of the forces that produced the fissuring it is impossible to form any idea as to the probable trend or dimensions of a stock-works. At Berners' Bay, Alaska, are several notable stock-works, of which the Kensington Mine is the best known. The stock-works here occurs in diorite and probably is caused by local straining, which left a fractured zone in place of a clean fissure.

Tenth—Mineralized Dikes or Batholiths of Eruptive Rock—It is not, as a rule, difficult to recognize this class because the ore is evidently a different rock from the surrounding country. Occasionally, however, one finds a mineralized dike in a country of similar eruptive rock. In such a case a good microscope comes in handy. One can generally find some distinguishing feature of the mineralized dike and so trace out the float.

Eleventh—Segregation deposits in Eruptive Dikes, or Batholiths—In the prospecting stages the boundaries of this class of deposit are very hard to determine, because they are so entirely irregular in outline. The limits of the ore body are not fixed by any wall or cleavage, neither is there any connection between one ore body and another. Unless the ore bodies adhere to a contact it is simply a case of going it blind.

The evidences that an ore body is one of magmatic segregation consist of the negative observations that it is not on a vein or contact, that it is not an anticlinal fold nor a stock-work and the positive observations that the ore is eruptive rock in which the metallic crystals are intergrown with the rock forming crystals.

Twelfth—Veins in Bedded Eruptives—This class is unusual in that the veins may be confined to one bed, and hence they are a dangerous class. As an example, I will mention the southern group of the Batuc Mines of Sonora. These mines consist of several very strong and rich quartz veins which occur on the east slope of Batuc Mountain. This mountain consists of bedded eruptives. The east slope conforms to the bedding. The west slope exposes the truncated edges of the beds. At the time of my visit the wily Mexicans had cleverly covered up all the deeper works which had penetrated the underlying beds because the veins are entirely confined to one bed. This bed is of andesitic rock about 500 feet thick at its thickest place. The veins do not penetrate either the underlying beds or the overlying beds. The underlying beds were examined with the aid of a rope on the western face of the mountain, which is a sheer precipice. The eastern slope dips gradually down to a gulch, the far bank of which consists of overlying beds of rhyolitic rock. The veins do not penetrate this rock, but do apparently go down undiminished in strength and richness on the dip underneath the overlying beds.

This illustration brings out both the dangers and the possibilities of veins in bedded eruptives. While the veins very likely will terminate at the lower limit of the bed, they may just as likely extend indefinitely in the lay of the bed.

Thirteenth—Cave Deposits in Quartzite or Limestone—For some reason not fully understood by me, cave deposits are practically confined to calcareous rocks. Quartzites are often calcareous, and when such is the case they often harbor caves. Limestones are notorious for their caves. An ore deposit occupying a cave is easily classified because the ore is generally a soft "filled-in" substance and there is generally an open place along the top of the cave. Sometimes, as at the American Nettie Mine, Ouray, Colorado, the cave is mostly empty with a deposit of enriched gravel in the bottom. The outcrop of such deposits looks like an ordinary deposit in limestone, but a very little development reveals the cave character. Cave deposits are generally in

groups, and diligent search will usually reveal an open channel leading from one deposit to another.

Fourteenth—Fractured Strata Such as Anticlinal and Synclinal Folds—This class often laps over upon stock-works on the one hand, and upon impregnation deposits on the other hand. Still there is a distinct class which is not covered by the other divisions. At Bendigo, Australia, the sedimentary beds are crimped into sharp folds with pretty regularity, the brittle strata, consisting of shaly sandstones, were crumbled on the anticlinals and eventually entirely decomposed by the solutions which found these fractured zones a favorable circulation conduit. On the anticlines and some of the synclines they have been entirely replaced with gold bearing quartz. Thus we have the beautiful "saddle reefs" of Bendigo. I walked nearly a mile through an old stope and it reminded one of walking on top of a huge elongated boiler with an arched roof overhead.

It is seldom that anticlinal folds take the simple and beautiful form of the saddle reefs of Bendigo, but varieties of this form of deposit are more common than is often suspected. In eruptive areas the beds are apt to be folded and twisted. The more brittle beds are likely to be crushed, thereby forming a favorable channel for mineralized solutions. Such areas may not be recognizable as anticlinal or synclinal folds, yet they are crushed zones due to flexure. In practice they are apt to be called big pockets or deposits.

To the examining engineer, however, it is not sufficient to class an ore body as a big pocket if it is possible to decipher its structure, because if the structure is understood, developments may be intelligently carried out to find the extension of that body or another similar one.

Fifteenth—Fractured Eruptives, Such as Explosive Vents, etc.—The "crater" at Cripple Creek is a good example of this class of deposit. This enormous shoot was apparently an explosion vent which filled up with loose detritus. It naturally formed a favorable passage for mineralized solutions, but if one may judge from results there was too much channel and too little solution, for the material is very low grade. Deposits of this character are simply loose masses of broken country rock more or less cemented together with quartz and mineral. Such deposits are very continuous in depth if the body is a true explosive vent.

Sixteenth—Lenses in Schist and Slate—This class is a very important one. Such famous districts as the Angels Camp district of the Mother Lode, California, the Homestake, in the Black Hills, Dakota, and Silver Peak, Nevada, come under this class. Sometimes the lenticles are connected by veinlets, sometimes not. Where there is no connection between any of the lenticles, it is thought by some that there has been movement in the slate or schist since the lenticles were formed, thereby obscuring the original connecting links. In early prospecting stages this formation can generally be deciphered by surface indications. If the lenticles are sufficiently close together on the surface to warrant fairly easy development, the same may be assumed as a probable condition at depth. If, on the other hand, the lenticles are so scattered on the surface that all the profit from one would be lost in finding another (in case the same condition prevailed underground), it is pretty safe to pass the proposition along.

Superficial Alternations.

Having briefly skimmed over some of the structural problems which must be worked out by the engineer, I pass now to a few words about the character of the outcrop itself.

If the prospect gives no evidence of any value but gold, it is generally a safe assumption that the superficial zone is somewhat richer than the unoxidized vein below. The reason for this is that gold is so chemically inert that it rarely yields to surface leaching. Hence we have all the gold left in the vein and part of the iron, sulphur and other minerals gone. The result is that while the leached zone may not be any richer per cubic yard, it is richer per ton.

It must be borne in mind, however, that no rules are absolute. Gold sometimes does leach away from the oxidized zone and leave a barren outcrop over a rich ore shoot. The Kendall Mine in Montana is an example of this.

Where the iron of a vein has been oxidized to hematite no leaching of the gold may be looked for, but where the iron has formed limonite and been largely washed away it will often carry very fine gold in suspension. I proved this by experiment in the McBreen Mine, Siskyou County, California. Where gold occurs in the vein as a salt, such as a telluride, selenide, or sulph-arsenide, it is more apt to leach away then where it occurs as metallic gold.

Silver goes into solution readily, but owing to its great affinity for chlorine it seldom migrates very far, the silver chloride being a very insoluble salt. Hence silver outcrops are often barren, but good ore is often found 30 or 40 feet from the surface.

Copper, on the other hand, is not only readily taken into solution by oxidizing waters, but it is not readily precipitated. Hence copper outcrops are often barren to depths as great as 600 feet.

The study of leached outcrops is one of the fascinating features about examining prospects. A careful study of the outcrop will sometimes result in finding pseudomorphic cavities which may give an idea of what the ore was before leaching.

The rules of surface alteration vary with the climate. In desert regions there is generally an important zone of secondary enrichment. In moist localities which have been heavily scored by glaciers, like the coast of British Columbia, the zone of secon-

dary enrichment is almost wholly lacking and oxidization rarely extends more than 50 feet deep. The age of deposits is another disturbing feature. There is evidence in some deposits that alterations took place under conditions totally different from those existing today. Thus the copper outcrops on the lower Bill Williams Fork in Arizona look very different from similar outcrops in similar formations, but at a higher altitude. There are a few residues of recent beach gravel in the lower country, and I think the inference is justified that the leaching of the lower outcrops was assisted by the action of tide waters. The lower outcrops are more honey combed and show less carbonate of copper than those above the beach-gravels.

In the above discussion I have omitted all mention of faults and foldings which may occur after the ore body's formation and so distort the same. This a subject in itself, and may well form the subject of a separate paper.