Addresses, Communications

—AND—

DISCUSSIONS.

MEETING OF JANUARY 2d, 1883.

Address of the President, S. F. EMMONS.

(Read by the Secretary.)

Gentlemen:

We have met here to-night for the purpose of organizing a scientific society for the State of Colorado, whose objects, as briefly stated in the constitution you have adopted, are: the promotion of scientific intercourse among its members, of scientific observation and investigation, and the recording of these investigations if they are found worthy of record, so that they may go to swell the sum of scientific literature now accumulating with such rapidity the world over.

You have been pleased to designate me as your President for the coming year, and to expect of me some remarks in the form of an opening address. I can think of no more appropriate text for such remarks than the first article of our constitution above quoted, whose conciseness may well admit of some elaboration.

The title of our Society is broad enough to include all the branches of science; but in the commencement at least, considering our surroundings, it may be wise to confine ourselves to those branches which are more closely related to the interests of the community in which we live: chemistry, in its relation to metallurgy; geology and mineralogy, more particularly in their application to mining.

On all the broad extent of these United States certainly no region can be found which presents more facts of interest, more opportunities for investigation, and greater possibilities of new discoveries, than the State of Colorado. In other parts of the country vast revolutions in mining industries have been brought about by the application of scientific methods to the development of the natural resources of our land. In Pennsylvania the first great step was the development of the anthracite coal of that State. Anthracite coal

was already known in Europe, but had proved of little practical value. The mining, preparation and practical use of this coal is virtually an American achievement and the making of iron with raw coal entirely so. Following on that, of comparatively late years, has been the introduction of the Bessemer process, which, though invented in Europe, was made practically applicable on a large scale by an American, Alex. Hollay, who has personally planned most of the enormous Bessemer plants which have produced a revolution in railroading. At Lake Superior, one mine which produces to-day more copper than all the rest of the mines in the United States put together (and they furnish about one-third of the worlds production), was practically brought into existence by an American scientist, Agassiz.

Attention was first called to the mineral wealth of the Rocky Mountain region by the discovery of gold in California. The greater part of this gold, which in the first few years was obtained in such amount as to produce a marked change in the purchasing power of gold throughout the world, was obtained by the most primitive of all methods of mining, and one which has been practiced probably even before historic times. The application of a few simple scientific principles to this primitive method of mining has originated another truly American process, that of hydraulic mining, where the gold pan and sluice box of the gold-washer are replaced by the "Little Giant," by which a single man is able to bring the force of a river to bear directly upon the side of a mountain.

Besides her gold, California has also deposits of quicksilver, whose product vies in importance with that of Spain and Austria, long the only sources of quicksilver in the world; and to these quicksilver deposits we now look for important light on one of the most vexed of scientific questions : the manner of deposition of metallic minerals in veins ; for in the Sulphur Bank deposits, we are told, one can see the formation of a vein going on, as it were before one's eyes.

In Nevada, on the great Comstock Lode, which has added $300,000,000 of si ver to the worlds store within the last twenty years, and where mining has been carried down to a depth of 3000 feet in the face of the most intense subterranean heat, the machinery and appliances for deep mining have been brought probably to a greater degree of perfection in that short period, than elsewhere in the world.

In Colorado, long considered far behind these States in mineral wealth, and whose development is just commencing, we have coal fields whose extent is probably greater than those of Pennsylvania; iron deposits whose magnitude is hardly determined, but which are amply sufficient for the present wants of the country; and a Bessemer plant already in operation. Of the precious metals we have copper, not in the concentrated form it is true, in which it is found at Lake Superior, but in a variety of combinations which require a vastly greater exercise of skill on the part of the metallurgist to extract it from its ores; and here in the immediate vicinity of Denver the only works in the country (and among the largest in the world) for extracting silver from copper ores by the Augustin-Ziervogel process.

In silver, Colorado stands pre-eminent. Nevada which for long years was the great silver producer of the Continent, now takes rank second to Colorado. Her wealth is perhaps not as concentrated in locality, and in methods of mining and machinery Colorado is as yet hardly equal to that State, but her natural resources are far more varied, more wide spread, and the problems presented to the geologist, the mineralogist and the metallurgist are infinitely more diversified.

Her gold product is still below that of California, and her gold ores are far more complicated and offer greater difficulties for the extraction of the precious metals. For that very reason the field for investigation and for the application of scientific methods is all the larger.

From a mineralogical point of view the wealth of Colorado exceeds that of the other States. It had seemed hitherto that, while America was rich beyond compare in ores of economical value, her mines were singularly barren of interesting and well developed minerals. As the mines of Colorado have been more and more developed however, this bids fair to be no longer true. In the metallic minerals almost every variety has been found here; and to offset the absence of workable deposits of quicksilver, we have in Boulder county the remarkable development of Telluride ores, which hitherto have been found in quantity only in the mining districts of Trans-sylvania. In the non-metallic minerals, the search for which has not the incentive of the pecuniary return to be derived from ores, her wealth is undoubtedly great, if it may be judged from the infinite variety

already discovered in the localities of Pike's Peak, where the Greenland cryolite, the Amazon stone, phenacite, topaz and other rare minerals have been obtained; and the basaltic mesas of Golden, which contain almost all the known varieties of Zeolites.

To the geologist Colorado presents a field even more varied and complete. For the study of the Archaean, the oldest portion of the earth's crust to which we have access, and of the problems of metamorphism and the evidences of the originally stratified condition of these now thorougly crystalline rocks, it is safe to say we have nowhere else in the world such opportunities as in the deep gorges which the Colorado streams have cut through its mountain chains. Of the Mesozoic eruptive rocks, porphyries and diorites, which have hitherto been known over comparatively small areas, at widely separated localities in this country, Colorado presents a most unusual development. Not only are they of practical interest on account of their close connection with the formation of mineral deposits, but their study promises to offer valuable data in determining the vexed problems of the origin, manner of eruption, and sequence of eruptive rocks in general. The limited time devoted to the study of these rocks has already resulted in what might be considered the discovery of a new form of eruption, to which the name of "laccolite" has been given by the first observer. It is that of an eruptive mass forced up from below through sedimentary beds; not reaching the surface, but stopping at a certain horizon; forcing up the superincumbent beds in an arch or dome, and spreading out for a considerable distance between the strata. The admission of such a type of eruption is opposed to the dogma long since thoroughly accepted by European geologists, that eruptive rocks do not exert any upheaving force. As a rule, our brethren on the other side of the water are very slow to accept any scientific novelties from their American cousins, but the evidence of this phenomenon is so conclusive that it has already been adopted by the present director of the British Geological Survey, Mr. Geikie, and has been found by him to explain satisfactorily the manner of occurrence of eruptive beds in a field which has been so thoroughly examined both by himself and his predecessors, viz: Scotland.

These Mesozoic eruptive rocks, whose importance as an indication of the greater or less mineral wealth of a region

cannot be overestimated, are very generally distributed throughout the State. In the Archaean their mass is usually small, and they occur rather in the form of narrow dikes than of laccolitic bodies. In the Palaeozoic formations they are perhaps more frequently observed, as where these horizons outcrop, erosion has cut deeper; but I have also observed what are probably the same class of rock cutting through the Cretacous formations in the Gunnison country; and it seems probable that in San Juan they underlie the volcanic or Tertiary outflows.

In Tertiary eruptive or volcanic rocks, Colorado is also rich. Their greatest development seems to be in the southern portion of the State, in the San Juan region, but lines of Tertiary eruption also extend north through the park-areas to the borders of Wyoming, and to a limited extent along the foot-hill region. In the beautiful geologoical maps of the Hayden Atlas, we have a very fair general outline of the distribution of the various sedimentary series in the geological scale throughout the State; but I regret to say that the classification of eruptive rocks given there is very unreliable; and it is impossible to distinguish from their nomenclature whether the masses indicated on the map belong to the Tertiary or to the earlier series. For that reason it is impossible to say to what extent Teritary volcanic rocks have influenced the concentration of mineral in veins and deposits. My impression is however, that this influence has been vastly less important than that of the earlier eruptive rocks; and it is a fair *a priori* assumption, if we grant that the metalic minerals are mainly derived from eruptive rocks, that this would be the case even were the latter rocks originally equally rich, because the former would have been subjected for a much longer period to the leaching out of percolating waters.

As regards the sedimentary formations, the Cretaceous beds are the coal producers of the Rocky Mountain region; and it is of the utmost importance for the future industry of the country that their outlines should be accurately laid down, and the areas over which they are deposited systematically explored. The coals of the eastern flank of the mountains belong to the extreme upper portion of this formation, which has by some geologists been classed as Tertiary, owing to the fact that fresh and brackish water fossils have been found in them, and their flora corresponds more

nearly with the Tertiary than the Cretaceous flora of Europe. It is conceded, on the other hand, that those beds are not only similar in lithological character, but perfectly conformable with the underlying Cretaceous series; and that the great physical break in the Rocky Mountain region occurred *after* their deposition; non-conformity between Cretaceous and Tertiary, wherever it can be detected, being above this horizon. For this reason, in spite of the partially negative evidence of Palaeontology, it seems to me that they are more properly classed among the Cretaceous rocks. The decision of this question one way or the other is, however, entirely unimportant from an economical stand-point. In either case their lithological characteristics are well marked and easily recognized.

On the western slope of the mountains toward the Colorado basin, it seems probable that the coal development occurred at an earlier period than on the eastern flanks. The Cretaceous formations thicken, as do the other sedimentary beds, as they approach the central line of the Cordilleran system, the Wahsatch upheaval. A very considerable thickness of Cretaceous rocks overlies the coal beds of the western slopes; and the character of the sediments immediately above and below the coal is not absolutely identical with that found on the eastern flanks. In the local development of anthracite among the bituminous coals of these western basins, is presented an extremely interesting subject for investigation by the geologist and terrestrial chemist; and one whose solution may throw addititional light on the origin and manner of formation of coal in general.

Many geologists and mining Engineers are inclined to consider that certain geological horizons are peculiarly favorable for the development of certain classes of mineral deposits. The Carboniferous and Silurian limestones are by them supposed to be essentially the silver bearing horizons of the whole Rocky Mountain system. The Triassic rocks are copper bearing in certain parts of Europe, notably Germany and Russia, and evidences of copper are found in them in Colorado. In my opinion however, these are generalizations founded on coincidences, rather than on any cause inherent in the conditions of deposition at the time of formation of the sediments of these periods. In Nevada the silver deposits of Eureka and White Pine are found at the horizon of the Devonian and Cambrian. At Leadville, on

the other hand, these horizons are comparatively barren; and it is the lower Carboniferous limestones that carry the silver. In the adjoining district of Ten-Mile, it is the limestone and sandstones of the upper Carboniferous that contain the valuable metallic deposits. In the Lake Valley district, New Mexico, so far as known at present, the silver-bearing limestones belong to a horizon intermediate between those of Leadville and those of Nevada. In Gunnison county a considerable portion, at any rate, of the veins and deposits are found as high as the Cretaceous rocks, and in a horizon which is apparently above that of the coal. It seems to me therefore, from the little I have been able to see of the mining regions of Colorado, that the mineral developments are dependent rather upon the prevalence of the eruptive rocks, especially those of Mesozoic age, than confined to any particular geological horizon.

A serious want is felt by the mining Engineer in his description of a mine or ore deposit, if he makes it for the scientific rather than stock-getting public, in the absence of a rational system of classification of ore deposits in general. Up to the time of the development of the Leadville deposits, a mine, to which the term "true fissue vein" could not in some way be applied, was thereby considerably depreciated in public opinion. Now "contact deposits" are also well thought of, but neither of these terms are to my mind sufficiently explicit. The term "true fissure vein" originated from Prime's translation of Von Cotta, who classed veins, as fissures, on the theory that they were necessarily the filling in of a pre-existing cavity or fissure in the rock by foreign vein matter, either gangue or metal; probably the type present in his mind was the famous Chur Prinz vein near Freiberg, where the comb structure, parallel bands of different minerals, evidently formed in this way, is so remarkably developed. It would probably seem rank heresy to the true Colorado miner to say so, but it is my private opinion that the "true fissure vein" is of the greatest rarity in Colorado, and that most veins generally called "true fissures" are simply a mineralization of the country rock along certain joints or fault planes, or in some cases, of a dyke or intrusive mass of porphory, through its entire mass, if narrow, or at its contact with the country rock, if large. In the latter case this also would be a contact deposit, but quite different from

the deposits along the bedding planes of a limestone formation. Although we hardly know enough about the *origin* of ore-deposits in general to attempt a new classification based upon that, yet in our study of deposits we should take it into consideration as far as possible, and in time material will be accumulated for establishing one on a sounder basis than obtains at present.

From the above brief and imperfect recapitulation of a few leading facts with regard to the geology and mineral resources of Colorado, with which you are doubtless already familiar, it is evident that we have here a fruitful field for scientific investigation; but the incentive thus offered by Nature must be supplanted by an energetic and active spirit among our members. We must each of us resolve to do his part, however small it may seem, to contribute new facts. or suggest paths for investigation. It is not enough to listen to what others may have to offer; but if we are to prove ourselves worthy of the opportunities which Nature has offered, we must each of us lend a hand in the work. Only at considerable intervals can one be expected, it is true, to prepare a finished paper on any subject, which should be the result of thorough investigation and considerable thought and study; but the scientific intercourse mentioned as one of the objects of our Association may be promoted by the presentation of any new facts, in a broad field of subjects, which may come under the notice of members individually in the intervals between meetings. Such pesentations should provoke mutual discussion, suggestion and criticism on the part of fellow members.

On the other hand, I would caution our members to avoid hasty conclusions. True Science is ever cautious; and a readiness to adopt new and startling hypotheses, and present theories which afford a universal explanation of scientific phenomena, is too often the mark of a shallow mind, or one which does not appreciate the true methods of scientific investigation.

A legitimate, and it seems to me very important field of usefulness for the Society will be found in that of criticism of scientific books, papers, and lectures. One of the great wants of American science is scientific criticism. True criticism should be thoroughly impersonal, made in a friendly spirit, and should be received by the person criticised rather as an aid in his work than, as is too apt to be the case, an

evidence of personal ill-feeling or jealousy on the part of the critic. The American has hitherto been considered a very thin skinned individual, and the social criticisms of foreigners have in former times been very badly received. Latterly we seem to have been somewhat outgrowing this tendency, and showing a readiness to feel more or less independent of such criticisms, and perhaps to take advantage of them, when well founded, It is high time that some such spirit should be shown among scientific men, for certainly American science can show enough good work to warrant the same independence that is found in purely social matters. The want of this criticism does America a great deal of injustice in the scientific world. In reading the notices of scientific publications made by individuals, societies, or government surveys, I find the same unmeaning praise bestowed on all works, irrespective of their individual merits. Once a man has obtained a certain amount of scientific notoriety, it seems to be considered it would be doing him a personal injury to mention his work in anything but terms of praise. In consequence we find that American science abroad is too apt to be gauged by the standard of our poorest work; a great deal of which I am sorry to say, even though backed by a prominent name, or the authority of government publication, is *poor* indeed. It is therefore in the interest of science in general that those who are competent to judge should point out to the untechnical public what is real and what is false among that which is presented to it as scientific publication. Here in the west is the danger to true science particularly great. A man dubs himself "Professor" and delivers a course of lectures on scientific subjects, which are largely listened to by an audience incapable of analyzing his facts and theories, and which is only too ready to accept all sorts of wild theories; these are often the more interesting from their very scientific absurdity.

It seems to me that the cool, impartial presentation of the falsity of such theories, if made with the sanction of our society, and therefore free from any personal bias, would have a great and useful influence on the public mind.

Again there are often matters of great moment to the community at large, which are "scientifically" treated of in public prints by whoever feels so disposed, whether he be competent or not, upon which a valuable opinion might be

given after some simple but reliable investigation by a specialist. Such specialists, if there are any competent in the State, should be found among the ranks of our Society; and to it, when we have become firmly established, the investigation of such matters might probably be referred. It might be considered advisable later to obtain an official recognition from the legislature of the State, such as is held by the National Academy of Sciences from the General Government. In the Charter of this Academy, it is provided that on the request of Congress it shall investigate and report on any question of public interest to which scientific investigation is properly applicable.

In conclusion, I would call on members to bear in mind in their papers and discussions, that clearness and conciseness of statement is an essential requisite; and taking warning from the address of their President, not to talk for the sake of talking.

Formation of Hills by Mineral Springs on the Island of Java, BY P. H. VAN DIEST.

(Abstract.)

About midway between Batavia and Buitenzorg are two white limestone hills formed by deposition of calcium carbonate as aragonite from springs. The one hill is six hundred feet in length, one hundred in width, by sixty in height. The second, at a distance of six hundred feet from the first, is of about the same dimensions. The waters which have formed these hills have a temperature of 113° F. and are charged with calcium bicarbonate, some magnesium carbonate, chlorides of calcium, magnesium and sodium, and hydrogen sulphide. Rising through various channels, the water has flowed over the surface of the ground, depositing continually calcium carbonate until the present elevation has been reached; the pressure being sufficient to raise the water so high and no higher, as can be observed in basins about the orifices of the channels opening along the summit, the water of which does not overflow. The pressure of gas in the subterranean waters appears to vary greatly, and was sufficient in 1871 to rend asunder one of the hills with a tremendous report.