The Gold Belt of California, The Ancient Placers and Their Relation to Wall Rocks, N. 1.

*[Witten for the Mining and Scientific Press by Stephen Barton, Kernville, Cal.I*

There is a growing disposition to study the wall rocks of a metal-bearing lode and from that standpoint to endeavor to deduce some rule as to the mode of occurrence of valuable ore bodies throughout the lode. This study has been made to yield results with almost mathematical exactness in the Bonanza mine at Sonora, Tuolumne county, also at the Willard mine, near the town of Murphys, in Calaveras county. Some observations have tended to show a loss of ellex in the walls of the lode in proportion as it appears in the lode itself. The porphyries of the mother lode are being studied, and in obedience to rules observed elsewhere, a higher percentage of gold is being searched for in the west wall of the Comstock,

Since the source from which the ancient placers were fed remains a mystery, the question arises as to whether light may be shed on the subject by the study of wall rocks. I know that all this is foreign to the idea that ore bodies are results of accidental eruptive force; but it only serves to remind me of a conversation I recently had with three mining experts who were discussing the richness of the "blue gravel" deposits, which, at certain points, have discharged their wealth into the South Yuba. After the immense treasure still stored there had been fully discussed, I asked the question which is made the subject of these articles, "Where did that gold come from?" One of the party, while looking to the others for acquiescence, said in substance: “Most of that gold came from lodes between soft and friable walls, and has been bottomed and removed by the eroding forces which plowed out the ancient channels. In some places the bottoms of the lodes are still left on the tops of the ridges, and in other cases lodes of great force are seen to-day, penetrating the earth to great depth." I reminded him that this idea was hardly in accord with accepted theories in the matter of a whole system of metal-bearing lodes having been bottomed by denuding forces. He responded that mining experts paid very little attention to accepted theories. Said he: “Your lodes here at Kernville are mostly in the granite, and that is the reason why so many of them pinch out at the bottom or in the gulches." If this reasoning is correct in regard to Kernville, then deeper mines should be found in the metamorphic rocks east of present exploration.

There are places where the metamorphic rocks extend to great depths below the beds of the ancient rivers, and there, at least, we should be entitled to search for a reserve from which the ancient channels were fed. As we turn to the history and circumstances of placer mining, we shall seem to see evidence that millions were supplied by a local source, and from the geology and configuration of the country that millions upon millions remain.

If any one not conversant with the facts was told that a little bit contained within two parallel lines running north and south, not more than one mile apart, had yielded nine-tenths of all the placer gold in California, which was contained in lumps worth more than $1000 each, astonishment would be the result. The surprise would not be lessened if told that the quartz mine of California which had yielded the largest lump of free gold in a quartz matrix was within the same belt. Still surprise would only be increased if told that it was a physical impossibility for any of these lumps to have been carried from any known quartz lode by natural causes. Now, after ah that has been written about the mother lode, if we should turn to the scientist and say this was five miles east and up the mountain from the mother lode, we shall only be capping the climax. I believe all these propositions are within the facts, but before I specialize localities I must generalize a little further.

Original research is all that will enable us to master the unsolved mysteries of mining. Whoever will look up the attitude of the scientists 25 years ago in relation to the geology of mining, and will compare it with the position of the most advanced of standard authorities of to-day, will see that we

have drifted, are drifting, and are almost without sail, rudder or anchor, so far as relates to the occurrence of the gold bearing matrix. When we find it we know where it is. Solomon, heathen as he was, knew that much. True, it has been said that some of the best gold mines in South America are between granite and diabose. But this only looks to the immediate contact. We must remember that the gold-bearing lode occurs in every kind of contact met with in metamorphic formations. If it has not been mined in recent years, I can go and show where a thin sheet of quartz rich in free gold appears in a solid ledge of blue limestone. This is the most impossible place for gold to be found in a gold region. I made this fact public and furnished specimens before the Mining and Scientific Press was founded. There was no capping, and the two rocks were as nearly "froze" as quartz and lime could be. My knowledge of that class of lime rook of which I have broken and handled thousands of tons teaches me that that vein was probably four or five feet deep and eight or ten feet long, and that the whole vein probably contained $20 possibly $100. Some scientists may question this attachment. If any public-spirited man acting in a public capacity will call on me and ask me to do so, I will accompany him to that place at my own expense, and show him the spot, and probably obtain him a specimen showing free gold. This, too, is within that one-mile belt. Now what I want and what the miner wants, and what we must have, is a science which can explain the presence of gold wherever found—a science which does not have to be rewritten every third year. Before digressing in a subsequent chapter, I will say that the specimens referred to were furnished to H. 0. Bennett, editor and publisher of the Columbia Times^ and appropriately noticed by him.

There are several things relating to the history of placer gravels which may be learned by studying them. Where the gravel is well rounded and pretty uniform in size, the inference would be it had been driven a long way. When the gold was very much water-worn, the conclusion would be that it had entered the stream near Its source. Where the pebbles retain more or less of their original angularity and vary very much in size, the inference will be that they were not driven far. Where the gold is rough and craggly, and in grains of every size from the finest flour gold to lumps of 50 or 100 pounds, the conclusion will be irresistible that they had not been transported very far nor long subjected to the assorting power of water. Water has a transporting power in proportion to surface exposed, and flour gold is nearly all surface.

These conditions have all been noted and commented on by miners engaged among the ancient placers. It is not hard to point out where $150,000,000 were mined within a few miles of a given point, and if the character of the deposit can be made to refer the origin of this wealth to a locality where the character of the formation bespeaks for it the proper place for deep and strong gold-bearing ledges, the rising generation may conceive it worth their while to turn their attention in that direction. Most of the placer miners had very little knowledge of quartz, and had a vague and ill-defined idea that most of the placer gold came from volcanic eruption. They made no search for the gold-bearing lode, and since it would differ radically from a gravel deposit it might have been mined over, in many cases, unnoticed. The accessible placers were mined out. The miners had no families. Many were drawn away to the silver mines of Nevada, They neither perpetuated their own race nor imparted their knowledge to others, and to-day California can boast of but few able-bodied young men competent to manage a ground-sluice. The placers are neglected, and because these men, who knew nothing of quartz, mined over this ground, took out wealth and departed like the Toltecs, in search of the terrestrial paradise, the capitalists give this region the go-by. Canals which cost hundreds of thousands of dollars still pour their sparkling currents among gravel piles where the young pine has taken root and offers a lonely home to the cooing dove.

Over such a region as this there once swept a current strong enough to carry along a nugget of gold containing $8000, and remember that gold is more than once and a half as heavy as lead, and that the

accompanying gravel was very little water-worn — two circumstances which can only be reconciled with the hypothesis that this lump had rolled but a short distance.

{ To he Continued )

*Mining and Scientific Press, V. 61, 11/15/1890, p. 314*

The Gold Belt of California, The Ancient Placers and Their Relation to Wall Rocks. N. 2

*[Witten for the Mining and Scientific Press by Stephen Barton, Kernville, Cal.I*

The light of experience must guide us in determining what should constitute wall rocks, and why we should expect to find that in certain localities the ancient channel only grazed the outcrop of the gold-bearing matrix and left the great body of its wealth penetrating the earth to great depths. We must remember, however, in the face of experience, that there is a theory that the wall rock is to the lode merely that of the product of the molders' art, that it gives shape merely to a vein of eruptive matter. If this latter is true, then there is no use of studying geological formation, as a gold-bearing lode may be found wherever a rent may occur in the earth's crust. This latter theory is responsible for half the mixing failures that have occurred on the Pacific Coast since Marshall's discovery. It was responsible for the squandering of $50,000,000 in the bottom of the Comstock, below the realm of profitable mining, and finds a place in that portion of the literature of to-day published at public expense. A theory which has wrought so much evil should be able to vindicate itself by reference to some one fact established in its favor, or some one dollar secured as a return for the millions squandered, or it should cease to pretend to the position of a scientific truth. Unfortunately such is not the case. Nine tenths of our mineral lodes fail to penetrate the earth as deep as the gorges of the modern streams. The great mother lode is broken up, scattered, demoralized or absent in the beds of all the rivers it crosses. Few if any of the explorations in the ridges have reached the level of adjacent river-beds; and still we are to be told, by authority, that the talk of "gold ores" must only excite a smile with scientific men, and that gold is found only in positions consistent with mechanical deposit by eruptive force.

Gentlemen, stand aside; don't allow yourselves to remain a drag-yoke upon the neck of civilization. We will show you that gold is found in certain fixed geological relations; that it exists as a metal, and that it also exists "as an ore;" that it enters into the most intricate combination with many minerals; that it observes the laws which ^govern the brotherhood of metals, and confuses you only by the fact that it is obnoxious to oxygen.

What rules, then, must govern the geology of a mineral region, and where may we safely look for a paying ledge ?

As being first in mineral wealth we will take the calcareous formations. If a lime belt or formation occurs 100 miles wide and of great depth, with no adjacent metamorphism and no intervening formations, the galenas will only carry a low percentage of silver and a bare trace of gold, except near the edges of the formation, nothing more. Where lime dikes of moderate width contact with mica slate, taleoose slate, or any of the highly silicified or metamorphic rocks, whether eruptive or otherwise, minerals containing any or all of ^the metals may be looked for in or near one of the contacts. This rale may be carried up through all the grades of calcareous and carboniferous slates. In many places numerous small veins rising in the granite a mile away will be seen heading for the contact and expanding into a complicated system as they approach. But as most of these lime formations trend south about 24$^{o}$ east in California, and as there is a very marked difference between the conditions observable in the two walls, I will leave the explorer to determine for himself some of the mysteries hidden there. For 15 years I have been fully impressed with the idea that the vicinity of the calcareous contact not only gave birth to a high percentage of the gold of

the ancient placers, but that the adjacent lime, acting upon the silex and sulphur of the matrix, released the gold and offered it to the current in its present form.

I have no theory to which I have not been involuntarily led by observing facts. So far as my observations go, what is known as pocket mining, where fortunes have been realized in a day, were all near the contact of a calcareous formation. If we accept this as a rule, we shall see how very little of the wealth of the earth's crust is exposed to man's grasp. Take the bed of Owens valley, where the granite and the Silurian rocks meet. We see this decomposition is going on, the sulphur, the lime, the silex and the soda, the boracic acid and potash, are being carried forward by decomposition; but the contact itself is left to the realm of seismic forces. On a smaller scale the same rule will apply to the valley of Kern river below Kernville. This latter formation expands a few miles to the southeast of Kernville, and before dipping beneath the desert near Mojave station, on the railroad, is seen to offer one of the most promising of unexplored regions, and from its trend is doubtless part of the system lying east and north of the San Bernardino range. There may come a day when the tremendous amount of oxygen required to metamorphose those older rocks and give them a granitic cast may inflate the Owen-river region into a mountain, and then there will be good mining there. While the lime itself will not be metamorphosed into granite, it will yield up its sulphur now combined in the form of gypsum and become a more perfect granular mountain limestone.

When we see where granite has been in the melted form, and has run in a regular flow, and now reposes on the broken outcrop of vertical slate; when we see Silurian slate half metamorphosed into granite; when we see the immense gain of oxygen in these altered forms, and see the escape of sulphureted hydrogen from the contact, and conclude that for a certainty water Is surrendering its oxygen to the granite, we say this is the place where granite is made; and when the action is rapid, the movement shakes the world. Such forces have elevated vast areas and have left us dead-river channels far above the beds of modern streams. In the conversion into granite the bulk of the rock is nearly doubled, while its ponderosity is increased, there being in a cubic foot of granite once and a half as much weight of oxygen as the whole weight of a cubic foot of water. In a Pickwickian sense, our lost rivers may be said to be engaged in the laudable work of elevating real estate.

There must have been a time when silex and sulphur were combining with metals and forming themselves into solid lodes. There doubtless was another time when this same sulphur, under other circumstances, was aiding to decompose the quartz and to soften the walls of the lode. It required millions of years to work those changes. While these changes were going on the forces employed were converting the lode into one vast voltaic pile, the earth itself was a vast magnet, and these, acting in harmony with the law of affinity, which gives to each angle of crystallization its own substance, were drawing the atoms into grains.

The forces which elevated the ancient riverbeds may have hardened subjacent formations, and the incasing walls of the lodes which imparted their wealth to the ancient rivers may have been soft and friable. The sulphureta in the lode may have been decomposed and the gold thus exposed to the current aa denuding occurred. On any smaller scale we know such chemical changes would beget electric currents, and we know that the earth is a great magnet. We know that the electric current revolves only upon the surface of the magnet. We know, further, that wherever met with it engaged in transferring metals in solution. Let us add now one other fact. Eruptive forces have not occupied the metal-bearing fissure since the formation of the matrix only to destroy it.

There may be chemical agencies at work in regions noted for the display of eruptive force. There are certainly chemical agencies at work where no such force has ever been directly manifested. Perhaps it

will be urged that the two forces differ, mainly In intensity. I grant this affinity of origin, yet the presence of an eruptive force is not the place for the formation or the perpetuation of the gold-bearing matrix. Let us learn to discriminate between chemical and physical results. Let us learn to scout the idea that the fighting qualities of the soldier are fortified by mixing gunpowder with his brandy.

If the earth is a great magnet and magnetism has anything to do with fixing the position of the metal in the lode, then there must be a difference in the character of the deposit on the two sides of the lode. Some one will say, " Ob, yes, there is a difference between the foot and the hanging-wall, but what I want to know first is which is the hanging-wall ? The magnetic needle points to the north. Electric currents run at right angles with the course of the magnet. Now how do these suggestions fit the information about the hanging-wall ?" Let us change the form of inquiry. “Is the diabose in the west wall, or is the great field of granite there ? Is there calcareous slate or serpentine back of the diabose ?" Let us know something of the surroundings. Never mind the “foot and hanging-walls," except you give something of those. We have started out for original research. We have squandered our money by following a beaten path long enough. The object was to try to give some suggestion aa to where the gold of the ancient placers came from. It was not intended to refer the mining public to Webster's dictionary for the information, nor yet to Dana's "Elementa of Geology." The object of the discussion Is to try to discover something which no one knows, and yet what every old placer miner would like to know.

( To be Continued )

*Mining and Scientific Press, V. 61, 11/22/1890, p. 330*

The Gold Belt of California, The Ancient Placers and Their Relation to Wall Rocks. N 3

*[Written for the Mining and Scientific Press by Stephen Barton, Kernville, Cal. ]*

I have spoken of a belt one mile wide having yielded a large percentage of gold found in lumps worth more than $1000 each. The belt referred to would extend in length from the town of Sonora in Tuolumne county to the South Fork of the Stanislaus river, a distance of about eight miles. The largest body of gold found in a quartz matrix in this State was in the town of Sonora, at the south and lower end of this belt. The Strain lump was found in the immediate vicinity of the southeast corner of the corporate limits of the then city of Columbia. The piece found by Virgin, West & Co. was found about 40 rods west of the said corporate limits. North of where the Strain piece was found, in Three Pine Gulch, three pieces were found having an aggregate value of more than $12,000. This gulch rises in Summit pass, which overlooks the mining camp of Pine Log, on the South Fork of the Stanislaus. For 20 years there was seldom a week passed that there was not from one to several lumps extracted from this bar which weighed up in the ounces, and certainly more than one was found worth more than $1000 each. Here, on this little belt, was found at last from $28,000 to $30,000, which was in lumps above the size mentioned. The major portion of the underlying formation was lime throughout this whole region. If this gold was produced in any other formation and was carried there by the current, then we should look higher up the stream for larger lumps. I have before mentioned that in this same lime formation a thin sheet of quartz was found rich in free gold. It may be mentioned further that in several places where there was a contact between lime and what was called "Block Ledge" (a rook too much decomposed for its character to be determined), several bodies of quartz in place carrying free gold have been developed in recent years.

I have called attention to the fact that in several mining camps in the middle and southern placers, the placer gold reposed on the same character of lime formation, and also to the further fact that this gold yielded a higher assay than gold obtained either to the east or west of this line; and to the still further fact that most of the placer gold of this region was dug above the mother lode. If we go to the Willard mine at

Murphys on this same kind of a formation, we shall find the gold near the slate of the southwest wall almost chemically pure, while to the east 300 or 400 feet the bullion is by weight seven-eighths silver. In the Bonanza mine at Sonora there is much the most silver in the pockets found near the eastern wall. Now I have thought and have earnestly believed for years that such facts aa those I have mentioned might lead us to look for the source of the gold of the ancient placers nearer home than was suspected, and might induce old miners to return and look over the ground again and enable all those who have acquired any knowledge of quartz to view the subject in a new light. With this end in view, I have undertaken the discussion of this subject.

( To be Continued.)

*Mining and Scientific Press, V. 61, 11/29/1890, p. 346*

The Gold Belt of California, The Ancient Placers and Their Relation to Wall Rocks. N 4

*[Written for the Mining and Scientific Press by Stephen Barton, Kernville, Cal. ]*

The occurrence of these heavy nuggets of gold in such close proximity, while no such nuggets were found elsewhere in that section, together with the occurrence of nuggets of equal size in the original matrix in the same belt and formation, is sufficient proof that they were born close at hand. To the east the mountains stood high above the ancient channel, and explorations failed to locate a valuable mine there, from which these nuggets could have been carried. To the northeast the lime belt carves np the Sooth Fork of Stanislas and appears still farther east on the north bluff of the North Fork of that stream. The region between the forks of this stream has been neglected for want of water, and still it was over this region that the ancient gravel passed which covered the region around Colombia, For a number of miles the track of this current was over alternations of lime and soft slate, with an occasional showing of coarse porphyry and greenstone. If these nuggets did not pass over the region between the forks of the Stanislaus, then they came from lodes situated at the head of Three Pine Gulch. Until very recently there was no disposition to look for a quartz lode in that locality, and still the currents which once swept over there deposited millions of dollars along their track. I will allow that this ancient current was of great force and volume. On the south of Gold Hill, west of Colombia, is a block of quartz five feet in diameter reposing on a lime formation, and brought there by the current which deposited the gravel of the ancient placers. But admitting the force of the current, no reason can be assigned why still heavier matter should not have lodged farther up the stream, and hence we conclude that these large nuggets remained near the original matrix. If they were all carried across the region now occupied by the gorge of the Stanislas, then many of them should have been left to be carried down along the bed of that stream. On the other hand, the coarse gold of the Stanislaus was mainly limited to the Pine Log Bar, and almost certainly came into the stream there from the south. Pine Log is 1300 feet below the level of Colombia, and if this gold was born of the contact between intervening formations of lime and slate, there must be a mint of it left; but if it was erupted there, then the chance for drainage would offer an opportunity to strike the main body nearer Pinto's dominions.

During the last summer, as agent of mining statistics for the 11th census, I had frequent occasion to notice the transitory nature of quartz lodes in granite. Some mines I noticed where a film of gold and a thin sheet of kaolin clay served as an excuse for a lode. In many cases the width of the lode varied from a half-inch to six inches. All these lodes are shallow and richest near the surface. The Joe Walker mine at Walker's Basin, Kern county, offers one instance which has come under my observation where rich rook was followed down between granite walls to a depth of 200 feet, but the course of this lode is diagonally toward the contact of slate and lime to the northeast and bat a short distance away. Most of the Havilah

mines are similarly located, except that the main lode, of which most of the others are spurs in the westward, is located parallel to and in close proximity to the Ume contact farther east. While this latter lode carries most of the gold of that district, it has not been worked because it is not free-milling ore; that is to say, that the gold is so intricately combined with other metals and substances that it passes the skill of the ordinary miner to separate it. The miner and the capitalist will condemn such ore as worthless and pass it by; but to the scientist it presents the question of Its recondite history. After five minutes devoted to figures he discovers that this character of formation contains more than a moiety of the precious metals of the State; that with them are combined nearly all the useful metals, nearly all the refractory ores. The dawn of these truths upon his imagination awakens a new interest in these vast ore deposits, and his thought is as to how to extract the precious metals without destroying the useful ones.

There are several streams in California which have not yielded placer gold. On the heads of these streams the metal-bearing lodes contain gold in such close chemical combination with lead, zinc, antimony, tellurium, seieninm, vanadium and many other substances, that it requires a careful assay to determine its presence. This fact explains why no gold was dug in certain districts on the western slope of the Sierra Nevada mountains. It has also done much to obscure the true geology of gold. It has no nobler lineage than the other metals. It was born of the same canses; and if we reckon the refractory ores, the great bulk of it is combined in the same matrix. In some instances and in certain localities, oxygen has carried away Its associates, and has left the pure metal for scientists to ascribe a volcanic origin to. On a line running to the east of south from Mono lake, through the heart of the Sierra Nevada mountains, crossing the heads of the San Joaquin, Kings river, the Kaweah, and thence down Kern river and to the Mohave desert, there ia a formation which is indeed rich in Its refractory ores, I am not aware that any of the ancient channels covered any of this region, but from the summit of the Sierras I see a white mountain to the east of Tehachapi and to the north of Mohave, which closely resembles the lava-capped hilts minus the lava; and I am told it is composed of porcelain clay. I am strongly inclined to the opinion that It covers an ancient gravel deposit, and shall try to satisfy myself on that point acme day. This line of refractory ores has a great similarity throughout, and will afford food for the reflection of the metallurgist of coming generations,

(To be Continued.)

*Mining and Scientific Press, V. 61, 12/6/1890, p. 369*

The Gold Belt of California, The Ancient Placers and Their Relation to Wall Rocks. N 5

*[Written for the Mining and Scientific Press by Stephen Barton, Kernville, Cal. ]*

In order to reach a just conclusion as to the remaining wealth of the ancient river beds and their source of supply of the precious metals, it Is necessary to know the conditions under which the deposit was made. Prof, Hanks looks to glacial action. In a previous series I have pointed to evidences of climatic conditions such as do not accompany the movement of glaciers. But when we contemplate the excessive supply of water and the long distance which the gravel in some of these channels had evidently traveled, the question arises, may not glaciers farther to the north have contributed much of the water ?

Before deciding such a question, the geologist must master all the other sciences. He must look to astronomy for causes of climatic change; to statics and dynamics for means of estimating the volume of flow; to botany and paleontology for estimating the age and nature of the deposit.

It is quite unnecessary to explain to the student of nature that there was a time when an ice continent capped the pole, covered the highest mountains of New England, sent a glacial drift into

Northern New Jersey, and spread a broad terminal moraine over the prairies of Central Iowa. Nor is it necessary to explain that this ice afterward melted away. Let the reader recall, then, that it would take the present Mississippi a number of years to fill a cube of ten miles, and that this ice capping must have represented a depth of ten miles on the shores of Hudson's bay. It is very evident to the geologist that during the melting of that ice a stream as large as the present Mississippi flowed from Lake Michigan through the channel of the present Illinois river, that a similar stream came down the Wabash, and that Lake Ontario outleted through Lakes Champlain and George into the Hudson at Troy. While this was going on, probably an amount of water equal to the whole drainage of the American continent of to-day was passing through the State of Nevada to the Gulf of California. What is called the Japan current then, probably, struck the coast lower down and gave to this country, under other condition, a climate similar to what it now has.

Scientific men have not done, however, with inquiring the cause of this changed condition of climate, and before returning to the main subject of inquiry, I will make a few observations m relation thereto. Whoever has been so fortunate as to be able to visit the modern school room, has seen suspended on one of the walls a chart or diagram of the continental and oceanic hemispheres. The one striking fact, at once observed, is that these hemispheres stand diagonal to the poles. Let us now enter the school yard. We find the boy spitting on one side of his top and weighting the wetted side with sand, doubtless for the very purpose of noting the staggering movement this diagonal weighting of polar regions will produce. While spinning very fast, the top staggers but slightly and very slowly; but as diurnal rotation diminishes, the staggering increases in extent and rapidity, A change in the amount of diagonal weighting increases or diminishes the precessional movement. Now it la conceded that the whole Mississippi valley was filled to an unknown depth by sediment brought down from a lofty mountain range which once stood on the shores of Hudson's bay. When this mountain was then in all its pristine grandeur, it intensified the diagonal weighting of the northern pole. The attraction of the sun and moon upon the higher regions of the equator were not sufficient to overcome this vibrating tendency, and the earth's poles were inclined 55 degrees from the perpendicular to the plane of the ecliptic. During a portion of the year the rays of the sun fell quite as directly upon the pole as upon the equator; besides, at the pole, it did not set for six months. This gave to each of the polar regions such a vegetable growth as is hardly met with now under the equator, and was the parent of the vast coal-fields of high latitudes. As this diagonal weighting wore away, by the denuding forces everywhere at work, the poles of the earth started to right themselves to a position more nearly at right angles with the plane of the ecliptic, but a movement once begun did not stop at the point of a true mean, but like the pendulum continued as far the other way, and came to within say 5 degrees of the perpendicular. The equinoctial and the ecliptic now nearly coincided, and the sun moved but 5 degrees from the equator. Polar regions were enveloped in ice. While ice was shoving great blocks of granite upon the prairies of Iowa, the valley of the Parana was invaded at the south and glacial silt was finding its way even to the valley of the Amazon. Ocean currents were more pronounced than now, and did much to maintain the dominion of the sea. But on the land this diagonal weighting was again taking place, ice being substituted for granite. Like the return of the pendulum, the poles of the earth were only ready to return again in the direction of the point of mean inclination when it felt the additional impulse of this extravagant weight of ice. As the sun rose to a higher elevation in the polar regions, every summer, the ice of ten thousand winters began to disappear, and one half of the contents of the ocean no longer remained locked in a solid form. To assume that these vibrations have not been repeated—repeated as often as the swinging of the pendulum—ie to assume that the earth had a beginning, and no scientist la ready to declare, as a known and scientific truth, that it ever did grow any

faster than as we see it growing to-day, by the falling of meteoric matter from the regions of space. There probably have been times in which one of these ice continents outgrew the other. In consequence of these two facts: First, the earth's orbit is elliptical and in its yearly circuit it is three days longer in making 180° on the long than on the shorter side; second, this extra amount of sunshine is given first to one pole and then to the other, every 26,000 years, in consequence of the swinging of the poles, which swinging gives the processional movement of the points when the equinoctial crosses the plane of the ecliptic. Hence for a period of 12,000 years there are three days more of sunshine per annum upon one pole than on the other, and then the extra sunshine passes the equator in the direction of the other pole. The building of an ice continent on one pole in excess of that on the other would change the center of gravity of the whole earth to the extent of balancing the matter thus transported, and this increase of the solids would draw the fluid ocean after it and raise coast lines in that hemisphere.

Thus we see that the ancient channels may have met the sea in the region of the placer mines. If this was the true condition, then the coast line must have been elevated farther north and the ancient channels must have had a lower grade than that now indicated. This was undoubtedly the ease. The great caverns in the line at Columbia which were filled to a depth of 50 feet or more in some instances, were undoubtedly filled by the sobbing and circling of the cross currents of a mighty stream running over a rough formation at a low grade. Every placer miner knows that when a current plunges into a pot-hole it will leave no gold there; but here the gravel bad been deposited by a circling current against all the walls of the “sink," as these deposits were called, the sheet of gravel standing nearly vertical against all the walls.

It remains to be noticed the chemical effect which ice and rain-water have upon formations containing lime, whereby every fissure is eaten into a cavern in addition to the eroding power of a powerful current. Such forces, In many cases, tore down the Incasing walls of the lode and subjected the matrix to decomposition. In the older granites, the bottoms of the lodes were reached, and the evidence of their location obliterated. In other oases, the entangled current, struggling with a broken bed, had its transporting power reduced, and deposited gold and gravel near the native matrix. Thus I conclude that the large lumps found near Columbia were born of that region.

I did not start in to write a geology of California, nor did I, like some of our most eminent geologists, aim merely at the harmonizing of theological creeds, I have aimed to present an honest and impartial view of the facts presented to me during years of mining life and the conclusions which I deem justly deducible therefrom. I am aware that the conclusions I have arrived at are at war with those of many eminent writers, but must plead in extenuation that none of them claim to be able to explain all the observed facts. If some one of the old mines in Mexico, of which the Padres have handed down a record, should be reopened to great depth and be found to be fabulously rich, as reported, in the bottom, after hundreds of disappointing results in similar searches, I should probably do like other writers on geology— eliminate what I have said about mines and try a new theory. I have aimed to keep in harmony with all known laws, while I have refused to take the dictum of a great name against the evidence of my senses. And now I believe I will close, perhaps forever, my discussion of the geology of the placer mines.

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