Gold in Ancient California River Channels.

The resignation of Felix Chappellet as manager of the Mayflower mine recalls the richness of that section of California, the success he attained in locating and working that portion of the ancient river channel known as "The Mayflower," on the Forest Hill Divide, Placer Co., Cal., and, incidentally, the unique character of that form of mining and the great richness of that section.

Ross E. Browne has given an intelligent technical account of that region, a section that gives good example of a class of gold mining peculiar to California.

The extensive workings on the Forest Hill Divide have developed a good idea of the prehistoric geological formation, and besides yielding about $30,000,000, have aided in solving some of the problems that present themselves in handling similar propositions elsewhere.

The Forest Hill Divide is a ridge on the western slope of the Sierras, twenty-seven miles long. Along its north side flows the north fork of the American river, the middle fork flows in the canyon forming the boundary of the south side of the Divide. It is thought that the present bed of the north fork is 3000 feet lower and the middle fork 2500 feet lower than when these streams first started to flow down through their present courses.

In the course of years extensive mining carried on in the gravel deposits of the Divide goes to show that what now is a ridge was just the reverse in the topography of the country before the period of volcanic eruptions covering the country with a cap of lava. The ridge contained the channel of a river bed; it was the trough of Nature's drainage system of that section for that period, and where the present river beds are the country was higher than the ancient channel bed. The formation underlying all the surface deposits, the base or bedrock of the country, is metamorphic rock which vary in character. Active mining has been carried on there for forty-five years and by the hydraulicking of banks from 50 to 200 feet high, and by the driving of miles of tunnels and the excavation of tens of thousands of yards of gravel, miles of the bedrock thus exposed give insight into the changes that have taken place on the surface of the bedrock during part of the present geological epoch.

It seems that the trough above described was the watercourse of an ancient river or rivers, and that it was valley-like in places, being some miles in width and 1000 feet in depth in the deepest place. It was no small stream that found its way through this depression; the gravel deposits show a width of 1000 feet in places. How long the river flowed on without obstruction is unknown, but at some time there came a volcanic eruption followed by a flow of volcanic matter in the form of a semi-fluid, or mud, from the craters on the summit of the Sierras. The flow naturally occupied the watercourses, solidifying and sealing up the river channel as it was deposited from the flow down the trough. This flow filled up the valley or trough to a depth varying from 100 to 180 feet, as shown by the excavations in the mines opened. This volcanic matter is called cement, and in places is firm as artificial concrete. Some good samples of this cement were shown in the Placer Co. exhibit in the Golden Jubilee Mining Fair in San Francisco in February, '98.

The river channels were changed by this volcanic deposit, but still followed the same general direction to the basin of what is now the Sacramento, as the watercourses were still confined by the rim or walls of the trough or valley.

It is reasoned from the large quantity of gravel and sand deposited over the volcanic cement that a great period of time passed before the next great lava flow capping the channels of the second period occurred, but it is evident that several minor flows happened in the interim which diverted the watercourses and mixed with the river deposits masses of volcanic matter. The frequent displacements of the streams is shown by the fragments of channels found on this level. The rivers of this age at times and places cut down through the cement cap of the first period to the bedrock, obliterating the deposits and evidences of the original channel by following its course for a distance or cutting directly across it in other places. The deposits here described are known as the upper lead.

Following the second period came the volcanic eruptions with great flow of masses of lava or cement, which filled the trough or valley, making a cap over the bedrock at the upper portion of the Divide 1000 feet deep and 300 feet at the lower end.

Then followed the final work of Nature in creating the topography of the Forest Hill Divide. The trough was filled higher than the bordering country and the streams started new courses along the edges of the cap, along the line of least resistance, eroding new channels which in the ages that have elapsed have cut deeper by hundreds of feet than their predecessors, forming the deep canyons and gulches of the forks of the American river and tributaries.

There is but little doubt that the modern courses are in some places occupying the sites of the ancient channels, cutting through and down deeper into the bedrock, leaving cross-sections of the old river bed in plain sight upon the canyon sides where the new river had come into the old bed and cut it off or left it with the same effect. So the modern streams have assisted in the fragmentary condition of the ancient channels under the lava cap.

Ross E. Browne says that from the frequent displacement of the streams during the second period, there have arisen various complications in the channel systems. Although the mining developments are extensive in portions of the district, it still remains a difficult matter to separate the channel systems of the second period, and it is not always easy to distinguish between those of the first and second periods. In a genera! way, it may be said that the channels of the second period differ from those of the first as follows: Their beds are narrower, rims steeper, and accumulations of bedrock gravel incomparably smaller. Regarding the gravels in the deeper channel bottoms, and their immediate volcanic cappings, it may be said that the characteristic channel deposit of the first period consists of a large body of gravel of exclusively bedrock material, and a light cement capping; the characteristic channel deposits of the second period, either of a small body of bedrock gravel and a heavier cement capping, or of a large body of volcanic gravel and a heavy volcanic conglomerate and cement capping.

Where one deep channel cuts across the deposit of another, the channel which does the cutting belongs, as a rule, to the second period. The channel which has been cut may belong to either period. There occurs occasionally very large accumulations of bedrock gravel between the deposits of volcanic cement, which are evidently the result of the cutting and dislodgment of sections of the older deposit.

The section given in the cut of "Weske channel, longitudinal section," shows an interesting occurrence. The cement filling the bed to a depth of 100 feet is a more uniformly fine-grained sediment than is commonly encountered. It encloses a number of oak and cedar trees standing on the banks of the channel, with the roots intact in the gravelly soil and bedrock. One of these is a cedar nearly 100 feet in height and 4 feet in diameter at the base and stands perfectly upright, and, considering its age, is in a surprising state of preservation. These standing trees show also that the first flow of the cement was not torrential, though moving with a certain velocity. The existence of a current and its direction are plainly indicated by the structure of the deposit immediately surrounding the trunks of the trees. In certain districts in the State the ancient channel system, together with its dividing ridges, was completely covered by a broad lava-cap or mantle prior to the starting of the modern channel system.

There appears no definite indication of such a mantle in the district herein described. On the contrary, the presumption is against it. Had the second period been closed by a broad, flat topped lava mantle, completely covering the earlier divides, one should expect to find the modern channel, independent of the cement channel in its course, occasionally cutting and occasionally avoiding the same without a very definite guidance and leaving as much of the old lava-capped divide as of the cement channel to form the present ridge. Such, however, is not the case on the Forest Hill divide. The prospecting shafts and tunnels have invariably developed the existence of a trough-like depression under the volcanic cap. The ridge for twenty-six miles shows under the cap a practically continuous depression in the bedrock surface. There is good reason for regarding this as the main cement channel of the district. It is difficult to establish satisfactorily the cause which led the modern river to avoid the older cement channel to so marked an extent. In picturing the periods it has been assumed that the old riverbed, or rather the valley, was filled with volcanic material to a level high up on its widespread rims, but not to actual overflowing; that the thick volcanic mud formed a more compact conglomerate of the heavier debris in the central line of flow, and a lighter and more sandy cement toward the shore lines; and that these conditions tended to divert the streams toward the marginal lines of the deposit. The streams would necessarily cut across the deposit at the juncture of the volcanic-capped tributaries.

The gravel deposits of the old river beds contain the gold, and these places are still the scenes of active mining operations. The deposits are commonly referred to as "channels," and the channels bear the name of the respective mines, although in some cases the channels contain the deposits of one and the same water course and are the same ancient river bed.

The gold in the gravel originally came from the quartz ledges in the bedrock, traversed by the old rivers and tributaries. Throughout the entire bedrock occur seams and ledges of gold-bearing quartz; and where belts of soft laminated slates appear, there is found a greater quantity of the gold yielding silicates. All of the gold found is in the form of nuggets or scale and shows the effect of abrasion or hard usage in contact with the gravel in its journey down the rapid streams to the place of its final resting. In uncovering the bedrock in removing the gravel deposits, some very large ledges have been found, but none so far as known have proven very rich.

It is assumed that the ledges were richer nearer the original surface and that in ages past they have been worked down perhaps for several hundred feet by the erosive action of the elements.

As a rule, the richest pay is found in with the bedrock, although in some of the mines pay is found in the gravel for the entire depth of the deposit. Scales of gold become embedded in the seams of bedrock, and especially where occurs the softer laminated slates it generally pays to remove the surface of the bedrock for several inches.

It is a common idea that the gold will be found in greatest quantities in the deepest holes or depressions of the river beds, but the experience of the miners in these ancient channels is to the contrary. The richest dirt is found in the channel on the brow of the lower side of a hole or depression. Mr. Ross Browne, who has given this matter study, says that the effect of the swiftness of the current upon the pay is important. An underloaded current, i. e., a current charged with less detritus than it is well able to carry, is apt to cut its bed and prevent the accumulation of gravel. A greatly overloaded current will deposit too rapidly to admit of the concentration of gold dust. It is apparent, therefore, that a suitable relation between the velocity of the current and the amount of material carried is an important factor in forming a streak of pay gravel. If such a relation exists, and is undisturbed for a considerable period of time, and the material passing over the riffled bed carries sufficient gold, a rich body of pay gravel may be formed. An increase of grade, or narrowing of the channel, will cause an increase of velocity, and the same stream may be underloaded in a narrow, steep section and overloaded in a broad, flat section. Furthermore, a stream may be underloaded in the center of the channel and overloaded on the rims, or it may be underloaded on the outer rim of a curve and overloaded on the inner rim. Other conditions being the same, when the average grade of the channel is very great, one should expect to find the pay in the broad, flat sections, on the rims and high up on the inner rim of the bend; when the average grade is very small, rich gravel will be more likely to occur in the sections where the current is relatively swift. In the Forest Hill district, where the average grades range from 60 to 80 feet to the mile, the general experience in working the bottom leads seems to be about as follows:

In the larger channels of the first period the best pay is found on the brow of the steeper pitches on the down-stream course and on the inner rims of the bed. The pay generally favors one rim for long stretches. Near and at the foot of steep pitches, and in very narrow sections, there occur potholes and the deposit is barren, consisting of round boulders and sand. In the channels of the second period there is a scarcity of gravel in the narrower sections, hence the broad, flat sections are preferred, even though the gravel may not be so rich.

Felix Chappellet of the Mayflower is believed to have been the first to make the first complete development of the deep lead, or the channel system of the first period. His discovery gave new life to the mining industry there, proving that, instead of the mines having been exhausted, many of them would yet supply the world with millions of dollars of gold and hundreds of men with years of employment.

It was first attempted to mine the deep channels by shafts through the volcanic cap, but large quantities of water were encountered in every case, and the cost of pumping entailed such heavy expense that this method was abandoned, and long, deep drain tunnels are driven in through the bedrock to points underneath the trough or channel bottoms, upraises at intervals, and the gravel breasted out is dumped through these openings into cars holding about one ton each. The loaded cars are taken out of the mines in trains of a dozen to twenty-five cars, hauled by a mule to the mills, if the gravel is of the kind to be crushed, or to the sluice boxes, if the free or loose kind that only needed washing. Some of these drain tunnels are very long and cost thousands of dollars and many months of tedious work before the pay was reached. The cost of running such a tunnel used to be about $25 per linear foot, and when mine owners were compelled to run a mile of this kind of work they had to expend a fortune in dead work. The work can be done now at very much less expense. That these tunnels should be successful it was necessary that they should be below the grade of the channel bottom, and to thus properly locate the tunnel the best of judgment and engineering talent was required. Especially is this true of the first few tunnels located. The depth of the volcanic caps could be easily ascertained by sinking a shaft through it to the bedrock, and by drifting thence the locality of the channel could also be definitely established; but to find its grade or fall was a more difficult matter. At that time it was not definitely known whether the pitch was east or west. The grade of the caps and the grade of the rims, however, indicated to the observing miner that the bottom of the trough had a corresponding pitch to the west, and that if he wanted to have his tunnel reach a point under the bottom of the channel, say, 1000 feet west of where he had found the bottom by means of his shaft, he must allow for a fall or pitch about 18 or 20 feet in that distance. When contemplating the anxiety of the mine owner who first staked an investment of $150,000 and months of hard work on the correctness of this theory, one can imagine the exultation and gratification experienced when the completion of the work demonstrated the correctness of the calculation.

Twice in this article the fact has been referred to that Mr. F. Chappellet had done much to clear up uncertainty and aid in practicable and profitable getting of gold from those ancient river channels, or as it is called in California, "drift mining." How this was done will next be taken up. What is called the "Paragon channel" was discovered at a point on the north side of Volcano canyon, in 1853, and after some of the embankment was cut away by hydraulicking in later years a complete cross-section of the main channel of the first period was then exposed. The channel from this point bears a northerly course for a mile, then turns sharply to the west southerly, making almost a complete horseshoe. The gravel is cemented together, it is assumed, by the percolation of silicious waters. It is of blue and gray color. About 25 per cent of the gravel is large boulders, which are left in the mine, filling up spaces breasted out. The average width of the pay gravel extracted is 50 feet. The entire length of the channel within the limits of the claim has been worked for a distance of about 7000 feet, and connection is made with the workings of the adjoining claim, the Mayflower, into the territory of which latter company the channel continues, though it is there known as the Mayflower channel; thence into the ground of the Excelsior, Dardanelles and some minor claims, and there known by the titles of those mines, although it is one and the same ancient river bed. The gravel from the channel was so strongly cemented that it had to be put through a stamp mill, and had to be drilled and blasted out of the mine.

The Mayflower mine, which has the continuation of the deep channel as above described, was opened by Mr. Chappellet as part owner and superintendent. In the character of the gravel of the two channels, the method of mining and milling and the yield of gold, the Mayflower does not materially differ from the Paragon, except that the mine was operated on a larger scale and the company owned more territory. There are about two miles of the deep channel within the claim, the larger part of which has been mined out. The company still has a large amount of gravel to handle in the upper leads and also several hundred acres of rich ground to work by the hydraulicking process.

The mine was first known as "a hydraulic proposition," and was worked by that system until the Debris decision compelled the owners to shut down. It was then that Mr. Chappellet decided to sink down through the cement forming the bottom of his hydraulic pit in search of the channel which he felt certain was there. The hard cement had been generally accepted as the bedrock by many miners, and there were few to agree with his theory. He had reasoned out that the slate was the formation of the earlier geological period, and, therefore, the real bedrock of the country; and that the rims of this rock, exposed on the sides of the ridge, pitched to the center, plainly showing a trough or depression, and that the cement was clearly a formation of comparatively recent age, and, consequently, there must be a channel underlying it.

Firm in this opinion and regardless of any adverse comment, he commenced sinking his shaft, and, after going down 200 feet, struck the slate or bedrock, but had not penetrated the cement. Finding the bedrock pitching sharply to what he thought was the center of the ridge, he concluded he had not reached the bottom, so started a drift east; and, after running 100 feet, struck down a winze 22 feet to bedrock, which he still found pitching to the center of the ridge. He ran another drift 50 feet and sank another winze 90 feet and 100 feet in and 14 feet down, thus feeling his way until success crowned his efforts and the Mayflower channel was discovered. It was a great triumph for Mr. Chappellet.

The gravel proved to be rich. A mill was erected near the mouth of the shaft and it was attempted to work the mine through the shaft, but the flow of water was too strong to be successfully handled. The man who had found the channel was not to be balked, for then it was he conceived the idea of running a tunnel from a point some two miles down the canyon so as to tap the channel and drain it. He also planned to work the mine through the tunnel, thus avoiding the expense of hoisting works.

From the entrance of the tunnel to the point where the channel was reached by the best location that could be made the distance was 5585 feet—over one mile—driven through hard slate for the entire distance. The cost of the tunnel was about $150,000. It took one year and a half to complete it.

The completion of the tunnel and the tapping of the - channel were another great victory for the superintendent, for he had now twice demonstrated the correctness of his theory, as well as the existence of the ancient channel with its valuable gold deposits.

Mining and Scientific Press, V. 77, 7/30/1898, p. 107