

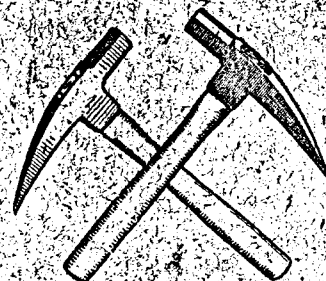
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Practical Information on the  
Geological Structure of Tonopah  
Goldfields, Nevada and of California,  
illustrated for Prospectors.  
By JOHN D. HOFF, M. E.

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## PREFACE

Twenty years of Geological observations in the field in California and Nevada, condensed in these articles for the benefit of those who are seeking knowledge concerning these fields.

John D. Hoff, M. E.

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## PRESS NOTICES

The Tonopah Miner says in regard to five pages of matter in the San Francisco Bulletin of recent date that: Hon. Geo. D. Merklejohn ex-Secretary of War gives his impressions of the district. John D. Hoff the Mining Engineer, describes the Geological conditions in an instructive way.

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*The Goldfield Review* says:

Professor John D. Hoff, one of the most expert geologists in the west, has devoted considerable research and personal examination of the formations of minerals of this state, and especially of the southern portion. In some respects his researches differ from many who have gone over the same ground and he seems to have the best of the argument in many particulars.

# A THEORY ON THE GEOLOGICAL FORMATION OF TONOPAH, NEVADA.

By J. D. Hoff, M. E.

(See Cuts.)

Written for *The Mining and Engineering Review*.

The following practically gathered information of the formations of and around Tonopah may be of service to those who expect to visit this greatest mining camp of the world. Its whereabouts and production, which makes operators and prospectors rich daily, is an oft-told tale.

I would first liken it to a great flat plain at the close of the Cenozoic age and Tertiary era and Eocene period, with water receding off it, and being suddenly lifted in one central strike running through the great plain northerly and southerly until all its sedimentary strata were made by the same uplifting to pitch at an angle westerly from the apex of the anticline, so to speak, about 15 degrees into Lone Mountain Valley and to pitch easterly into Ralston Valley (a portion of Ralston desert). Finally, by water and erosion, washing away these broken sedimentary strata, leaving buttes called Mt. Butler, Mt. Oddie and Mt. Brougher. This washing away exposed the metalliferous metamorphic core that caused this uplifting of the sedimentary formations; and following the same northerly from Tonopah toward the Ray mining district we find the granite core (called Alaskite) exposed running northerly and southerly.

In this porphyry and granite core are found the strong metalliferous veins formed by the now well known and generally accepted theory of hot water circulating, dissolving and precipitating metals, silver, etc. Water raised to a temperature of 450 degrees will dissolve quartz and reduce it to a pasty condition from which it can be reprecipitated again when the temperature is lowered.

The result of my examination of Mt. Brougher and the tilted stratum dipping into Lone Mountain Valley is that it rests on a metamorphic core, and is a sedi-

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mentary stratification of shale, sandstone and impure distomaceous material and some limestone. To strike the metalliferous core going toward the valley a shaft would have to penetrate this stratification for a long distance. In going northerly from Tonopah toward the noted Ray mining district we have an opportunity to study in an intelligent manner the absolute conditions. We find for the first time the granite core exposed, which is the cause of all the trouble which mixes up miner and operator, but if it had not been for it we would not have any Tonopah. On it lying conformably is the mineral bearing porphyry and on the porphyry is the black, mineralized, lead-bearing limestone, and on the limestone is the lava (so miscalled with no craters in camp for it to come from). We want to say here in regard to the confused theories of formation of the so-called capped mountains, or rather buttes, and sedimentary deposits, by some technical men called lava flows, that they are erroneous and growing obsolete, and are to say the least mystifying to the practical field operator who backs his opinions of formations by his coin. The last and recent deposits on top of the buttes and so-called basalts and lava in some cases is nothing more or less than the ancient sea mud bottoms, composed of alkaline slickens containing lime and iron, which solidified on the receding of the inland seas, formed a cement and was elevated into anticlines by metamorphic core. This core we allude to so much was formed by the contraction of the earth's poles, which made elevations running northerly and southerly in California and Nevada, with large crevices breaking across them nearly at right angles, which are filled with minerals in commercial quantities in a great many cases, especially at Tonopah and Goldfield, Ray and Lone Mountain. I predict that the great system of Tonopah ledges will go down through the porphyry and pass on and into the original granite core which is the underlying formation and large deposits of mineral be found in the contact of the granite porphyry core.

## THEORIES OF VEINS AND OTHER FORMATIONS OF ROCKS AND ORES.

Many have they been, and all are interesting, even the igneous theories, but they all lack positive proof to the operator. At the present time most all scientists are agreed that in general the vein fillings are the result of circulating alkaline hot waters, holding in solution the different minerals and silica, which were dissolved from the country rocks or firm material, where the sea water has deposited minerals from its solution on the ancient sea bottoms in the presence of organic matter or by electric currents. This is proven by the ribbon structure and the systematic hexagonal crystals of quartz exhibited in the Comstock, and Mizpah veins. Silica or quartz is the gangue of most minerals. These crystals often contain fluid which was enclosed at the time the vein was formed. These cavities could not have been formed if the veins had been under any other condition than by aqueous solution; also many of the minerals found in veins will not stand fusion, which seems to have been overlooked, and have, therefore, undoubtedly been deposited without fusion.

The springs of California and Nevada, and especially the Steamboat Springs near Virginia City, Nevada, are forming such deposits at the present time. The waters of the Steamboat Springs are strongly alkaline and deposits silica in abundance. This deposit fills fissures, some of which are practically filled and form veins. The filling material exhibits a perfect ribboned structure in some cases. Moreover, the sulphides of several metals, i. e., iron, lead, mercury, copper and zinc, have been found in the quartz gangue material, and in boring to develop hot water the sand pump brought up sulphide material that assayed high in silver and gold. An effort has been made to sink a shaft to develop the discovery, but the hot water interferes.

At the Sulphur Bank, Lake County, California, where hot alkaline sulphide waters coming up beneath are de-

positing silica and cinnabar in small, irregular fissures and cavities, thus forming quartz veins containing cinnabar, the deposit is so recent that much of the silica is in a soft, hydrated condition and can be cut like cheese.

We will quote Joseph Le Conte in *Elements of Geology*, pages 223, 224, 225, 226: "Most granites are not the result of simple, dry fusion, as is usually supposed, and have not given rise to eruptions at all, incipient fractures by heat and water make gneiss complete pastiness, completely destroying stratification, makes granite. Not only gneiss, but even granite is sometimes interstratified with undoubted sedimentary rocks, crystals of quartz, hornblend and mica are frequently found in nature by the humid water process, as for example in metamorphic rocks, and have been artificially formed by the same process by Daubus and Sensamont."

*Geological Magazine*, Vol. VI, page 224, 1899. Le Conte says further, on page 225: "It seems almost certain, therefore, that many granites have not been formed by dry, igneous fusion, granite being produced by the more silicious sediments and diabase and gabbro from the more basic, impure clays. It is certain that many, if not all, the rocks of the Trappean group, also, may be made by metamorphism of sediments. Many bedded diorites, dolerites and felsites are undoubtedly formed in this way, for the graduations can be distinctly traced into slates."

Professor Dana has recently recognized this as so certain that he proposes the addition of the prefix meta to these to indicate their origin, a syenite, a meta-syenite, a diorite, a meta-diorite, a dolerite, a meta-dolerite, and a granite, a meta-granite.

Deeply buried sediments and heat in presence of water and pressure undergo incipient changes and form metamorphic rocks, under greater heat become pasty and form granite, meta-syenites, meta-diorites, meta-felsites, and, we can add now, meta-porphyrysts, meta-andesite, meta-ryolite of Tonopah and Goldfield formations process described in illustrations.

Written for the *Denver Daily Mining Review* by John D. Hoff, M. E.

(See Cuts.)

In the geological study of the Tonopah-Goldfield mining belt, which runs northwest and southeast 10°, and the illustration of same in the drawings, there are no theories but facts.

I want to call attention to the first outcrop of Alaskite Plutonic Granite, which has elevated the metamorphic and sedimentary stratas, the first stratas consisting of earlier and later porphyrys, called Andesites and ryolites. The second (sedimentary) consisting of limestone shale, sandstone, and the last a cement capping called lava. By breaking this so-called lava we often find in the solid interior perfect crystals of sulphate of lime (gypsum) firmly imbedded, which heat would have completely altered. (See our other articles on this subject.)

This first outcrop of Alaskite is six miles north of Tonopah, with the above-mentioned stratas dipping easterly and westerly from it, forming an anticline.

As we go southerly from Tonopah, at Gold Reef, near Gold Mountain, we find it again, making an anticline of same, and as we near Goldfield, going southerly, we find it again a little east of Columbia Mountain at Columbia, and it has made an anticline of Columbia Mountain. The layers of quartz and porphyry can be seen dipping east and running southerly and on the west of the Alaskite peak, which is only a few minutes' walk from the Merchants' Hotel at Columbia, can be seen trenches which have uncovered the stratas of quartz and porphyry, which lie comfortably on the Alaskite or Granite core, dipping westerly and running northerly and southerly.

The same can be seen, where uncovered in trenches, on the east side of the Alaskite uplifting core on the road to the Sandstorm mine, and we further proceed and go south of Goldfield about eight miles we find the Alaskite outcropping, beyond the summit and on the road to Lida and Bishop, but the uplifted, overlying stratas as above described are not entirely broken or eroded away

but nearly touch each other, which is illustrated by second drawing, and still dipping easterly and westerly and running northerly and southerly. The instrument placed on these elevated outcrops of the Alaskite line up with the Columbia, Gold Reef and Ray Alaskite or granite core, 10° west of north.

The large Diamond drill just brought into Goaldale to develop this large coal basin of bituminous coal, which lies west of Tonopah and Goldfield mineral belt, will further demonstrate the sedimentary formations above described, and coal will finally be found very near to Goldfield and Tonopah, to the east as well as to the west, where it outcrops.

JOHN D. HOFF, M. E.

## STRATIFICATION OF GOLDFIELD, GOLD HILL AND GOLD REEF.

In connection with the stratification of Tonopah, described in a previous article, the above fields are on a continuation of the metamorphic core from Tonopah running southerly, the center of the core being composed of a Plutonic porphyritic granite, called by some Alaskite, extending for a short distance southeast of Gold Mountain, which seems heretofore to have been overlooked, then outcropping again near Goldfield. Lying over this porphyritic granite is the metalliferous porphyry of the core, which is composed of andesite and porphyritic and silurian limestone layers (not lava flows), which contain numerous reefs of great width and length, running northerly and southerly with the Alaskite core, and are absolutely contacts between different layers of porphyry and limestone and contain valuable and large pay shoots of high-grade gold ore, the gold being worth about 20 per ounce.

To give an idea of the value of these gold porphyry reefs running between Tonopah, Klondike, Gold Reef and Goldfield, a twenty-one mule team one of its trips to Tonopah brought in 20 tons of gold ore to be shipped by railroad to Salt Lake City from the January mine on the Kendell & Co.'s lease, worth \$20,000, and a twenty-eight mule team brought in at the same time thirty tons of gold ore from the Jumbo mine worth \$45,000. The Combination Gold M. Co. is now paying \$40,000 per month dividends from shipping ore and building a mill. The Sandstorm milled 15 tons of ore and got a \$45,000 gold brick. These results speak for themselves what this district is developing into—the greatest of the world's discoveries. These ores in the near future will not have to be shipped, as good water has been developed in the valley between Gold Reef and Goldfield in abundance at a depth of a little over 200 feet. We also predict that in the porphyritic granite core, near its outcrops, abundance of water can be developed by drilling for it. No doubt this porphyritic granite is

connected with that of the Sierra Nevada range. Up-to-date mills can extract 90 per cent of the values of the ores.

As we near the town of Goldfield we see the sedimentary capping of the mineral bearing core, which back of the town, has not been removed entirely, lying nearly horizontal with a slightly westerly dip toward Lone Mountain valley and dipping easterly into Ralston valley as at Mt. Brougher. Further, in regard to this capping, which was shown in the previous article to be sedimentary, we found in it at one place, lying nearly horizontal and dipping with the general angle of the capping, carbonate of lime and sandstone, which fact alone proves the general sedimentary characteristic of the formation of the capping of this district. It was no lava flow. The metalliferous core here is not raised up very much, nevertheless between Diamondfield and Goldfield the core is exposed. The capping is all eroded and washed away and here is where we see the great mineral bearing reefs which are the wonder and great surprise of all mining men who visit this unique and rich mining district.

The following is from *The Mining and Engineering Review* by John D. Hoff, M. E.:

#### OPINION REGARDING TONOPAH AND GOLDFIELD FORMATION.

"I hesitate to give my views on this subject. I consider the accepted theories by some to be so erroneous and misleading that I feel it my duty to call the attention of those most interested in this field to a few facts which came under my observation in actual exploitation and operating in those formations in this field, especially in regard to the various layers or strata. In the first place, we hear continually quoted the earlier andesite and later andesite and the rhyolite lava flows. In the first place there is no andesite or rhyolite mineralogically speaking in this district, but they say it is andesite and rhyolite altered and was andesite at one time, but they fail to tell us how it was altered, which they

know very well would be difficult in consequence of their accounting for the different up-lifted layers of strata by calling them different lava flows.

"I cannot comprehend how a crater in this district (which is about the only thing in the district that has not been discovered), could belch forth as lava a certain rock formation and evenly distribute it over an extended area of a great many square miles and just an even thickness, then subside for a while and then again belch forth an entirely different formation and run it evenly over the first flow or formation, then after subsiding again out of this same crater belch forth another different layer, evenly distributed and the same thickness. This phenomenon, I am constrained to believe, is an impossibility, with all due respect to some of our worthy students of nature. My impression of the plan, accounting for the existence of these formations in this great mining district, which is open to criticism, and from which the truth may be eventually evolved, is as follows:

"First, we will quote Le Conte, the greatest of modern practical geologists, who says: 'The origin of granite' (which is the underlying core of the great Tonopah-Goldfield district, which all of the strata lie upon in a tilted position, making an anticline of same) 'was formerly supposed to be entirely igneous, but there is strong reason for believing that much of it was produced by the metamorphism of highly siliceous sediments without any accompanying eruptions, and it seems almost certain that granite has not been formed entirely by dry igneous fusion.'

"I want to say here, the principal agents of metamorphism are water, heat, alkali and pressure, but this heat is not intense, so water in contact with most rocks at a temperature of 450 degree Fah. reduces them to a pasty condition and at this temperature quartz, feldspar, mica, augite and other crystals are formed. Only a small amount of water in contact with heat, which is produced by pressure produces heat necessary for this result, and consequently sedimentary rocks, which we claim all these to be, are thus changed into different rocks or formation as they lie. Therefore, my conclus-



ions are that the formation of the above mentioned districts is, including the granite core, the different porphyritic layers, the limestone and later the diatomaceous infusorial deposits and finally the cement capping are all sedimentary, the older layers or strata being simply metamorphic as above described.

#### MY RECONNOISSANCE AS A PROSPECTOR

N. B.—In my field work as a student of geology and prospecting I discovered eight mines of minerals which became producers, and some of them are still producers to this date. My first mining experience I recollect well was in 1864, at the age of five years, riding on a mining car going in the tunnel of the Gould & Curry mine at Virginia City, Nevada; my father being one of the owners and pioneers had at that date sent back to Ohio for his wife and baby boy. The mines finally gave out and we all went back East. But I had the mining bee humming in my bonnet. I craved for technical knowledge. I got a little.

My first field work on stepping out of a college laboratory was the discovery of the manganese mine in Floyd county, Georgia, followed by the discovery of a gold quartz mine in Cherokee county, Georgia, in a cotton field that had been plowed and cultivated for 30 years, followed by another in a farmer's barnyard, where he had used the slabs of gold-bearing material to build his fireplace and chimneys. The practical result of these discoveries was that the mortgages on two homes and farms were burned soon after, and I had a deed for two houses and lots in Cartersville, Sam Jones' town, where I knew him before he became famous.

I next explored the coal field of Alabama, near what was then the village of Birmingham. I was taken out to a coal croppings there by Mr. De Bart Leaborn. It afterwards turned out to be the great Platt mine of Alabama.

I then visited my native state, Ohio, studied the action of the glacial period and gathered fossils from the upper and lower Silurian formations of Indiana and

Ohio, wondered how thick this record of extinct animal life could be (at this time drilling for gas had not commenced), and when it commenced and this mass of fossil in the Silurian limestone was penetrated 500 feet, which I knew was a great many miles square, I at once announced, "gas will shortly be struck," and a few feet below the fossil limestone in the porous Trenton limestone, the gas was found, and Anderson, Indiana, from a village to a city is the result. My theory was, if there is such a record of a large mass of animal matter, where is the gas from said decomposition of animal matter.

I was sent to the Black Hills in Dakota to expert a gold mine for an Indiana company and soon discovered that it was salted, and on to Colorado I went, engaged as an expert and discovered a mine of ruby silver ore at Irwin, Colorado, sold the mine and went back East and banked the money. The bank broke and I went broke. I then went to Northern Idaho on a grub stake proposition. I discovered the first high bench gold gravel deposits there, which were blind and covered up, near Murry, Idaho. I walked over the great lead croppings at what is now Wallace, Idaho, which are now the great lead mines of the world. They were then considered worthless on account of impossible transportation facilities. Winter was coming on and I took my little bag of gold and to and through the Golden Gate again I went. But San Francisco was not as of old to me. No mother, father, brother or sister with me now, and even no Woodward's Garden as of old; so to the City of Angels I went, with the result that I discovered, built a factory, made known and demonstrated by said factory the valuable clay deposits of Elsimore, Riverside county, California, that has developed in to such magnitude that the Santa Fe railroad built a spur track out from their main line eight miles to the mines and shipments of five to ten cars daily are now being made at the present time to build Greater Los Angeles. Five large sewer pipe, terra cotta, stoneware and fire brick works are kept supplied with this raw material at Los Angeles, and one large factory in operation in the dis-



trict where the clay is mined, and I still own several hundred acres of this clay land which is patented.

I was next engaged by an officer of the International Land Company of Mexico to take charge of an exploration outfit in Lower California, Mexico, with the result of discovering the Never Give Up, Encantada and Asbestos gold mines at Alimo, which have produced considerable gold from time to time.

About this time I bought the Asbestos mines on San Jacinto mountain, Riverside county, California. Then I developed the asbestos industry in California, inventing fire-proof paints and white wash, asbestos stove back lining cements, boiler cements and asbestos fire brick, which I have been interested in for years until recently, when I sold out. It was then known as the Hoff Asbestos Mfg. Co. of San Francisco and Los Angeles, where I built up a good trade and factory in each city.

About nine years ago I discovered and opened up a gold quartz mine on the Fred Roberts ranch, between his house and barn, at Escondido, California, over which many mining men had walked. Result: This mine, now known as the Oro Fino, is still in operation, with a first class mining and milling plant, which paid for its own installation from the first sixty days' run on ore.

In 1901 I returned to Virginia City, Nevada, to see if I could locate old works on the Caledonia mine, in which my father had discovered a gold bearing ledge in 1860, and of which he gave me a description before he died. After examination I endeavored to lease the Caledonia mine, of which my father was one of the original owners and locators in 1859, but W. E. Sheron, the president, turned down my proposition and commenced immediately to run crosscuts in virgin ground, and now he announces his new discovery in virgin ground of a gold bearing ledge. Result: Got left.

My latest complete, finished work was to restore the value of the La Trinidad gold mine in Placer county, California, to its owner after lying idle three years, George S. Montgomery of San Francisco, after it had

been given up by him as a failure, and which at the present time is in full operation.

As consulting engineer I still have some unfinished mining and oil problems on hand to be solved in Nevada and California, which I hope to be successful in, and at this date they are well financed with everything in favor of them becoming noted properties.

JOHN D. HOFF, M. E.

## THE AQUEOUS THEORY OF THE EARTH'S CRUST FORMATION.

Gen. 1: (revised version)

"In the beginning God created the Heaven and the earth."

Gen. 1-2:

"And the earth was waste and void and darkness was upon the face of the deep and the spirit of God moved upon the face of the waters."

Note that in the beginning God created the heavens and the earth and that the earth was waste and void. Note the waters were in existence, and all this before the first day and before even light or night existed. Thus it may be seen that it was in the beginning God created the heaven and the earth. Not in a day or in six days, but in the beginning. And when was the beginning? Who can compute it? The Bible makes Old Mother Earth older than any geological reckoning has ever made it. Note that the waste and void earth and water were in existence, without symmetry before the first day; and was being built up by the great water agency in thousands of feet of stratifications laid horizontally, which encompassed our globe, to be later elevated into ridges and mountain ranges running northerly and southerly by the original core (that resisted the disintegration of the waters) protruding up as peaks through the sedimentary metamorphic stratas.

Gen: 1-20 (revised version)

"Let the waters bring forth abundantly the moving creature that hath life."

This is the first record of life, and in the study of Paleontology we find the moving creatures that had life, as fossils, found in the Silurian and Cambrian formations, known as the Trilobites tracks of crustaceans, tracks of worms, the crinoids, etc., which are the very lowest and oldest order of animal life according to Paleontology.

Gen: 1-20

"Every living creature that moveth which the waters brought forth abundantly after their kind, including the sea monsters and every winged fowl after their kind."

So we find in the records of the earth in the Paleozoic age and the Devonian eras the fossil remains of fish whose bodies were cased with irregular horned plate with teeth similar to the sharks, and in the Mesozoic age and the Triassic and Jurassic and Cretaceous eras we look and find the reptiles and in the Jurassic which closely resemble birds, and in the Cretaceous we find the fossil remain of developed birds.

Gen: 1-24

"Let the earth bring forth the living creature after its kind, cattle and beasts of the earth."

Here again we find in the Cenozoic age, Tertiary and Quarternary eras the remains of great mammals and during the Tertiary period, the mammals developed to enormous size and some time during the Quarternary period man appeared; and we find there is absolutely no record in the rocks or formations than man gradually developed from a high order of animal to a lower order of man, but the different distinct animal life appeared at once in an imperfect form to some extent, but bettered their frames according to environment.

In our exploitations in the high Sierra Nevada Mountains near the summit, at Cisco, Cal., six miles south of the S. P. R. R., at the La Trinidad Gold Mine, in Salior's Canyon, we found the formation encasing the gold quartz vein consists of a metamorphic dark red slate tilted by a limestone and granite core. On breaking the slates with the cleavage of same to our wonder and surprise we saw plainly the fossil imprint of the older animal life, a Silurian fossil, the Amonites, Donella Monotis, Calymene Blumenbachii and the Trocholites Ammonius and we finally found them in abundance, and these formations which were thought to be only metamorphic slates

are now found to be of the lower Silurian eras, a water laid formation. It then dawned upon me that the great Sierra Nevada range of mountains was a great uplifted anticline, with an Archean Plutonic granite and Grano-diosite core, with its west slope in California and its east slope in Nevada, being of the Paleozoic age, Silurian, Jurassic and Triassic and Cretaceous eras, which includes the mother lode districts.

There is a wonderful geological phenomenon in the Grand Canon in Arizona, where the Colorado river cuts through the stratified formation for 5,000 feet perpendicular, dipping to the east near Hank's trail and to the west of same, making this anticline of great magnitude. From closer observation on approaching the foot of Hank's trail, where the Colorado river runs, we find a dark, narrow, Hellish defile, where lives have been lost, which the waters are attacking with all their furor endeavoring to disintegrate and widen its passage through this dark, irregular formation, which we discover to be the grano-diorite core, which has come up and tilted this one mile of deep cut in twain, stratas of various formations consisting of serpentine, ampyolites, limestone, sandstone and shale.

The greatest and most wonderful geological phenomenon or freak is yet to be told, which shows the part played by the waters in the formation of the crust of our globe. We relate no theory, but a fact. It upsets some geological theories in the text books. It can be explained better by starting from Flagstaff, Arizona, from whence we drive northward to the edge of the Grand Canon, which cannot be seen until you are at the very edge, and then you can look straight down 5,000 feet into the bowels of the earth with a gap of 16 miles wide, with a cone-shaped peak coming straight up from the bottom peering into your face, with the different stratifications throwing off the different bright colors that are made by the oxidization of all the different minerals in the exposed face of the different formations. And its grandeur has not yet been fittingly described by anyone to date by pen or picture. In regard to magnitude, one traveler of note remarked that you could put the Yellowstone Park,

the Yosemite and Niagara Falls in the bottom of this canon and you could not find them. We start from this wonderful scene, down Hank's steep trail, passing by and examining all the different formations, which are lying upon each other for one mile thick, and wondering what the next strata from the last will be. As we get lower and lower into the bowels of the earth and get near to the bottom we strike a side trail running east from the main Hank's trail, where the stratas seemingly dip into the Colorado River at an angle of about 35 degrees. We are all at once struck and electrified with astonishment to see a well defined strata of rounded gravel exposed, and the rocks nearly as round as marbles, cemented so tightly that our prospecting pick could hardly dig one of them out; then looking up one mile to the rim of the canon and seeing this kind of formation near the bottom, the serpentine with stratas of asbestos of the best variety, called Crysolite, and the limestone and serpentine lying over the granite core, the strata of cement gravel lying over the limestone and five thousand feet of different kinds of formations still lying on top of all this and all exposed by the Colorado River cutting through, was a geological revelation to upset all of my former learning in regard to how the earth was formed. This phenomenon warrants one taking advantage of the opportunity offered to make exploitation at such great depth in the earth, which will demonstrate that the principal active agency of the formation of the earth's crust was by water. (See other articles on this subject.) But some say, "What about the volcanoes?" They are only local and of small extent. Clarence King, now deceased, who was a chief in the U. S. Geological Survey, says of them: "Volcanoes are only local and are produced by the liberation of pressure instantly, by the contracting of the north and south poles, and consequently all kinds of rock at this point will immediately go into a state of fusion and burst through the crevices made in the rock." Water pouring down the crevices and coming in contact with the molten mass makes a shower of mud and ashes.

The old theory of describing the interior of the earth being a molten mass and in state of fusion and volcanoes the vent for same, is obsolete and a thing of the past.

#### FORMATIONS IN REFERENCE TO OIL AND GAS.

(See Cuts.)

The tertiary, carboniferous and silurian formations shown up by the cross section, from the Pacific to the Atlantic Ocean, is very interesting when closely examined in reference to the regular horizontal continuation of same and the economic value of that geological age to man; also the regular parallel upheavals of the metamorphic and granite which seemingly were all done at the same time, resurrecting our continent from a watery grave, these upheavals forming large anticlines of metamorphic and granite cores. The tertiary formation of California, which has been charged with oil by the distilling of animal and vegetable matter by the heat generated in the metamorphic and granite by the chemical action of the minerals in same (the animal matter predominating in the asphalt base and the vegetable in the paraffine), the reader will see extends in width from the Pacific to the Rocky Mountains in Colorado, at which place the true carboniferous condition first makes its appearance, passing on through Colorado and Kansas to Indiana's great gas belts, where we find the silurian limestone 300 feet thick, covering a great many square miles, consisting of a mass of fossils of the first animal life, which were creeping things, "Invertebrates," which the Bible says were created first, "having life." The gas produced from the decomposition of this vast deposit of animal matter was caught in the porous Trenton limestone, which on being tapped by drilling yields up the gas of commerce, which has revolutionized the manufacturing interests in that part of the United States. Covering the formations in Indiana are the great glacial drifts. Passing on the formations vary but little until we come to the Appalachian mountain range, which makes a great anticlinal with a metamorphic core near the Atlantic Coast.

#### THEORY OF THE ANCIENT GRAVEL DEPOSITS.

(See Cuts.)

Instead of these deposits being ancient river-beds, they are, in fact, the ancient shore line of the Pacific Ocean where it beat against the Sierra Nevada Mountains, decomposing its granite core and reducing its altitude; thereby liberating the gold from the quartz veins. The gold was freed as the quartz was crushed and rounded into boulders and pebbles. The feldspar of the granite passing into solution settled over the gravel, forming what miners call "pipe clay." As is well known the Sierra Nevada Mountains rose up through the tertiary, and consequently, being of a recent and soft formation, were broken up by this upheaval for an extent of thirty miles by four hundred and several thousand feet thick. This produced "slickens" in great quantity by marine action. As the ocean receded, the slickens of the broken tertiary were deposited over the pipe clay, which lies just above the ancient gravel deposits. The heat caused by the decomposition, or the oxidation, of the sulphides in the quartz boulders, pipe clay, and the dynamical forces turned the slickens into hot mud which solidified. This capping is the mis-called "lava."

I find that these ancient gravel deposits have bed-rock varying from the tertiary to the archean age. This great deposit of gravel is 400 miles long and 65 miles wide, and no river or series of rivers could ever have deposited it.

The rich blue gravel channels, or blue lead, so-called, are the eddies of ocean currents, and the partially oxidized sulphides in the gravel accounts for its blue color. The red gravel is the complete oxidized form of the sulphides.

Wherever this so-called lava was found cutting off gravel and the formations in place, filling the earthquake crevices mixed with country rock, boulders and pebbles, it is not ejected from below as formerly thought, as the following illustration will aid one to see.



At the "Plumbago Mine" in Sierra county, California, the vein, as well as the formations, is cut by the so-called lava for a distance of 80 feet wide and several hundred feet deep. Upon close examination of the 80 feet I found a large crevice made by an earthquake, which was filled with the surrounding rock and water worn boulders and pebbles imbedded in the so-called lava, showing that the mass came from above and not from below. There was no evidence of fusion where the lava came in contact with the quartz vein.

In regard to volcanic actions I would refer those interested to some of the following:

U. S. Geological Survey, 18th Annual Report, 1896-97, Part III, P. 701, under head of "Igneous Rocks," which says that some of above described deposits were water laid.

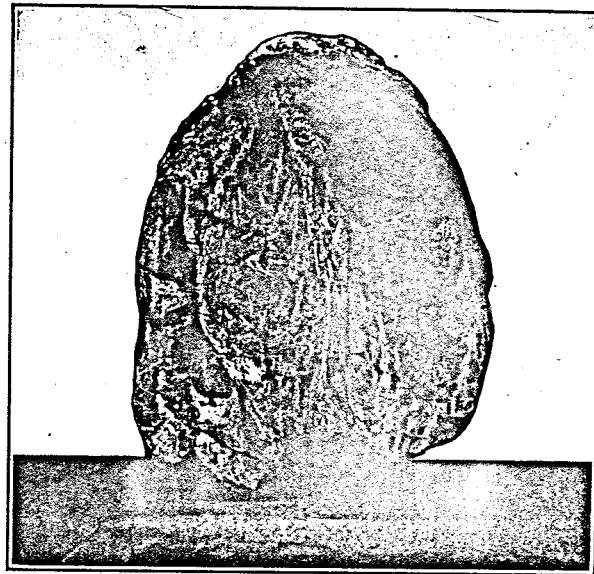
Elements of Geology, Joseph LeConte.

P. 231. "Heat combined with water seems to be the true agent. Recent experiments prove the water at 400c reduces to a pasty condition nearly all ordinary rocks."

P. 233. "There is much reason to believe that at least some granites are not the result of simple dry fusion, as is usually supposed; but on the contrary only the last term of metamorphism of highly siliceous sediments and have not given rise to eruptions at all."

P. 235. "Many geologists push these views so as to include also even the true lavas."

To those who doubt the above theory we might ask them to account for the non-existence of great gravel deposits on the Eastern slope of the Sierra Nevada Mountains, and why they are all on the Western slope.



Shell of extinct oyster (Ostrea Titan) original size 8 in. long and 7 in. wide. This class of animal matter is what has helped to produce California oils.

*I am an ancient oyster and with the oysters stand,  
And on an evil-day was overcome,  
And buried in the Eocene sands.*

## HISTORY OF OIL DISCOVERIES AND THE OIL INDUSTRY IN CALIFORNIA.

By JOHN D. HOFF, M. E.

(See Cuts)

Written for *The Mining and Engineering Review*.

Father Junipero Serra of the Franciscan order, a man of learning in the sciences of geology and mineralogy, a missionary and devout man of the first order, sacrificed comforts, luxuries and associates of the old world to preach to the Indians on the Pacific Coast about the year 1770, with the result that the 49ers found a mild, instead of a wild Indian to deal with, which made the development of the Pacific Coast possible without bloodshed of the whites or reds.

Father Junipero Serra on landing used his geological knowledge to acquire material in the raw state to construct the great line of missions from San Diego to San Francisco, using clay shales high in alumina and burning it in connection with limestone; by grinding it he manufactured hydraulic cement which was of such good quality it could never be reproduced until recently in California. He discovered the pottery clays to manufacture the mission tiles and finally the residue of petroleum which runs out of crevices of rocks in liquid form to be evaporated in the sands by the California sun, which makes a product called asphaltum and brea. This was used under his direction for roofs for small adobe buildings and pavements. As time went on and the value of oil became known, about 1864, shallow wells were drilled near the seepage of oil in different parts of California in the asphaltum, but without success except at Newhall, Los Angeles county, California, in 1874, where the Star Oil Company got oil in commercial quantities.

The next places to get oil in commercial quantities were Ventura and Puente, about 1883. These were all small districts and all further developments for oil in California were discouraged by geologists' and State reports, to the effect that the oil formations were so tilted, broken and of such small extent that its produc-

tion would never amount to anything, but to-day California is the greatest producer of oil in the United States. It became so within the last three years, and through the persistence of a brawny, stout quartz miner, E. L. Doheny, who believed in following up indications (which he found on a lot in Los Angeles City), with a pick and shovel, and at a depth of 75 feet he got oil. Then boring commenced on the city lots until hundreds of wells were drilled in the north-western portion of the city, which now has a production of 75,000 barrels per month. Doheny then followed up some indications of oil near Fullerton, California, and his persistence was again rewarded by bringing in the now celebrated Fullerton oil fields southeast of Los Angeles, and several hundred wells are now producing a large amount of high-grade oil which brings \$1.30 per barrel for refining purposes.

About this time, in 1901, a wood chopper was chopping wood near the banks of the Kern River, in Kern county, and noticed a small seepage of oil in the banks. He called the attention of a Mr. Ellwood to the indications. The latter immediately followed up the "lead" in an intelligent manner and at a depth of sixty feet struck oil. Immediately drilling commenced and a gusher was struck. Land went from \$1 to \$1,000 an acre, and hundreds of wells were drilled, which now produce from 100 to 300 barrels per day each, and a \$5,000,000 pipe line is finished from Bakersfield to San Francisco bay, where the Standard Oil Company erected refineries.

Chanslor and Canfield were drilling for oil at Coalinga, California, and had exhausted about all their resources, but still drilled on, and when hope and faith were all that was left they struck the Blue Goose well, which produced 2000 barrels per day, and Chanslor and Canfield became millionaires in a short time. Now hundreds of wells are producing in the Coalinga oil district from 100 to 1000 barrels each per day, and a pipe line is now completed from Coalinga to Monterey Bay, a distance of 110 miles, built by a close corporation of San Francisco.

Sunset, McKittrick and Midway oil fields were next discovered, which now have great wells and large productions, and a pipe line 80 miles long to Port Harford will soon be built.

The latest important new field just discovered is known as the Coast Line Oil Belt and was first developed by the Western Union Oil Company, at Santa Maria, California, which drilled three wells before it got oil in commercial quantities. The oil is high grade and the present price is 80c to \$1.00 per barrel at the wells. A number of wells are producing 400 barrels per day, and at the present time millionaires are being made in this field, which runs from Santa Barbara county through San Louis Obispo and Monterey counties, California, and is developing into the greatest and best field in the State on account of the great area and the thickness of the oil sands; the grade of oil is high, and it is a first class refining oil, and consequently brings a high price. It is being eagerly sought after by the Standard Oil Company for the big refining plant at Point Richmond, California, which could handle 5000 barrels daily.

It is not generally known that the California refiners are producing the high grade kerosene, but it is a fact nevertheless. California oils that run from 14 to 20 gravity are the fuel oils that are now produced in great quantities in California. Twenty-two gravity to 42 gravity oil is the high grade oil which is just beginning to be produced in large quantities and is generally found in the Coast Line Oil Belt extending through the three coast counties named. It is near tide water, which gives excellent transportation facilities.

The very latest developed field is the Sargent field, on the boundary line of Monterey and Santa Clara counties. Four wells are completed, having a production of 100 barrels per day, and a refinery just built near Chittenden Station is now producing high grade kerosene and other by-products.

In Sari Mateo county in the Half Moon Bay district oil of very high grade has also been found.

In reference to the geology and stratification of the oil belts in California my conclusions, after large field

experience, are as follows: That all of the formations producing heavy low gravity oil belong to the Caenozoic age, Tertiary era and Eocene period, and all the formations producing high grade, light gravity oil especially in the Coast Line Oil Belt, belong to the Mesozoic age and Cretaceous era, and as this formation is older than the other oil belts great things may be expected in the future. These belts run northwest and southwest through the State, and as an illustration of its formation we can liken it to a plate of corrugated iron elongated northwesterly and southwesterly about 40 degrees. We can imagine the State at the close of the Eocene period as a flat sheet of iron without hills or mountains. Suddenly the State was corrugated like unto a piece of corrugated iron, which was caused by contraction of the earth's poles and forming ridges running northwesterly and southwesterly. Some were high and some low. They included the two parallel ranges, the Coast Range and the Sierra Nevada, which mountains protrude up through the Tertiary, Cretaceous and Silurian formations, leaving the sandstone and shales lying on their foothills at an angle of 40 to 70 degrees pitch. The Metamorphic and Archaean formations protrude up in towering heights, in which are found and mined the precious metals, while in the valleys on and alongside of the small ridges, called anticlines (which did not protrude through the sandstone and shales), are the oil belts of California. The benefits of this wonderful discovery and revelation of nature within the past three years to mankind, and especially to the Pacific Coast, can only in time be approximated.

A few items of interest may be mentioned. About \$5,000,000 annually was the amount sent away for imported fuel, which amount is now kept at home and distributed among the oil companies of California for fuel alone, and the refineries are paying to oil companies millions more for oil to refine, the by-products of which are now being shipped all over the world. The fuel oil now brings a low price but the refining oil is sought after at a good price, and its production will

soon be enormous. The increased production does not seem to lower the price at present. Another item of vast importance to the State is that we are now able to realize and manufacture from the raw material so abundant here on account of cheap fuel being possible, and California has the world for a market. Nowhere else is such abundant raw material and fuel found so close together.

A plan is now being fertilized in the brains of a few prominent San Francisco people whereby a large manufacturing town will be established on Monterey Bay, where iron ore, manganese ore and limestone for flux can be secured in the metamorphic hills, and a great iron and steel plant is a probability. As oil is now being brought to Monterey Bay by a six inch pipe line and by mixing the oil with a semi-bituminous coal just being developed at Stone Canyon in Monterey County, a substitute for a high grade coke can be produced to reduce the iron ores in stack blast furnaces.

There can also be built at this new manufacturing city sewer pipe, fire brick, terra cotta and building blocks, as the material, a fine clay, underlies the coal. With this fire clay and limestone, hydraulic cement works may be made profitable, and immense beds of gypsum make plaster of Paris works also a possibility; unlimited beds of good sand with fuel in abundance make glass works a consideration; fine beds of diatomaceous earth and asbestos make boiler and steam pipe covering works and fire proof paint and plaster works a possibility, and large deposits of iron pyrites make sulphuric acid works a part of the plans in embryo. This is all feasible and probable with a railroad sixty miles long to Monterey Bay.

## NOTES FROM JUDICIAL DECISIONS UNDER THE UNITED STATES LAWS.

**Length and Width of Lode Claims:** The act of Congress of May 10, 1872, authorizes a claim to be located 1,500 feet in length along the vein, and in the absence of any local rule or custom, the width of such claim may extend 300 feet on each side of the middle of the vein; but said act of Congress, by implication, authorizes the miners to limit the width of such claims to 25 feet on each side of the middle of the vein.

**How Location to Be Marked:** A location of a mining claim must be distinctly marked on the ground so that its boundaries can be readily traced; but the law does not define or prescribe what kind of marks shall be made, or upon what part of the ground or claim they shall be placed. Any marking on the ground claimed by stakes, mounds and written notices, whereby the boundaries can be readily traced, is sufficient.

**As to Record:** The law of Congress requires no record of a mining claim except in obedience to valid local rules or customs of miners; but when such local rules or customs require a record it must contain the names of the locators, the date of the location, and such a description of the claim by reference to some natural object or permanent monument as will identify the claim; but such natural objects or permanent monuments are not required to be on the ground located, although they may be, and the natural object may consist of any fixed natural object; and such permanent monument may consist of a prominent post or stake firmly planted in the ground, or of a shaft sunk in the ground. If by reference to any such natural object or permanent monument the claim recorded can be identified with reasonable certainty, the record will be sufficient in this particular; otherwise not.

**Work Necessary to Hold a Claim:** The statute requires one hundred dollars' worth of work on each claim located after May 10, 1872, in each year, and in default thereof authorizes the claim to be re-located by other parties; provided the first locator has not resumed work upon it. But if the first locator resumes work at any



\* time after the expiration of the year, and before any relocation is made, he thereby preserves his claim; the statute nowhere authorizes a trespass upon or a relocation of a claim before located by another, however derelict in performing the required work the first locator may have been, provided he has returned and resumed work, and is actually engaged in developing his claim at the time the second locator enters and attempts to secure the claim.

**Work to Hold Adjoining Claim:** When one person or company owns several continuous claims, capable of being advantageously worked together, one general system may be adopted to work such claims; and work done according to such system for the purpose of prospecting or working all such contiguous claims, although done on only one of such claims, or even outside of all of them, is available to hold all such contiguous claims intended to be worked or prospected by such general system.

There is no limit placed by the law upon the number of claims an individual may acquire by location, but the law requires that not less than \$100 worth of work shall be performed, or improvements made for each claim, annually, until patent is secured. The prior location is also first in right in case of conflicting interests.

Another question which sometimes arises is: "In locating a lode claim is it necessary to have discovered the ledge and to have ascertained that mineral really exists?"

The law requires that unless the vein can be traced upon the surface, before recording a mining notice a shaft should be sunk, a tunnel or drift run, or an open cut made sufficient to discover a mineral-bearing lode, vein or crevice and that the general course of the vein should be determined, for the location notice should give the course of the vein. But we would advise locators to put up location notices before proceeding with the work of discovery; for in a recent decision in the United States Supreme Court it was held that a miner who has first located *on any portion of the public domain* has a prior right to the land claimed whether mineral is in sight or not, and should have ample time to prove whether it is mineral land or not. The decision went

further and it was decided that any land, *whether characterized as mineral or agricultural* in the records of the land office surveys.

## TITLE TO UNPATENTED CLAIMS.

There seems to be an impression among many that unpatedented mining locations are not subject to taxation, the idea seeming to be that as the Government has not passed title by patent to the locator the title rests in the Government. It is not easy to define the nature of the estate acquired and held by the possession of a valid mining location, but from the early history of mining the title acquired by a miner to his claim by location was absolute so long as he complied with the statutory provisions. The claim was recognized as real property, was liable to sale on execution, and was subject to taxation. With passing years this idea has not changed materially, nor at all. A mining location properly made, and upon which all the requirements of the law have been complied with, is property in the strictest sense of the term, as much so as a patented claim. As a matter of course, if the claim holder ceases to comply with the law regarding claims so located, his rights in the estate cease and the claim reverts to the public domain, and is then subject to relocation by any person, a citizen of the United States. The miner's title to his unpatedented claim is founded upon the law of possession. In the early days of mining there was no other way of maintaining possession of mining claims than by complying with certain local laws and requirements. These local laws, rules and customs came, in time, to be the foundation of the mining law as it exists at present. In establishing rights under the mining law the fact was recognized that no person could enter upon a claim legally held by another, on the plea that he had no title, as the title was still vested in the Government. The fact of possession was considered sufficient evidence of title. To be in possession does not involve the necessity of an actual residence upon the mining claim. If a mining claim be legally located upon the public domain, and all the acts

performed in connection with such location as are required by the Federal Statute, State and local laws, the locator is said to be in possession, and he has a legal title to the claim to the exclusion of every one else—even the Government—and he may maintain this right so long as he complies with the requirements of the law.

#### EXTRACT FROM U. S. LAND OFFICE DECISION IN FAVOR OF MINING CLAIMS.

One who has made a mining location upon the public land in the manner provided for in the statute and in conformity with the local laws and regulations of miners, has a qualified title to the land which may be bought and sold as other property; *Silver Bow Mining and Milling Co. vs. Clark*, 5 Mont. 378. He is not bound to apply for a patent or to pay for the use of the land; *Chapman vs. Toy Long*, 4 Sawyer 28. Therefore, he is not required to give the land department notice of his claim in order to give him a vested right to the land. By his location he has segregated the land from the public domain; *St. Louis Mining Co.*, 171 C. S. 650, and has the exclusive right of possession and enjoyment of all the surface included within the lines of his claim; *Belk vs. Meagher*, 104 C. S. 279; *Gwillim vs. Donnellan*, 115 U. S. 45; *Noyes vs. Mantle*, 127 U. S. 348; *Sullivan vs. Iron Silver Mining Co.*, 143 U. S. 431. Whether that claim is valid or whether the land is vacant and open to settlement is not left to the agricultural claimant to decide, merely by his affidavit, especially where he fails to state the facts or thinly disguises them. Congress has entrusted the land department with the determination of whether a mining claim contains valuable minerals; *Steel vs. St. Louis Mining Co.*, 106 U. S. 447; *Coleman vs. McKenzie*, 28 L. D. 348. If the agricultural claimant stated the facts, the local officers should have required him to give the mineral claimant notice of the proposed filing. He is on the land in *personal occupancy* and under color of right and should be *allowed an opportunity to show that the land possessed minerals* in paying quantities, in which event his *rights* would relate back to the date of location. See *Lindley on Mines*, par. 219,

*Belk vs. Meagher*, 3 Mont. 65. I am not unmindful of the recent ruling that the land department has no control over a mineral claimant until he seeks patent, but such ruling (*Barklage et al vs. Russell et al*, 29 L. D. 401) only holds that questions arising between rival mineral claimants as to the right of possession are solely matters for the courts and did not hold that the department, at any time prior to patent, is ousted of its jurisdiction to determine under what provision of the public land law patent shall issue.

#### HOW TO LOCATE A MINING CLAIM IN NEVADA.

The law on "How to Locate" is as follows:

"Any person, a citizen of the United States, or one who has declared his intention to become such, who discovers a vein or lode, may locate a claim upon such vein or lode by defining the boundaries of the claim in the manner hereinafter described, and by posting a notice of such location at the point of discovery, which notice must contain:

"First—The name of the lode or claim.

"Second—The name of the locator or locators.

"Third—The date of the location.

"Fourth—The number of linear feet claimed in length along the course of the vein, each way from the point of discovery, with the width on each side of the center of the vein, and the general course of the vein or lode as near as may be."

This must be followed by the performance of a certain amount of discovery work and the defining of boundaries of the claim by the erection of monuments, all to be done within ninety days from the posting of the notice of location. The following is the law on these points:

"Before the expiration of ninety days from the posting of such notice upon the claim, the locator must sink a discovery shaft upon the claim located to the depth of at least ten feet from the lowest part of the rim of

such shaft at the surface, or deeper if necessary, to show by such work a lode deposit of mineral in place. A cut or crosscut, or tunnel, which cuts the lode at a depth of ten feet or an open cut along the ledge or lode, equivalent in size to a shaft four feet by six feet by ten feet deep, is equivalent to a discovery shaft.

"The locator must define the boundaries of his claim by marking a tree or rock in place, or by setting a post or stone, one at each corner, and one at the center of each side line. When a post is used it must be at least four inches square by four feet six inches in length, set one foot in the ground, with a mound of stone or earth four feet in diameter by two feet in height around the post. When it is practically impossible on account of bedrock or precipitous ground to sink such posts, they may be placed in a pile of stones; or where the placing of such posts or monuments of stone is impracticable or dangerous to life or limb, it shall be lawful to place such post or monument of stone at the nearest point, properly marked to designate its right place.

"When a stone is used, not a rock in place, it must be at least six inches square and eighteen inches in length, set two-thirds of its length in the ground, which trees, stakes or monuments must be so marked as to designate the corners of the claim located."

With all this done and ten feet of work performed in every case (nine and a half feet will not be sufficient), the recording of a location certificate follows, and in this the prospector must be careful if he desires to have a valid location. The law is as follows:

"Within ninety days of the date of posting the location notice upon the claim, the locator shall record his claim with the mining district recorder, and the county recorder of the mining district or county in which such claim is situated, by a location certificate which must contain:

"First—The name of the lode or vein.

"Second—The name of the locator or locators.

"Third—The date of the location and such description of the location of said claim with reference to some natural object or permanent monument, as will identify the claim.

"Fourth—The number of linear feet claimed in length along the course of the vein each way from the point of discovery, with a width on each side of the center of the vein, and the general course of the vein or lode, as near as may be.

"Fifth—The dimensions and location of the discovery shaft, or its equivalent, sunk upon the claim.

"Sixth—The location and description of each corner, with the markings thereon. Any record of the location of a lode mining claim which shall not contain all the requirements named in this section shall be void."

#### NOTICE OF LOCATION.

Notice is hereby given that the undersigned have located 1,500 linear feet running southerly on this lode, vein or deposit of mineral, the general course of which is northerly and southerly, with surface ground 600 feet wide, being 300 feet on each side, easterly and westerly, of this discovery monument.

This claim shall be known as the Blank Mining claim, and is situated on the northeast slope of Blank mountain, about one mile southeasterly from the town of Blank, and about 2,500 feet from the .....mine shaft house in .....mining district, .....county, Nevada.

Three hundred feet westerly from this discovery monument is the northwest corner, a stake marked "northwest corner of the ..... mining claim;" thence 1,500 feet southerly is the southwest corner, a blazed tree, marked "southwest corner of ..... mining claim;" thence 600 feet easterly is the southeast corner, a stake, marked "southeast corner of ..... mining claim;" thence 1500 feet northerly is the northeast corner, a stake, marked "northeast corner of the ..... mining claim."

This claim adjoins the ..... mining claim on the south.

The location work required by law has been performed in running an open cut ..... feet long.....

5-  
feet wide, and 10 feet deep at the face, about.....  
feet southeasterly from this discovery monument.

Located.....

Locators, ....., .....

Prospectors who have made locations that do not conform to the law should take advantage of another section of the Nevada law, which permits an amended notice to be filed correcting any mistakes made in the original certificate.

See Cuts and Illustrations in folder form. To be consulted in reading the articles, which simplifies the matter contained therein.

END.