CALIFORNIA STATE MINING BUREAU.

HENRY G. HANKS, STATE MINERALOGIST.

SIXTH ANNUAL REPORT

OF THE

STATE MINERALOGIST.

PART I.

FOR THE YEAR ENDING JUNE 1, 1886.

SACRAMENTO:
STATE OFFICE.....J. J. AYERS, SUPT. STATE PRINTING.
1886.


SKETCH MAP
OF
SAN DIEGO COUNTY
SHOWING THE POSITION OF
MINES AND MINERALS
REFERRED TO IN THE 6TH ANNUAL REPORT OF THE
STATE MINERALOGIST OF CALIFORNIA
FOR THE YEAR ENDING JUNE 1ST 1886.
HENRY G. HANKS
STATE MINERALOGIST.
LITH BRITTON & REY S.F.
REFERENCES
RAILROADS
COUNTY ROADS
SAN BERNARDINO COUNTY
LOS ANGELES COUNTY
PACIFIC OCEAN
LOWER CALIFORNIA
ARIZONA
COLORADO RIVER
COLORADO DESERT
SAN JACINTO RANGE
SAN BERNARDINO RANGE
CHEM-E-HUEVIS MTS
RIVERSIDE MTS
SAND HILLS
DRY LAKE
250 FT. BELOW SEA LEVEL
S. P. R. R.
BOUNDARY LINE
NEW RIVER BASIN
1ST STANDARD
2ND STANDARD
3RD STANDARD
4TH STANDARD
SAN JACINTO NUEVO
SAN JACINTO
TEMESCAL RANCE
LAGUNA
TEMECULA
SANTA ROSA
PAUBA
SANTA MARGARITA Y LAS FLORES
SAN ONOFRE MTS
MONSERRATE
PAUMA
PALOMAR OR SMITHS MOUNTAIN
CUCA
LA JOYA
SAN JOSE DEL VALLE
AGUA CALIENTE 3000 FT.
SAN LUIS REY
BUENA VISTA
AGUA HEDIONDA
VALLECITOS DE S. MARCOS
RINCON DEL DIABLO
GUEJITO
MESA GRANDE
SANTA ISABEL
BALCAN MTS
VALLE DE SAN FELIPE
JULIAN
BALLENA
SAN BERNARDO
SANTA MARIA
SAN VICENTE
CUYAMACA
CUYAMACA PEAKS
LAS PEÑAS QUITAS
SOLEDAD
LA JOLLA
MISSION
MISSION LANDS OF SAN DIEGO
OLD MISSION
EL CAJON
LOS COCHAS
JAMACHA
JAMUL
JANAL
OTAY
LA NACION
NEW TOWN SAN DIEGO P.O.
BAY OF SAN DIEGO
FALSE BAY
LIGHT HOUSE
BALLAST POINT
LA PUNTA
TIJUANA VALLEY
OTAY MESA
TIJUANA RIVER
SAN YSIDRO MTS
LAGUNA MTS
CAMPO
MOUNTAIN SPRING
WALKERS
VALLECITA
PALM SPRING
COLORADO PASS
CARRISO CREEK
BOREGO SPRING
SPRINGS
SODA SPRINGS
MUD VOLCANUS
SACKETTS WELLS
INDIAN WELLS
FISH SPRING
FRINKS SPRING
FLOWING WELL
TORTUCA
MAMMOTH TANK
MESQUIT
CACTUS
CARGA MUCHACHO MTS
PILOT KNOB
FORT YUMA
YUMA
Gila River
CASTLE DOME CITY
CHIMNEY PEAK
BARRIE ISLAND
EUREKA MINES
SLEEPER'S BEND
THREE POINT BEND
PORPHYRY GATE
LIGHTHOUSE ROCK
LONG BEND
DEEP WATER BEND
CHUCAWALLA
TABASECA
MULE SPRING
SWALLOW NEST BEND
SWAMP & OVERFLOWED LANDS
EHRENBERG
OLIVE CITY
LONG SHOAL
LA PAZ
BLACK POINT
SAND ISLAND SHOALS
LAGUNA
DRY LAKE
CHICANALLA
TALASACHA
CANON SPRING
DOS PALMAS
LONE PALM
DRY CREEK
WALKERS
MARTINEZ
LOS TORES
INDIO
PALMA SECA
INDIAN WELLS
AGUA CALIENTE
SEVEN PALMS
WHITE WATER
SAN GORGONIO PASS
CABEZON
BANNING
SAN JACINTO PEAK
FALLBROOK
PALA P.O.
AGUANGA
T TERTIARY
A ARCHEAN
P PERMO-CARBONIFEROUS
Q QUATERNARY
NOTE. THE COLORING OF THIS MAP IS PROVISIONAL.
A LARGE PORTION OF THE AREA IS ALMOST WHOLLY
UNEXPLORED, OR HAS BEEN EXAMINED ONLY AT ISOLATED POINTS,
BUT IT REPRESENTS WITH SOME DEGREE OF ACCURACY,
THE PRESENT OPINION OF GEOLOGISTS.

To his Excellency GEORGE STONEMAN, *Governor of California:*

SIR: I have the honor herewith to submit the sixth annual report of the State Mineralogist, and report of progress of the California State Mining Bureau, for the year ending June 1, 1886, prepared in accordance with the Act of Legislature, approved April 16, 1880.

Permit me to express my thanks to you and to other State officials for courtesies extended to me, and for the interest you have taken in the State Mining Bureau.

I have the honor, sir, to remain very respectfully,

HENRY G. HANKS,
State Mineralogist.

REPORT.

HISTORY OF THE STATE MINING BUREAU.

A very full history of the California State Mining Bureau, from its commencement in 1880 to the fifteenth of May, 1885, may be found in the five annual reports which precede this. The history includes a relation of the many difficulties met with in the establishment of the institution, which it will not be necessary to repeat here.

The Board of Trustees appointed by Governor Stoneman, in accordance with an Act of the Legislature (Assembly Bill No. 78, which passed the Assembly February 11, 1885, and the Senate March 5, 1885), organized April 18, 1885.

The following gentlemen constitute the Board: William Irelan, Jr., S. Heydenfeldt, Jr., J. Z. Davis, Walter E. Dean, and George Hearst. William Irelan, Jr., was elected Chairman, and S. Heydenfeldt, Jr., Secretary.

The Act providing for a Board of Trustees is published in full in the fifth annual report of this office.

Immediately on the return of the State Mineralogist from the New Orleans Exposition, preparation was made for removal to the fine fireproof building recently erected by the Society of California Pioneers. The building is situated on Fourth Street, near Market, on the property donated to that society by James Lick.

The removal, which was made during an unusually rainy season, was nevertheless finished without serious loss from breakage, and the entire time, up to the date of this report, has been employed in placing the museum in order.

The collection of seven thousand catalogued specimens, and many not yet entered, is arranged in cases, and classified into seven principal groups, as follows: Minerals, Ores, Rocks, Fossils, Shells, Ethnology, and Sundries. The whole should now be rearranged into geographical divisions. This, by my calculation, would require the entire time of an industrious man for one year, as I have planned to do it. From this may be inferred the estimate I place on the magnitude and importance of the State Museum at the present time.

While the exhibition of the State minerals at New Orleans was worth far more than the cost necessitated by twice packing and thrice removing the specimens, it set back the work of the Mining Bureau for six months. The removal to the new building, and arrangement of the museum, occupied three months more. The specimens are now all in place, and I am pleased to state that no serious loss, or material injury from breakage, or otherwise, has been sustained.

PRESENT CONDITION OF THE STATE MINING BUREAU.

The condition of the institution is most satisfactory. The State is now in possession of a very extensive museum, which has cost but a trifle compared with its actual value.

It would have been impossible to make so large and varied a collection, even if many times the money expended had been at the disposal of the State Mineralogist, were it not that prospectors were willing to send to the State Mining Bureau many fine and interesting specimens in return for information extended to them. The State is greatly indebted to Wells, Fargo & Co., and the several steamship companies, for free transportation.

The museum is one of which the people should be proud.

Mr. Joseph Wasson, to whom the State of California owes a just debt of gratitude, gave the future of the State Mining Bureau much thought, and nobly made the foundation broad and ample. But the institution has grown more rapidly than even he expected, and while it is at the present time in a healthy and prosperous condition, its future should be made the subject of careful legislation.

The institution has been carried through many difficulties, and has been placed in a safe and suitable building, and the financial management transferred to a Board of Trustees, who will care for it in the future. There is money enough to keep it alive until the meeting of the next Legislature. The museum is still growing, and will continue to do so. It is to be hoped that the next Legislature will make sufficient provision for its support.

From the experience I have made during a period of six years while holding the office of State Mineralogist, it is my opinion that the State Museum should be entirely separated from the office of State Mineralogist, and all the responsibility of that department removed from him. He should be provided with the necessary assistants and money (which need not be a large sum). The money for the support of his office, which is really the most important branch of the State Mining Bureau, should be entirely under his control, and he should be allowed to manage his department according to his own judgment, without interference from the Board of Trustees, he bearing the responsibility.

DONATIONS.

Many valuable specimens have been presented to the museum during the past year, and I regret that, owing to reasons mentioned elsewhere, it has been impossible to present in this report a full list of the names of those who have thus enriched the State Museum by their generous donations. I take this occasion to acknowledge, generally, the receipt of many valuable gifts which have been placed in the museum cases when it has been possible to do so. Others will be arranged and catalogued in due time.

CORRESPONDENCE.

This department has grown in proportion to the advance of the institution, and to that extent that it is now fully the work of one individual during business hours to care for it properly. I am sorry to say that the numerous letters received by the State Mining Bureau have not always been answered as promptly as they should have been—addressed as they were to an important institution in one of the most important States of the American Union. I can only offer as an excuse the utter impossibility of doing better, for reasons too often repeated in the reports of this office. The State Mining Bureau numbers among its correspondents scientific societies, State and foreign governments, and noted individuals, besides many citizens of the Pacific Coast, wishing information as to the natural resources of California. When it has been possible to do so, all procurable information has been given. The reputation of California as a mineral-producing State

is so widespread, and so much is expected of the Mining Bureau and the State Mineralogist, that it is a matter of regret that his work has been impeded for want of needed assistance in this department.

CHEMICAL WORK.

Since Mr. Edward Booth, the very efficient chemist employed during the first year of the Mining Bureau, was discharged for want of funds, nearly all the chemical work has been done in the private laboratory of the State Mineralogist, maintained at his own expense. The work has been considerable, but not in proportion to the requirements of the office. Some of the results will appear elsewhere in this report.

LIBRARY.

Very few volumes have been added to the library. Since the administration of the Board of Trustees a few valuable works have been purchased and a few acquired by donation.

VISITORS.

The number of visitors to the museum has gradually increased. Since the removal to the new rooms the increase has been very noticeable.

PUBLICATIONS.

The reports of this office, although below my standard, are much in demand, showing the interest taken by the world in our affairs. These reports should be made fuller and better with each issue; but this cannot be done until the State Mineralogist is furnished with more assistance and money with which to visit the localities in the State where valuable minerals are found. No matter how industrious he may be in collecting and arranging matter for his publications, unless he has clerical assistance to carefully revise the work, annoying and discreditable errors will be found when it is too late to correct them in the too hastily prepared reports. For these reasons the publications are not without certain crudities. If the most valuable parts of each volume were carefully revised, provided with maps and engravings, reprinted in one, and published officially, a volume would be so produced which might be given a wide circulation, to the advantage of the State.

SACRAMENTO STATE COLLECTION OF MINERALS.

There is at the Capitol, in the State Library, in rooms wanted for books, a large and valuable collection of minerals, which was purchased many years ago by the State at an expenditure of a considerable sum of money. It is my opinion that this collection should be joined to the one now in the Pioneer Building in San Francisco, to which it would form a fine supplement. Repeated efforts have been made to effect this union, but always with opposition. Still it seems to be the proper thing to join them.

STATE MAPS.

Considerable work has been done and much data collected with a view to the publication of a preliminary geological map of the State, and a large

map in sections, on a scale of one centimeter to the mile, on which it was intended to mark the exact locality of all valuable minerals found in the State. It is to be hoped that this work will be continued. An appropriation of several thousand dollars would not be too much for this alone.

CATALOGUE.

A portion of the third volume of the museum catalogue has been printed, which brings the numbers up to seven thousand. When the entries number nine thousand this volume will be put into book form by the State Printer.

ORIGIN OF THE NAME CALIFORNIA.

In preparing a history of the geological surveys and explorations of California, I frequently met with the statement that the name of our State was derived from a Spanish romance, published first in 1521. This was ignored or contradicted by other authors. I became very much interested in this subject, and wrote to the Librarian of the British Museum, asking him if there was such a work in his library. In due time a reply came from G. K. Fortescue, the Librarian, informing me that there was, and that in Chapter 157 the name California appears. Mr. Fortescue kindly offered to have the chapter copied for me, which I accepted, and received the chapter in Spanish, which follows this. I then applied to Mr. Camilo Martin, Consul for Spain, who made for me a literal translation, in which he aimed to reproduce in English the quaint idiom of the original.

In his first letter, Mr. Fortescue gave me certain references, which led to my finding in the Proceedings of the American Antiquarian Society, April 30, 1862, a paper on this same subject, by Edward Everett Hale, in which he quotes a few lines from the romance.

As the commander of the expedition sent out by Cortez did not discover Lower California until 1534, and as the romance was so popular that it passed rapidly through a number of editions, it is reasonable to infer that the name California had its origin in the fertile brain of the author. Mr. Hale seems to have been the first to discover and publish these facts.

Las Sergas del muy esforzado Caballero Esplandian, hijo del excelente Rey Amadis de Gaula.—Madrid, 1521.

CAPITULO CLVII.

Del espantoso y no pensado socorro con que la reina Calafia en favor de los turcos al puerto de Constantinopla llegó.

Quiero agora que sepais una cosa la mas extraña que nunca por escriptura ni por memoria de gente en ningun caso hallar se pudo, por donde el dia siguiente fué la ciudad en punto de ser perdita, y cómo de alli donde le vino el peligro le vino la salud. Sabed que á la diestra mano de las Indias hubo una isla, llamada California, muy llegada á la parte del Paraiso Terrenal, la cual fué poblada de mujeres negras, sin que algun varon entre ellas hubiese, que casi como las amazonas era su estilo de vivir. Estras eran de valientes cuerpos y esforzados y ardientes corazones y de grandes fuerzas; la insula en si la mas fuerte de riscos y bravas peñas que en el mundo se hallaba; las sus armas eran todas de oro, y tambien las guarniciones de las bestias fieras, en que, después de las haber amansado, cabalgaban; que en toda la isla no habia otro metal alguno. Moraban en cuevas muy bien labradas; tenian navios muchos, en que salian á otras partes á hacer sus cabalgadas, y los hombres que prendian llevábanlos consigo, dándoles las muertes que adelante oiréis. Y algunas veces que teinan paces con sus contrarios, mezclábanse can toda seguranza unas con otros, y habian ayuntamientos carnales, de donde se seguia quedar muchas dellas preñadas, y si parian varon, luego era muerto. La causa dello, segun se sabia, era porque en sus pensamientos tenien firme de apocar los varones en tan pequeño número, que sin trabajo los pudiesen señorear, con todas sus tierras, y guardar aquellos que entendiesen que cumplia para que la generacion no pereciese.

En esta isla, California llamada, habia muchos grifos, por la grande aspereza de la tierra y por las infinitas salvajinas que en ella habitaban, los cuales en ninguna parte del mundo eran hallados; y en et tiempo que tenian hijos, iban estas mujeres con artificios para

los tomar, cubiertas todas de muy gruesos cueros, y traianlos à sus cuevas, y alli los criaban. Y siendo ya igualados, cebábanlos en aquellos hombres y en los niños que parian, tantas veces y con tales artes, que muy bien conocian à ellas, y no les hacian ningun mal. Cualquiera varon que en la isla entrase, luego por ellos era muerto y comido; y aunque hartos estuviesen, no dejaban por eso de los tomar y alzarlos arriba, volando por el aire, y cuando se enojaban de los traer, dejábanlos caer donde luego eran muertos. Pues al tiempo que aquellos grandes hombres de los paganos partieron con aquellas tan grandes flotas como la historia vos ha ya contado, reinaba en aquella isla California una reina muy grande de cuerpo, muy hermosa para entre ellas, en floreciente edad, deseosa en su pensamiento de acabar grandes cosas, valiente en esfuerzo y ardid de su bravo corazon, mas que otra ninguna de las que antes della aquel señorio mandaron. Y oyendo decir cómo toda la mayor parte del mundo se movia en aquel viaje contra los cristianos, no sabiendo ella que cosa era cristianos, ni teniendo noticia de otras tierras, sino aquellas que sus vecinas estaban, deseando ver el mundo y sus diversas generaciones, pensando que con la gran fortaleza suya y de las suyas, que de todo le que se ganase habria por fuerza ó por grado la mayor parte, habló con todas aquellas que en guerra diestras estaban, que seria bueno que, entrando en sus muy grandes flotas, siguiesen aquel viaje que aquellos grandes principes y altos hombres seguian; animándolas y esforzándolas, poniendoles delante las muy grandes honras y provechos que de tal camino seguirseles podrian, sobre todo con muy grande fama que por toda el mundo dellas seria sonada, que estando así en aquella isla, haciendo no otra cosa sino la que sus antecesores hicieron, no era sino estar como sepultadas en vida, como muertas viviendo, pasando sus dias sin fama, sin gloria, como los animales brutos hacien.

Tantas cosas les dijo aquella muy esforzada reina Calafia, que no solamente movió á sus gentes á consentir en el tal camino, mas ellas, con mayor deseo que sus famas por muchas partes divulgadas fuesen, le daban priesa que entrase en la mar luego, porque se hallesan en las afrentas, juntas con aquellos tan grandes hombres. La Reina, que la voluntad de las suyas vido, sin mas dilatar, mandó bastecer su grande flota de viandas y de armas todas de oro, y de todo lo demás necesario, y mandó reparar la mayor fusta de las suyas, hecha á manera de una red de gruesa madera, y hizo en ella meter hasta quinientos grifos, que, como ya se vos dijo, desde pequeños mandó criar y cebar en los hombres; y haciendo allí meter las bestias en que cabalgaban, que de diversas maneras eran, y todas las mas escogidas mujeres y mejor armadas que tenia en la flota, dejando tal recaudo en la isla con que segura quedase, y metióse ella las otras en la mar; y dióse tanta priesa, que llegó á las flotas de los paganos aquella noche que se os dijo del combate; con que todos ellos hubieron muy gran placer, y luego fué visitada de aquellos grandes señores, haciendole muy grande acatamiento. Ella quiso saber en qué estado estaba su hecho, rogándoles mucho que por extenso se lo contasen, y oida la relacion dello, dijo: "Vosotros habies combatido esta ciudad con vuestras grandes gentes, y no la pudístes tomar; pues yo con las mias, si á vosotros pluguiere, quiero el dia siguiente probar mis fuerzas á que bastarán, si quisieredes estar á mi consejo." Todos aquellos grandes señores le dijeron que como por ella fuese señalado, que asi lo mandarian cumplir.

"Pues enviad luego á todos los otros capitanes que por ninguna manera salgan mañana ellos ni los sujos de sus estancias, hasta que por mi les sea mandado, y veréis un combate el mas extraño que hasta hoy nunca vistes, ni de que jamás oistes hablar." Esto fué luego hecho saber al gran soldan de Liquia y al soldan de Halapa, que tenia cargo de todas las huestes que estaban en la tierra; los cuales así lo mandaron á todas sur gentes, maravillándose mucho á qué podria acudir el pensamiento y obra de aquella reina.

TRANSLATION.

The Exploits of the very valiant Knight Esplandian, son of the excellent King Amadis of Gaul.—[Madrid, 1521.]

Chapter CLVII.

The marvelous and not thought of succor with which the Queen Catafia came to the Port of Constantinople in favor of the Turks.

I wish you now to know a thing the most strange which ever either in writing or in people's memory could be found, by which the city was the following day on the point of being lost, and how from there where the danger came, salvation came to it. Know then that to the right hand of the Indies, there was an island called California, very near the part of the terrestrial Paradise, and which was inhabited by black women, without there being among them even one man, that their style of living was almost like that of the Amazons. They were of robust bodies and valiant and ardent hearts and of great strength; the island itself was the strongest that could be found in the world through its steep and wild rocks; their arms were all of gold and also the harness of the wild beasts on which they rode after taming them, as there was no other metal in the whole island; they dwelled in well-finished caves; they had many ships in which they went to other parts to obtain booty, and the men whom they made prisoners they took along, killing them in the way you shall hear further on. And sometimes, when they were at peace with their adversaries, they used to mingle with them with entire confidence; if any of them gave birth to a son, he was put to death at once. The reason for it, as it was known, was because in their thoughts they were resolved to lessen the men to so small a number that they would be able to master them without much trouble, with all their lands, and preserve those who would understand that it was convenient to do so that the race might not perish.

In this island, called California, there were a great many griffins, the like, on account of the ruggedness of the land and the very many wild beasts therein contained, were not found in any other part of the world: and when they had little ones, these women would go covered with thick skins to catch them by tricks, and they would bring them to their caves and there rear them; and when they were accustomed to them, they would feed them with those men and with the male children they bore, so often and with such cunning that they very well learned to know them, and never did them any harm. Any man who landed on the island was at once killed and eaten by them; and though they might be glutted, they would not the less take them and lift them up, flying through the air, and when tired of carrying them, they would let them fall, where they would be killed at once. Well, at the time when those great men of the pagans departed with those large fleets, as history has already told you, there reigned in said Island California a Queen very tall of stature, very handsome for one of them, of blooming age, desiring in her thoughts to do great deeds, valiant in spirit, and in cunning of her fearless heart, more so than any of the others that before her reigned in that seigniory. And having heard how the greatest part of the world was moving in that expedition against the Christians, she, not knowing what beings were the Christians, nor having any knowledge of other countries except those which were next to hers, wishing to see the world and its different races, thinking that with her great valor and that of her adherents all that would be gained she would have, by force or by cunning, the largest share of, she spoke with all those that were skillful in war, telling them that it would be well that, going in their great fleets, they should follow the same road that those great princes and eminent men were taking, inciting and encouraging them by laying before them the very great honor and gain that might result to them from that undertaking; above all, the great fame that would resound in the whole world about them; that remaining in the island as they were, doing nothing but what their ancestors had done, would be only to be buried in life, like living dead, passing their days without fame and without glory, like wild animals.

So many things said to them by that very valiant Queen Calafia, that she not only moved her people to consent to the undertaking, but they, with their great desire that their fame should be published in many parts, hurried her to put to sea at once, so as to happen to be in the danger jointly with those great men. The Queen, who saw the determination of her people, ordered her great fleet to be supplied with provisions, and with arms all of gold and with all other necessaries; and she ordered the repairing of her largest vessel, made like a grate of thick timbers, and she had put into her up to five hundred griffins, which, as you have been told, she had raised from tender age and fed with the flesh of men, and having therein also put the animals on which they rode, and which were of different kinds; also, the best chosen and best armed women which were in the fleet, and, leaving such garrison in the island as to be secure, she put to sea with the others, and she hurried so much that she joined the fleets of the pagans the night of the combat, of which you have been told, which caused them all very great pleasure, and then she was visited by those great lords, who showed her great reverence. She wanted to know in what state was their enterprise, begging them to relate it to her minutely; and having heard the report from them, she said: "You have fought this city with your many people and could not take it; well, I with mine, if it is agreeable to you, will, on the following day, try the reach of my power, if you will accept my advice." All those great lords answered her, that whatever was by her indicated, they would order it executed. "Then notify at once all the other commanders that to-morrow, on no account, they nor theirs leave their quarters, until it is so ordered by me, and you shall see a fight the most strange never seen before this day, and of which you never have heard spoken." This was then made known to the great Sultan of Liquia and the Sultan of Halapa, who had charge of all the armies which were on land, and who thus ordered their people, wondering much what could be the thought and deed of that Queen.

GENERAL CONDITION OF MINING IN CALIFORNIA.

California is just emerging from a condition of things that will be remembered for many years to come with regret and astonishment, and which will pass to history as one of those periodic manias which come over mankind like a calamity and shake the very foundations of society.

If the majority of the people of the Pacific Coast should be informed that instead of having been engaged in mining, they have simply been gambling, and have in the most foolish manner possible, given up their money to a comparatively few unscrupulous and dishonest sharpers, they would be slow to admit the fact, yet perhaps in the annals of history, there has never been such a wholesale transfer of money from a multitude of pockets to a few, without consideration, under the deceptive but fascinating name of mining.

Stock gambling is in no sense mining. It is a favorite excuse by those who have lost their savings in this way, to say sadly, "I invested all my

money in mines and lost it," which most of them did not, but bought worthless stocks instead. To recount the most successful deceptions that have been practiced to induce those who had money to invest it in stocks, would fill many pages and leave much more to be said. Still honest gold and silver mining presents the best field for the investment of capital of any business in California, for the following reasons:

Gold is becoming scarce, and consequently its purchasing power is greater than it has been for many years. The market for gold is in no way dependent on the population of the Pacific Coast; while a large population is essential to render manufacturing successful. We can produce gold with perfect confidence that the market of the world will gladly take all we are willing to spare, and in return will manufacture for us cheaper than we can hope or desire to do for ourselves.

Mines can now be worked in California at a much less cost than during the delirium of the first gold excitement, for the reason that transportation, provisions, labor, and fuel are cheaper; and every ounce of gold obtained is practically of double value. These facts are well known to intelligent miners in the State, and our mines are being better worked than ever before. New quartz veins are being taken up wherever they can be found; and there are indications of a new era in mining, which, it is to be hoped, will cause renewed prosperity in the State, even if we cannot utilize our vast deposits of placer gold.

MINING ECONOMIES.

Within a few years railroad lines have been extended and settlements advanced. Ores that could only be worked if they would yield from twenty-five to fifty dollars per ton are now found to be rich, as they can be mined and milled at a very reduced expense. Dump piles, formerly considered worthless, are now valued at many thousands of dollars. Tailings, allowed to go to waste in former years, are now being prospected and assayed. The concentration of these tailings will furnish employment for many men in the near future.

When on a large scale gold quartz has been crushed in quartz mills, a sandy powder passes through the screens and over the amalgamating copper plates. Theoretically the gold contained in the quartz remains attached to the mercury; what flows away (which is nearly all that passes the screens) is known among miners as tailings. If the operation of milling was as perfect in practice as in theory, the tailings would be worthless, but this is not the case; not only does a considerable quantity of gold escape, but mercury also. The sulphurets, which are nearly always auriferous, are not decomposed in the operation, and carry their precious contents with them to the beds of the streams below the mills, or to the reservoirs, which the most prudent of superintendents or managers provide for the reception of the tailings. The ordinary quartz mill saves only *free* gold, and even a portion of that escapes, owing to defective milling, and the sometimes peculiar condition of the gold, which has been before referred to in these reports. Mercury is used in the batteries, and on the plates, but, notwithstanding the skill acquired by the amalgamators, and the experience of many years in California, a considerable portion escapes, taking gold with it that had already become amalgamated. To prevent this well known loss many ingenious inventors have spent years of their lives and much money in the construction of machines and in the planning of processes, many of which have been patented, until the art of concentration has reached a point approaching perfection. But there is still

room for improvement. There is a great future in California for the concentration of tailings and low grade ores which were wasted during the time of excitement, when it was found to be more profitable to extract gold and silver from the pockets of the credulous than from the mines. In this connection it is interesting to note that companies are now engaged, with large capital, in working the lead slags of Laurium in Greece, and other ancient mines in Spain, and with great profit.

The following newspaper extracts have a special bearing on this subject:

In cleaning up in quartz mills a lot of scraps of iron are always found, consisting of fragments from shoes, dies, shovels, picks, hammers, and drills; and these lumps are knocked about in the mortar until numerous particles of gold are driven into their interstices. A lot of such scraps collected in the Jefferson Mill, in Yuba County, supposed to weigh half a ton, after being broken up with sledges, were digested in warm sulphuric acid until the surface had been eaten away and the gold liberated, and the yield thus obtained was $3,000. The shoes and dies, being too large to be broken up or digested in acid, were boiled half an hour in water, and then when the iron was repeatedly struck with a hammer, the particles of gold dropped out.

The Pennsylvania Company have run a lot of tailings, formerly considered worthless, through one of Wheeler & Randall's grinding pans, and cleaned up eighty-four ounces of amalgam, worth $5 per oz.

In some comments yesterday on the new drift of mining industries, the more extreme instances of the working of low grade ores were not cited. In Calaveras County during the last two years more than eighty thousand tons of quartz rock have been worked by one mill, the yield of which rock was less than two dollars a ton. And yet this mine was worked at a profit—the yield per ton ranging from one dollar and eighty cents up to about one dollar and ninety-five cents. The assays show that the rock carried more gold. But this is all that could be saved by any process now known. Of course, when the yield per ton is so small, there must be many advantages of working. The quartz must be abundant, and there must be no long land transportation. It would appear from these and other facts that low grade gold quartz can be worked with as much advantage now in California as in Australia, or in any other part of the world. These facts are of special importance just now, while fresh attention has been turned to gold quartz mining in California. Gold bearing ledges will not hereafter be neglected because of low grade ores. Nothing comes amiss now in that way from two-dollar ore in good situations up to twenty-dollar quartz in more remote and less accessible districts.

The value of the gold in the tailings not only of the quartz mines, but the hydraulic mines, is something enormous. It is considered by the most practical miners in California that at least one half the gold in placer mining is lost—or, rather, not saved. The loss of mercury may be reckoned by hundreds, if not thousands, of tons. This can to a great extent be recovered by reworking and concentration. This subject is well worthy the attention of laborers and capitalists.

IMPORTANCE OF GOLD AND GOLD MINING.

It cannot be denied that the love of gold is widespread, intense, and universal. It is vain to argue that gold is not an absolute necessity—to say that we cannot eat or wear it; that it is heavy and cumbersome—for we learn both in ancient and modern history that from the earliest ages mankind would sacrifice almost everything else for gold, and would even risk their lives to obtain it. The producers of all other staples, and the manufacturers of all articles of use and luxury, will gladly transport them from the ends of the earth and lay them at the feet of the miner in exchange for his yellow gold.

During a golden age, such as that through which we have just passed, real and personal property increase enormously. Without gold it would be impossible that there should be so many men possessing great wealth,

known as millionaires. The country that produces, holds, or utilizes the most gold, makes the greatest progress, and advances most rapidly in civilization and power. The discovery of gold in California stimulated commerce and manufactures and general progress more than any event in modern history, and its effect was felt over the whole civilized world. Without it the Pacific railroads would not so soon have been built, nor would the advancement of the Pacific Coast have been so rapid.

There has never perhaps been a period when labor has been so well paid and the world progressed as during the recent golden age, for in all former gold excitements the precious metal was extracted by slave or convict labor, and enriched kings instead of the people. While it is true that the thirst for gold brings in its train many evils, it must also be admitted that it is productive of much good. It begins to be realized by the world generally what a powerful lever or motor gold is to commerce, manufactures, and trade; that on the product of distant gold fields depends the rise and fall of prices, including salaries, in countries not producing gold, and whether trade and manufactures shall thrive or languish. In the United States the importance of our gold production is too often wholly disregarded, or but slightly considered.

Gold is true wealth. It cannot be destroyed by fire or by the action of ordinary chemical agents, and will always command its bullion value in whatever state or condition it may be. It is not only wealth in itself, but is the accepted measure of all other values. There is no other description of real property that can be so readily turned to account as gold. It seeks no market; on the contrary, all branches of trade and commerce seek it.

In digging for gold, the most desired of all products, natural or artificial, the miner becomes a consumer of all other products, and has at the same time the power to purchase them, conditions which render trade or barter most active. In the exchange of commodities—the business of the merchant—nothing is produced; the world is accommodated, but actual wealth is not increased. So with the manufacturer. He adds to the value of the crude material, but adds nothing to the actual wealth of the world. The agriculturist also produces what is consumed as food, and must be reproduced from the same source. But the real wealth of the world is derived from its crude products, generally dependent upon mining. The checking of gold mining, then, in our State, becomes a very serious matter, and affects not only California, but the United States and the world. Since it can be shown that our great and exceptional prosperity for many years was owing to the advantage we derived from our prolific gold fields, is it not more than possible that we have made a great mistake in crippling the most important producers, the gold miners?

The failure of any legitimate harvest is felt far beyond the area of its production. Thus the sudden cessation of the cotton crop in the Southern States, during the civil war, was the cause of great and widespread destitution among the mill operatives of Great Britain. In the same way the decrease of the gold crop of California not only places the people of our State at great disadvantage, but is felt in the general depression of business and the stringency of the money market in the country at large.

When the supply of gold diminishes suddenly, there follows a series of financial crises, so calamitous and far reaching that the most distant lands suffer in common with us. It can be shown that the present shrinkage in values, which is distressing the laboring classes at home and abroad, is the direct result of this decrease of gold, and is only a repetition of what has occurred many times in history under similar conditions.

If you ask ten men of average intelligence the cause of the present

general stringency of the times, the uneasiness of capital, the clashing between laborer and employer, the uprising of the many against the few, the stagnation of trade the world over, the apparent overproduction of manufactures and crude material, each would give a different answer, and probably none of them would be the full solution of the question. The primary and immediate cause is the scarcity of gold. Other minor influences are generally local, and nearly all of them hinge on the former.

The best thinkers and financiers of Europe assume that the production of gold is less than the requirements, and gold coinage is nearly suspended.

Assuming, therefore, the fall of prices to be caused by the diminished gold production, we must admit that if this were gradual, it would occasion no serious distress. It is the *sudden* diminution that causes the disturbance. Our people have the same elements of prosperity, but cannot divert the property they possess, or exchange to mutual advantage as when gold was plentiful. It is claimed that gold is hoarded in bank and Government treasuries. If this was so, the very necessity of the case would cause it to be brought out and used. The real truth is that it is scarce, and becoming more so, and unless new and prolific gold fields are discovered, the present depressed condition of trade will continue until prices adjust themselves to the increased value of gold.

Because the management of our gold and silver mines has too often been unwise and extravagant, and because in the days of our plenty we have disregarded small things, it should not be charged that the business itself is defective. On the contrary, its excellence is proved by its frequent success, even under admitted mismanagement.

Gold mining is a legitimate, honorable, and interesting occupation, and, when properly conducted, as safe as any that can be mentioned. The Government of Victoria, in Australia, already realizes how important to the Colonies and the mother country is the continued production of gold, and has enacted laws to assist the prospectors in discovering and working new gold fields; while California, with less wisdom and foresight, discourages mining. It should be the policy of our State, as of other countries, to turn her vast mineral resources to the best account. Instead of crippling the gold miner, he should be encouraged and afforded special facilities for his work. Instead of treating him as a public enemy, he should be regarded as a useful and important agent in maintaining the wealth of the country. Instead of stopping the work of those who injure without malice a small portion of the agricultural lands of the State, we should rather consider the vast importance of the gold yield, and seek some remedy or formulate some plan, whereby the miner may continue his work and the farmer at the same time be protected.

BIMETALISM.

While it cannot be denied that gold is the king of metals, and that all values are measured directly or indirectly by it, silver and other inferior metals should not be scorned. From present indications California will become a large silver-producing State. Having had a period of gold production, a new era of silver begins to dawn upon us. It is known that at various times in the world's history, after an unusual output of gold, when that metal became scarce some inferior metal was substituted for it. Silver was at first taken for this purpose, but copper, and even iron, were also used for money. To this extent bimetalism is admissible and possible, but any attempt to establish and to long maintain a fixed relative value between any two or more metals, must result in failure.

The idea of sustaining a double standard is an absurdity. The word

standard implies something having a fixed or permanent value. While any one substance may be accepted as the measure of the comparative value of many or all others, if a double standard was possible, it would be equally possible to have a quadruple or multiple standard. There must be one standard, or none.

Any act of Legislature to create and maintain a double standard would be no less ridiculous than the deed of Xerxes, who lashed the Hellespont because it destroyed his bridge, or of Cyrus, who punished the river Gyndes.

So difficult has been the settlement of this question in times past—for it is as old as history—that the Chinese were compelled to substitute copper for gold as a measure of values. The standard, whatever its substance may be, is *fixed* only in name, for it fluctuates in obedience to the universal law of supply and demand; but as a standard it remains stationary, while everything measured by it fluctuates in proportion. This was shown in the case of United States currency during and immediately following the civil war, when paper was created a legal tender and assumed to be a standard. This was a fallacy, for while gold was said to fluctuate, it was in fact the currency that did so. In California, where we had no currency, the price of gold remained as nearly the same as it could, compared with other articles of commerce, and there was no change in the value of gold in other countries.

If it should be thought wise to make silver the standard, values would adjust themselves, and with an increased circulating medium, trade and commerce would prosper or seem to prosper as before. There would be no gold in circulation; if we wanted that metal we should have to buy it as we do any other commodity. Unless other nations also accepted the silver standard, our silver coin would be at a discount in all countries which retained the gold standard.

The acceptance by the United States of a silver standard would be a benefit to our State, for it would stimulate silver mining and lead to the opening of many mines now idle, whatever effect it might eventually have on trade and commerce.

We have the satisfaction of knowing that there are in our State practically inexhaustible reserves of the precious metals, which we can draw upon if we desire. That our people should not fully avail themselves of these advantages seems incredible.

DIFFICULTIES ATTENDING MANUFACTURING IN CALIFORNIA.

Another reason for encouraging mining in California is the difficulty which manufacturers experience in disposing of their products, owing to competition with the East and Europe, and to the small population of the State and Pacific Coast. If the miners cease to be producers they must embark in some other business or leave the State. If the former, there is no avenue open but agriculture, manufactures, or commerce, all of which are already full, not to say overdone. If there is no gold produced for exchange with other centers, it will prove a check to enterprise on this coast. The sudden cessation of the former golden income to our merchants, manufacturers, mechanics, and farmers, cannot but be felt in every department of industry.

Upon agriculture alone the former prosperity of our State cannot at present be maintained. In course of time, when our population becomes larger, and prices have sunk to a level with those in older States; when we form habits of economy, frugality, and providence; when we discover new coal mines, or learn to utilize our petroleum, and all the various resources

of our State, the general prosperity will equal that of others; but now, without gold, we have no special advantage over our sister States, save in climate.

Population of California and the Pacific Coast, as compared with other centers:

California, in 1880	864,694
Oregon	174,768
Washington Territory	75,116
Nevada	62,266
Arizona	40,440
Total Pacific Coast	1,217,284

New York and neighboring cities:

New York	1,206,299
Brooklyn	566,663
Newark	136,508
Jersey City	120,722
Patterson	51,031
Hoboken	30,999
Elizabeth	28,229
Total	2,140,451

It will be seen by the above figures that New York and the cities in its vicinity contain nearly twice as many people as the entire Pacific Coast.

How would New York prosper if it depended solely on its own inhabitants for a market? How can California support large manufactories with so small a market, and against the competition of eastern dealers, who have far greater advantages and facilities, and produce manufactured goods cheaper than we can?

BUILDING STONES AND BUILDING MATERIALS IN CALIFORNIA.

I have had occasion in all my reports to allude to the building materials already found and likely to be found, and the increasing use of them in the State. The subject is of such importance that I cannot refrain from again calling attention to it, to sum up recent discoveries made and to give general information, which I trust will be interesting and instructive to citizens of the State who have not the opportunity or the leisure to study the large number of reference works which treat on this subject.

HISTORY OF BUILDING IN ANCIENT AND MODERN TIMES, WITH SOME ACCOUNT OF THE MATERIALS USED IN CONSTRUCTION.

The question as to what shall replace the perishable structures now so generally built in the State, and especially in the city of San Francisco, is one that should engage the serious and immediate attention of our people.

To those who have not well considered this subject, the solution would seem to be simply the selection of some accessible stone and its immediate use in buildings, but such hasty action might prove an error.

In the history of the world very serious mistakes have been made in the selection of building stones, to the injury of individuals and communities.

There are certain conditions which render stones suitable and durable in one locality, but short-lived and nearly worthless in others.

This was strikingly illustrated in the selection of stone for the construction of the Parliament Houses in London.

In their native beds these stones had withstood climatic influences for centuries, and two fine buildings, Southwell Minster and York Minster, both of the same material, and both many years old, were still in a good state of preservation. But when the same stone was laid in the magnificent walls of the palace, in the smoky, acid, foggy atmosphere of London, decay early commenced, and a system of patching, painting, scraping, and cleaning was found necessary, which has been continued at intervals, to the disappointment and chagrin of the good people of the world's greatest city. The obelisk which stood for thirty centuries, more or less, in the dry atmosphere of Egypt, crumbled in a few years in New York. If it had been set up in Arizona, or on the Colorado Desert of California, and protected from wind-driven sands, its deeply sculptured hieroglyphics would, without much doubt, have remained legible for a thousand years more. The desirable qualities which characterize a really good building stone are: *First*, durability. *Second*, beauty. *Third*, ease with which it can be cut into suitable forms for use. And, *Fourth*, proximity to the cities where the stone is required.

The advantages of stone over other building material may be summed up as follows: beauty, durability, and safety from fire and ordinary earthquakes, the latter an important consideration in California, and one we may not ignore.

In the one item of insurance alone, should fireproof buildings replace those of wood, millions of dollars would be retained in the country, while the cost of the Fire Department system would be reduced to a minimum.

The construction of good buildings gives employment to mechanics and workingmen, who are thereby enabled to support their families, and to live in comfort. Another consideration which is often overlooked is loss of capital employed in the construction of perishable buildings which become worthless in a few years. The rocks most generally used as building material are: *granite*, *syenite*, *porphyry*, *diorite* or *greenstone*, *lavas*, including basalt and trachyte; *freestones* or *sandstones*, and *limestones*, including tufa, travertine, and dolomite, *slates*, *serpentines*, etc.; all these are found in California and most of them are abundant.

The crust of the earth, as far as known to man, is composed principally of seven minerals, to the extent of nineteen twentieths, as follows:

1. Quartz.
2. Talc or steatite.
3. Serpentine.
4. Hornblende and augite (varieties of pyroxene).
5. Feldspar, several varieties.
6. Mica.
7. Carbonate of lime.

When two or more minerals are mechanically mixed they form *rocks*, as generally understood. Some minerals occur in such large masses that they also are classified as rocks. The crystalline rocks as granite, syenite, gneiss, etc., are complex, and contain nearly, if not all the elements which enter into the composition of volcanic, plutonic, sedimentary, and metamorphic rocks, including the metals, gold, silver, lead, tin, iron, etc.

They decompose to sand, kaolin, and alkalies, which form new combinations in soils and minerals. Sandstones, shales, slates, mica schists,

and argillaceous rocks, are built up of the ruins of older crystalline rocks, and, if we are not mistaken, return to their former condition and become crystalline rocks again.

In California building stones abound. It was a wise remark made by some writer unknown to me, but frequently quoted, that "Time seldom spares what it does not take time to create." This aptly applies to the art of building, an art greatly conducive to the comfort, prosperity, and happiness of mankind.

Wood was extensively employed in building ancient cities. These temporary houses were replaced first by brick, and then by those constructed of marble and other building stones. Wood was largely used in Rome. Up to the time of Augustus brick was the common building material, but the upper part of the better class of dwelling houses still continued to be of wood. From the reign of Augustus better materials were generally introduced, and after the great fire in Nero's time, a volcanic rock now called "peperino" came into quite common use. Nero did not allow the wooden upper structures to be renewed, and made the streets wider and straighter. Peperino is a volcanic ash, cemented by carbonate of lime or silica. It is very light, and for that reason suitable for a certain class of buildings. It was extensively used in the ancient cities of Herculaneum and Pompeii. This rock, or one of a similar character, is abundant in California.

Specimens from ancient Rome may be seen in the State Museum, numbered 6437, and others.

During the splendor of the Empire magnificent and costly buildings, both public and private, were erected in Rome; each Emperor vieing with his predecessor in their construction. After the time of Augustus, the then known world was ransacked for new and elegant marble. It was early discovered that certain volcanic tufas or ash, called Pozzuolana, when mixed with the proper proportion of lime, became a hard and durable cement.

The discovery of the cementing properties of this material seems to have been accidental. At Baiæ, on the coast of Italy—which was a celebrated watering place and resort of the wealthy Romans in ancient times—it was thought desirable to increase the coolness of the situation by building the summer villas on masonry, extending beyond the shore, and surrounded by the waters of the bay. In experiments for this purpose, made with different cements or mortar, a kind of earth now known to be of volcanic origin, was discovered at Puteoli, to which the name of Pulvis Puteolanus was given, afterwards corrupted to Pozzuolana, by which it is still known.

It is claimed by historians, that tc the discovery of this cement, Rome owes, in great measure, the massive and stately character of her public works and buildings, and that without it, the magnificent bridges, aqueducts, and roads, would ere this have fallen into decay.

California is known to be rich in volcanic materials, and it is not unlikely that Pozzuolana may yet be found among them. Such a discovery by the State Mining Bureau would be worth more to California than the whole cost of the institution since its inception. The fact that our State is specially subject to earthquakes, must be admitted. It is also known that it is possible to construct buildings that will resist all but the most violent shocks. Since the weakest part of modern buildings is the cement or mortar with which they are put together, it is evident we must improve the quality of that, in order to insure their durability. It has been observed in many old Roman structures, that the mortar outlasts the stones themselves, and that where the latter have been worn away by the

influence of time, the cement, in some cases, actually projects from their surface.

A tufaceous limestone or travertine of a pale straw color was found in extensive quarries near Tivoli, a few miles from Rome, which proved to be a durable and beautiful building stone. This became the principal building material of the ancient and modern city. It was selected by the Emperor Augustus, and soon a style of building which combined travertine with Carrara marble became very popular. The first great public building of this material was the Colosseum, which was finished by Vespasian and Titus. After it fell into ruin, it became a convenient quarry from which stones were selected to put into more modern buildings, and it is intimated that even Michael Angelo was guilty of this vandalism.

In more modern Rome the following well known buildings and many others of lesser note, are built of travertine: *St. Peter's*, the *Museum and Church of Lateran*, the *Castle of St. Angelo*, and the *Quirinal*.

Travertine had the convenient property of being soft when first taken from the quarry, and could be cut with a common saw, but it hardened with time. Specimens of pozzuolano and travertine also find a place in the State Museum. In ancient Greece marbles were also extensively used; in Egypt granite, syenite, and porphyry; in Babylon, sun-dried brick and asphaltum.

Many of the ruins of ancient cities show that architecture had reached a point, even in very ancient times, as near to perfection as anything human can. It is admitted that the moderns have never equaled the ancients, and at the present time our best architects are content to imitate them.

Marble is generally understood to be *carbonate of lime*, either white or colored, uniform or variegated, and pleasing to the eye; the term is also applied to any colored stone soft enough to easily cut, and hard enough to bear a good polish. Under the latter meaning may be classed the following minerals and rocks: dolomite, serpentine, verde antique, steatite, ophite, and even diorite, and porphyry; *Inyo marble*, so called, is dolomite.

Webster gives the following definition of marble: "Any species of calcareous stone or mineral of compact texture, and of a beautiful appearance, susceptible of a good polish; any firm limestone, fitted when polished or otherwise for ornamental use. Also other rocks of nearly the same hardness, capable of the same uses, as serpentine; but improperly, polished slabs of harder rocks, as porphyry, granite, and the like."

The name is derived from a Greek word, to *sparkle* or *flash*.

True marble is *carbonate of lime*, composed of carbonic acid and the oxide of calcium, or lime, in the following proportions:

Carbonic acid	44
Lime	56
	100

Edward Clarke, who traveled in Europe in the year 1800 and after, came to the conclusion, from his large experience and observation, that Parian marble was the most enduring of stones used in ancient sculpture and architecture; but Geike, the English geologist, informs us that inscriptions on marble tombstones, in large towns where coal smoke and rain are abundant, become illegible in fifty years. Crystalline limestone has been formed artificially by heating chalk or lithographic stone, which seems to prove that marbles are metamorphic. The accounts given by travelers and historians concerning the art works of the ancients, are almost incredible. Clarke describes in pleasing detail the architectural ruins met with by him in the Crimea, in Greece, and on the plain of Troy; Volney has written in the

most charming language of the ruins of Palmyra; and Pliny informs us that the art of cutting marble into slabs dates back to the building of the palace of Mausolus at Halicarnassus. The walls of that celebrated building, one of the seven wonders of the world, were of brick, covered with Cyzican marble from Proconnesus.

This art was introduced into Rome, and the described mode of cutting, by the use of strips of iron and sand, does not materially differ from that practiced at the present day.

The same author states that marble began to be used in public buildings in Rome in the Ædileship of M. Sacurus. His theater, described by Pliny as "the greatest that has ever been made by the hands of man," was three stories high. The lower was of marble, supported by three hundred and sixty columns of the same material; the second of glass, and the highest of gilded wood. This building was planned to seat eighty thousand spectators. After this period there was a rivalry as to who should erect the most costly and grand public buildings; interior walls were not only covered with the most costly imported marbles, but the stone was richly sculptured, and even in part painted or gilded. In the time of Nero, a method of inserting spots, or ornamental patches of other marbles, was invented—a sort of Mosaic or inlaid work, very costly and unnatural, but nevertheless much admired.

Then followed a general mania for marbles and rare ornamental stones, which were introduced into private as well as public buildings, and which were sought in every part of the known world.

The first private citizen who covered the entire walls of his house in Rome was Mamurra, who was only satisfied with the costly and rare marble of Carystus and Luna, the modern Carrara. M. Lepidus made the lintels of his house of Numidian marble (Giallo Antico), in the year of Rome 676. A few years later columns of foreign marble were first erected in Rome by L. Crassus, the orator; his house on the Palatine Hill was remarkable for its magnificence. The columns were six in number, and twelve feet in height; they were of Hymettian marble (Carrara).

L. Lucullus, when Consul, introduced into Rome a black marble, which was found on the island of Melos, and named Lucullan marble after him. We are indebted to Pliny for this information.

The following is a list of the rarer and most noted of ancient marbles:

White: Parian, Pentellic, Luna.
Black: Lucullan, Nero Antico.
Red: Rosso Antico, Cottonello.
Green: Verde Antico.
Variegated: Lumachella, Phrygian, Oriental Alabaster or Onyx.

The Parian and Pentellic marbles were pure white, and were considered better than those of Carrara. They are nearly pure carbonate of lime. Parian was found on the Island of Paros, one of the Grecian Archipelago. It could be distinguished by a peculiar luster on the freshly broken surface. The quarries from which this fine marble was obtained are very ancient. Pentellic marble was from Mount Pentellicus, in Attica, ten miles only from Athens. The Parthenon, in that ancient city, was constructed of this stone. Being completed in 438 B. C., it has resisted the destroying hand of time for two thousand three hundred and twenty-four years. Phidias, born four hundred and ninety years B. C., and Praxitales, celebrated Grecian sculptors, both worked on this, the most magnificent of ancient or modern buildings. The Pentellic quarries have been lately reopened.

Luna or Carrara marble is also nearly pure carbonate of lime (98.1 per cent), the usual impurities are clay, pyrites, and quartz. The marble often contains imbedded crystals of quartz, perfectly transparent and doubly terminated, called "Cararra diamonds." There are a number of varieties of this marble, but the best has a delicate waxy luster which is much admired; there are many fine specimens in the State Museum. The quarries of Carrara are supposed to have been opened by the Romans one hundred years B. C.; they were worked in the time of Julius Cæsar, and more extensively in the time of Augustus, who was called by Livy "the builder and restorer of all the temples." The ancient Etruscan seaport of Luna, eight miles from Carrara, described by Pliny as a "noble harbor," is now more than a mile and a half inland, with meadows extending to the shore. Marble was largely used in the construction of this city; large blocks still remain which are supposed to have been the seawall, from a large metal ring found attached to one of them. During the dark ages, Luna having then fallen into decay, was robbed of its marble blocks and columns, which were sent to construct buildings elsewhere. The marble for the Pantheon at Rome was brought from Carrara; this building was erected by Agrippa twenty-six years B. C., and is still in a good state of preservation. The palace and arch in the Via Domizi, and the baths of Caracalla are of Carrara marble. Lucullan black marble was supposed to have been brought from Meroe in Abyssinia; it sometimes showed small spots and veining of white, but the best quality was pure black. A California marble, recently found near Colfax, and numbered 2799 in the State Museum Catalogue, answers very nearly to the description of the Lucullan marble. The "Nero Antico" was also a black marble, said to have been found in Laconia; it was fine-grained and compact, sometimes showing delicate veining of white.

Fragments of "Rosso Antico" marble are frequently found in the ruins of ancient Rome. The locality of the quarry is unknown, but a similar, if not the same, marble has recently been found at Skautari, a village in Greece. It is of a deep blood red color, sometimes inclining to purple, and even rose color; and sometimes clouded with white, black, or purple lines. A fine specimen from ancient Rome may be seen in the State Museum, numbered 6020. This marble was much admired and prized by the ancients. A marble of beautiful rose color has been found in California; it is numbered 5344 in the Catalogue of the State Museum, and is nearly identical with "Rosso Antico." Very little is yet known of its occurrence, but it is likely to be valuable and important. A description has been given elsewhere.

Cottonello marble was found near a town of the same name a short distance north of Rome. It was of many shades of red, but of inferior quality, although somewhat extensively used.

"Verde Antico," or as it is now called in English, "Verde Antique," is not a true marble, but is serpentine combined with carbonate of lime or magnesia. It was much prized by the ancients, and is still extensively used. The color is due to oxide of chrome, and as chromic iron and serpentine are both common and abundant in California, there is reason to hope that this beautiful ornamental stone may yet be found in the State. There are many fine specimens of "Verde Antico" from Italy in the State Museum.

"Giallo Antico" was considered one of the most valuable and beautiful of the ancient marbles. The grain was very fine, and the coloring beautiful and rich. It resembled the Sienna and Verona marbles, but exceeded them in beauty and texture. It was first found in Numidia, in Northern Africa, and for that reason sometimes called "Numidian marble." It

received a high polish. The base or keynote color was yellow of many shades, from the deepest to nearly white or pale straw color. Some varieties were brecciated, and others veined or mottled.

There are a number of examples of this marble still to be seen in Rome; columns at the Pantheon, the Arch of Constantine, and two columns at the Vatican. An ancient quarry has lately been discovered in Algiers, which is supposed to be that worked by the Romans, and afterwards abandoned and lost.

A beautiful yellow brecciated marble has been found at Tehachapi in Kern County, California, which resembles some of the described varieties of "Giallo Antico." It is certainly very beautiful. It is numbered 710 in the State Museum Catalogue. Another mention of this beautiful marble is made elsewhere.

Sienna marble, found near Volterra, is from cream color to dark yellow, sometimes veined with white, and even black. It is much employed at the present time, and is a durable and beautiful ornamental stone.

Nummulitic, or Verona marble, is in color from cream to nearly white. It was much used in ancient and mediæval buildings; the Roman amphitheater of Diocletian was built of it. It was extensively used in Venice; the porch and interior columns of the cathedral of Verona are fine examples.

Lumachello, or "fire marble," owes its wonderful brilliancy and play of colors to imbedded shells; it is now found at Bleiberg in Carinthia.

The Phrygian marble was very rare and costly; the ground color was creamy white, with veins of dark red, sometimes pink, or yellow. From its fancied resemblance to the plumage of the peacock, it was sometimes called "Pavonazetta." The Emperor Hadrian was very fond of it, and it was used in the construction of his tomb. The temples of Juno and Jupiter had one hundred and twenty columns, and a pillar of it was found in the ruins of Pompeii.

Oriental alabaster or onyx marble was held in high esteem by the ancients a thousand years or more ago. The quarries were lost, and for a long time remained unknown, until rediscovered in Egypt in 1849, by M. Delmonte, a French traveler. The marble of the same nature found in California and known as "Suisun marble," and "California onyx," is more beautiful in some of its varieties than the ancient, and it has gained a world wide reputation for beauty. In the fourth annual report of this office, on folio 72, this beautiful ornamental stone has been described, and the principal locality given. Attention has only lately been called to the marbles of our State, and while few fine varieties are known, many more will doubtless be found. There is reason to believe that there will soon be an awakening in our State and principal cities to the importance of this subject, and in time our mountains, now so celebrated for the vast quantities of gold they have given to the world, will be searched over for building materials, and the fortunate person who discovers a quarry of good building stone or marble, will be more sure of a fortune than the gold seeker who now prospects the heights for the precious metals. In anticipation of this, new localities have been recorded in these reports, and discoveries already made. It will be seen that during the few years of the duration of the State Mining Bureau, that something has been accomplished in this direction.

TECHNICAL DESCRIPTION OF THE RED MARBLE (ROSEO ANTICO), FOUND IN AMADOR COUNTY, MENTIONED ABOVE.

Color, blood red, with mottlings of a slightly different shade, and an occasional vein of pure white. Specific gravity, 2.828; hardness, 3. By

qualitative analysis it was found to contain *lime*, *carbonic acid*, *oxide of iron*, and *silica*.

It dissolves with violent effervescence in hot hydrochloric acid, leaving a small red insoluble residue. The filtrate was golden yellow; ammonia threw down a heavy precipitate, leaving a transparent and colorless liquid, in which oxalate of ammonia caused a heavy precipitate of lime. This filtered off, phosphate of soda gave no precipitate, but the filtrate became slightly opalescent.

A few fragments of the marble, heated to redness in a platinum crucible, lost 14 per cent by weight. The residue was nearly white. It slaked and became hot on addition of water, but still contained carbonic acid, and effervesced slightly with hydrochloric acid. When dissolved and the residue dried on a water bath, a considerable portion was found to be magnetic. The non-magnetic portion looked, when seen under the microscope, like selenite, or more like brucite.

A sample treated in powder with cold diluted hydrochloric acid, left a large red residue, 9.4 per cent, and the solution was colorless. The red residue was partly soluble in boiling hydrochloric acid. Fused with alkaline carbonates it became decomposed, and was then soluble in hydrochloric acid, leaving a residue of silica, equal to 3.74 of the marble. The solution containing sesqui-chloride of iron was golden yellow; ammonia precipitated all the iron, leaving the solution colorless.

The yellow brecciated Tehachapi marble, from Kern County; the California giallo antico, mentioned above, was also examined chemically. It effervesced with acids and was nearly all soluble, the insoluble portion being only 1.6 per cent. From the solution carbonate of soda threw down a precipitate weighing 92 per cent.

Mr. Israel Luce, of Sacramento, called April 20, 1886, at the State Mining Bureau, and gave the following information regarding the locality of this marble.

The deposit is a large one, and is situated half a mile from the town of Tehachapi, on the road to Caliente. At that distance, on a flat on which there are springs of water, stands a small house. Less than a quarter of a mile from the house, up the hill, by an old wagon road, the excavations may be seen, and some large blocks lie quarried out. Mr. Luce says that some of the marble is of a pure yellow color and very beautiful.

TEHACHAPI MARBLE (not Giallo Antico).

Mr. W. G. Campbell called April 23, 1886, at the State Mining Bureau and informed me that the so called *Tehachapi marble* is found nine miles west of the town of Tehachapi, in Bright's Valley. It is found in large quantities, and there is a large block at the railroad station at Tehachapi. The marble is fine grained and beautifully mottled, resembling specimen No. 5860 of the museum catalogue.

The beautiful recently discovered Humboldt marble is found on the lumber claim of Flanegan & Brosman, seven miles from Eureka. This is all the information this office has concerning it.

DOLOMITE.

Dolomite is a double carbonate of lime and magnesia, sometimes in chemical equivalents, sometimes in mechanical mixture. It is called by many names, as dolomite, magnesian limestone, bitter spar, magnesian spar,

pearl spar, brown spar, compound spar, rhomb spar, muricalcite, picrite, tharandite, miemite, conite, gurhofian, and, lastly, Inyo marble.

It is considered true dolomite when in chemical proportions, otherwise magnesian limestone. Its hardness is from 3–5 to 4; specific gravity, 2–9; weight of cubic foot, about 180 pounds; luster, from vitreous to earthy; color, white, various shades of rose red, gray, brown, green, or nearly black. The composition is so varied that no single analysis would convey a correct idea; when expressed by the formula, Ca O, CO_2+MgO CO_2, it contains—

Carbonate of lime	54.35
Carbonate of magnesia	45.65
	100.00

In Klaproth's Chemical Mineralogy, published in English in 1801, may be found detailed analyses of two specimens, one from Sweden, and the other from the Tyrol, since which time very many analyses have been made and published. Before 1791 dolomite was confounded with the limestones, until the celebrated French chemist and mineralogist, Dolomieu, called attention to it. He first noticed it among the remains of ancient sculpture in Rome. In a paper to the Journal of Physics, he described it under the name of "A calcareous stone which effervesces but little with the acids." Saussure, a Swiss naturalist, found it in place in the Alps, and named it after the original discoverer "dolomie." The present name, "dolomite," was given to it in 1794 by Kirwan, an Irish chemist and mineralogist.

Dolomite was originally a sedimentary rock; this is proved by the fossils it often contains. There are several theories as to its formation, but the chemistry of its genesis is admitted to be very imperfectly understood. One theory is that it was formed in the beds of large lagoons, which became inland seas by being cut off from the ocean by some geological change in the earth's surface. As the confined water slowly evaporated, it dropped its lime, its salt, and lastly its magnesia, forming beds of dolomite. This theory is supported by the fact that beds of clay, gypsum, and rock salt are frequently found associated with dolomite. Another theory is that it was originally a precipitate let fall from the primitive sea by supersaturation, as thinolite is now being and has been formed in the alkaline lakes of the Great Basin of California, Nevada, and Utah. Still another theory assumes that the deposit was originally limestone, formed at the bottom of an ancient ocean, and that metamorphism has taken place by the addition of carbonate of magnesia from concentrated sea water, or by the abstraction of a portion of the lime by the action of water holding carbonic acid from a mineral or rock already containing a notable quantity of carbonate of magnesia. Dolomite has been formed artificially in several instances. Once in a glass flask containing a mineral water, which held bi-carbonate of lime and magnesia in considerable quantity, crystals of dolomite formed from two to three millimeters long.

Morlot produced dolomite crystals by heating carbonate of lime with solution of sulphate of magnesia in a closed tube.

Durocher subjected fragments of porous limestone in a bed of chloride of magnesium for three hours in a gun barrel kept at a red heat. Dolomite crystals formed which were stained yellow by iron. Other successful experiments of a similar nature have been recorded.

Dolomite has been used in sculpture, in architecture, and for making lime and cement. In the United States lime made of it is held in esteem,

but in England it is considered of bad quality, and is not much used. Magnesian limestones burn more easily, slake more slowly, and do not set so quickly as other limestones. As a building stone dolomite ranks among the best, but there are many different qualities, some of which are inferior to others. It is one of the chief building stones of the north of England, where a silicious dolomite is used in paving and building which gives perfect satisfaction. A yellow dolomite was used for the front of the Museum of Practical Geology in London, and the Parliament houses are built of it; but it has been shown that this stone was a failure. The commission of geologists and scientific men appointed to select a suitable stone for these buildings decided that crystalline dolomite was the best and most durable in proportion as the composition approached a mixture in chemical equivalents.

Dolomite was much used by ancient sculptors. The Apollo Belvidere, the greatest existing work of ancient art, is of dolomite. It was so called because placed in the belvidere of the Vatican. It represents the deity at the moment of his conquest of the python. The statue was found in the ruins of ancient Antium in 1503, and placed in the Vatican by Pope Julius II. Many other statues and works of art are of dolomite.

The so called Inyo marble has been selected for the building material to be used in the construction of the Sharon Gate at Golden Gate Park, and of which I am quite sure the people of San Francisco and California will be proud. It is my opinion that no use of the generous bequest could be more appropriate, or more likely to give general satisfaction, and I am fortunate in knowing by actual observation something concerning this now much-talked-of "Inyo marble."

As early as 1862 I traveled from the south side of Mono Lake to the head of Owen's Valley, then without a house or a settler north of Camp Independence. From Adobe Meadows our party of four saw for the first time the grand summit of White Mountain, capped with what seemed to be snow, slightly yellow in tint, which we attributed to the golden light of the setting sun, or dusty particles blown upon it from the desert adjacent; but snow it certainly appeared to be. When, however, we reached the base of the mountain, I discovered that the apparently snowy summit was in reality composed of a white rock; and in the rugged cañons we picked up fragments which, when freshly broken, were as pure and white as the finest Carrara marble. Subsequent chemical examination proved it to be dolomite of the finest quality. This was the now celebrated Inyo marble, which is found in numerous localities in the Inyo Range, from White Mountain south one hundred miles or more. While we make special mention here of Inyo marble, we must not for that reason omit to state that other beautiful marbles and building stones are found in those mountains, which I have seen and examined with great interest.

The most beautiful porphyries, equal to those of Egypt, are of frequent occurrence, while granite, syenite, pegmatite, and various crystalline and metamorphic rocks are met with in the sublime cañons, or lie tilted against the flanks of the higher mountains.

TECHNICAL DESCRIPTION OF INYO MARBLE.

Color, pure white, saccharoidal, cryptocrystalline, hardness between 3 and 4, scratches calc-spar with ease, specific gravity 2,856, which being the case a cubic foot will weigh 178.5 pounds avoirdupois. While in mass the mineral is resistant to crushing force, a small fragment can be crumbled between the fingers to a crystalline powder, which under the micro-

scope may be seen to be obscure crystals with concave faces; some four sided pyramidal terminations are more distinct. At a red heat continued for two hours, the mineral loses 30.3 per cent by weight; the calcined mineral when wet with water becomes very hot and falls to a powder. In cold concentrated hydrochloric acid the mineral even when pulverized effervesces but feebly, but on application of heat the action is intensified, and a perfect solution is obtained which is golden yellow when concentrated, and pale straw color when dilute. The hydrochloric acid solution becomes darker colored on addition of nitric acid, and solution of sulphocyanide of potassium imparts a deep blood red color to it. From the first solution ammonia throws down a small precipitate; the filtrate from this precipitate is colorless. Oxalate of ammonia throws down a copious precipitate; this being filtered off, phosphate of soda gives a second and also copious white precipitate. The mineral does not absorb water to any considerable extent; a fragment weighing 39.71 grains, soaked in water for twenty-four hours, increased in weight only 79 milligrams.

Before the blowpipe on charcoal the mineral falls to a powder like aragonite. This is owing to the fact revealed by the microscope that it consists of crystals distinct in themselves held together by a feeble force. In a closed glass tube the mineral gives traces only of water. These reactions show the presence of the following substances: Carbonic acid, lime, magnesia, iron, alumina. The two latter in small quantities, and traces of water. A full qualitive and quantitive analysis will be made in the future.

Measurements of the crystals, average of ten, in decimals of an inch:

Smallest	0 — 00082 +
Largest	0 — 02853 +
Average	0 — 01472 +

Mr. Israel Luce, a marble cutter of Sacramento, has given the following information as to the quarry from which the Inyo marble is to be taken to build the Sharon gate to the park: It lies a few miles from Keeler and near the lake. The exact locality is the southwest quarter of section fourteen, township sixteen south, and range thirty-seven east. It is owned by the Inyo Marble Company, incorporated last September in the State of Nevada.

A variety of dolomite has been found cropping on the Contra Costa hills, not far from the State University. When found it was said to be pozzuolana. An analysis made by Professor Rising, of the State University, gave the following result:

Lime	24.52
Magnesia	17.48
Carbonic acid	38.48
Alumina and iron	3.13
Silica	14.55
Water	2.09
	100.25

The rock has not been sufficiently developed to prove its quantity.

THE FOLLOWING ARE LOCALITIES

Of the principal rocks, building stones, and building materials collected by the State Mining Bureau:

1. AGALMATOLITE (?), somewhat resembling the Chinese figure stone. This beautiful ornamental stone is found two miles west of Greenwood, El Dorado County, in a vein from six inches to a foot in thickness.
2. BASALT, plains between Oroville and Pence, Butte County.
3. BASALT. Used for street pavement. Mt. Pisgah quarries, one mile south of Petaluma, Sonoma County.
4. FINE GRAINED DIORITE OR BASALT, Folsom, Sacramento County. Strongly resembling serpentine externally.
5. BUILDING STONE, Mr. Wheat's house, Double Springs, Calaveras County.
6. DIORITE, wall rock of the Clipper Gap Iron Mine, Placer County.
7. DIORITE, near the bridge, section fifteen, township eighteen north, range thirteen east, Mount Diablo meridian, Placer County.
8. DIORITE, township thirteen north, range eight east, Mount Diablo meridian, Placer County.
9. DIORITE, iron mines near Clipper Gap, section twenty-four, township thirteen north, range eight east, Placer County.
10. DIORITE, wall of furnace building, Clipper Gap Iron Mines, Placer County.
11. DIORITE, fine grained, Mineral Hill District, Mono County. It contains considerable finely divided magnetite.
12. DIORITE, fine grained, in which magnetite is replaced by pyrites, Mineral Hill, Mono County.
13. DIORITE, croppings near Cave City, Calaveras County.
14. DOLERITE, east wall, Comanche Mine, Mono County.
15. DOLOMITE, Modoc Mine, Inyo County.
16. DOLOMITE, Guadalupe Quicksilver Mine, Santa Clara County.
17. DOLOMITE (resembling fossil coral), Morro, San Luis Obispo County.
18. DOLOMITE, Deep Spring Valley, Inyo County.
19. DOLOMITE, white, Amargosa Wash, San Bernardino County.
20. DOLOMITE, Inyo County.
21. DOLOMITE, white, Tujunga Cañon, seven miles from San Fernando, San Gabriel Mountains, Los Angeles County; valuable for building and manufacturing purposes.
22. DOLOMITE (impure), found near the State University, Berkeley, Contra Costa County; mistaken for pozzuolana.
23. FOSSILIFEROUS ROCK, near Soledad, San Diego County.
24. GARNET ROCK, Calpella, Mendocino County. A large cropping.
25. GLAUCOPHANE ROCK, wall rock of the Collier Mine, six miles northeast from Murphy's, Calaveras County.
26. GNEISS, brought to San Francisco on river schooners and used for street pavements.
27. GNEISS, said to be found in San Francisco in place.
28. COARSE GRANITE, near Sacramento.
29. GRANITE, Newcastle, Placer County.
30. GRANITE, Folsom, Sacramento County.
31. GRANITE, Rocklin, Placer County.
32. GRANITE, Yosemite Valley, Mariposa County.
33. GRANITE, Mariposa Mine, Mariposa County.

34. GRANITE, Crystal Lake, Summit Valley, Nevada County.
35. GRANITE (micaceous), near Penryn, Placer County.
36. GRAVEL, San Pablo, Contra Costa County.
37. GRAVEL, distinct from the sandstone; used in macadamizing streets, Los Angeles.
38. HORNBLENDE ROCK, Santa Barbara Mountains.
39. HORNBLENDE ROCK, Healdsburg, Sonoma County.
40. HORNBLENDE ROCK, Folsom, Sacramento County.
41. HORNBLENDE ROCK, Gold Run, Placer County.
42. LAVA, Mendocino County.
43. LAVA, Napa County.
44. LAVA, compact, near St. Helena, Napa County.
45. LAVA, basaltic, near Calistoga, Napa County.
46. LAVA, red, Butte Mountain, near Jackson, Amador County.
47. LAVA, near Santa Rosa, Sonoma County.
48. LAVA, trachytic (?), which caps isolated hills between Milton and San Andreas, Calaveras County.
49. LAVA, brecciated, found in immense cliffs, Little Shasta River, Shasta County.
50. LAVA, basaltic, showing a scale, which is due to oxidation of iron to limonite, near Doon's Mill, Butte County.
51. LAVA, white (so called), indurated volcanic ash, near Murphy's, Calaveras County.
52. LAVA, which exists in immense quantities on the borders of Mono Lake, Mono County. Owens River cuts through this formation in a deep cañon. It is easily decomposed, and supposed to yield the soda salts so abundant in that region. It crops out also at Adobe Meadows, in Mono County.
53. LAVA, white (so called), probably indurated volcanic ash, Southern Pacific Railroad, Los Angeles County.
54. LAVA, and pumice, Alviso, Santa Clara County. The Guadalupe River winds through a chain of volcanic vents. They rise but a few feet above the valley.
55. LAVA, cellular, with zeolite, Soledad Cañon, Los Angeles County.
56. LAVA, cellular, Captain Jack's Cave, Modoc Lava Beds, Modoc County.
57. LIMESTONE, calcite, Santa Cruz.
58. LIMESTONE, San Bernardino County.
59. LIMESTONE, tufaceous (thinolite?), Lassen County, section thirty, township thirty north, range fourteen west.
60. LIMESTONE (marble), Clipper Gap Lime Quarry, section thirty, township thirteen north, range nine east, Mount Diablo meridian, Placer County.
61. LIMESTONE (marble), Cave Valley, near Auburn, Placer County.
62. LIMESTONE (hydraulic?), found at the residence of Captain J. M. McDonald, San Francisco.
63. LIMESTONE (fossiliferous), Almaden Consolidated Quicksilver Mining Company, southwest quarter section thirty-four, township twenty-six south, range ten east, San Luis Obispo County; elevation fifteen hundred feet.
64. LIMESTONE, Bridgeport, Mono County.
65. LIMESTONE, Tres Pinos, San Benito County, fifteen miles east of the town.
66. LIMESTONE, Modoc Mine, Inyo County.

67. LIMESTONE, arenaceous, found in the bed of the river, near Yreka, Siskiyou County.

68. LIMESTONE OR MARBLE, blue, with veins of white, Pence, Butte County. It is soluble in hydrochloric acid with effervescence, leaving a small hepatic residue—when struck with a hammer it emits a feted odor—anthraconite—burns to a pure white lime, which slakes perfectly. This stone is well adapted for building purposes, as a useful and ornamental stone. Valuable, also, for manufacturing purposes.

69. LIMESTONE, Posa Creek, foothills of the Sierra Nevada, Kern County.

70. LIMESTONE, near Auburn, Placer County.

71. LIMESTONE, silicious, with what seems to be graphite or molybdenite in small scales, Kern County.

72. LIMESTONE (marble), Bitterwater Ranch, San Benito County.

73. LITHOGRAPHIC STONE, Kern County.

74. MAGNESITE (carbonate of magnesia), Tulare County.

75. MAGNESITE, Damascus, Placer County. Large quantities of this mineral at the locality.

76. MARBLE, white, fifteen miles from Monterey.

77. MARBLE, near Angel's Camp, Calaveras County.

78. MARBLE, Bear Creek, three miles from Colfax, Nevada County.

79. MARBLE, Abby's Ferry, Tuolumne County.

80. MARBLE, Giallo Antico, Tehachapi, Kern County.

81. MARBLE, white, Tuolumne County.

82. MARBLE, white, section fifteen, township thirteen north, range eight east, Mount Diablo meridian, Placer County. This marble has been used in San Francisco for the generation of carbonic acid in the manufacture of mineral waters. It is used also as a flux in iron smelting.

83. MARBLE, white, Tehachapi, Kern County.

84. MARBLE, black, near Central Pacific Railroad, two miles above Colfax, at the lower end of the high trestle, Placer County.

85. MARBLE, half a mile from the railroad depot, Auburn, Placer County.

86. MARBLE, from the Cave, at Cave City, Calaveras County.

87. MARBLE, bed of the Tuolumne River, Tuolumne County.

88. MARBLE, white, nine miles north of Ione, Amador County.

89. MARBLE, red, a beautiful ornamental stone, bearing a good polish, Amador County.

90. MARBLE, fine white, slightly bluish green, suitable for building stone and lime, Inyo County, near C. & C. R. R.

91. METAMORPHIC SLATE, which accompanies the quartz vein, Soulsby Mine, Tuolumne County.

92. METAMORPHIC SLATE, with quartz attached, Soulsby Mine, Tuolumne County.

93. MICA SCHIST, Gold Lake, Plumas County.

94. MICA SCHIST, Ivawatt District, San Bernardino County.

95. MICA SCHIST, Berkeley Hills, Alameda County.

96. PORPHYRY, foot wall Standard Mine, Bodie District, Mono County.

97. PORPHYRY, Bodie Mine, Bodie Mining District, Mono County.

98. PORPHYRITIC DIORITE, Clipper Gap, Placer County.

99. PORPHYRY, red, eight or nine miles from Mesquite Station, San Diego County.

100. PORPHYRY BEDROCK, Malakoff Mine, North Bloomfield, Nevado County.

101. PORPHYRY, Polar Star Mine, Dutch Flat, Placer County.

102. PORPHYRY (probably diorite), Placer County. Said to be found in large quantities. A very beautiful building and ornamental stone, equal to the finest porphyries of Egypt and Europe.
103. PORPHYRY, seventy-five feet thick, Bodie Mine, Mono County.
104. PUMICE STONE, near Mammoth City, Mono County.
105. PUMICE STONE, near Dos Palmos, San Diego County.
106. ROCK RESEMBLING HALLEFLINTA, Fruit Vale, Alameda County.
107. ROCK RESEMBLING HALLEFLINTA, Spanish Ranch, Plumas County.
108. SAND ROCK, with chalcedony, ten miles west of Havilah, Kern County.
109. SANDSTONE, near San José, Santa Clara County.
110. SANDSTONE, eighteen feet thick, Tuolumne County.
111. SANDSTONE, Saucelito, Marin County.
112. SANDSTONE, Glenn Mills, San Mateo County.
113. SANDSTONE, eight miles west of Napa City, Napa County.
114. SANDSTONE, suitable for building stone, Eureka, Humboldt County.
115. SANDSTONE (stained red), Santa Margarita Ranch, San Diego County, near San Luis Rey.
116. SANDSTONE, Glenn Mills, San Mateo County.
117. SANDSTONE, west side of Great Eastern Quicksilver Mine, Sonoma County, supposed to be the footwall.
118. SANDSTONE (coarse grained), Coal Mine, San Benito County, township nineteen south, range eleven east.
119. SANDSTONE (fine grained), Coal Mine, San Benito County, township nineteen south, range eleven east.
120. SANDSTONE, Seal Rock, off Point St. George, northwest boundary of California.
121. SANDSTONE, fossiliferous, near Shasta.
122. SANDSTONE, variegated, near Buchanan Copper Mine, Fresno County.
123. SANDSTONE, feldspathic, sedimentary rock, composed of feldspar, quartz mica, and hornblende, Telegraph Hill, San Francisco.
124. SANDSTONE, Pescadero, San Mateo County.
125. SCORIA, Point San Pedro, San Mateo County, eighteen miles south of San Francisco.
126. SCHIST with garnets, mouth of Russian River, Sonoma County.
127. SCHIST, with impressions of fossil plants, found in the lignite near Vacaville, Solano County.
128. SEDIMENTARY DEPOSIT, Chalk Bluffs, near surface, containing impressions of fossil leaves.
129. SEDIMENTARY MATTER, North Bloomfield Mine, Nevada County.
130. SEDIMENTARY DEPOSIT, found in digging a well, at a depth of seventy-five feet, near Roseville Station, Placer County.
131. SEDIMENTARY ROCK, San Francisco.
132. SEDIMENTARY ROCK, Cliff House, San Francisco.
133. SEDIMENTARY ROCK, Oil Creek, San Luis Obispo County, found in slabs from two to eight inches thick, and from one to three feet wide.
134. SEDIMENTARY DEPOSIT, resembling diatomaceous earth, twelve miles east of Santa Rosa, Sonoma County.
135. SERPENTINE, Bear Valley, Mariposa County.

136. SERPENTINE, Key's Tunnel, California Mine, Yolo County.
137. SERPENTINE, three hundred yards northeast of Pine Tree Mine, Bear Valley, Mariposa County.
138. SERPENTINE, transformation from gabbro, Peninsula of San Francisco.
139. SERPENTINE, Fort Point, San Francisco.
140. SERPENTINE, Yuba County.
141. SERPENTINE, Market and Guerrero Streets, San Francisco.
142. SERPENTINE, center of Lone Mountain Cemetery, San Francisco.
143. SERPENTINE (five varieties), Lone Mountain Cemetery, San Francisco.
144. SERPENTINE, Market Street Cut, San Francisco.
145. SERPENTINE SCHISTOSE, met with before reaching the so called footwall, New Almaden Quicksilver Mine, Santa Clara County.
146. SERPENTINE, Kelseyville, Lake County.
147. SERPENTINE, Bald Prairie, Placer County.
148. SERPENTINE, Monterey, Monterey County.
149. SHALE (with Lignite), near San Bernardino, San Bernardino County.
150. SHELL ROCK, Sandstone Bluff, township one north, and on the Humboldt meridian, Humboldt County.
151. SILICIOUS BRECCIA, Little Butte, section thirteen, township thirteen south, range thirty-five east, Mount Diablo meridian.
152. SLATE AND GRANITE, Bodie District, Mono County.
153. SLATE AND PYRITES, Mariposa Tunnel, two thousand six hundred and twenty foot point, Mariposa County.
154. SLATE, which crops out over a large extent of country between San Andreas and Cave City, Calaveras County; strike nearly west northwest, dip nearly vertical.
155. SLATE, near Red Hill, Butte County.
156. SLATE, near Emigrant Gap, Placer County.
157. SLATE, roofing, El Dorado County.
158. STRATIFIED FORMATION, old lime kiln, near Clipper Gap, Placer County.
159. SYENITE, Point San Pedro, San Mateo County, eighteen miles south of San Francisco.
160. TALCOSE ROCK, wall rock of the Idaho Mine, Grass Valley, Nevada County.
161. TALCOSE SLATE, Tuolumne County.
162. TALCOSE SLATE, El Dorado County.
163. TRACHYTE, near St. Helena, Napa County.
164. TRIPOLITE, Santa Barbara.
165. TUFA, Kern County.
166. TUFA, Sulphur Springs, Mono County.
167. TUFA, very interesting formation, Gold Gravel Hydraulic Mine, La Porte, Plumas County.
168. VOLCANIC BRECCIA, used as a building stone in Susanville. It is said to resist the action of fire, as shown during a recent conflagration in that town. Section five, township twenty-nine north, range thirteen east, eight and one half miles from Susanville, Lassen County.
169. VOLCANIC CONGLOMERATE, Mono Lake, Mono County.
170. VOLCANIC ROCK, Kelsey Valley, Lake County, taken from a well ten feet deep. It is several feet in thickness. Sinking the well was discontinued, owing to the emanation of large quantities of carbonic acid gas.

171. VOLCANIC ASH (allied to pumice stone), Calaveras County, eighteen miles from Lodi.

172. VOLCANIC TUFA (so called white lava). A similar rock is used in Europe in building ovens for bread baking. Found near Etna Springs, Napa County.

173. VOLCANIC ASH, Chalk Bluffs, Nevada County.

174. VOLCANIC ASH, Ione Valley, Amador County.

175. VOLCANIC ASH, Tufa or Lava, Mono County, near Carson and Colorado Railroad.

The following have been added since the publication of the second volume of the museum catalogue:

176. ANTHRACONITE, cave at Murphy's, Calaveras County.

177. BITUMINOUS SHALE, from which oil and gas can be manufactured, Calistoga, Napa County.

178. BRECCIATED QUARTZ, vein matter, Calistoga or Venus Mine, Mt. St. Helena, Napa County.

179. BROWN COAL (Lignite), from vein near Lancha Plana, Calaveras County.

180. BUILDING STONE, Valley Springs, Calaveras County.

181. CAPROCK, used for paving sluices, worn from thickness of eighteen inches by eight months' use, Spring Valley Mine, Cherokee, Butte County.

182. CONCRETION, resembling a geode, Bottle Hill, El Dorado County.

183. DUNNITE, from Carga Muchacho gold mining district, San Diego County. This rock is more minutely described elsewhere.

184. FELDSPAR (orthoclase), Hunsecker Grade, stage road from San Diego to Julian, San Diego County.

185. FREESTONE, from Stony Brook, near Niles, Alameda County, on the property of J. D. Farwell. It seems to possess many of the qualities which characterize a good building stone. In the quarry where the croppings have long been exposed to the elements, it shows evidences of great durability, as it does laid in the piers and abutments of the railroad bridge which crosses the Alameda Creek near by. This block has been sculptured by Morton A. Edwards, of San Francisco, and was presented by J. D. Farwell.

186. LAVA, used in building at Mokelumne Hill, Calaveras County. Three varieties. It is a durable and convenient material, and could be more generally utilized.

187. PEGMATITE, Hunsecker Grade, stage road from San Diego to Julian, San Diego County.

188. ROCK SPECIMEN, from the summit of Mt. St. Helena, altitude 4,343 feet. It rises in columns like basalt, in large outcrops; the whole summit of the mountain is of this formation. The soil produced by its disintegration is of a pale green color. Napa County.

189. ROCK SPECIMEN, from the side of Mt. St. Helena, Napa County.

190. ROCK RESEMBLING HALLEFLINTA, found on the sides of Mt. St. Helena, Napa County.

191. ROCK SPECIMEN, with veins of cinnabar, Manhattan Mine, Napa County.

192. ROCK SPECIMEN, near Deffebach's Ranch, one mile from the bay, Sausalito, Marin County.

193. ROCK SPECIMEN, from first tunnel on N. P. C. R. R., Blithdale Station, Marin County.

194. ROCK SPECIMEN, with microscopical section, Union Mine, near San Andreas, Calaveras County, believed to be slaty serpentine.

195. ROCK CONTAINING FOSSIL TURRITELLA. Section thirty-three, township twenty-two south, range sixteen east, Mt. Diablo meridian. Fossils are very abundant at this locality.

196. SAND, from the beach, near the whaling station, Monterey, Monterey County.

197. SAND, from opposite the bath house, Santa Barbara.

198. SAND, from the ocean beach, two miles south of Pescadero, San Mateo County.

199. SERPENTINE, Point Tiburon, Marin County.

200. SERPENTINE FOLIATED, altered to Picrolite, found in considerable quantity in Mendocino County, township nineteen north, range ten west, Mt. Diablo meridian.

201. SILICIOUS MINERAL, OR ROCK, probably a deposition from hot mineral water. This specimen is opaque, and shows the effect of solfataric action about the orifices, round the mouths of which little ridges of silica have been deposited. Manhattan Quicksilver Mine, Napa County.

202. STEATITE, Coulterville, Mariposa County. Of excellent quality, and said to be in large quantities.

203. WALL ROCK, Manhattan Mine, Napa County.

204. WALL ROCK WITH FOSSILS, Manzanita Gold Mine, Sulphur Creek, Colusa County.

An excellent building stone is found in a white rock, of sedimentary origin, thought to be volcanic ash. It is found in the foothills over a large extent of country. It has been used in building in Mokelumne Hill, Calaveras County, for many years, where it has been found to be very durable. The walls of some buildings which were destroyed by fire are uninjured, or only slightly so. There are some fine buildings being constructed of this stone in St. Helena, in Napa County. Their general appearance is very fine. This material should be introduced into San Francisco and other large towns.

Basaltic rocks are quite common in numerous localities in the State. In Butte County, between Oroville and Magalia, there are large outcrops of cellular lava and fine columnar bluffs. The stone is of excellent quality, and quite suitable for pavements and building. The basaltic columns of Mount St. Helena have been described elsewhere.

EXAMINATION OF DUNNITE FROM SAN DIEGO COUNTY—NO. 183 OF THE ABOVE LIST.

Color pale green, with dark spots. It consists of three distinct minerals—*olivine*, *magnetite*, and a *micaceous mineral*, unknown.

In its natural state it slightly deflects the needle. When pulverized, a portion can be removed by the magnet, and on heating to redness, a second smaller portion becomes magnetic, and can be separated in the same way. A sample of rock was pulverized, sized by sifting, and placed in a long glass tube full of water. On placing the tube in a vertical position, the magnetite fell first. The other two minerals did not separate, but fell together, showing that they had nearly the same specific gravity.

Another portion was divided into three parts by the magnet as follows:

(A) magnetic	12.2
(B) magnetic by heating	2.1
(C) non-magnetic	85.7
	100.0

The non-magnetic portion (C) was examined under the microscope and found to consist of two minerals, one dark colored, but which changed to bronze color by heating. The other was pale green in nearly transparent angular particles, with vitreous luster. Being of the same sized particles, of nearly the same specific gravity, they were counted under the microscope and found to be in equal numbers very nearly, therefore the mechanical analysis would stand thus:

Magnetic (A)	12.20
Magnetic by heating (B)	2.10
Micaceous (D)	42.85
Pale green (E)	42.85
	100.00

The portion (C) from which magnetite had been removed by the magnet was boiled repeatedly in nitro-hydrochloric acid, by which treatment the micaceous mineral was decomposed. The residue being well washed, the pale green mineral (olivine) was left in a state of apparent purity. The specific gravity was found to be 3.321.

This is a beautiful and interesting rock, and one that it would seem might be put to some practical use. Sections cut for the microscope are also very interesting.

The following is the result of an examination of the straw-colored sandstone from Santa Barbara, used in the construction of the old Mission, and latterly in a number of fine modern buildings in the beautiful town of Santa Barbara: Specific gravity, 2.7; one part of the stone by weight absorbed only .012 parts of water. The stone is rather easily reduced to powder; more so when wet. In this respect it resembles the sandstone of a similar color found at San José. Under the microscope the powder is seen to consist of rounded grains of milky quartz. The silica was determined and found to be 75 per cent. The specific gravity being as above, a cubic foot would weigh 168.75 pounds. While this is a beautiful and easily worked building stone, its use in the old Mission has shown that it is not very durable.

TABLE OF ALTITUDES.

The first 1,109 are copied from Bulletin of the United States Geological Survey No. 5; the remainder are gathered from various sources, and may be considered as approximative. They are probably as correct as those generally first published in a new and large State like California.

No.	Station.	Authority.	Elevation. Feet.
1	Abbey Hill	U. S. C. & G. S.	1,232
2	Abbott	U. S. C. & G. S.	375
3	Acampo		59
4	Adalante	Cal. P. R. R.	76
5	Adams, Mt.	Wheeler	8,431
6	Adobe	Wheeler	282
7	Adobe Meadows	Wheeler	6,594
8	Agua Caliente	Emory	3,013
9	Agua Caliente	Wheeler	725
10	Agua Caliente	Wheeler	3,617
11	Alamo Mocho	P. R. R. Reports	—70
12	Alcatraz Island	U. S. C. & G. S.	143
13	Algodones	P. R. R. Reports	46
14	Alpine	C. P. R. R.	2,822

TABLE OF ALTITUDES—Continued.

No.	STATION.	Authority.	Elevation. Feet.
15	Alta	C. P. R. R.	3,607
16	Altamont	C. P. R. R.	740
17	Alturas	Wheeler	4,365
18	Alturas Hill	Wheeler	4,459
19	Amys' Ranch	Wheeler	1,494
20	Anaheim	C. P. R. R.	130
21	Anderson	Toner	33
22	Anderson, Mt.	Whitney	9,000
23	Angel Island, N. W.	U. S. C. & G. S.	159
24	Angel Island Peak	U. S. C. & G. S.	782
25	Aneta	Toner	161
26	Antelope	C. P. R. R.	154
27	Antelope Ranch	Wheeler	359
28	Antelope Spring	Wheeler	4,272
29	Arab Spring	Wheeler	5,697
30	Arcade	C. P. R. R.	55
31	Arlington Bridge	Wheeler	3.375
32	Ash Springs	Wheeler	1,810
33	Auburn	C. P. R. R.	1,360
34	Auburn	Smithsonian Institute	1,176
35	Aurora	Wheeler	7,449
36	Advisadera, Point	U. S. C. & G. S.	171
37	Azusa	Wheeler	594
38	Babbitt, Camp	Williamson	384
39	Bache, Mt.	U. S. C. & G. S.	3,793
40	Bache, Mt.	Peterman	3,790
41	Bacons' Ranch	Wheeler	4,076
42	Bagley's Ranch	Wheeler	5,387
43	Bah-li-vah Spring	Wheeler	6,284
44	Bakersfield	Wheeler	432
45	Baker's Ranch	Toner	3,285
46	Bald Mountain	Wheeler	5,829
47	Bald Mountain	Wheeler	8,295
48	Bald Rock	Wheeler	7,825
49	Balley, Mt.	Whitney	6,357
50	Ballona	L. A. & I. R. R.	103
51	Bantas	C. P. R. R.	30
52	Bardins	Monterey R. R.	48
53	Bare Mountain	Wheeler	6,039
54	Bares' Ranch, Surprise Valley	Wheeler	4,680
55	Barker's Ranch	Wheeler	594
56	Barnard's Hotel	Wheeler	3,851
57	Batavia	C. P. R. R.	64
58	Battle Creek Meadows	Wheeler	4,700
59	Battle Hill		2,389
60	Baxter's Station	Wheeler	4,115
61	Bear Valley Post Office	Wheeler	2,087
62	Bear Valley, Town Hotel	Wheeler	6,592
63	Beckworth's Pass	Wheeler	5,193
64	Beckworth's Pass	R. R. surveys	4,682
65	Beckworth's Pass	Whitney	5,327
66	Beckworth's Store	Wheeler	4,887
67	Bell Mill	Wheeler	3,681
68	Bello	Cal. P. R. R.	203
69	Benicia Arsenal	U. S. C. & G. S.	6
70	Benicia Barracks	Med. Dept., U. S. A.	64
71	Bennett's Wells, Death Valley	Wheeler	—68
72	Berenda	Toner	256
73	Bidwell	Wheeler	4,612
74	Bidwell Camp	Wheeler	4,647
75	Bidwell Camp	Med. Dept., U. S. A.	4,680
76	Bidwell, Mt.	Wheeler	8,551
77	Bidwell's Bar, South Fork Feather River	Wheeler	342
78	Bielowski	Whitney	3,269
79	Biggs's	C. P. R. R.	124
80	Big Logan	Toner	70
81	Big Meadow Ranch	Wheeler	6,464
82	Big Meadows	Wheeler	4,234
83	Big Oak Flat	Wheeler	2,823

TABLE OF ALTITUDES—Continued.

No.	STATION.	Authority.	Elevation. Feet.
84	Big Springs	Wheeler	4,553
85	Big Tree Grove, Calaveras County	Wheeler	4,794
86	Big Tree Station	Wheeler	3,925
87	Birds' Springs	Wheeler	3,949
88	Black Bluff	U. S. C. & G. S.	208
89	Black Mountain	U. S. C. & G. S.	2,811
90	Blackmore's Ranch	Wheeler	2,230
91	Black Ridge	U. S. C. & G. S.	756
92	Black Springs	Wheeler	6,485
93	Blodgett's Ranch	Wheeler	216
94	Blood's Station	Wheeler	6,979
95	Blue Cañon	C. P. R. R.	4,693
96	Bluff Point	U. S. C. & G. S.	177
97	Board Ranch	Wheeler	4,639
98	Boca	Wheeler	5,230
99	Boca	C. P. R. R.	5,531
100	Bodega Head	U. S. C. & G. S.	241
101	Bold's Ranch	Wheeler	141
102	Bonita, Point	U. S. C. & G. S.	283
103	Boneyard Ranch	Wheeler	2,450
104	Bootjack Ranch	Wheeler	2,107
105	Borden	Toner	172
106	Boston Peak	Wheeler	6,519
107	Bower Cave	Wheeler	2,360
108	Box Elder		1,430
109	Boyd's Ranch	Wheeler	622
110	Bozeman's Ranch	Wheeler	3,157
111	Brandy City		3,592
112	Breccia Pass	Goddard	10,150
113	Breckinridge, Mt.	Wheeler	5,693
114	Breckenridge, Mt.	Wheeler	7,418
115	Brewer, Mt.	Whitney	13,886
116	Brewery	Wheeler	2,838
117	Bridgeport	Wheeler	1,357
118	Pridgeport Post Office	Wheeler	6,423
119	Brighton	S. & P. R. R.	42
120	Brighton, cross S. V. R. R.	C. P. R. R.	54
121	Broncho	Wheeler	5,310
122	Brown's Flat	Wheeler	1,964
123	Brown's Peak	Wheeler	5,392
124	Brown's Ranch	Wheeler	1,759
125	Buckeye	Wheeler	4,938
126	Buckhorn Ranch (or Warren Station)	Wheeler	693
127	Buck's Ranch	Wheeler	5,112
128	Buena Vista	Wheeler	323
129	Buena Vista	Nev. Co. N. G. R. R.	2,618
130	Buena Vista Oil Works		790
131	Buffalo Station	Wheeler	4,378
132	Burrows, Mt.	Wheeler	4,267
133	Burst Rock	Wheeler	9,157
134	Bush Hill	U. S. C. & G. S.	482
135	Butte Creek Bridge	Wheeler	4,692
136	Butte Creek House	Wheeler	5,758
137	Butt, Mt.	Wheeler	7,830
138	Byrnes' Ferry	Wheeler	380
139	Cady, Camp	Wheeler	1,894
140	Cahto	Smithsonian Inst.	2,000
141	Cahuenga Pass	Wheeler	750
142	Cajon Pass	Pacific R. R. Reports	4,676
143	Cajon Pass Divide	Wheeler	4,195
144	Cajon Ranch	Pacific R. R. Reports	412
145	Calaveras Grove	Wheeler	4,730
146	Caliente	C. P. R. R.	1,290
147	Caliente	Wheeler	1,314
148	Caliente Springs	Wheeler	3,688
149	California City Point	U. S. C. & G. S.	75
150	Calistoga	C. P. R. R.	331
151	Campo, Signal Station	U. S. Signal Office	2,527
152	Camptonville	Toner	2,388

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
153	Camp Weldon (Mountain)	Wheeler	2,716
154	Canebrake Ranch	Wheeler	3,904
155	Cannelas Ranch	Wheeler	799
156	Cannon	C. P. R. R.	90
157	Cañon de Turruco Pass		4,256
158	Cañon Spring	Wheeler	1,238
159	Cañon Station	Wheeler	2,650
160	Capitan Grande	Pacific R. R. Reports	730
161	Caples Ranch	Wheeler	7,780
162	Caples Spring	Wheeler	5,512
163	Carbondale	C. P. R. R.	222
164	Caribou Bridge, North Fork	Wheeler	2,843
165	Carizzo		431
166	Carlos, Mt.	Whitney	4,977
167	Carmel, Mt.	U. S. C. & G. S.	4,415
168	Carnelian Hot Springs	Wheeler	6,237
169	Carson Cañon Toll House	Wheeler	6,596
170	Carson Pass	Goddard	7,972
171	Carson Pass	Whitney	8,759
172	Carson Pass	Wheeler	8,634
173	Cartago		3,589
174	Carthage, on Owens Lake	Wheeler	3,589
175	Cary, Mt.	Wheeler	9,970
176	Cascade	C. P. R. R.	6,538
177	Castle, Mt.	Wheeler	9,013
178	Castle Peak	Whitney	12,500
179	Castle Rock	Wheeler	9,872
180	Castroville, on line of S. P. R. R.	Monterey R. R.	19
181	Catherines	S. P. R. R.	512
182	Cathedral Rock (lower)	Wheeler	6,430
183	Cathedral Rock (higher)	Wheeler	6,529
184	Cathey's Ranch	Wheeler	1,260
185	Cavallos, Point de los	U. S. C. & G. S.	126
186	Coyote Ridge	U. S. C. & G. S.	1,034
187	Cedar, Mt.	Wheeler	8,308
188	Cedar Point	Toner	5,614
189	Cedarville	Wheeler	4,675
190	Centerville	Wheeler	503
191	Cerro Gordo Landing, Col. River	Wheeler	3,656
192	Cerro Gordo Pass	Wheeler	8,874
193	Chapman's Ranch	Wheeler	4,992
194	Chapperal House	Wheeler	5,076
195	Chemehuevis Pass	K. P. R. R. Surveys	675
196	Chico	C. P. R. R.	193
197	Chico	Smithsonian Inst.	150
198	Chico	Wheeler	177
199	Chinese Camp	Wheeler	1,299
200	Chiquita Peak	Wheeler	8,136
201	Chuckawalla	Wheeler	2,095
202	Cicero	C. P. R. R.	90
203	Cienega	L. A. & I. R. R.	121
204	Cisco	C. P. R. R.	5,934
205	Cisco (site) South Fork Yuba River	Wheeler	5,654
206	Clark Peak	Wheeler	11,295
207	Clark's	Wheeler	3,925
208	Clark's Ranch	Wheeler	4,677
209	Clayton	Smithsonian Inst.	76
210	Clear Lake	Wheeler	5,808
211	Clipper Gap	C. P. R. R.	1,759
212	Cloud Rest	Wheeler	9,772
213	Glover Valley	Wheeler	3,464
214	Cohen's Ranch	Wheeler	281
215	Cohuilla Village	Pacific R. R. Reports	85
216	Colby's Ranch	Wheeler	4,990
217	Cold Spring	Wheeler	3,126
218	Cold Spring	Wheeler	5,375
219	Cold Spring Ranch	Wheeler	565
220	Cole's Ranch	Wheeler	1,221
221	Coleville (blacksmith shop)	Wheeler	5,190

TABLE OF ABTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
222	Colfax	Nev. Co. N. G. R. R.	2,422
223	Colfax	Wheeler	3,022
224	Colfax Junction, with Nevada Co. R. R.	C. P. R. R.	2,422
225	Colona		835
226	Colton	Wheeler	808
227	Colton	C. P. R. R.	965
328	Columbia	Toner	2,314
229	Columbia P. O.	Wheeler	2,157
230	Columbia Rock (above valley)	Wheeler	5,005
231	Conejos	Wheeler	2,565
232	Conejas Ranch	Wheeler	579
233	Conness Peak	Wheeler	12,518
234	Contra Costa	U. S. C. & G. S.	96
235	Cook's Point (Mountain)	Wheeler	6,336
236	Cook's Wells	Pacific R. R. Reports	—62
237	Coomb's Station	Wheeler	2,886
238	Cooper's Ranch	Wheeler	8,406
239	Copperopolis P. O.	Wheeler	1,015
240	Corbett's Ranch	Wheeler	1,075
241	Corcoran, Mt.	Wheeler	14,093
242	Cordelia	C. P. R. R.	11
243	Cordelia	Pacific R. R. Reports	69
244	Cory's Peak	Wheeler	11,326
245	Costa	C. P. R. R.	85
246	Cottonwood	Toner	423
247	Cottonwood Island	Wheeler	787
248	Cottonwood Station	Wheeler	2,488
249	Coulterville	Wheeler	1,665
250	Cow Creek Ranch, Sonora Road	Wheeler	5,905
251	Cow Head Lake	Wheeler	6,041
252	Cow Head Lake Spring	Wheeler	5,329
253	Cow Spring	Wheeler	3,876
254	Cox's Ferry	Wheeler	250
255	Crabtrees	Wheeler	934
256	Crane Flat	Wheeler	6,054
257	Crane Valley	Wheeler	3,185
258	Crater Station		1,000
259	Crescent City	Smithsonian Inst.	12
260	Crescent City	Wheeler	3,306
261	Cress's Ranch	Wheeler	5,157
262	Creston	C. P. R. R.	313
263	Crimea House	Wheeler	1,221
264	Crook, Fort	Medical Dept. U. S. A.	3,390
265	Crow's Ranch, Clover Valley	Wheeler	5,464
266	Crystal Lake	R. R. Reports	5,907
267	Culbertson's	Wheeler	980
268	Culbertson's Vineyard	Wheeler	981
269	Cucamonga	C. P. R. R.	952
270	Cucamonga	Wheeler	1,328
271	Cucamonga Peak	Wheeler	8,529
272	Cucamonga Ranch	Wheeler	1,168
273	Cuddy's Ranch	Wheeler	5,278
274	Cunningham's Ranch	Wheeler	387
275	Curtis	C. P. R. R.	39
276	Daggett's Pass	Goddard	6,824
277	Dahlonega	Wheeler	2,162
278	Dalton's Ranch	Wheeler	568
279	Dana, Mt.	Whitney	13,227
280	Darwin Cañon	Wheeler	3,143
281	Davis	C. P. R. R.	54
282	Dawes Ranch	Wheeler	451
283	Deadfall Bridge	Wheeler	3,426
284	Deadwood Peak	Wheeler	4,451
285	Decoto	C. P. R. R.	68
286	Deep Spring	Wheeler	4,957
287	Deer Creek	Wheeler	4,518
288	Delaney's Ranch	Wheeler	4,840
289	Delano	C. P. R. R.	313
290	Desert Springs	Wheeler	1,989

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
291	Dewser's Station	Wheeler	2,922
292	Devil's Peak	Wheeler	6,910
293	Diablo Point	U. S. C. & G. S.	202
294	Diablo, Monte, Hotel	U. S. C. & G. S.	2,327
295	Diablo, Monte	U. S. C. & G. S.	3,849
296	Dixon	C. P. R. R.	65
297	Donner Lake	R. R. Reports	5,964
298	Donner Lake	Wheeler	5,885
299	Donner Pass	C. P. R. R. Surveys	7,901
300	Donner Pass	Whitney	7,056
301	Doon's Sawmill	Wheeler	3,420
302	Dos Palmas	Wheeler	103
303	Downey	C. P. R. R.	114
304	Downieville	Smithsonian Inst.	2,200
305	Downieville Buttes	Whitney	8,400
306	Downieville Buttes	Wheeler	8,541
307	Drew's Ranch	Wheeler	1,090
308	Dribblesby's Ferry	Pacific R. R. Reports	954
309	Drune Barracks	Medical Dept. U. S. A.	32
310	Dudley's	Wheeler	2,959
311	Duxbury	U. S. C. & G. S.	797
312	Dugan's	S. & P. R. R	1,106
313	Dunderberg Peak	Wheeler	12,289
314	Dutch Flat	C. P. R. R.	3,395
315	Dutch Henry's Ranch	Wheeler	1,195
316	Dutch Hill Mining Camp	Wheeler	4,692
317	Dyer Mountain, near Big Meadows	Wheeler	7,369
318	Eagle Lake	Wheeler	5,115
319	Eagle Mountain	Wheeler	9,933
320	Eagleville	Wheeler	4,632
321	Ebbitt's Pass	P. R. R. Reports	8,793
322	Echo Peak	Wheeler	11,231
323	Edgar's Spring	Wheeler	4,061
324	Eisen Vineyard	Wheeler	358
325	El Dorado Mill	Wheeler	863
326	Elephant, Mt.	Wheeler	10,418
327	Eleven Mile Station, Mariposa Road	Wheeler	5,567
328	Eliot's Ranch, on Little Truckee River	Wheeler	6,233
329	Elizabeth Lake	Wheeler	3,317
330	Elk Grove	C. P. R. R.	53
331	Elk Horn	Pacific R. R. Reports	89
332	Elkhorn Ranch	Wheeler	1,049
333	Elk Valley		3,751
334	Ellis	C. P. R. R.	76
335	Ellis Mountain	Wheeler	8,675
336	Elmira	C. P. R. R.	75
337	El Monte	Wheeler	329
338	El Paso Mines	Wheeler	4,113
339	Emigrants' Gap	C. P. R. R.	5,221
340	Emigrants' Gap	Pacific R. R. Reports	5,221
341	Eureka		5,223
342	Eureka Valley	Wheeler	5,957
343	Excelsior Hotel	Wheeler	4,570
344	Fandango Peak	Wheeler	7,849
345	Far West, Camp	Medical Dept. U. S. A.	175
346	Fears' Station	Wheeler	3,393
347	Ferguson's Mill	Wheeler	1,389
348	Fifteen Mile Creek	Wheeler	1,267
349	Fisherman's Peak	Wheeler	14,448
350	Fishpond Station	Toner	1,900
351	Florence	C. P. R. R.	153
352	Florin	Toner	42
353	Folsom	S. & P. R. R.	182
354	Forest Ranch	Wheeler	2,217
355	Forgay's Ranch	Wheeler	3,381
356	Fornis' Ranch	Wheeler	4,225
357	Forsee's Ranch	Wheeler	3,587
358	Fort Point	U. S. C. & G. S.	186
359	"Forty-nine," Cañon Pass	Wheeler	6,306

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
360	Foster's Bar	Toner	1,371
361	Foster's Station	Wheeler	3,265
362	Fowler's Peak	Wheeler	1,760
363	Francis' Spring	Wheeler	4,220
364	Frank's Lagoon	U. S. C. & G. S.	497
365	Fredonyer's Peak	Wheeler	7,995
366	Freels' Mountain	Wheeler	10,848
367	Fremont	C. P. R. R.	58
368	Frenchman's Cove	Wheeler	5,565
369	Fresno	C. P. R. R.	294
370	Fresno	Wheeler	314
371	Fresno Flat	Wheeler	2,192
372	Fryes'	Wheeler	2,181
373	Fulsom & Hall's Ranch	Wheeler	4,282
374	Furnace Creek	Wheeler	405
375	Furnace Springs	Wheeler	337
376	Galt Junction	C. P. R. R.	49
377	Gavilan	U. S. C. & G. S.	2,816
378	Gavilan	Whitney	3,381
379	Georgetown	Toner	2,433
380	Georgetown Pass	Whitney	7,119
381	Georgetown Pass	C. P. R. R. Surveys	7,154
382	Gilroy	Toner	193
383	Glenville	Wheeler	3,094
384	Gold Run	C. P. R. R.	3,220
385	Gold Spring Ranch	Wheeler	2,014
386	Goodrich's Ranch	Wheeler	4,883
387	Goose Lake	Wheeler	4,697
388	Gordon's Ranch	Wheeler	737
389	Gorman's Ranch	Wheeler	3,838
390	Goshen	C. P. R. R.	278
391	Goshen Junction (with S. P. R. R.)	C. P. R. R.	280
392	Guano Island	U. S. C. & G. S.	28
393	Granite Spring	Wheeler	1,435
394	Granite Springs	Wheeler	4,115
395	Granite Station	Wheeler	1,744
396	Granite Wells	Wheeler	2,080
397	Grapevine Peak	Wheeler	8,528
398	Grapevine Ranch	Wheeler	2,247
399	Grapevine Spring	Wheeler	2,432
400	Grass Lake	Wheeler	8,564
401	Grass Valley		2,090
402	Grass Valley	Nev. Co. N. G. R. R.	2,454
403	Gravel Range	Wheeler	2,987
404	Gray's Ranch	Wheeler	307
405	Gray's Ranch	Wheeler	1,100
406	Green Bluff	U. S. C. & G. S.	486
407	Green Mountain	Wheeler	1,351
408	Green Mountain	Wheeler	1,352
409	Green's Ranch	Wheeler	4,479
410	Greenville	Wheeler	3,544
411	Gridley	Toner	97
412	Griffith's Ranch	Wheeler	473
413	Grizzly Giant, Mariposa Grove	Wheeler	5,838
414	Grizzly Hill	Wheeler (Theod)	5,709
415	Grizzly Peak	Wheeler	11,723
416	Grizzly Peak	Wheeler	10,369
417	Groveland	Wheeler	2,828
418	Gyser's	Wheeler	5,864
419	Haighs'	Wheeler	1,807
420	Hale's	Wheeler	2,739
421	Halfway House	Wheeler	3,359
422	Halloran Spring	Wheeler	3,272
423	Hamilton Mountain	Whitney	4,440
424	Hamilton (near)	Pacific R. R. Reports	260
425	Hardin's	Wheeler	3,396
426	Harkness Mountain, near Big Meadows	Wheeler (Theod)	8,875
427	Harris' Ranch, Madeline Plains	Wheeler	5,339
428	Harris' Station, Amander Road	Wheeler	5,439

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
429	Hart's Ranch	Wheeler	242
430	Haskell's Peak	Wheeler	8,126
431	Hat Mountain	Wheeler	7,676
432	Haughtown Crossing	S. & P. R. R.	85
433	Havilah Town	Wheeler	3,150
434	Hays' Station	Wheeler	5,957
435	Hazel Green	Wheeler	5,550
436	Hazelton Peak	Wheeler	2,960
437	Hazel Valley	Wheeler	3,404
438	Helena, Mount	Whitney	4,343
439	Henness Pass	C. P. R. R. Surveys	7.031
440	Henness Pass	Whitney	6,996
441	Hennessy's Bridge	Wheeler	1,821
442	Henry, Mount	Whitney	2,398
443	Hermit Valley	Wheeler	7,039
444	Hickman's Ranch	Wheeler	1,907
445	High Bluff	U. S. C. & G. S.	533
446	High Hill	U. S. C. & G. S.	490
447	Highland Peak	Wheeler	10,956
448	Hill's Ranch	Pacific R. R. Reports	4,131
449	Hite's Cove	Wheeler	1,601
450	Hodgdon's	Wheeler	4,506
451	Hoffmann Peak	Wheeler	10,872
452	Hogle	C. P. R. R.	76
453	Hollister	Toner	284
454	Homestead	S. & P. R. R.	32
455	Honey Lake	Wheeler	3,949
456	Hooker		543
457	Hope Valley	Williamson	7,072
458	Hornitos Hotel	Wheeler	847
459	Horn Spring	Wheeler	5,477
460	Horseley's Station	Wheeler	3,860
461	Hosselkus' Ranch	Wheeler	3,635
462	Hotchkiss Ranch	Wheeler	2,931
463	Hot Springs	Wheeler	6,080
464	Hot Springs	Wheeler	7,384
465	Hot Springs	Wheeler	7,692
466	Hough's Mountain	Wheeler (Theod)	7,391
467	Hovely's Camp	Wheeler	3,860
468	Hubertville	Toner	980
469	Hughes' Ranch	Wheeler	3,122
470	Humboldt, Fort	Med. Dept., U. S. A.	50
471	Humbug Park	Wheeler	4,847
472	Humpahyamup Pass	P. R. R. Reports	5,351
473	Hunter's Ranch	Wheeler	6,274
474	Hunter's Ranch	Wheeler	6,275
475	Huntington, Mohave River	Wheeler	2,899
476	Hupps' Mill	Wheeler	2,667
477	Hyde's Union Sawmill	Wheeler	5,288
478	Illinois Ranch	Wheeler	1,759
479	Illinoistown	Toner	2,234
480	Independence, Camp	Wheeler	3,957
481	Independence, Camp	Smithsonian Inst.	4,800
482	Indian Gulch	Wheeler	951
483	Indian Valley	Toner	3,280
484	Indian Wells	C. P. R. R.	—20
485	Indian Wells	Wheeler	2,608
486	Ingalls, Mount	Wheeler	8,471
487	Inskip Toll-gate	Wheeler	4,808
488	Ione	C. P. R. R.	287
489	Ivanpah	Wheeler	4,238
490	Jackson	Toner	934
491	Jacksonville	Wheeler	602
492	Jelly's Ranch	Wheeler	360
493	Joe's Peak	Wheeler	9,712
494	John's, Mount	Petermann	8,000
495	Johnson's Pass	Goddard	6,752
496	Johnson's Pass	C. P. R. R. Surveys	7,374
497	Johnson's Pass	Simpson	7,222

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
498	Johnson's Pass	Whitney	7,339
499	Johnson's Ranch	Wheeler	3,460
500	Johnson's Ranch, Bresser Creek	Wheeler	5,643
501	Jones, Fort	Med. Dept., U. S. A.	2,570
502	Jones' Mill, near Dutch Flat		3,416
503	Junction House	Wheeler	3,562
504	Junction House, on Reno and Susanville road, near Beckwith's Pass	Wheeler	4,639
505	Junction with Oregon Branch	C. P. R. R.	163
506	Kaweah Peak	Whitney	14,000
507	Keg Spring, Willow Creek	Wheeler	5,757
508	Kern Lake	Pacific R. R. Reports	398
509	Kernville	Wheeler	2,551
510	Kettle Rock Peak	Wheeler	7,843
511	Keystone House	Wheeler	1,093
512	Keysville		2,558
513	Kincaid's Flat	Wheeler	1,589
514	Kincaid's Ranch	Wheeler	1,771
515	King's Springs, Death Valley	Wheeler	—225
516	Kingston	Petermann	1,118
517	Kirkwood's	Wheeler	7,677
518	Knight's Ferry Bridge	Wheeler	180
519	Knight's Landing	C. P. R. R.	43
520	Kress	Nev. Co. N. G. R. R	2,857
521	La Bayonne	Wheeler	16
522	Lagrange	Wheeler	222
523	Lake City	Wheeler	4,624
524	Lake City Pass	Wheeler	7,035
525	Lakeview	Wheeler	4,851
526	La Laguna Ranch	Wheeler	129
527	Lambert's Soda Spring	Wheeler	8,558
528	La Motte's	Wheeler	6,491
529	Lane's Crossing, Mojave River	Wheeler	2,819
530	Lankershin's Ranch	Wheeler	563
531	Lassen's Butte	Wheeler	10,437
532	Lassen's Butte	Whitney	10,577
533	Lathrop Junction with Visalia Division	C. P. R. R.	26
534	Latrobe	S. P. R. R.	782
535	Lava Bed Station	Wheeler	446
536	Lawrence	Toner	66
537	Leach's Point	Wheeler	3,409
538	Leek Spring	Wheeler	7,242
539	Lewis' Ranch	Wheeler	966
540	Lewis' Ranch, near Loyalton	Wheeler	4,949
541	Lievre Ranch	Wheeler	3,756
542	Lillie's Ranch	Wheeler	3,647
543	Lime Point Bluff	U. S. C. & G. S.	495
544	Lincoln	C. P. R. R.	161
545	Lion's Head	Wheeler	1,693
546	Little Yosemite	Wheeler	6,442
547	Livermore	C. P. R. R.	485
548	Livermore Pass	Whitney	686
549	Liverpool Landing, Colorado River	Wheeler	606
550	Lobos Point	U. S. C. & G. S.	326
551	Lobos Point	U. S. C. & G. S.	378
552	Lodi	C. P. R. R.	55
553	Lomo	Wheeler	3,848
554	Lone Pine	Wheeler	3,810
555	Longville	Wheeler (Theod.)	4,309
556	Lookout Hill	Wheeler	4,214
557	Lookout Mountain	Wheeler	9,670
558	Loomis' Ranch	Wheeler	4,357
559	Lopez Ranch	Wheeler	3,248
560	Los Angeles	C. P. R. R.	265
561	Los Angeles	Wheeler	326
562	Los Angeles	Pacific R. R. Reports	250
563	Los Angeles, San Pedro Dessa	L. A. & I. R. R	260
564	Los Angeles, Signal Station	U. S. Signal Office	350
565	Los Encinos Ranch	Wheeler	772

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
566	Los Pozos Ranch	Wheeler	259
567	Los Toros	Wheeler	203
568	Lott's Diggins	Wheeler	6,310
569	Luther's Pass	Goddard	7,185
570	Luther's Pass	Simpson	7,505
571	Lyell, Mt.	Wheeler	13,190
572	Lyell, Mt.	Whitney	13,217
573	Lyon's Ranch	Wheeler	1,397
574	McBride's	Wheeler	5,561
575	McBride's Peak	Wheeler	13,441
576	McConnahas'	Wheeler	3,981
577	McCumber's Mill	Pacific R. R. Reports	3,491
578	McDonald Peak	Wheeler	7,954
579	McDonald Ranch	Wheeler	5,297
580	McGill, Mt.	Wheeler (Theod.)	9,214
581	McKesick's Peak	Wheeler	7,083
582	McKesick's Ranch	Wheeler	4,469
583	McQuade's	Wheeler	1,888
584	Macon	Toner	450
585	Madeline Hat Peak	Wheeler	7,676
586	Madeline Pass	P. R. R. Reports	5,667
587	Malaga	Wheeler	2,320
588	Mapes	Wheeler	5,039
589	Mare Island, N. E.	U. S. C. & G. S	283
590	Mare Island, N. W.	U. S. C. & G. S.	101
591	Mare Island	U. S. C. & G. S.	29
592	Marin Island	U. S. C. & G. S.	74
593	Marion	U. S. C. & G. S.	74
594	Mariposa	Wheeler	1,962
595	Mariposa Town Hall	Wheeler	1,971
596	Mariposa Post Office	Wheeler	1,942
597	Mariposa Peak	Whitney	3,700
598	Markleeville	Wheeler	5,525
599	Marlett's Lake	Wheeler	7,750
600	Marlett's Peak	Wheeler	8,631
601	Marlett's Ranch	Wheeler	8,074
602	Marl Spring	Pacific R. R. Reports	3,793
603	Martinez, East	U. S. C. & G. S.	187
604	Martinez C. H.	U. S. C. & G. S.	27
605	Martin's	Monterey R. R.	16
606	Martin's	Monterey R. R.	1,982
607	Martin's Ranch	Wheeler	2,055
608	Marysville	C. P. R. R.	67
609	Marysville	Smithsonian Institute	80
610	Master's Hill	U. S. C. & G. S	2,445
611	Matthews' Ranch	Wheeler	6,294
612	Maturango, Mt.	Wheeler (Theod.)	8,844
613	Mayfield	Toner	34
614	Mayhews	S. & P. R. R.	58
615	Meade, Mt.	Wheeler	10,540
616	Meadow Mountain	Wheeler	11,734
617	Meadow Valley	Wheeler	3,757
618	Melrose	C. P. R. R.	18
619	Menatchey Valley	Wheeler	9,503
620	Merced	C. P. R. R.	173
621	Merced Falls	Wheeler	360
622	Merced, Mt.	Wheeler	11,413
623	Merritt's	C. P. R. R.	54
624	Mesquite Spring	Wheeler	2,010
625	Mesquite Wells		3,674
626	Middle Lake, Surprise Valley	Wheeler	4,551
627	Midway	C. P. R. R.	356
628	Mill Creek, Sonora road	Wheeler	7,076
629	Miller, Fort	Med. Dept., U. S. A.	402
630	Miller's Ranch	Wheeler	4,055
631	Mills of Madera Flume and Trading Co.	Wheeler	4,499
632	Milton	Wheeler	376
633	Milton	Wheeler	5,845
634	Mineral Bar	Toner	1,121

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
635	Mitchell's Ranch	Wheeler	4,285
636	Moccasin, Mt.	Wheeler	2,791
637	Modesto	C. P. R. R.	93
638	Mojave	C. P. R. R.	2,751
639	Mokelumne	Toner	5,523
640	Mokelumne, Mt.	Wheeler	9,467
641	Molate Island	U. S. C. & G. S.	169
642	Molate Point	U. S. C. & G. S.	133
643	Mono Lake	U. S. Geol. Survey	6,730
644	Mono Pass	Whitney	10,765
645	Monte	Toner	354
646	Monte Diablo	Whitney	3,856
647	Monterey	Monterey R. R.	7
648	Monterey	Med. Dept., U. S. A.	140
649	Moonlight Valley	Wheeler	5,433
650	Moquelumne Hill	Smithsonian Institute	1,502
651	Moran's Ranch	Wheeler	3,984
652	Mormon Bar	Wheeler	1,630
653	Morocojo	Monterey R. R.	15
654	Morongo Basin	Toner	1,500
655	Morrow, Mt.	Wheeler	2,065
656	Mosquito Spring	Wheeler	2,010
657	Mountain House	Wheeler	5,641
658	Mud Spring, Amador road	Wheeler	5,973
659	Mud Springs	Wheeler	4,671
660	Murphy	U. S. C. & G. S.	2,703
661	Murphy's Cabin, Lake Tenaiya	Wheeler	7,971
662	Murphy's Mining Village	Wheeler	2,195
663	Murphy's Ranch, Buffalo Salt Works	Wheeler	3,845
664	Myers' Ferry	Wheeler	7,434
665	Myers' Station	Wheeler	3,759
666	Nadean's Station	Wheeler	2,394
667	Napa	C. P. R. R.	18
668	Napa Junction	C. P. R. R.	8
669	Napa Junction (Adalante)	C. P. R. R.	76
670	Nash's Ranch	Wheeler	4,431
671	Nelson	Toner	125
672	Nevada City	Nev. Co. N. G. R. R.	2,531
673	Newbury Peak	Wheeler	3,375
674	Newbury Park	Wheeler	830
675	Newcastle	C. P. R. R.	956
676	Newhall	C. P. R. R.	1,152
677	Newhall's Ranch	Wheeler	974
678	New Pass	P. R. R. Reports	3,164
679	New York Tent	Wheeler	1,143
680	Niagara Creek, Sonora road	Wheeler	6,690
681	Nicholas (near)	Pacific R. R. Reports	289
682	Nichols Point	Wheeler	6,262
683	Niles Junction with San José Branch	C. P. R. R.	88
684	Nimshew	Wheeler	2,451
685	Noble's Pass	Wheeler	5,963
686	Noble's Pass	Williamson	6,260
687	Noman's Spring	Wheeler	3,735
688	Nora	C. P. R. R.	153
689	Nordhoff	Wheeler	819
690	North Dome (above valley 3,633)	Wheeler	7,484
691	North End Peak	Wheeler	8,472
692	Northups (Excelsior Hotel)	U. S. C. & G. S.	4,519
693	Norwalk	C. P. R. R.	95
694	Nott's Ranch	Wheeler	7,110
695	Null's Ranch	Wheeler	1,299
696	Oakdale	Wheeler	149
697	Oak Knoll	C. P. R. R.	102
698	Oakland	C. P. R. R.	12
699	Oakland Wharf	C. P. R. R.	14
700	Observation Peak	Wheeler	8,009
701	Ogburn's Ranch	Wheeler (Theod.)	2,270
702	Olancha Peak	Wheeler	12,250
703	Old Bony Mountain	Wheeler	1,892

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
704	Old Kimshew Settlement	Wheeler	4,992
705	Omjumi, Mountain	Whitney	8,378
706	Omjumi, Mountain	Wheeler	8,292
707	Orange	C. P. R. R.	134
708	Oroville	Wheeler	188
709	Oso Meadows	Wheeler	5,982
710	Oso Mountain	Whitney	3,363
711	Owens' River Bridge	Wheeler	3,618
712	Pacheco	U. S. C. & G. S.	21
713	Pacheco Pass	Whitney	1,470
714	Pacheco's Peak	Whitney	2,845
715	Pacific House	Wheeler	3,451
716	Pah Ute Mines	Wheeler	6,607
717	Pah Ute Peak	Wheeler	8,342
718	Pah Ute Springs	Wheeler	2,849
719	Pajaro	Toner	22
720	Paleta Peak	Wheeler	4,507
721	Palmer's Ranch	Wheeler	2,346
722	Pampa	Wheeler	871
723	Panamint	Wheeler	6,605
724	Panamint Station	Wheeler	3,549
725	Panoche Pass	Whitney	2,500
726	Panola	Toner	48
727	Paradise	Toner	125
728	Paris	C. P. R. R.	400
729	Park	L. A. & I. R. R.	178
730	Parker's Ranch	Wheeler	4,136
731	Parrott's (formerly Pandola) Ferry	Wheeler	834
732	Peach Spring	Wheeler	5,303
733	Peddler's Hill	Wheeler	6,831
734	Peña Blanca (Haigh's Ranch)	Wheeler	1,807
735	Peninsula Hill	U. S. C. & G. S.	367
736	Penole, Point	U. S. C. & G. S.	68
737	Penryn	Toner	624
738	Perkins	S. P. R. R.	51
739	Petalume Creek	U. S. C. & G. S.	111
740	Phillips' Ranch	Wheeler	6,999
741	Phillips' Ranch	Wheeler	242
742	Phillips' Station	Wheeler	6,871
743	Pilot Knob	Wheeler	5,525
744	Pilot Peak	Whitney	7,605
745	Pinos Mountain	Petermann	9,500
746	Pinto Rock	Wheeler	3,903
747	Piute Point	K. P. R. R. Surveys	2,579
748	Placerville	Toner	2,109
749	Placerville	Williamson	1,965
750	Placerville Post Office	Wheeler	1,893
751	Plainsburgh	Toner	209
752	Pleasanton	C. P. R. R.	353
753	Pleasant Valley	Wheeler	2,405
754	Point of Rocks	Wheeler	2,542
755	Porcupine Flat	Wheeler	7,749
756	Potraro	Wheeler	1,028
757	Prattville	Wheeler	4,394
758	Priest's Hotel	Wheeler	2,558
759	Princeton	Wheeler	2,104
760	Probasco's Ranch	Wheeler	973
761	Pulgas Base, East End	U. S. C. & G. S.	19
762	Pulgas Base, West End	U. S. C. & G. S.	129
763	Pyramid Mountain	Wheeler	10,127
764	Quincy	Wheeler	3,381
765	Quiqualmingo	Toner	1,084
766	Railroad Flat	Wheeler	2,606
767	Rancho del Chino y de Jurupa	Med. Dept. U. S. A.	1,000
768	Ravenna	C. P. R. R.	2,347
769	Rawhide Camp	Wheeler	1,556
770	Rawson	Wheeler	228
771	Read	U. S. C. & G. S.	474
772	Reading, Fort	Pacific R. R. Reports	596

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
773	Reading	Pacific R. R. Reports	675
774	Reading	Pacific R. R. Reports	674
775	Reading	Med. Dept. U. S. A.	518
776	Red Bluff	Wheeler	307
777	Red Bluff	Williamson	370
778	Red Bluff	C. P. R. R.	308
779	Red Bluff Signal Station	U. S. Sig. Office	324
780	Redding	C. P. R. R.	556
781	Red Hill Station	U. S. C. & G. S.	188
782	Redmans Ranch	Wheeler	1,181
783	Red Rock Station	Wheeler	2,394
784	Red Slate Peak	Whitney	13,400
785	Redwood City	Toner	10
786	Reilly's Station	Wheeler	1,477
787	Reservoir House	Wheeler	1,013
788	Reservoir in Concord Valley	Wheeler	202
789	Reynolds' Ferry	Wheeler	543
790	Rhett Lake	P. R. R. Reports	4,014
791	Richardson	U. S. C. & G. S.	1,116
792	Richmond Point	U. S. C. & G. S.	192
793	Rincon	Toner	2,050
794	Ripley Mountain	Petermann	7,500
795	Ritgers' Ranch	Wheeler	4,345
796	Roberts' Ferry	Wheeler	184
797	Robertson's	Wheeler	819
798	Roble	Toner	179
799	Rocklin	C. P. R. R.	249
800	Rock Spring	Pacific R. R. Reports	4,898
801	Rocky Island	U. S. C. & G. S.	157
802	Rook's Ranch	P. R. R. Reports	4,181
803	Rose Springs	Wheeler	3,545
804	Ross Mountain	U. S. C. & G. S.	2,205
805	Routiers	S. P. R. R.	72
806	Rowland's Ranch	Wheeler	6,222
807	Rutherford	C. P. R. R.	168
808	Sackett's Wells	Toner	312
809	Sacramento	C. P. R. R.	30
810	Sacramento	Smithsonian Inst.	82
811	Sacramento	Williamson	81
812	Sacramento Signal Station	U. S. Signal Office	70
813	Saddle (Malaga) Mountain	Wheeler	2,896
814	Saint Clair Ranch	Wheeler	1,961
815	Saint Helena	C. P. R. R.	244
816	Salinas City		42
817	Salsbury	S. P. R. R.	126
818	Salt Wells	Wheeler	117
819	San Andreas	Wheeler	1,033
820	San Antonio Peak	U. S. C. & G. S.	9,931
821	San Antonio Peak	Wheeler	10,191
822	San Benito	Smithsonian Inst.	140
823	San Benito Pass	K. P. R. R. Surveys	2,700
824	San Bernardino	Wheeler	950
825	San Bernardino Mountain	Whitney	11,600
826	San Bernardo	Pacific R. R. Reports	1,118
827	San Bruno	Toner	16
828	San Ruenaventura	Toner	12
829	San Carlos Peak	Whitney	4,977
830	Sand Creek	C. P. R. R.	2,315
831	Sand Knoll	U. S. C. & G. S.	227
832	San Diego	Emory	30
833	San Diego Mission	Pacific R. R. Reports	64
834	San Diego Signal Station	U. S. Signal Office	67
835	San Emigdio Store	Wheeler	788
836	San Fernando	C. P. R. R.	1,066
837	San Fernando	Wheeler	1,034
838	San Fernando Pass	Pacific R. R. Reports	1,940
839	San Fernando Peak	Wheeler	3,793
840	San Fernando Tunnel, south mouth	Wheeler	1,429
841	San Felipe	Pacific R. R. Reports	2,176

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
842	San Felipe	Pacific R. R. Reports	2,456
843	San Francisco, Signal Station	U. S. Signal Office	60
844	San Francisco, Presidio	Med. Dept. U. S. A.	150
845	San Francisco	U. S. C. & G. S.	384
846	San Francisquito Cañon	Wheeler	2,382
847	San Francisquito Pass	P. R. R. Reports	3,718
848	San Gabriel	Wheeler	419
849	San Gabriel Church	Wheeler	481
850	San Gabriel Mine	Wheeler	1,703
851	San Gabriel Peak		6,232
852	San Gabriel Range	Whitney 4,500 to	6,500
853	San Gorgonio	C. P. R. R.	2,560
854	San Gorgonio Pass	P. R. R. Reports	2,800
855	San Gorgonio Pass	T. & P. R. R.	2,621
856	San Isabel Rancho	Toner	2,957
857	San Jacinto Mountain	Wheeler	10,987
858	San José	C. P. R. R.	91
859	San José	U. S. C. & G. S.	118
860	San Leandro	C. P. R. R.	48
861	San Lorenzo	Toner	35
862	San Luis Obispo	Toner	402
863	San Luis Pass	P. R. R. Reports	1,556
864	San Luis Rey	Med. Dept. U. S. A.	20
865	San Mateo	Toner	23
866	San Miguel	Toner	616
867	San Pablo Point	U. S. C. & G. S.	97
868	San Pascual	Emory	716
869	San Pedro	Pacific R. R. Reports	30
870	San Pedro Point	U. S. C. & G. S.	356
871	San Pedro Hill	Wheeler	1,462
872	San Quentin, Point	U. S. C. & G. S.	173
873	Santa Ana	U. S. C. & G. S.	3,620
874	Santa Ana	C. P. R. R.	137
875	Santa Ann Hotel	Wheeler	141
876	Santa Barbara	Smithsonian Institute	20
877	Santa Buenaventura	Wheeler	146
878	Santa Catalene	Toner	3,000
879	Santa Clara	Smithsonian Institute	98
880	Santa Cruz Station	U. S. C. & G. S.	359
881	Santa Cruz Point	U. S. C. & G. S.	32
882	Santa Isabella		3,050
883	Santa Isabella Rancho	Pacific R. R. Reports	2,957
884	Santa Monica	L. A. & I. R. R.	20
885	Santa Monica	Wheeler	15
886	Santa Paula	Wheeler	384
887	Santa Rosa Valley	Wheeler	175
888	San Vicente	L. A. & I. R. R.	167
889	Say-qui-to Spring	Wheeler	5,553
890	Schaffers, Mount	Wheeler	6,864
891	School House	S. P. R. R.	109
892	Schultz, Mount	Wheeler	2,275
893	Scodie's Ranch	Wheeler	2,716
894	Semi Pass	P. R. R. Reports	1,577
895	Sentinel Dome (above valley 4,160)	Wheeler	8,011
896	Sesma	Toner	229
897	Sevastapol Flat	Wheeler	2,210
898	Seven Palms	C. P. R. R.	1,126
899	Shafer's Station	Wheeler	4,026
900	Shasta		1,160
901	Shasta, Mount	Whitney	14,442
902	Shasta, Mount (timber line on)		8,000
903	Shaw's Flat	Toner	2,270
904	Shaw's Flat	Wheeler	2,036
905	Shaw's Ranch	Wheeler	6,311
906	Shear's Bridge	Wheeler	2,007
907	Sheep Head	Wheeler	3,914
908	Sheffer's Hot Springs	Wheeler	4,094
909	Sheridan		113

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
910	Shingle Springs	S. P. R. R.	1,427
911	Shinn's Ranch	Wheeler	5,040
912	Shoo-fly Bridge	Wheeler	3,071
913	Shumway's Ranch	Wheeler	5,067
914	Sierra Valley	Wheeler	4,910
915	Sierravile, Junc. of S. T. and L. Road	Wheeler	4,904
916	Sierraville, Post Office	Wheeler	4,880
917	Silliman, Mt.	Whitney	11,623
918	Silver Creek	Toner	3,700
919	Silver Lake Hotel	Wheeler	7,174
920	Silver Mt.	Whitney	10,934
921	Silver Mountain City	Wheeler	6,446
922	Silver Mountain Pass	Whitney	8,793
923	Simi Ranch	Wheeler	674
924	Smith's Ranch	Wheeler	1,047
925	Smoke Creek Depot	Wheeler	4,163
926	Snelling Post Office	Wheeler	252
927	Snider's Store	Wheeler	4,925
928	Snow's Hotel	Wheeler	5,217
929	Soap Spring	Wheeler	706
930	Soda Lake	Pacific R. R. Reports	1,002
931	Soda Lake	Wheeler	1,128
932	Soledad City	Wheeler	2,513
933	Soledad Pass	A. & P. R. R. Surveys	3,215
934	Solfatara	Wheeler	5,908
935	Sonoma Mountain	U. S. C. & G. S.	2,292
936	Sonora Mountain	Wheeler	11,478
937	Sonora Pass	P. R. R. Reports	10,115
938	Sonora Post Office	Wheeler	1,816
939	Soto	Toner	186
940	South Dome (lip) (above valley 4,953)	Wheeler	8,804
941	South Fork Mountain	Wheeler	7,408
942	Spadra	C. P. R. R.	705
943	Spadra	Wheeler	802
944	Spanish Ranch	Wheeler	3,636
945	Sprague's Ranch	Wheeler	2,950
946	Springville	Wheeler	48
947	Stanford Mountain	Whitney	9,175
948	Starr King Mt. (above valley 5,171)	Wheeler	9,022
949	State Line Peak	Wheeler	8,405
950	Stevens Bar Ferry	Wheeler	614
951	Stevens Mountain	Wheeler	10,011
952	Stevens Ranch, Hope Valley	Wheeler	7,382
953	Stockton, Junc. with S. & V. & S. & C. R.R.'s.	C. P. R. R.	23
954	Stockton's Cabin	Wheeler	5,877
955	Stockton Mill	Wheeler	4,639
956	Stokes Mountain	Wheeler	2,069
957	Stonebreakers	Wheeler	4,360
958	Stony Point		500
959	Storms	Nevada County N. G. R. R.	2,424
960	Strawberry	Wheeler	5,238
961	Strawberry Station (toll house)	Wheeler	5,695
962	Strawberry Valley	Toner	3,567
963	Strawberry Valley	Williamson	5,707
964	Sugar Loaf Mountain	Wheeler	8,416
965	Sulphur Peak	U. S. C. & G. S.	3,471
966	Sulphur Spring Ranch	Wheeler	4,466
967	Summit Peak	Wheeler	8,301
968	Summit Post Office, west of Beckwith's Pass	Wheeler	4,875
969	Summit Station	Wheeler	6,983
970	Summit Valley	Toner	6,765
971	Sumner	C. P. R. R.	415
972	Sunday Peak	Wheeler	8,335
973	Sunday Peak	Wheeler	11,089
974	Sunoe	Toner	264
975	Surveyors' Wells	Wheeler	3,567
976	Susanville	Wheeler	4,195

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
977	Suspension Bridge, Mokelumne River	Wheeler	2,092
978	Sutler	Toner	919
979	Swann's Ranch, E. Walker River	Wheeler	5,042
980	Sweetwater Mountain	Wheeler	11,778
981	Sycamore		302
982	Sycamore Grove	Wheeler	447
983	Tahoe City	Wheeler	6,252
984	Tahoe Lake	R. R. Reports	6,247
985	Tamalpais, Mount	Whitney	2,597
986	Tamarac		6,209
987	Tamarack Flat	Wheeler	6,234
988	Tannery	Wheeler	4,400
989	Tapo Ranch	Wheeler	1,373
990	Tassett		83
991	Taylor's Ranch	Wheeler	1,047
992	Taylorville	Wheeler	3,479
993	Tehachapai, Mount	Wheeler (Theod.)	9,214
994	Tehachapai Pass	Wheeler	3,832
995	Tehama	C. P. R. R.	222
996	Tejon, Fort	Med. Dept. U. S. A.	3,240
997	Tejon, Fort	Wheeler	3,245
998	Tejon Pass	P. R. R. Reports	5,364
999	Tejon Ranch	Wheeler	1,450
1000	Telegraph Hill	U. S. C. & G. S.	300
1001	Telescope Mountain	Wheeler (Theod.)	10,937
1002	Temescal Mountain	Wheeler (Theod.)	5,730
1003	Thomas Ranch	Wheeler	3,772
1004	Thompson	C. P. R. R.	9
1005	Thompson's	Wheeler	2,114
1006	Thompson's Ferry	Wheeler	188
1007	Thompson's Peak	Wheeler	7,752
1008	Thunder Mountain	Wheeler	9,121
1009	Tilley's Ranch	Wheeler	2,609
1010	Tipton	C. P. R. R.	267
1011	Todos Santos Pass	P. R. R. Reports	637
1012	Toolucha Peak	Wheeler	7,022
1013	Tomales Bay	U. S. C. & G. S.	673
1014	Topsail Rock	U. S. C. & G. S.	81
1015	Towler's, Napa Valley		369
1016	Town Talk	Nev. Co. N. G. R. R.	2,774
1017	Tragedy Spring	Wheeler	7,989
1018	Trinchera	Wheeler	7,567
1019	Trinidad		5,820
1020	Trout Meadows	Wheeler	5,998
1021	Truckee	C. P. R. R.	5,819
1022	Truckee	Wheeler	5,795
1023	Truckee Pass	P. R. R. Reports	7,200
1024	Truebody	C. P. R. R.	88
1025	Tulare	C. P. R. R.	282
1026	Tulare Lake	Pacific R. R. Reports	398
1027	Tull Flat	Wheeler	5,594
1028	Tullock	Toner	106
1029	Tuolumne Grove	Wheeler	5,794
1030	Turner's Ranch, Sierra Valley	Wheeler	4,904
1031	Tuttletown	Wheeler	1,321
1032	Twin Lake	Wheeler	5,106
1033	Twin Peak	Wheeler	8,824
1034	Twin Peaks	Whitney	8,925
1035	Twist's Ranch	Wheeler	1,121
1036	Tyler's Ranch	Wheeler	4,802
1037	Uhl's Ranch	Wheeler	2,662
1038	Union Camp	Smithsonian Institute	54
1039	Union Hill	Nev. Co. N. G. R. R.	2,706
1040	Vacaville	Toner	175
1041	Vala Citron	Emory	1,539
1042	Vallecito	Toner	1,643
1043	Vallecito Post Office	Wheeler	1,748

TABLE OF ALTITUDES—Continued.

No.	Station.	Authority.	Elevation. Feet.
1044	Vallejo	U. S. C. & G. S.	87
1045	Vallejo	U. S. C. & G. S.	371
1046	Vallejo (North)	C. P. R. R.	26
1047	Vallejo (South)	C. P. R. R.	13
1048	Vergennes Ranch	Wheeler	940
1049	Vina		211
1050	Visalia	Williamson	384
1051	Visalia, Signal Station	U. S. Signal Office	348
1052	Volcano	Wheeler	2,075
1053	Wabler Lake House	Wheeler	6,808
1054	Wades' Meadows	Wheeler	4,567
1055	Wades' Peak	Wheeler	7,153
1056	Wahguyhe Mountain	Wheeler (Theod.)	8,527
1057	Walker's Pass	P. R. R. Reports	5,302
1058	Walker's Pass	Wheeler	5,322
1059	Wallace's Ranch, Warner Lake	Wheeler	4,487
1060	Walnut Grove	C. P. R. R.	308
1061	Warm Springs	C. P. R. R.	46
1062	Warm Springs, Sonora Road	Wheeler	7,385
1063	Warner's Pass	P. R. R. Reports	3,870
1064	Warner's Ranch	P. R. R. Reports	3,021
1065	Warren's Peak	Wheeler	9,668
1066	Washington, Mount	Wheeler	10,802
1067	Washington Quartz Mill	Wheeler	1,032
1068	Watsonville		45
1069	Wancoba Peak	Wheeler	11,267
1070	Webster	C. P. R. R.	24
1071	Welden	Wheeler	2,668
1072	Welds	Wheeler	2,217
1073	Wellington Mountain	Wheeler	7,665
1074	West Point	Wheeler	2,749
1075	West's Ranch	Wheeler	596
1076	Wheatland	C. P. R. R.	84
1077	White Granite Mountain	Wheeler	7,045
1078	White Rock	S. P. R. R.	495
1079	Whitney	Wheeler	10,051
1080	Whitney Meadows	Wheeler	9,371
1081	Whitney, Mt.	Whitney	14,898
1082	Wellington Mountain	Wheeler	7,665
1083	Wild Rose Spring	Wheeler	4,683
1084	Wiley's Station, Amador Road	Wheeler	5,027
1085	Williamson River	Wheeler	4,387
1086	Williamson's Lake		2,588
1087	Willow Lake	Wheeler	5,382
1088	Willow Ranch	Wheeler	4,275
1089	Willow Spring	Wheeler	420
1090	Willow Spring (head of Willow Creek)	Wheeler	5,084
1091	Willow Tree Spring	Wheeler	2,500
1092	Wilson's Ranch	Wheeler	1,115
1093	Woodford's	Wheeler	5,676
1094	Woodland, Junction with N. R. R.	C. P. R. R.	63
1095	Woodland	U. S. C. & G. S.	58
1096	Woods Peak	Whitney	10,552
1097	Workman's Hill	Wheeler	1,363
1098	Workman's Ranch	Wheeler	362
1099	Wright Lake	P. R. R. Reports	4,470
1100	Yellowbally	Petermann	8,000
1101	Yankee Jim's		3,185
1102	Yerba Buena	U. S. C. & G. S.	345
1103	Yosemite Valley	Whitney	4,060
1104	Yosemite Valley (cliffs and domes about it range from 7,000 to 9,000 ft. above sea)	Williamson	3,935
1105	You Bet	Nev. Co. N. G. R. R.	2,172
1106	Yountville	C. P. R. R.	97
1107	Yountville	Cal. P. R. R.	105
1108	Yreka	Williamson	2,731
1109	Yreka Gap	Whitney	6,642

TABLE OF ALTITUDES—Continued.

No.	Station.	Elevation. Feet.
1110	Alleghany, Sierra County	4,375
1111	Altaville, Calaveras County	1,577
1112	American Mine, Nevada County	1,843
1113	Amador City, Amador County	862
1114	Angels, Calaveras County	1,394
1115	Aqueduct City, Amador County	2,435
1116	Argus Peak, Inyo County	6,333
1117	Atkinson's Grade, San Diego County, foot	416
1118	Atkinson's Grade, San Diego County, first bench	726
1119	Atkinson's Grade, San Diego County, summit	1,220
1120	Bald Mountain, Calaveras County, summit	1,801
1121	Bald Mountain, Sierra County, mouth of tunnel	4,489
1122	Ballena Valley, San Diego County	2,440
1123	Banner, San Diego County	2,800
1124	Birchville, Nevada County	1,683
1125	Blacksmith's Flat, El Dorado County	3,831
1126	Blue Tent, Nevada County	3,108
1127	Bonaparte's Hat, Placer County, summit	8,661
1128	Borax Flat, Inyo County	1,800
1129	Borax Works, Inyo County	1,816
1130	Boston Ranch	1,500
1131	Bottle Hill, El Dorado County, crest	2,570
1132	Bowman Dam, Nevada County	5,393
1133	Brady's, Yuba County	211
1134	Bridgeport, Nevada County	1,500
1135	Brownsville, Yuba County	2,125
1136	Buck's Bar, El Dorado County	1,628
1137	Bunker Hill, Sacramento County	267
1138	Burn's Ranch, El Dorado County	2,518
1139	Cajon Ridge, San Diego County	510
1140	Cajon Valley, San Diego County	220
1141	Cajon Valley, San Diego County, eastern rim	375
1142	Canada Hill, Placer County, summit	7,091
1143	Canada Hill, Placer County, Yank's Cabin	6,217
1144	Cave of the Catacombs, Calaveras County	1,708
1145	Centerville, Pilot Hill Post Office, El Dorado County	1,191
1146	Cherokee Flat, Butte County	1,187
1147	Cherokee, Nevada County	2,575
1148	Chili Bar, El Dorado County	931
1149	Christmas Hill, Nevada County, top of	3,225
1150	Cold Spring, Mountain Summit, Placer Couty	3,679
1151	Coleman's Grade, San Diego County, top, five miles from Julian	3,400
1152	Columbia Hill, Nevada County	2,958
1153	Coso, Inyo County	5,884
1154	Coso Mines, Inyo County	6,000
1155	Coso Peak, Inyo County	8,425
1156	Damascus, Placer County	4,006
1157	Dardanelles, Placer County, bed rock	2,677
1158	Dark Cañon, El Dorado County	4,229
1159	Deadwood, Placer County	3,951
1160	Dirty Flat, El Dorado County	2,355
1161	Dogtown (Magalia), upper, Butte County	2,150
1162	Dogtown (Magalia), lower, Butte County	2,080
1163	Doon's House, Butte County	2,940
1164	Douglas Flat, Calaveras County	1,986
1165	Downieville Trail, Summit of, between Rock Creek and Forest City, Sierra County	5,404
1166	Drytown, Amador County	642
1167	Eagle Borax Works, Inyo County	—69
1168	Empire Flat, Nevada County	1,716
1169	Empire Ranch, Yuba County	840
1170	Fairplay, El Dorado County	2,385
1171	Fiddler's Green, Placer County	4,123
1172	Fiddletown, Amador County	1,693
1173	Forbestown, Butte County	2,625

TABLE OF ALTITUDES—Continued.

No.	Station.	Elevation. Feet.
1174	Forest City, Sierra County	4,465
1175	Forest Hill, Placer County	3,237
1176	Forney's, El Dorado County	4,173
1177	Foster's, San Diego County	260
1178	French Corral, Nevada County	1,566
1179	Funeral Mountains, highest peaks, Inyo County	6,754
1180	Georgia Slide, El Dorado County	2,330
1181	Geyser's Springs, Sonoma County	1,900
1182	Gibsonville, Sierra County	5,500
1183	Granite Chief, summit, Placer County	9,144
1184	Greenwood, El Dorado County	1,610
1185	Gregory Mountain, El Dorado County	3,525
1186	Grizzly Flat, El Dorado County	3,949
1187	Grizzly Flat, Placer County	2,982
1188	Gurley's, Yuba County	172
1189	Halfway House, San Diego County (road from San Diego to Julian)	180
1190	Highland Springs, Lake County	1,700
1191	Horse Camp Springs, Inyo County	4,690
1192	Howard Springs, Lake County	2,225
1193	Hunsaker's Grade, San Diego County (four miles from Nuevo)	1,760
1194	Hunsaker's Grade, San Diego County, summit	2,230
1195	Hyatt's, Nevada County	1,259
1196	Indian Diggings, Amador County	3,162
1197	Iowa Hill, Placer County	2,873
1198	Jackson, Amador County	1,243
1199	Jackson Valley, Buttes, summit of	829
1200	Jamison City, Plumas County	4,800
1201	Johnstown, or Garden Valley, El Dorado County	1,951
1202	Jones Hill, El Dorado County, summit of	2,343
1203	Julian City, San Diego County	4,000
1204	Keeler, Inyo County	3,656
1205	King's Hill, Placer County	2,538
1206	Lane's Springs, Calaveras County	1,000
1207	La Porte, Plumas County	4,993
1208	Last Chance, Placer County	4,583
1209	Little Grass Valley, Plumas County	5,025
1210	Little Spanish Hill, crest of, El Dorado County	2,321
1211	Little York, Nevada County	2,839
1212	Logtown, El Dorado County	1,939
1213	Lolo Montez Diggings, Nevada County	2,489
1214	Lone Star Hill, Inyo County	4,911
1215	Lookout Hill, Inyo County	4,214
1216	Malakoff, Nevada County	3,173
1217	Manzanita Hill, summit, Nevada County	3,054
1218	Marble Valley, El Dorado County	925
1219	Michigan Bar, Sacramento County	227
1220	Michigan Bluffs, Placer County	3,491
1221	Mohawk Valley, Knott's Ranch, Plumas County	4,325
1222	Monte Christo	5,056
1223	Montezuma Hill, Nevada County	2,853
1224	Mooney Flat Hill Summit, Yuba County	1,170
1225	Moore's Flat, Nevada County	4,231
1226	Morris Ravine, Butte County	524
1227	Mud Springs, El Dorado County	1,658
1228	Needle Peak, Inyo Connty	7,086
1229	Newtown, El Dorado County	2,482
1230	Nichols' House, Cave City, Calaveras County	1,593
1231	Nine-Mile Station, Inyo County	2,510
1232	North Bloomfield, Nevada County	3,278
1233	Nuevo, San Diego County	1,200
1234	Oliver Mountain Summit, El Dorado County	3,221
1235	Omega, Nevada County	4,201

TABLE OF ALTITUDES—Continued.

No.	Station.	Elevation. Feet.
1236	Onion Valley, Plumas County	6,160
1237	Ophir Mountain, Inyo County	6,063
1238	Oro Flat, Placer County	2,842
1239	Oroville, Butte County	375
1240	Pilot Hill (Summit), El Dorado County	1,857
1241	Pinto Peak, Inyo County	7,267
1242	Plugugly Hill (Summit), Placer County	3,251
1243	Pluto Summit, Placer County	8,633
1244	Post Office Spring, Inyo County	1,294
1245	Prospect Flat, El Dorado County	2,214
1246	Puckerville, Amador County	1,037
1247	Quaker Hill, Nevada County	3,265
1248	Reeds, Yuba County	433
1249	Rice's Bar, Placer County	1,184
1250	Rough and Ready, Nevada County	1,901
1251	Sailor Cañon, Placer County	5,251
1252	Sailor Flat, Nevada County	3,050
1253	St. Helena Mountain, Napa County	4,343
1254	St. Helena Mountain, Napa County, first bench above Toll House	3,825
1255	Salt Spring, Death Valley, Inyo County	—63.9
1256	San Bernardino Hot Springs	1,600
1257	San Juan, Nevada County	2,143
1258	Santa Barbara Hot Sulphur Springs	1,500
1259	Santa Ysabelle Valley, San Diego County	2,700
1260	Sebastopol, Nevada County	1,893
1261	Secret Hill, Summit, Placer County	6,536
1262	Secret House, Placer County	5,423
1263	Sentinel Peak, Inyo County	9,850
1264	Sheep Ranch, Calaveras County	2,273
1265	Sierra City, Sierra County	4,188
1266	Smartsville, Yuba County	758
1267	Smartsville Hill, summit, Yuba County	1,074
1268	Snowy Mountain, Placer County, summit	8,425
1269	Soda Springs, Shasta County	2,363
1270	South Yuba Bridge	420
1271	Spanish Dry Diggings, El Dorado County	2,158
1272	Squaw Valley, Placer County	6,304
1273	Steep Hollow, Nevada County	3,342
1274	Sucker Flat, Placer County	670
1275	Summit, Soda Springs, Placer County	6,009
1276	Sugar Loaf, Butte County, summit	1,647
1277	Sugar Pine Pass, Placer County	7,130
1278	Surprise Cañon, Inyo County	2,650
1279	Sutter Creek, Amador County	1,197
1280	Table Hills east of Owen's Lake, Inyo County	7,343
1281	Table Mountain, Tuolumne County, summit	2,214
1282	Three Prong, Placer County, summit	9,000
1283	Timbuctoo, Yuba County	441
1284	Timbuctoo Mountain, Yuba County	917
1285	Todds Valley, Placer County	2,750
1286	Toll House, St. Helena Mountain, Napa County	2,300
1287	Tucker's Ranch, Plumas County	4,100
1288	Tuscan Springs, Tehama County	600
1289	Volcanoville, El Dorado County	3,081
1290	Water Station, Inyo County	2,110
1291	Webber Hill, El Dorado County, summit	2,184
1292	Whitesel's Ranch, Nevada County	1,686
1293	Wilcox Meadows, El Dorado County	5,344
1294	Wilcox Ravine, Nevada County	2,799
1295	Windy Gap, Inyo County	2,053
1296	Wisconsin Hill, Placer County	2,936
1297	Wilks' Ranch, El Dorado County	3,386

WATER POWER.

In a State like California, in which a large portion of the area is much above sea level, and where there are a multitude of streams, large and small, flowing from the high lands, there must be and are many localities where water power is abundant and available. This very important matter is just beginning to attract attention in California. At Grass Valley, in Nevada County, where gold mining has been the principal business and the support of the people, up to a recent date, steam was almost universally used to drive the quartz mills. But in 1882 the Idaho Company, although possessing the best quartz mine in the State, began to consider the advantage that would be derived from the substitution of water for steam power. They began to buy water from the South Yuba Canal Company, and after an experimental working for a year, found the annual saving over steam to be from $25,000 to $30,000. There are many localities in the mountains and foothills of California where may be found gold quartz veins, water power, and fertile hillside and mountain valley lands. This Piedmont region will support a large population, and is really the most beautiful part of the State. Mines that would hardly pay if steam power was employed, with cheap or free water power, all the operations of mining and milling may be performed, with but few hands. The same water that serves the mill will hoist the ore, pump, force air into the mine for ventilation and power drilling. Almost any quartz vein in California could be made to pay under these circumstances, and the application of this cheap power would add much to the prosperity of the State.

It will soon again be cheaper to move manufactured articles from water power to a market than to make them by steam elsewhere. Water is equally useful for irrigation and mining purposes after being used for water power, as long as it is not allowed to fall below a certain altitude.

IRRIGATION.

Soon after the first excitement caused by the discovery of gold in California began to subside, attention was turned in a limited way to the agricultural resources of the State. It was first supposed—from the peculiar dryness of the summer months, during which rain seldom falls—that the country would never be an agricultural one in any general sense, but this theory was disproved by experience. At the same time it became evident that a different system of culture, suited to the climatic periods of excessive moisture alternating with equally excessive dryness, must be pursued. Experiment led to the adoption of a system of irrigation.

When the new method began to be understood, and intelligently carried out, it was found that most extraordinary crops were the result.

The dry valley lands of Fresno, San Bernardino, Kern, and other southern counties where water has been introduced, are found to be unusually fertile, and beautiful and prosperous settlements have sprung up in what was at first thought to be a desert. The subject of irrigation and the use of the waters of the State for other purposes than navigation, has grown in importance until it is admitted to be the most momentous question now before the people. The rights of riparian owners have been questioned and much useless legislation has been enacted without arriving at any satisfactory conclusion. The debris or mining question goes hand in hand with irrigation, and though seemingly different, is in fact only another phase of the same important subject. Judging from the trouble the ancients had with this same question, it will not be settled in California for some time to

come. The proper and just distribution of the surplus waters of the State, and the extraction of the vast deposits of gold known to exist in the foothills, are matters which have an important bearing on our material interests. To solve this problem, and protect the conflicting interests of those concerned, is work for future legislators, and the more the matter is agitated now, the sooner will a settlement be effected.

In some localities where it is difficult to obtain water from living streams, artesian wells are being sunk, and very successfully. From these wells, in some parts of the State, natural gas escapes in considerable quantities, giving hope that gas-wells similar to those now attracting so much attention in Pennsylvania may yet be discovered. A notable example of this at the present time is at the city of Los Angeles, where a vein of gas was struck in sinking a well. The gas became ignited from a cigarette, and blazed up to a height of ten feet. An article in the Los Angeles *Herald* assumes that a dozen wells sunk within the city limits would each of them yield gas which might be utilized.

The city of Stockton is supplied with water from artesian wells, some, if not all, of which also produce gas as well as water. The wells sunk for oil in various parts of the State, in perhaps a majority of cases, produce gas. This is a subject worthy the attention of scientific and practical men. May not these emanations of gas indicate vast bodies of coal, which we may at any day discover by sinking wells in search of water?

The State Mining Bureau should employ special persons to study and investigate these matters, and preserve in the State Museum sections of the various wells, which would enlarge our information as to the geology of the valleys, and throw light upon their origin.

Mr. George A. Raymond, more thoughtful than most persons engaged in the business of sinking artesian wells, has carefully preserved specimens of borings, and kept a register of the findings. This should be done officially by the State Mineralogist, and all the results published as frequently as possible, in the general interest. Mr. Raymond has donated to the State Museum samples of borings which are specially interesting. The following are copies of these tabulated records, exactly as kept by him on printed blanks.

RECORD OF STRATA IN ARTESIAN WELL

Drilled by Geo. A. Raymond for J. B. Haggin, Kern County, on Sec. 30, T. 29 S., R. 25 E., Mount Diablo Base and Meridian. Screw Casing 5 5-8 inches diameter.

Depth—Feet.	Thickness—Feet.	Character.	Remarks.
12	12	Black clayey soil	
14	2	Sand	Surface water.
24	10	Yellow clay	
27	3	Sand	
49	22	Yellow clay	
57	8	Sand	
68	11	Brown clay	
80	12	Sand	
82	2	Hard pan	
130	48	Sand	
152	22	Clay and cement	
155	3	Hard pan	
185	30	Sand	
191	6	Cement	
193	2	Yellow clay	
220	27	Sand	
225	5	Yellow clay	
245	20	Sand, cement, and hard pan	In streaks very hard.
255	10	Yellow clay	
272	17	Sand and cement	
285	13	White clay	Like potters' clay.
287	2	Sand	
297	10	White clay	Like potters' clay.
330	33	Sand	
342	12	Hard pan	Very hard.
387	45	Sand	
395	8	Hard pan	Very hard.
403	8	Sand	
433	30	Hard pan and clay	Very hard streaks.
455	22	Hard pan and cement	Very hard streaks.
463	8	Sand	
475	12	Yellow clay	
493	18	Sand and gravel	
530	37	Hard pan and sand	Very hard streaks.
542	12	Sand	
602	60	Hard pan, clay, gravel, and cement	*Streaks very hard—water.
608	6	Yellow clay	
630	22	Hard pan, clay, gravel, and cement	Streaks very hard—water.
642	12	Sand	
648	6	Yellow clay	
650	2	Sand	

Stopped work for the present May 20, 1886.
* Water rose to within seven feet of surface.
No flow at above depth.
This well will be carried deeper within a few months. Say about August or September, 1886.

RECORD OF STRATA IN ARTESIAN WELL

Drilled by Geo. A. Raymond for J. B. Haggin, in Kern County, on Sections 29, 30, 31, 32, T. 30 S., R. 26 E., Mount Diablo Base and Meridian. Screw Casing 5 5-8 inches diameter.

Depth—Feet.	Thickness—Feet.	Character.	Remarks.
4	4	Dry sandy soil	
96	92	Quicksand	*First surface water.
98	2	Yellow clay	*No toughness or strength.
280	182	Quicksand and gravel	*Small streaks cement of no strength.
283	3	Blue clay	
340	57	Quicksand and gravel	†Small streaks cement and hard balls.
344	4	Blue clay	
374	30	Quicksand and gravel	†Hard balls.
376	2	Blue clay	
412	36	Sand and gravel	Hard streaks cement.
421	9	Blue clay	
432	11	Quicksand	
440	8	Blue clay	
460	20	Quicksand	Small flow water.
464	4	Blue clay	
472	8	Sand	Second flow water.
----	-----	Blue clay	Bottom of casing in blue clay.

Sufficient flow of water for two thousand head of stock.

*Equivalent to 280 feet of continuous quicksand, as the yellow clay was so thin and frail that it would not hold up the weight of the quicksand above.

†Samples of hard balls given to Mr. Hanks.

Well completed March 15, 1886.

Some of the specimens taken from the wells, I have examined microscopically and otherwise, and found exceedingly interesting, but to publish an account of them in their present unfinished condition would be premature.

MINERAL SPRINGS IN CALIFORNIA.

Numerous mineral springs are known to exist in California, some of which have gained celebrity, others are nameless and are only known by their localities. Some of the latter may eventually prove to be of great value. From the fact that it has been impossible to maintain a chemical laboratory in connection with the Mining Bureau, the official guide-book which was planned has not been made, and it has not been possible even to visit the most noted springs to study and publish their characteristics. The State Mineralogist has only been able to gather such information as could be easily obtained, and to condense it into the following list.

Among the many mineral products of the State the numerous mineral springs are not the least important. In Germany, Italy, Switzerland, England, France, Spain, Austria, Scotland, Ireland, Bohemia, and Portugal, in Europe, and New York, Virginia, Arkansas, Pennsylvania, West Virginia, Wisconsin, Kentucky, Ohio, Mississippi, Michigan, and Alabama, in the United States, and in Canada and elsewhere in the world, mineral springs are found. Mineral waters are generally divided into two principal groups—hot and cold. The principal subdivisions are—

Salt waters.	Alkaline waters.
Iron waters.	Mud springs.
Sulphur waters.	Alkaline saline.
Lime waters.	Magnesian.

A few more or less celebrated springs contain notable quantities of some special mineral or salt, to which they owe their peculiar character, as iodine, bromine, lithium, or fluorine.

California abounds in mineral springs more or less celebrated, but there seems to be no system in the use of the waters. People go to any spring which suits their taste or convenience, without knowing or seeming to care for the effect the water will have on them. This results from the fact that but few reliable analyses have been made, and physicians are at a loss how to prescribe for that reason. There should be an official guide book made by the State Mineralogist, which would be of very great utility to the State.

Such a work would necessitate the establishment and maintenance of a very complete chemical laboratory, and the employment of able assistants. The following are the most important known mineral springs in the State. There are many others of less note, but which may be of equal and possibly greater value and importance. The late Dr. Hatch published the best account and description of the mineral waters of California, that has been previously written.

Alameda County.

(1) *Piedmont Springs.*

Situated three miles from Oakland. As far as I am aware, no analysis has ever been made of the water of these springs, although they have attained considable celebrity.

Calaveras County.

(2) *Lane's Mineral Springs.*

These springs are located in the foothills of the Sierra Nevada, at an altitude of one thousand feet above sea level. They lie thirty-five miles east

of Stockton, from which place they may be reached by stage on alternate days; visitors are accommodated at a good hotel, besides which there are cottages for those who prefer them. The water in the springs is clear and cold, but no other information has been obtained, nor has any analysis been published as far as I know.

COLUSA COUNTY.

(3) *Simmon's Hot Sulphur Spring.*

This spring is situated in Sulphur Cañon, but the exact locality is not given. The water has a temperature of 170°, but no analysis has been received.

(4) *Wilbur Hot Sulphur Springs.*

The route to these springs is by rail to Williams, and thence by stage. An analysis by an unnamed chemist has been published. It is claimed that the waters possess curative properties specially applicable to the treatment of rheumatism and cutaneous diseases.

CONTRA COSTA COUNTY.

(5) *Byron Springs.*

There are said to be a number of springs at this locality, some of which are hot, while others are cold, some charged with carbonic acid gas, some with sulphuretted hydrogen. They are situated very near to Byron Station. There is a good hotel at the springs, and the accommodations are said to be first class. Trains leave San Francisco at 9 A. M. and 3 P. M., and Byron at 6:30 and 9:30 A. M. I have no reliable information as to the water of these springs, nor am I aware of any analysis having been made.

HUMBOLDT COUNTY.

(6) *A very remarkable mineral water*

Has been discovered in a nameless spring in the town of Eureka. The water issues from the bank at the edge of the bay. At high tide the waters of the bay rise and cover the spring. The Indians knew of this spring and ascribed to it remarkable curative powers. It was rediscovered accidentally by a workman while the steamer Humboldt was being built near by. The water is now used in Eureka and San Francisco.

The following analysis, not before published, reveals the remarkable character of this water:

SAN FRANCISCO, May 8, 1885.

Mineral water—one U. S. gallon.

Sodium chloride	1403. grains.
Magnesium sulphate	211.3 grains.
Magnesium chloride	101. grains.
Calcium sulphate	42.5 grains.
Sodium bromide	14. grains.
Potassium sulphate	12.2 grains.
Sodium carbonate	10.1 grains.
Calcium carbonate	3.8 grains.
Alumina	1.3 grains.
Silica	.95 grains.
Carbonate of iron	.12 grains.
Manganese	Traces.
Boracic acid	Traces.
Iodine	Traces.
Lithium	Traces.

Contains a little carbonic acid, and is saturated with sulphuretted hydrogen. It is a sulphur, saline water, and should prove beneficial in affections of the glandular and lymphatic system, rheumatism, and diseases of the skin.

W. D. JOHNSON, M.D.

(7) *Felt's Springs.*

The following from the *Humboldt County Standard* contains all the information I have been able to obtain concerning these springs:

FELT'S SPRINGS.

Situated about twenty-five miles from Eureka, near the head of Strongs' Valley. Dr. Felt of Hydesville, the fortunate proprietor of these notable mineral waters, must eventually realize a handsome sum for his property. Some years ago he built a good private road from the public highway to the springs, laid pipe, concentrated the waters, cleared off some ten acres of the dense forest surrounding the springs, and erected on the opening a comfortable hotel, large barn, and other necessary improvements. The place was resorted to by many people, some for pleasure, others hoping to be benefited by drinking the mineral water, which it was well known possessed medicinal virtues of a high order. From the springs and thereabouts exudes a species of gas, which Dr. Felt collected in a primitive gasometer and utilized for the purpose of illuminating the premises, and it answered this end well. The waters have been found to be beneficial for persons afflicted with or having dropsical tendencies, many being entirely relieved who were affected in this way. About the time these springs were beginning to be appreciated on their merits, an unfortunate conflagration swept off the improvements. Since the fire the place has remained unoccupied as a public resort. We apprehend, however, upon the completion of the Eureka and Eel River Railroad, the present year (which passes within a short distance of the springs), they will again be opened for patronage.

ANALYSIS OF THE WATER.

From an analysis, made in San Francisco of a quantity of the water of Felt's Springs, it was found to contain the following substances: Carbonate of soda, carbonate of lime, a trace of iron, chloride of potassium, chloride of magnesium, carbonate of magnesia, carbonate of manganese, sulphate of potassa, and chloride of sodium. The location of this property is very picturesque, and its climate cannot be surpassed for salubrity, and with railroad communication it will make a delightful resort for the pleasure seeker as well as the invalid. There are plenty of trout in the streams and game in the woods and valleys.

Inyo County.

(8) *Owens' Lake.*

While the water of Owens' Lake is a mineral water in every sense of the word, yet it is not a mineral spring. It results from the evaporation of the water brought down by Owens' River, which enters the valley pure, but takes up in its long passage to the lake, soluble matter from the soil.

The mineral matter in solution in the waters of the river and lake is augmented by small salt and alkaline streams and the seepage from a multitude of mineral springs which abound in the foothills of the Sierra Nevada and the Inyo Mountains. The waters so extensively sold and advertised on the Pacific Coast and elsewhere under the trade name of "*Castalian*" is taken from this lake. The engraving on the circulars of this company is a deception, as it shows an imaginary spring on an isolated hill or mountain, from which a small stream is figured flowing down to the plain. The circulars claim that it is a natural mineral water from the Castalian Spring, Inyo County, which it is not. Owens' Lake is one of the most remarkable sheets of water in the world, and it is well worthy of a visit by tourists and Californians. Descriptions have been given of it in previous reports of this office. The waters are highly alkaline, remarkably dense, and in effect a nearly saturated solution of valuable salts, which will certainly be turned to account in the near future.

The waters of this lake have been analyzed by several chemists; a very full one by Thomas Price of San Francisco is published on the circulars

of the Castalian Company. The following is an approximate analysis by a London chemist by the name of Philips:

	Grains in an Imperial Gallon.
Chloride of sodium	2,942.15
Sulphate of soda	956.80
Carbonate of soda	2,914.43
Sulphate of potash	35.74
Silicate of potash	139.54
Organic matter	16.94
Pure water	2,994.40
	10,000.00

Owens' Lake may be reached by rail from San Francisco or Reno to Keeler Station, which is the present terminus of the road. The town is situated on the eastern shore of the lake.

(9) *Thermal Acid Springs.*

All the information this office has of these springs is contained in the following extract from the *Inyo Independent*, June 20, 1883:

These singular springs are situated in Inyo County, in the Coso Range of mountains, about sixteen miles southeast of Olancha Post Office. The springs have but a limited flow, and from crevices on the mountain side, through which steam is continually ejected, and thousands of tons of pure sulphur cover and surround the locality. The taste of the water is intensely sour, making it unfit for drinking purposes. It has no smell, but formerly there must have been large quantities of sulphureted hydrogen contained in it, as the sulphur deposit indicates. Large quantities of free sulphuric acid is found in the water, but the sulphur deposit, it is claimed by chemists, cannot be derived from this source. Chemists are at least unacquainted with a process by which free sulphuric acid would turn under the circumstances, such as the above, into sulphur. The composition is certainly a remarkable one, as will be seen from the following analysis. In one hundred thousand parts are contained parts:

Free sulphuric acid	78.4
Potassium sulphate	2.5
Sodium sulphate	15.1
Calcium sulphate	15.3
Magnesium sulphate	1.2
Aluminium persulphate	127.0
Iron persulphate	33.2
Nitric acid	Trace.
Chlorine	Trace.
Ammonia	Trace.
Lithium	Trace.

Springs or lakes of a chemical character like this are very rare; singular is also the small trace of chlorides in a water so strongly charged with mineral matters. The only known instance analogous to it is the Sour Lake in Texas, and a spring in the vicinity of the volcanoes in South American Cordilleros de los Andes.

Lake County.

(10) *Adams Springs.*

These springs are located in the pine mountains of Lake County, about eight miles south of Clear Lake, and two and a half miles from Siegler Springs, six miles from Harbin Springs, and twenty-eight miles from Calistoga. They are reached from San Francisco by rail to Calistoga, and thence by stage on alternate days. There is a good hotel at the springs. An analysis of the waters has been made, but the name of the chemist is unknown to me. The water is highly charged with carbonic acid gas, and is said to have a decided taste of petroleum. The waters are said to be good for rheumatism, and bilious diseases, and several cases of Bright's disease are said to have been improved by its use.

(11) *Allen Springs,*

Are located in a cañon near the head of Cache Creek, forty-five miles from Williams, which may be reached by rail from Sacramento. Communication between Williams and the springs is made by stage.

The waters of Allen Springs are cold, saline, highly charged with free carbonic acid gas, temperature 50°. An analysis made by W. T. Wenzell, whose name is a guarantee of its correctness, has been published.

(12) *Anderson's Springs.*

The character of these springs is hot sulphur and steam. They lie nineteen miles from Calistoga, and five miles from Middletown. There is a good hotel at the locality and a number of commodious cottages. No chemical analysis has been reported, and no further information obtained.

(13) *Bartlett Springs.*

These springs lie sixteen miles northeast of Clear Lake, in Lake county, and forty miles west of Williams, in Colusa county. They may be reached from San Francisco by rail to Calistoga, thence by stage. While no analysis has been published, the water is said to contain arsenic, by which reputed skin and other diseases are said to have been cured. The water is cold. It is largely bottled, and sold in San Francisco and elsewhere.

(14) *Bonanza Springs.*

There are several of these springs, about which, however, but little is known, aside from the fact that they are warm chalybeate; one is cold. There is also a cold plunge bath. No analysis has been made. Route from San Francisco is by rail to Calistoga, thence by stage to the springs.

(15) *Highland Springs.*

Situated twenty-five miles from Cloverdale, seven miles south of Lakeport, and four miles from Kelseyville, in sight of Clear Lake. Altitude, seventeen hundred feet. The springs are reached from San Francisco in ten hours by rail and steam to Cloverdale, thence by stage. There are several of the springs known by different names, as the "magnesia spring," the "magic spring," the "Dutch spring," and the "soda spring." The general character of the water may be learned by the following analysis:

Magic Springs, analyzed by Professor W. S. Rising, University of California. Temperature, 85°.

	Grains per U. S. Gal.
Chloride of sodium	1.290
Bicarbonate of potash	0.544
Bicarbonate of soda	21.763
Bicarbonate of lime	50.411
Bicarbonate of magnesia	70.243
Bicarbonate of iron	0.973
Bicarbonate of manganese	Trace.
Silica	7.398
Alumina	0.169
Organic matter	Trace.
Free carbonic acid	74.462
Total	227.253

Berkeley, April 3, 1882.

The water from these springs has been bottled and sold in the State and elsewhere to a considerable extent.

(16) *Hot Borate and Ammonia Spring.*

This remarkable mineral spring is situated on the edge of Clear Lake near the Sulphur Bank Quicksilver Mine. An analysis made by Gideon E. Moore may be found in Geology of California, vol. 1, by J. D. Whitney, folio. The water is remarkable as containing large quantities of potassium, ammonia, bromine, and borax. The waters have been used medicinally, but as yet to no great extent.

(17) *Hough's Mineral Spring.*

This spring, of which but little is known, is reached by stage from Williams in Colusa County, by which daily communication is made.

(18) *Howard Springs.*

Located five miles from Adams' Springs, one and one half miles from Siegler Springs, and five miles north of Harbin. Altitude, two thousand two hundred and twenty-five feet. May be reached from San Francisco by Napa Valley Railroad to Calistoga, thence by stage. There is a good hotel at the springs, and commodious cottages. There are said to be fourteen springs, hot and cold; temperature from 58° to 109°. One spring is chalybeate, one is cold, sparkling, and highly charged with carbonic acid gas. No analysis reported. Information as to the character of the water of this spring to be obtained without an actual visit to the locality is meager and unsatisfactory.

(19) *Iodine Spring.*

In April, 1872, a remarkable mineral water was examined by Falkenau & Hanks of San Francisco, which was found to contain considerable iodine. Information has since been obtained to the effect that the spring is situated at the entrance of Grizzly Cañon, Lake County, five or six miles from Wilbur Springs. This subject has been alluded to in the fourth annual report of this office, folio 230.

(20) *Saratoga Springs—formerly Pierson's.*

Situated fourteen miles from Lakeport, one mile west of Witter Springs. They may be reached from San Francisco by rail to Calistoga, thence by stage to Lakeport and the springs. There is a good hotel and accommodations. The springs, of which there are several, are cold. The waters are sulphurous and alkaline, containing, it is claimed, sulphur, soda, iron, magnesia, and free carbonic acid gas. No analysis is reported. It is claimed that a multitude of diseases are cured or ameliorated by the use of the waters.

(21) *Siegler Springs (hot and cold).*

These somewht celebrated springs are situated in a cañon, said to have an elevation of two thousand five hundred feet. There is at the locality a good hotel and accommodations. The waters are alkaline and chalybeate. One spring is said to contain arsenic, and to be valuable for the

treatment of chronic cutaneous diseases. An analysis of the waters is reported, but as far as can be learned it has not been published.

These springs are reached by stage from Calistoga. Time from San Francisco, twelve hours.

(22) *Witter Springs.*

These springs are situated in the Coast Range of mountains, five miles from the town of Upper Lake, and fifteen from Lakeport, near the Blue Lakes. There are several springs which are cold. They are alkaline, sulphurous, and have considerable reputation as yielding healing waters. There is a good hotel on the grounds, and a number of commodious cottages for visitors. No analysis has been published.

Lassen County.

(23) *Big Hot Springs.*

This spring lies about three miles north of Honey Lake. The exact locality is section twenty-three, township twenty-nine north, range fifteen east, Mt. Diablo meridian. It is called a boiling spring, which it practically is, its temperature being 200° F. The water rises with considerable force from an orifice equal to a foot square. From observations made by John Pfeninger, from a spout 4x18 inches, forty-five cubic inches flowed in one minute. The chemical character of the water is not known, as no analysis has been made. No medicinal properties are yet claimed for it.

Los Angeles County.

(24) *Fulton's Sulphur Wells.*

These artificial flowing wells yielding a mineral water claimed to be valuable, lie two miles north of Norwalk Station, on the Los Angeles and Anaheim railroad. An analysis is published in a circular issued by Dr. J. E. Fulton, from whom the wells are named. This shows the water to contain bi-carbonate of soda, lime, magnesia and iron, sulphate of soda, chloride of sodium, silica, traces of iodine and potash, and free carbonic acid, hydrosulphuric and nitrogen gases. The water flows from two wells three hundred to three hundred and fifty feet deep. The water is cold. There is a good hotel on the grounds, and good accommodations for visitors. A daily stage connects with the railroad at Norwalk.

Mendocino County.

(25) *California Seltzer Spring.*

This valuable spring I visited personally, and the following is the result of my observations. Analysis have been made and published by J. A. Bauer, Louis Falkenau, and by myself:

The spring is situated in Mendocino County, about one and one half miles from the Fountain House, which is twelve miles from Cloverdale, on the Ukiah road.

The distance from Cloverdale to the spring in a direct line is nine miles, and the direction, north forty-two degrees west.

The exact location may be stated as follows: It is on the southeast quarter of the northeast quarter of section five, township twelve north, range eleven west, Mount Diablo base and meridian.

The spring lies in a beautiful and picturesque valley, and the mountain scenery surrounding it is charming. A small frame building has been erected over the spring to protect it from the sun and rain. The water flows from a half-inch pipe, and I am informed by those who reside near the spring that the flow is continuous and equal throughout the

year. By careful experiment I found the discharge from the pipe to equal 45.89 wine gallons per hour, or 1101.36 gallons in twenty-four hours.

There are several points in the cañon where the same water issues from the ground, which is allowed to run to waste, all of which could be saved and turned to account.

When drawn from the spout, the water is cold, having a temperature of 61° Fahrenheit. At the time the temperature was taken that of the room was 98°.

The water, to the taste, is very agreeable. It contains such an excess of carbonic acid that that gas is continually being given off, like champagne. Carbonic acid gas is also continually bubbling up from the pool into which the water falls from the spout.

When first drawn the water is perfectly clear, but soon assumes a faint opalescence, and after standing for some time it lets fall an inconsiderable precipitate. At the exit there is a large deposit of a red sediment, which is seen on the sides of cisterns into which the water flows, and also on the stones in the bed of the stream.

The water does not act on all persons drinking it alike. To some it is a gentle cathartic, while others are not so affected.

When the water is shaken in a vessel there is a sudden evolution of free carbonic acid gas. When first drawn the water gives an acid reaction, owing to the carbonic acid; but after standing for some time, or after boiling, it becomes alkaline.

A large proportion of the solid constituents are held in solution by the free carbonic acid; these become insoluble, and precipitate, when the water is boiled.

The total solid constituents of the water in a wine gallon, obtained by evaporating that quantity of the water to dryness in a silver dish, was found to be 181.2311 grains.

Mono County.

(26) *Mono Lake.*

A wide spreading sheet of mineral water lies in Mono County, and is one among the many natural curiosities of our noble State, which should be more generally visited by tourists, which is now no hardship, as a first class narrow gauge railway runs within a short distance from its shores. This lake, which is more correctly an inland sea, resembles in many of its features the Dead Sea of the Holy Land. The same may be said of Owens' Lake, a description of which will be found in its proper place.

Mono Lake lies in a depression, in an extensive desert basin, which was probably in ancient times an extensive volcanic crater, and from which can be traced streams of ancient lava, which flowed in several directions.

The lake is fourteen miles, more or less, from east to west, and nine from north to south, but it varies in size, owing to temperature and the quantity of snow that falls during any year on the summits of the adjacent Sierras. When an unusually large quantity of snow falls the waters expand, and for the same reason they become more dilute. When the conditions are different the waters of the lake evaporate, and it shrinks. The waters becoming in proportion more dense and highly charged with salts, this fluctuation is marked on the shore by an amphitheater of low terraces.

At one time the lake was much larger than at present, as shown by magnificent terraces at a greater distance from the shores. The water derives its salts from rivers or creeks that flow into it. These collect from the volcanic soils the soluble parts, which they deposit in the lake. Having no outlet, the basin retains it, and by evaporation it becomes condensed. During a period of probably many centuries this lake has stored up vast quantities of valuable salts, which await the hand of man to gather and utilize.

These waters are intensely saline, but their exact constituents are not yet known; a careful and exhaustive analysis has been commenced by the Mining Bureau, the results of which will, no doubt, be duly published.

There are several islands in the lake, on one of which there are hot and mineral springs, a feeble remnant of the volcanic activity of former days. A few miles from the margin of the lake, may be seen several volcanic cones, expired years ago, but which have left lava and obsidian as a

memento of past volcanic energy. Great quantities of gulls and other aquatic birds flock to the shores of the lake to feast on the larvæ which abound in its waters.

The presence of worms and minute and curious living forms in the highly alkaline waters of the lake, is a striking example of nature's care for animal life. How these creatures can live in a solution so alkaline that it will attack the flesh of a human being, is one of the mysteries of the universe.

The water sent down to the Mining Bureau has been placed in a large vessel of crystal glass, and is now on exhibition in the Museum. When first received, on looking through it, one could see a number of strange animals swimming about in full possession of life and happiness; although preferring to swim on their backs, their motion resembled that of the oars of a Venetian gondola, or of the argo, as described in mythological fable. Yet, when the bottle is gently shaken, the water strikes against the sides of the vessel containing it like oil, or concentrated sulphuric acid. When evaporated this extraordinary water leaves behind a white saline mass equal to 2926 grains in an imperial gallon.

There is in my mind no finer view in the State than of the valley or desert in which Mono Lake lies, with the White Mountains for a background, as seen from the summit of Mono Pass. It is only a short distance from the Yosemite, which is visited by thousands of tourists annually. The route is by Lake Tenaya, Cathedral Peak, Tuolumne Valley, the Soda Springs, and the most romantic and highly interesting Mono Pass and Bloody Cañon. It is strange that more tourists do not avail themselves of the opportunity to visit these interesting localities.

The larvæ in the lake are thrown up by the sluggish waves, and accumulate in enormous quantities. They are gathered by the Indians and dried for food. To them they are as delightful a refection as locusts and wild honey of Bible fame.

The mineral salts contained in this vast depository should and will be utilized at no distant day. The reaction for boracic acid is so decided that it is almost safe to predict that crystals of borax will eventually be found in the mud at the bottom of the lake, as at Borax Lake, in Lake County, and it is to the interest of the State that an exhaustive analysis should be made of the waters.

The following analysis of Mono Lake water, by J. R. Murphy, was copied into the *Mining and Scientific Press*, vol. 12, fol. 59, from the *Reese River Reveille:*

Acids Present.

Quantitative.

Boracic	Large traces.
Carbonic	Abundant (free?).
Hydrosulphuric	Abundant (free?).
Phosphoric	Traces.
Silica	Traces.

Quantitative.

Chloride of sodium	5.854.
Chloride of potassium	1.581.
Chloride of calcium	2.630.
Chloride of magnesium	8.206.
Sulphate of lime	.402.
Sulphide of calcium	Traces.
Sulphide of magnesium	Traces.
Water	81.327.
Total	100.000.

Nameless Mineral Spring.

Near Bridgeport. This spring, represented in State Museum by No. 1,576, has deposited a very large quantity of aragonite or calcite.

MONTEREY COUNTY.

(27) *Paraiso Hot and Cold Mineral Springs.*

These springs are situated six miles from Soledad, one hundred and forty-three miles from San Francisco, on the Southern Pacific Railroad; a stage connects daily with the station. There is a good hotel on the grounds and twenty-five two-story cottages. The altitude is said to be 1,200 feet above the valley. The waters flow from a number of springs which have the same general character, as shown in the following analysis made by a well known and reliable chemist:

CHEMICAL LABORATORY, SANTA CLARA COLLEGE, S. J.,
SANTA CLARA, CALIFORNIA, November 25, 1871.

Mr. PEDRO ZAVALA: Your sample of water having been duly analyzed in our chemical laboratory, gave the following result: In one gallon of water were found—

	Grains.
Matter volatile on ignition, so called organic matter	5.25
Silica	2.62
Alumina and iron	1.60
Magnesia	Trace.
Chloride of potassium	0.35
Chloride of sodium	3.50
Sulphate of soda	35.50
Carbonate of soda	4.23
Sulphate of lime	4.32
Carbonate of lime	1.43
Total	58.80

Yours respectfully,

A. CICHI, S. J., Professor of Chemistry.

P. S.—The water contains 35.50 grains to the gallon of sulphate of soda. This sulphate of soda (written otherwise Glauber's Salt) is used universally as a cathartic.

NAPA COUNTY.

(28) *Calistoga Thermal Springs.*

These springs are in the town of Calistoga within a few minutes walk of the terminus of the Napa Valley Railroad. There are a number of them, all of which are warm; some very hot. Over the principal spring now stands a small, dilapidated, wooden building with no doors or windows. The spring from which steam escapes continually, is boxed up with boards; the box is about two feet square. The temperature of a bucket of this spring freshly dipped up when I visited it, was 196° F. by two observations, carefully taken. The temperature of the air was 86°. The water that overflows heats the surface water outside the building to 120°. The water in a small creek near by was 92°. The temperature of the old mud-bath was found to be 104°, and the spring that feeds it 148°. The plunge-bath spring was 132°, and the spring that supplies the bath house 173°. The chicken-soup spring had a temperature of 154°, and the water pumped up for baths at the Magnolia Hotel at Calistoga was 102°. The waters are used both for bathing and for drinking, but an analysis was made by J. T. Rudolph of Sacramento, and published in Dr. Hatch's report, showing that, with the exception of the rather large quantity of free hydrosulphuric acid, they contain no elements likely to give them much reputation for medicinal

virtues. But there is no locality that I know of in California where such facilities are found to make a delightful place of resort. The heat of the water, now going to waste, could be employed in manufacturing, specially for fruit drying, or conducted in pipes, would impart vitality to tropical plants. Conservatories so heated could be made to vie with the celebrated palm houses of Kew Gardens in London. Calistoga is a beautiful place, situated in a most delightful locality. With a judicious outlay of capital and labor, directed by men of taste, judgment, and ability, the grounds upon which these springs lie could be made an earthly paradise.

The springs seem to originate at the base of a conical mound or butte which rises on the grounds to an altitude of from seventy-five to eighty feet, which tends to give a landscape garden aspect to the grounds.

There are good hotels in Calistoga, and on the grounds there are a number of roomy cottages for the use of visitors; in front of each is a large palmetto tree which gives a tropical appearance to the grounds. At the time of my visit, all were deserted. The *chicken soup spring* is in no way entitled to the name. It is a trick of those interested, to take up a dipper of the water and to add pepper and salt, which, to a person of active imagination, does have somewhat the taste of soup. My experiments show that any warm water so treated has the same taste, and that it is to the pepper and salt and not to the water that the taste is due.

(29) *Ætna Springs.*

I visited these springs in September, 1881, having been at the same locality when it was being worked as a quicksilver mine, a number of years before.

These springs lie in a small depression at the northern end of Pope Valley. The exact locality is sections one and two, township nine north, and range six west, Mount Diablo meridian. The altitude is said to be one thousand feet, but by barometer it seemed to be only seven hundred and sixty feet. It is fifteen miles east of St. Helena.

There are two springs which discharge a large quantity of water; one is from the old mining shaft of the Valley Quicksilver Mine. The shaft is one hundred and twenty-five feet deep. The Valley Mine was incorporated in 1867, certificate filed May sixteenth. The company made the serious mistake of sinking the working shaft in the bed of the creek, which necessitated costly pumping apparatus, and in the winter the mine was flooded by the waters of the creek. There was also much trouble caused from emanations of carbonic acid gas in the workings. At one time considerable ore was extracted, but owing to the difficulties the yield was but small.

The springs have gained quite a reputation. The number of visitors is given below for four years:

1878	300
1879	600
1880	900
1881	1,200

A full analysis of the water was made by Edward Booth, chemist of the State Mining Bureau, which is published in the second annual report of this office, folios 10 and 11. An analysis made by A. J. Bauer was published in Dr. Hatch's report. The water is perfectly clear; at the time of my visit, the temperature was 98°, that of the air being 78°. The first taste is pleasant but peculiar, and sparkling as if containing much carbonic acid gas. Both springs deposit ferruginous matter and in the dry bed of the

stream drop an alkaline incrustation. There is a distinct alkaline smell at both springs. When shaken in a bottle gas escapes. There is also a decided smell of hydrosulphuric acid when so shaken.

In one spring large bubbles of carbonic gas rise to the surface, and in a pool in the creek bed a constant bubbling takes place.

On the grounds there is a commodious hotel, and cottages for the use of visitors. The valley is warm and dry and the mountain scenery charming.

Much is claimed for the curative properties of the waters of these springs, with what truth I am unable to say.

(30) *Harbin Springs,*

Lie twenty miles more or less from Calistoga. They are reached by stage from the station. There are numerous springs. The temperature of the principal one is 118°. The waters are sulphurous and chalybeate. No analysis has been published. The springs have a good reputation and many visitors. The accommodations are said to be good. As usual in California, cottages are provided for the convenience of those who prefer them to the hotel.

(31) *Kellogg Springs.*

They lie near Calistoga. I have no other information concerning them that is reliable.

(32) *Napa Soda Springs.*

These are the oldest and the best known of any California mineral springs. For many years the waters have been bottled and sold all over the Pacific Coast. They lie on the slope of the mountains east of Napa Valley, and seven or eight miles north of Napa City. An analysis of the waters made by Dr. L. Lansweert, in May, 1856, has been published in Dr. Hatch's report. The buildings and accommodations for visitors are the most numerous and extensive of any in the State.

(33) *White Sulphur Springs.*

These springs, which lie only two miles from the Town of St. Helena, have become a fashionable and elegant place of resort. There is a good hotel, beautiful grounds, and cottages for the use of visitors. There are nine springs, having a temperature from 65° to 89° F. Analyses of three of them, made by Professor Le Conte of the University of California, have been published in the report of Dr. Hatch. The waters are used both externally and internally.

Placer County.

(34) *Cornelian Hot Springs*

Lie on the margin of Lake Tahoe. There are several of them, hot and cold. The waters are used principally for bathing. They are said to be very efficient in the treatment of rheumatism and neuralgia. The springs are reached by railroad to Truckee, thence by stage. There is a good hotel and accommodations on the grounds. As far as I have been able to learn, no analysis has been made.

(35) *Summit Soda Springs.*

Situated twelve miles from Soda Spring Station, on the Central Pacific Railroad; thence by stage to the valley in which the springs lie. The

altitude is said to be six thousand and nine feet. The waters are alkaline, with an excess of free carbonic acid gas. An analysis, made by J. F. Rudolph of Sacramento, has been published in the report of Dr. Hatch.

San Bernardino County.

(36) *Arrowhead Hot Springs.*

Located ten miles from Colton and six miles northeast of San Bernardino. Altitude over two thousand feet. First came into notice in 1858. It is claimed that the waters and climate will cure consumption. One spring actually boils, having a temperature of 210° F. An artificial pond for bathing has been prepared, the dimensions of which are one hundred by seventy-five feet. There are mud baths, also, which are deemed of great use in cutaneous diseases. No analysis has been published.

Anti-Fat Spring.

Situated twelve miles from Temescal, on the Santa Ana River. A sample of the water was brought to the State Mining Bureau and was entered on the catalogue No. 1,577. There being no laboratory, no analysis was made. The name indicates what is claimed for the water.

(37) *San Bernardino Hot Springs.*

These waters gush out from crevices in granite. Sufficient water flows from them to raise the temperature of a small stream near by to 130° F. The water so heated is ample to constitute an efficient water power. It would not be a new thing in California to see a mill wheel turned by hot water. There is a large hot spring near Blind Springs, in Mono County, which cannot, however, be classed as a mineral spring, which actually drove a quartz mill for several years. I have seen this myself. The water was scalding hot.

The San Bernardino Hot Springs are calcareous and form a deposit or incrustation on twigs and pebbles which is snow white. The temperature is from 108° to 172° F. The altitude of the springs is said to be sixteen hundred feet. No analysis of the waters has been made.

San Diego County.

(38) *Aqua Caliente. Thermal Sulphur Springs.*

These springs are on Warner's ranch, fifty miles from San Diego. There are at least seven springs, varying in temperature from 58° to 142° F. They flow from small openings in a ravine, formerly the bed of a brook now diverted. Bubbles of sulphuretted hydrogen are continually escaping. The water, highly charged with this gas, has a pleasant acid taste. At one orifice a jet of steam issues with a hissing sound. No analysis of the waters has been made. Cures are claimed for dropsy, rheumatism, and cutaneous diseases. At last accounts these springs were in possession of a band of Indians, who let adobe huts or cottages to visitors.

There are other mineral springs in this county, near Elsinore. The following, from the San Diego *Union*, is all the information I have been able to gain:

> A wonderful little valley running through the town site, containing mineral springs of hot and cold water, sulphur, soda, white sulphur, magnesia, iron, borax, hot mud, fresh water, etc.—one hundred and eighty-six in number.

San Luis Obispo County.

(39) *Arroyo Grande Warm Springs.*

These springs are located fourteen miles south of San Luis Obispo, and fifteen miles from Port Harford, by which they are in communication by daily stage. Port Harford is reached by steamer from San Francisco. There are good accommodations to be obtained at all times. As in the case of all other mineral springs in the State, it is claimed that a large number of diseases are cured by the use of the waters.

(40) *Big Sulphur Spring.*

Of which nothing more is known, lies in section thirty-six, township thirty-two south, and range twenty-one east, M. D. M.

(41) *Bitter Water Spring.*

A spring so named is located in section four, township thirty-two south, range eighteen east. No further information has been obtained.

(42) *Black Sulphur Spring.*

Is situated in the same section.

(43) *Cameta Warm Springs.*

Lie in township twenty-nine south, range seventeen east, M. D. M. I have no other information concerning them.

(44) *Iron Mineral Spring.*

Located near the Huero-Huero Rancho, on section twenty-five, township twenty-eight south, range fourteen east, M. D. M. It is said to belong to a company, and to have much value as a curative agent.

(45) *Anonymous Mineral Spring.*

Township thirty south, range fourteen east, M. D. M. No other information obtained.

(46) *Newsom's White Sulphur Springs.*

Located fourteen miles, in a southerly direction, from the city of San Luis Obispo, and twelve miles southeasterly from Port Harford, and two miles from the Arroyo Grande stage station. This would place them near No. 39. They are within six miles of the ocean beach. Much is claimed for the medicinal virtues of these waters, and they are said to be a sure cure for nasal catarrh. There is a hotel on the ground and cottages for the use of visitors. This spring is represented in the State Museum by No. 1,572.

The five following springs, which are not yet named, are in the same neighborhood, are also represented in the State Museum. The catalogue numbers are also given:

(47)—1570—*Mineral Water.*

Spring No. 1, Cuesta Ranch, northwest quarter of the southwest quarter of section seven, township thirty south, range thirteen east, Mount Diablo meridian.

(48)—1571—*Mineral Water.*

Spring No. 2, Cuesta Ranch, northwest quarter of the southwest quarter of section seven, township thirty south, range thirteen east, Mount Diablo meridian.

(49)—1573—*Water.*

From the Arroyo Grande Warm Springs, sulphur water No. 2, Santa Manuella Rancho.

(50)—1574—*Water.*

From the Arroyo Grande Warm Springs, sulphur water No. 3, Santa Manuella Rancho.

(51)—1575—*Mineral Water.*

Arroyo Grande Warm Springs, sulphur water No. 4, Santa Manuella Rancho.

(52) *Paso Robles Thermal Sulphur Springs.*

Located twenty-three miles very nearly north of San Luis Obispo, township twenty-six south, range twelve east, Mount Diablo meridian. These springs have a widespread reputation, not only for the medicinal properties of the waters, but also for the fine climate and beautiful surroundings. They lie in a natural grove of oaks, from which the name is derived. There is a good hotel, and the best of accommodations to be had. There are several springs having a temperature of from 110° to 140° F. The waters are used for drinking and bathing. When largely used they are laxative, otherwise tonic, and are specially recommended for rheumatism, malarial affections, and cutaneous diseases. Two analyses have been published in the report of Dr. Hatch, one from a clear thermal spring and one of a mud bath. The name of the chemist is not given. The water is charged with gas. About the principal spring an inclosing wall of freestone has been built. The water is clear, but smells strongly of hydrosulphuric acid gas. The water of some of the springs is nearly cold. The mud baths are artificially prepared.

Santa Barbara County.

(53) *Santa Barbara Hot Sulphur Springs.*

Altitude, about one thousand five hundred feet. There are seven springs at the locality, nearly all of which are of the same general character. They are said to contain free sulphur (if so it must be held in suspense), and an excess of hydrosulphuric acid (sulphuretted hydrogen). Temperature, from 114° to 117° F. The waters are held in high esteem for the cure of cutaneous diseases, rheumatism, and paralysis. An artifical bath has been constructed, which is deep enough for a plunge. The springs are accessible by steamer to Santa Barbara; thence by stage. Distance, about five miles. No analysis has yet been made of the water. A thick incrustation of sulphate of alumina forms at the outlet of one of these springs.

Santa Clara County.

(54) *Gilroy Hot Sulphur Springs.*

These springs are situated twelve miles east of Gilroy, from which they may be reached by stage. There is said to be but one principal spring, located near Coyote Creek. The water is clear and hot. It is used both for bathing and drinking. There is a good hotel at the springs, which affords excellent accommodations. No analysis has been published, to my knowledge.

(55) *Alum Rock Sulphur Springs.*

Situated in Penitentiary Cañon, seven miles from San José. The character of the springs is given as sulphur, soda, and salt springs. The temperature is 85°. A partial analysis has been published in Dr. Hatch's report. There is a good hotel at the springs, and good accommodations. From San Francisco these springs may be reached by rail to San José; thence by stage.

(56) *Pacific Congress or Saratoga Springs.*

Locality in the Coast Range, ten miles west of Santa Clara. The water is quite extensively bottled and sold in the State. The springs are chalybeate and alkaline. If the water is freely used it acts as a purgative, otherwise the effect upon the system is tonic. Two analyses have been made—one by J. A. Bauer, and one by James Howden, which are published in the report of Dr. Hatch. The best of accommodations at the hotel or in cottages, according to the taste or desire of visitors. The springs may be reached by rail to Los Gatos; thence by stage.

(57) *New Almaden Vichy.*

This spring has long been known. It is situated near the New Almaden Quicksilver Mine. Many years ago the waters were largely bottled and sold. It was specially a favorite with the French population. An analysis by E. Pique, of San Francisco, was published as an advertisement by those who made a business of the sale of the water. The analysis is given below:

One bottle (two pounds) contains one hundred and eight grains and sixteen hundredths of solid matter, as follows:

Acide carbonique (carbonic acid)	28.02 grains.
Bi-carboate de soude (bi-carbonate of soda)	50.03 grains.
Bi-carbonate de chaux (bi-carbonate of lime)	8.00 grains.
Oxyde de fer (oxyd of iron)	1.02 grains.
Sulfate de chaux (sulphate of lime)	10.05 grains.
Sulfate de magnésia (sulphate of magnesia)	3.00 grains.
Chlorure de sodium (chloride of sodium)	8.04 grains.
Silice (silica)	Traces.
	108.16 grains.

It is claimed these waters possess curative properties in case of rheumatism and gout, and to be a valuable tonic. It is curious to note that an unusual number of the best mineral springs in the State are in the near vicinity of quicksilver mines.

(58) *Magnetic Mineral Spring.*

Near Watsonville; no reliable information could be obtained concerning this spring without a visit to the locality.

SHASTA COUNTY.

(59) *Soda Springs.*

These springs are situated in the cañon of the Sacramento River at an elevation of two thousand three hundred and sixty-three feet. The waters are chalybeate. As they run from the springs they deposit an extensive bed of iron. There is an excess of carbonic acid gas in the waters, which are cold; temperature, 52°. They may be reached from San Francisco by rail to Redding; thence by stage. The locality and the springs are described in Geology of California (Whitney), vol. 1, folio 332.

SOLANO COUNTY.

(60) *Tolenas Spring.*

Situated five miles north of Suisun. The waters are saline alkaline, but in the absence of any analysis no further information can be given. The water has, to a limited extent, been charged with carbonic acid, bottled, and sold. The spring may be reached from San Francisco by rail to Suisun, and thence by stage or private conveyance.

(61) *Fairmont Mineral Spring,*

On Whitman's Ranch, four miles east of Cloverdale. No analysis has been made that I can obtain information of.

(62) *Litton Seltzer Springs.*

These justly celebrated springs are situated near Healdsburg; the waters contain carbonated alkali, and an excess of carbonic acid gas. They are pleasant to the taste, and many cures are accredited to their use. The water is largely bottled, and sold in this city and State. There is a good hotel, and first class accommodations on the grounds, which are near a railroad station. When freshly drawn, the water is slightly acid; after standing, it becomes alkaline. One wine gallon contains 228.69 grains of solid constituents, which consist of the following:

Acids.	Bases.
Boracic.	Alumina.
Carbonic.	Ammonia.
Hydrochloric.	Iron.
Sulphuric.	Lime.
Silicic.	Silica.
	Magnesia.
	Potash.
	Soda.
	And organic matter.

There is a large quantity of free carbonic acid which escapes on standing. The water in the spring is abundant. When it is required in bottles it is forced into a receiver with considerable pressure, from which it is drawn into bottles and quickly corked. No carbonic acid gas is added artificially to the water.

(63) *Geyser Spa or Geyser Soda Spring.*

This spring is situated four miles from Geyserville, and very near the Litton Springs (No. 62). Large quantities of the water is bottled and sold in the city and State. There are agencies also in Sacramento, Oakland,

Santa Rosa, and San Rafael. These waters were thus sold twenty-four years ago. The business was resumed last November. An analysis published by Dr. Hatch in his report shows the water to be very nearly identical with that of Skaggs Spring.

(64) *Mark West Hot Sulphur Spring.*

Located eight miles from Santa Rosa on the road to Cloverdale, township eight north, and range eight west, by Bancroft's map. Beside the hot spring there are cold sulphur and iron springs. No analysis of the waters have been published. There is a good hotel and cottages on the grounds which furnish first class accommodations.

(65) *Skaggs Springs.*

Located eight miles southwest of Geyserville, in township ten north, range eleven west, Mount Diablo meridian. There are two springs of hot water, and a cold soda spring. The principal spring is situated in the bed of a dry creek. The temperature is 130° to 140° F. An analysis by Professor E. W. Hilgard, of the University of California, has been published. Besides those mentioned above there is a chalybeate well. A good hotel and commodious cottages offer ample and excellent accommodations. The waters are recommended for neuralgia, rheumatism, sciatica, dyspepsia, and chronic diseases of the kidneys.

(66) *Geysers.*

The group of mineral springs known by this name, of which there are three hundred in number, covering an area of one thousand acres, are counted among the natural wonders of California. The altitude is given as one thousand nine hundred feet above sea level. Some of the springs are hot, others cold. One blows off steam like the escape pipe of a steamboat, from which it takes the name of the "Steamboat Geyser." The springs were discovered in 1847, since which they have been visited by many persons. No sufficient analysis or analyses have ever been made of the waters of these springs, nor have the waters ever been bottled for sale. The springs are situated on the Pluton River, which empties into Russian River, near Cloverdale.

There are two routes to these springs. By rail, either to Cloverdale or Calistoga, and thence by stage. There are ample hotel and bathing accommodations. The temperature of the springs, of which there are three classes—aluminous, sulphurous, and chalybeate—is from 200° to 210° F.

(67) *Santa Rosa White Sulphur Springs.*

They lie only two miles from Santa Rosa. Hot and cold sulphur baths are offered to visitors. No further information has been obtained.

Tehama County.

(68) *Tuscan Springs.*

Lie in section thirty-two, township twenty-eight north, range two west, nine miles from Red Bluff. There are three principal springs of *cold sulphur waters.* The water for bathing is heated by burning the carburetted hydrogen gases given off by the springs. The temperature of

three springs is thus given: Black sulphur, 68° F.; white sulphur, 70° F.; red sulphur, 80° F. The waters are said to contain large quantities of iodine, lithium, and of potash, and to be effective remedies in treatment of rheumatism, cutaneous diseases, and intermittent fevers. They are said also to resemble the Blue Lick waters of Kentucky.

(69) *Lick Spring.*

This is one of the Tuscan Springs (No. 68), which was discovered by Dr. John A. Veatch in January, 1856, in what was then Shasta County. The subject is referred to on folio 15 of Part II, third annual report of this office, 1883. An analysis was made by Dr. L. Lanszwert and published by Dr. J. B. Trask, first State Geologist, in his report of 1856, folio 61. By referring to this analysis it will be seen that it was of a most surprising nature, but Dr. Veatch states that it is unreliable. Still, the practical results obtained were very extraordinary. In January, 1856, Dr. Veatch, while evaporating the water in course of a chemical examination, obtained several pounds of borax crystals, which were deposited in the museum of the California Academy of Sciences, where they probably still remain. This was the first borax known to exist on the Pacific Coast. By a reference to the former reports of this office it will be seen how important that discovery really was.

Tuolumne County.

(70) *Cold Soda Spring.*

This very important mineral spring, which I have visited, is situated in Tuolumne Valley, on the Mono trail from the Yosemite to Mono Lake. It is located on Holt's map in township one south and range twenty-four east, M. D. M. The water is cold, sparkling, and delightful to the taste. The surroundings are charming. No analysis has, to my knowledge, been made of the water. At some not very far distant time this will become a favorite place of resort.

CALISTOGA SILVER MINES.

For many years indications of silver have been found in the vicinity of Calistoga, in Napa County. The hot springs described elsewhere are evidences of active solfatara, which elsewhere in the State have produced mineral veins of greater or less value. In the strata exposed by the upheaval of Mount St. Helena, there are veins or deposits which are without doubt the result of solfataric action. Silverado, on the mountain above the toll house, was at one time the scene of considerable mining excitement. A mill was erected and much work done on the mine. While it is claimed that considerable silver was extracted from the ores, it has never been shown by figures that this was the case. Some years ago, but after the mine was abandoned and while the mill stood idle, I examined very closely some ore left on the platform, and found it to be very poor, from which I drew the inference that work was discontinued because the ores were practically worthless.

Afterwards, in 1865, I again visited the locality and made a very careful examination of the ore on the dump and in the workings of the Venus Mine at Silverado. My impression was that as far as developed the ores

were of very low grade, but from indications ore bodies of some value might eventually be discovered. The following is the result of an assay of sample of ore from this locality:

CALIFORNIA ASSAY OFFICE, WM. IRELAN, JR., ASSAYER AND CHEMIST,
ROOMS 47, 48, AND 49 MERCHANTS' EXCHANGE, SAN FRANCISCO, September 5, 1885.

Memorandum of assay of ores made for H. G. Hanks, State Mineralogist, of ores marked "Dump, Calistoga or Venus Mine," and "Average from Calistoga—Museum No. 6,518."

Dump, Calistoga or Venus Mine.

Silver, per ton ..... Troy ounces, 2.18
Gold, per ton ..... Troy ounces, 0.03

Average from Calistoga—Museum No. 6,518.

Silver, per ton ..... Troy ounces, 4.37
Gold, per ton ..... Troy ounces, 0.15

Respectfully submitted.

WM. IRELAN, JR.

I afterwards visited the Grizzly Mine, near the town of Calistoga, and was surprised to find a considerable quantity of good ore taken out, some of which was very rich, as may be seen by the following assay of sample brought to San Francisco and placed in the State Museum:

CALIFORNIA ASSAY OFFICE, WM. IRELAN, JR., ASSAYER AND CHEMIST,
ROOMS 47, 48, AND 49, MERCHANTS' EXCHANGE, SAN FRANCISCO, August 27, 1885.

Memorandum of assay of ore made for Henry G. Hanks, Esq., State Mineralogist.

Silver, per ton ..... Troy ounces, 514.79
Gold, per ton ..... Troy ounces, 0.5

Respectfully submitted.

WM. IRELAN, JR.

This result is very remarkable, and seems to justify the hope that valuable if not extensive silver mines may yet be found at this locality. The Calistoga Mining District is situated in section twenty-four, township nine north, range seven west, M. D. M. The altitude of the Grigsby Mine is two hundred and sixty feet above Calistoga, or five hundred and ninety-one feet above sea level. The Ida Easley Mine is still higher, but in the same district. This mine is not yet worked to any great extent. It would be hard to predict what developments may yet be made at this very interesting locality.

The little hill, or butte, at the thermal springs, mentioned elsewhere, is an outlier of the mountains which contain the silver ores.

ARROW MINING DISTRICT, SAN BERNARDINO COUNTY.

A new gold and silver district has recently been brought to notice, located and named as above. The name is derived from the arrow weed springs, so called, because they furnish the Indians with rush-like stems, which grow in abundance on the margin of the springs, and which they use for the shafts of their arrows. The district lies about twenty-eight miles northwest from Fenner Station, on the A. & P. R. R.

The veins, or ledges, bear north by east, and can be traced on the surface for several miles. The principal vein is a contact, the west wall being described as porphyry, and the west quartzite, or granite.

The ore contains gold 760 fine, stained also with copper, and gives indications of silver, aside from that occurring alloyed with the gold. There were eleven locations made on the principal vein at the time of the visit of

my informant, Mr. E. Wolleb of San Francisco, who examined the district in February, 1886. The Arrow and the Red Cloud are the principal veins. But little work had been done. Water from the Arrow springs could be used for mining and milling purposes, but the excessive dryness of the locality it is feared will form a serious impediment to the working of the mines.

MOUNT ST. HELENA.

On the twenty-third of August, 1885, I started from the toll house to ascend Mount St. Helena. This station is about two thousand one hundred and thirty-seven feet above Calistoga, or about two thousand four hundred and sixty-eight feet above the sea level. There is no wagon-road, but a good trail, leading by a circuitous route up the sloping side of the mountain. The distance from the toll house to the summit is about four miles. The first bench has an approximate altitude of one thousand five hundred and seventy-five feet above the toll house, or three thousand nine hundred and ninety-three feet above the sea level. From this point, the mountain top may be seen at the distance of a mile or so. The ascent from this bench is not difficult.

Before reaching the foot of the highest peak, a depression may be seen to the left, through which a view of the valley beyond is obtained. On the right hand side of this ravine, there is a fine outcropping of basalt in distinct columns, which average about eighteen inches in diameter; some, however, being three feet.

On the summit, the basalt occurs—the columns being broken off square and forming the extreme top of the mountain. This rock is peculiar and very interesting. It is somewhat brecciated or spotted, light colored, yellowish in places, in others a pale, undecided green; the latter seems to have changed from olivine. On the weathered surfaces, the iron has become peroxidized, and a reddish or tawny color is the result. There seems no doubt that the character of the rock has changed, and that it is now decidedly metamorphic. Under the microscope, the crystals imbedded in the magma forming the rock, are not distinct and have lost their luster. It is much to be regretted that it has been impossible to give this rock the careful study and thorough chemical and optical examination it deserves.

The sides of the mountain near the summit are covered with a greenish colored sand, resulting from the disintegration of the basalt. Lower down, near the toll house, the lava rocks, probably basalt, are dark brown, and inclose nodules resembling stone axes. If one of these only had been found, it would not be difficult to believe that it was made by human hands. One had a groove, very roughly cut, which the finder claimed had been made by human beings previous to the flow of the lava. Before I visited the locality, having seen this one only, I was inclined to the same opinion; but finding several resembling it on the same ground, I concluded that the grooving was the work of very recent hands.

On the summit of the mountain there are two brick columns that supported scientific instruments used by the Coast Survey, which had a station there for several months. There is also a bar of copper, marking the junction of Lake, Napa, and Sonoma Counties. The summit is nearly bare of vegetation, and is covered with broken blocks of basalt.

The elevation of Mount St. Helena, as determined by the Coast Survey, is four thousand three hundred and forty-three feet; Calistoga is three hundred and thirty-one, the Toll House about two thousand four hundred and sixty-eight, and the first bench three thousand nine hundred and

VIEW OF THE SUMMIT OF MOUNT ST. HELENA FROM FIRST BENCH ABOVE TOLL HOUSE.

BASALTIC COLUMNS NEAR SUMMIT OF MOUNT St. HELENA.

ninety-three feet. From the top of the mountain the view is very fine; on a clear day even grand. If a good grade should be made from the toll house, an easy matter, the locality would soon become a favorite place of resort.

There is reason to believe that St. Helena was once an active volcano, although the summit does not now present a crater-like appearance. That the action has not yet ceased is evinced by the hot springs at Calistoga and elsewhere, the emanations of carbonic acid in Clear Lake, especially at the remarkable spring at Soda Bay, the sulphur bank and quicksilver mines, and the ammoniacal springs near by.

June 12, 1841, this mountain was ascended by Wosnessensky, a Russian naturalist, sent out by the Academy of Science of St. Petersburg. He placed an engraved copper plate on the summit, which was removed by some vandal who found it there. It came into the possession of Dr. J. A. Veatch, who presented it to the California State Geological Survey. It would be interesting to know where it is now.

About Clear Lake there are great quantities of obsidian, from which the Indians for many years have not only made arrow and spear points, but have exported the material, or the manufactured articles, to distant tribes.

After thinking the matter over since my visit to this very interesting locality, and knowing of the evidences of recent volcanic action (recent in a geological sense only), I see no reason why the mountain may not again break out into active eruption at any time. It is not an uncommon circumstance for volcanoes to remain dormant for centuries, and then, without any special preliminary symptoms, to break out into violent eruption. Our frequent earthquakes are another evidence that the stupendous piles of eruptive matter, the result of volcanic action in centuries past, were thrown out by subterranean forces not yet extinct. Ætna remained dormant for several hundred years at a time; once, within historical period, for four hundred years; another interval was three hundred and fifty years. Vesuvius had been inactive for ages, when it suddenly burst into flames in the year 78 A. D., at which time the cities of Pompeii and Herculaneum were destroyed. It now rises only two thousand three hundred feet above the sea level; but in 1868, when augmented by the piling up of eruptive matter, its summit reached the height of four thousand two hundred and fifty-three feet—nearly that of St. Helena at present.

I would advise tourists in California to visit the hot springs of Calistoga, Clear Lake, and the summit of Mount St. Helena.

SAN DIEGO COUNTY.

Having found it convenient to visit the western part of San Diego County I am enabled to give some general information concerning it. It was my intention to commence at the Mexican line, and to have made a geological and mineralogical reconnoissance of the whole State to the northern boundary, but I was not able to carry out my plans. On several occasions during the last six years I have examined the eastern portion of this very interesting and important county, the results of which may be found in preceding reports.

I left San Francisco, May eighth, by steamer. The weather at this time of year is delightful on the coast, and a coasting voyage is always one of pleasure and interest. Passed Monterey at 4 P. M., and Point Sur, an outlying promontory, and arrived at Port Harford, San Luis Obisbo County, May ninth, at 2 A. M. Left this port at 7 A. M. and ran down by Point Sal and Conception. At 2 o'clock passed Goleta, and saw petroleum spreading over the sea, rising from submarine springs. As the ship throws aside the water in her passage, a strong smell of coal oil is observed. I had often heard of this locality and the oil springs, but I did not realize the extent of surface covered, or the signification from an economic standpoint. The smell is not of asphaltum, but of light coal oil, which to the experienced sense is distinctly different. This locality should be studied, and wells sunk at Goleta, in the hope that the source of these springs may be tapped and the oil utilized. At 3 o'clock P. M. the ship arrived at Santa Barbara, where she remained long enough to allow the passengers to see the town. I noticed a yellow or buff colored sandstone, which is now used for building purposes. It has been fully described under the head of Rocks and Building Stones. It is not very durable, which is evidenced by the decay of the Mission buildings, which are partially built of it. May tenth arrived at San Diego. In entering the harbor a striking feature is observed. The sea is covered with kelp, which, growing from the rocks beneath, spreads its flat leaves on the surface, and in time of storms is said to act like oil on the troubled waters, and to prevent the waves breaking as violently as they would otherwise do.

AREA OF SAN DIEGO COUNTY.

Assuming Bancroft's map of California, dated 1882, to be correct, San Diego County has an area of fourteen thousand four hundred and twenty-eight square miles, equal to nine million two hundred and thirty-three thousand nine hundred and twenty acres. There are eight States of the American Union that have less area than this one California county, as follows:

Rhode Island, square miles	1,306
Delaware, square miles	2,120
Connecticut, square miles	4,750
Massachusetts, square miles	7,800
New Jersey, square miles	8,320
New Hampshire, square miles	9,280
Vermont, square miles	10,212
Maryland, square miles	11,124

For seventy-five miles inland from the seacoast, the country is broken into irregular spurs and short mountain chains. The Colorado Desert

extends for about one hundred miles beyond this point to the Colorado River. The dividing ridge seems to be the San Jacinto Mountains, the highest elevation of which is eleven thousand feet. A portion of the Colorado Desert is below the sea level. The lowest depression, two hundred and sixty-two feet, is on section twelve, township ten south, and range twelve east, S. B. M., or very near that locality. The mud volcanoes lie in the northern part of section fifteen, township eleven south, and range thirteen east. This very interesting locality is fully described on folio 227 of the second annual report of the State Mineralogist, and a map of the region is also published in that volume. Beyond the basin of the dry lake the surface rises again, and is broken into isolated buttes which, from the almost total absence of water, have not been prospected, but appearances lead to the hope and expectation that valuable minerals will be found in them.

Since the discovery of carboniferous fossils, it is not unreasonable to expect, or at least to hope, that beds of true coal will eventually be found. A large bed of coal crops out on the seashore fifteen miles or thereabout, north of San Diego. At Elsinore also a bed of coal or lignite has been discovered on section twenty-six, township five south, and range five west, S. B. M., but no systematic exploration has been made. An approximate analysis of the latter will be found under the head of lignite. Salt is known to be very abundant, and since my last report extensive works have been undertaken along the shore of the ancient lake. I am informed by those interested that the enterprise is so far a success. My examination of the desert in 1881 led me to hope that nitrate of soda would be found. Other salts, in beautiful crystals, observed in the mud at that time should be examined by a competent chemist in the interest of the State. The so called desert lands are known to be very fertile, wanting water only to change them into a paradise. The climate is tropical, but exceedingly dry; rain seldom falls. The mountain divide separates two very distinct climates. To the east the country is hilly, and to a rather limited extent is traversed by streams of pure water. The hills are green and covered but rather sparsely with timber. The valleys are very fertile and well adapted for settlement, and the rainfall is sufficient to insure a crop nearly every year. This portion of the county has an approximate area of six thousand and eighty-four square miles, or three million eight hundred and ninety-three thousand seven hundred and sixty acres—a surface larger than the State of Connecticut.

Along the seacoast the climate is delightful. This portion of the county will undoubtedly support a large population. San Diego harbor is second only to that of San Francisco. The city is destined to become a great commercial center at no very distant day. The western slope of the divide is gradual, while that to the east is abrupt. This is the general character of all the mountain chains in California. The prospect of this county becoming a prolific gold-producing locality increases with the developments that have been made. Mines known to be productive have been discovered in the county in the Julian, Pinacate, and Carga Muchacho Mining Districts, while a vast area of unprospected country remains to be looked after.

The Carga Muchacho Mines, from discovery to June 17, 1882, worked fourteen thousand tons, which yielded $167,000, since which time the district has been idle. The mines lie in sections nineteen, twenty, twenty-nine, thirty, and thirty-two, in township fifteen south, range twenty-one east. Pinacate District is in the northwest corner of township five south,

range three west. The locality of Julian District will be given elsewhere. Besides gold and silver, the following minerals have recently been found in San Diego County: asbestus, clay, gypsum, mica, ocher, orthoclase, pegmatite, quartz. There are no doubt may others which will eventually be found and utilized.

The stage road from San Diego to Julian Mining District, sixty miles more or less distant, crosses a fertile and beautiful country. It passes through a succession of fine valleys—Cajon, Nuevo, Ballena, and Santa Ysabel. The ascent is so gradual that the stage is able to make the distance without difficulty in one day.

The following are roughly approximate altitudes taken with a good aneroid barometer, but by a single reading only:

Halfway House	180
Ridge near Cajon	510
El Cajon Valley	220
Rim of Cajon Valley, east	375
Fosters	260
Foot of Atkinson's grade	410
First bench	720
Head of grade	1,220
Summit	1,215
Nuevo	1,200
Foot of Hunsacker grade, four miles from Nuevo	1,760
Top of grade	2,230
Ballena Valley	2,240
Santa Ysabel Valley	2,700
Top of Coleman's grade, five miles from Julian	3,400
Julian City	4,000
Banner	2,800

For the first ten miles from San Diego heavy banks of drift, coarse gravel and bowlders are met with. Then a large outcrop of coarse granite may be seen, which presents a singular appearance, from spots or blotches of a darker color.

Santa Ysabel Valley is circular. It contains much good land. At the time of my visit it was covered with a luxuriant growth of wild oats. The rocks from this point to Julian seem to be syenitic. On Hunsacker's Grade there is a large outcrop of orthoclase and pegmatite, of a quality suited for the manufacture of fine pottery. At the town of Julian, near the Owens mine, coarse granite with mica crystals crops out. The country about Julian is generally mica schist, and of a quality bearing a striking resemblance to that about Dahlonega, in Georgia. I was struck with a marked likeness in other respects between the two districts.

JULIAN MINING DISTRICT.

This district, formerly called also Cuyamaca Mining District, was discovered and located in November, 1869, by Mike Julian, Webb Julian, James A. Bailey, and D. D. Bailey. These men had been prospecting in Arizona and Montana with indifferent success. In December placer mines were found, and worked in a small way. The first quartz mine discovered was the Van Wirt; the next the George Washington. Both were located on the same day, February 22, 1870.

The first Julian District, organized February 15, 1870, was bounded as follows, taken from the Recorder's books:

Beginning one thousand yards west of Harrold's Store and running north five miles and south five miles, and four miles west in width.

M. S. JULIAN, District Recorder.

R. 3 E. R. 4 E. R. 5 E.

T. 12 S. T. 13 S. T. 14 S.

SANTA YSABEL PEAK

SANTA YSABEL

Old Mission Indians

Ysabel Creek

Santa Ysabel

EL. 3860 FT.

Volcan

VOLCAN MTS.

VALLE DE SAN FELIPE

San Felipe Creek

Miles

Gilson

GOLD MINES

San Felipe Canon

JULIAN CITY
El. 4500 FT.

Julian to Santa Ysabel

Whitcomb

Howland

3rd Standard South

BANNER

JULIAN DISTRICT

Trail

Indians

GUYAMACA VALLEY

Laguna

EL. 4700 FT.

STONEWALL MINE

5 Miles

CUYAMACA PEAK
EL. 6500 FT.

RATTLESNAKE MESA

Mulkins

Laguna

Swim

Burton

LAS VIEJAS

Clendennin

VALLE DE

Creek

Small Valley

GUATAY

Emery

PINE VALLEY
EL. 3100 FT.

MAP OF

JULIAN DISTRICT

SAN DIEGO CO.
CAL.

BRITTON & REY, SF.

The following is a statement by the Recorder of mines located up to August 30, 1870:

CERTIFICATE OF MINING LOCATIONS.

STATE OF CALIFORNIA, } ss.
County of San Diego. }

I, M. S. Julian, Mining Recorder in and for Julian District, in the said County and State, do certify that the record books of the said district in my possession show that the following claims were taken up in pursuance of the laws and resolutions of the said camp, and that the names of the claimants are as given below, and that the quantity claimed and the date of the claim are as hereinafter given—that is to say:

George Washington—400 ft.; February 22, 1870; H. C. Bickers, etc.
Otilia—2,000 ft.: February 26, 1870; Mark Garrett, etc.
Wall Rock—2,400 ft.; February 20, 1870; John Fetherstone, etc.
Hammell—1,200 ft.; February 22, 1870; Wm. H. Hammell, etc.
Ida—1,200 ft.; February 22, 1870; Levi Hammell, etc.
Van Wirt—1,200 ft.; February 22, 1870; Calaway Putman, etc.
War Path—2,000 ft.; March 14, 1870; A. B. Woods, etc.
Hayden—1,000 ft; March 4, 1870; Paul Hayden, etc.
Good Hope—1,800 ft.; March 7, 1870; Geo. W. Swain, etc.
Lincoln—950 ft.; March 9, 1870; H. D. Young, etc.
Owens—1,000 ft.; March 11, 1870; James Kelly, J. E. Pember, Barney Owens, Francis Murphy.
High Peak—1,400 ft.; March 4, 1870; S. Southerimer, etc.
Washoe—2,200 ft.; March 6, 1870; Felix Fitzpatrick, etc.
Ione—2,000 ft.; March 2, 1870; D. D. Bailey, etc.
Aguadiente—2,000 ft.; March 21, 1870; H. E. Bingham, etc.
Monroe—2,400 ft.; March 24, 1870; Charles F. Monroe, etc.
Andy Johnson—1,200 ft.; March 22, 1870; John Bush, etc.
San Diego, No. 1—2,200 ft.; March 2, 1870; John P. Chambers, etc.
Keystone—1,200 ft.; April 2, 1870; J. M. Broom, etc.
Bedrock—1,200 ft.; April 2, 1870; John W. Pace, etc.
True Hope—1,400 ft.; June 6, 1870; J. B. Wells, etc.
Gilman—1,600 ft.; April 13, 1870; L. S. Gilman, etc.
Monitor—1,800 ft.; April 4, 1870; S. W. Black, etc.
Eagle—1,600 ft.; April 5, 1870; Wm. J. Moran, etc.
Leslie—1,400 ft.; April 6, 1870; Robert Leslie, etc.
Fairview—1,000 ft.; February 22, 1870; F. Scarborough, etc.
Crown—1,000 ft.; March 16, 1870; Frank Able, etc.
Horseshoe—800 ft.; April 4, 1870; C. R. Philips, etc.
Lone Star—1,200 ft.; February 28, 1870; J. Parsons, etc.
Rough and Ready—1,200 ft.; May 17, 1870; M. Martin, etc.
Challenge—2,000 ft.; May 10, 1870; O. P. Powers, etc.
Fair Play—1,600 ft.; May 26, 1870; R. J. Carroll, etc.
Swain—1,200 ft.; June 8, 1870; W. H. Swain, etc.
Pioneer Mill—1,400 ft.; May 1, 1870; James McMechan, etc.
I. X. L.—1,400 ft.; May 27, 1870; William Estes, etc.
Owens, First Extension—1,000 ft.; June 15, 1870; G. V. King, etc.
Crown Prince—600 ft.; April 2, 1870; R. Shelton, etc.
Crown, First Extension—800 ft.; June 29, 1870; D. Lipman, etc.
Home Stake—1,000 ft.; April 12, 1870; Joseph Moss, etc.
Farley—1,000 ft.; March 28, 1870; Richard M. Farley, etc.
Hudson—600 ft.; June 14, 1870; E. C. Phelps, etc.
Golden Rule—1,200 ft.; June 21, 1870; A. Pauly, etc.
North America—1,000 ft.; July 5, 1870; E. A. Ary, etc.
Sullivan—1,000 ft.; June 28, 1870; D. O. Sullivan, etc.
Victoria—1,000 ft.; July 11, 1870; M. Jones, etc.
San Francisco—1,200 ft.; March 21, 1870; J. P. Wealand, etc.
Minnesota—1,000 ft.; July 18, 1870; S. A. Coolidge, etc.
Little Giant—2,000 ft.; April 12, 1870; A. P. Dodge, etc.
Shamrock—1,000 ft.; April 23, 1870; John Madin, etc.
O'Connor and Ryan—2,200 ft.; April 4, 1870; David O'Connor, John Ryan, etc.
Owens' Ext. East—400 ft.; April 13, 1870; George McNier, etc.
Sonoma—1,800 ft.; March 28, 1870; B. T. Williams, etc.
Roanoke—1,400 ft.; March 28, 1870; Eli McDaniels, etc.
Hayden, First E. Ext.—1,200 ft.; April 11, 1870; Eugene Kelly, etc.

And I further certify, that the said claims are within the said Julian District, in the said county and State. In witness whereof I have hereunto set my hand and affixed my private seal, there being no public seal for said district, this third day of August, A. D., 1870.

[SEAL.] M. S. JULIAN, Recorder.

The Present Julian District, called JULIAN MINING DISTRICT, consolidates *Julian*, *Banner*, and several other mining districts. The following com-

mittee reported March 27, 1881: D. D. Bailey, Robert Gardner, George V. King, Committee.

The district is bounded as follows: commencing at the northeast corner of section four, township twelve south, and range four east, San Bernardino meridian, and running three miles west, to the northwest corner of section six; thence south three miles, to the southwest corner of section eighteen; thence east one mile, to the southeast corner of section eighteen; thence southwest along the line of the Santa Ysabel grant, to the southeast corner of said grant; thence along the line of said grant, in a westerly direction, four miles; thence in a direct line to the northwest corner of the Cuyamaca grant; thence along the north boundary of said grant, to the northeast corner; thence along the line of said grant, five miles; thence east five miles; thence north to the southwest corner of San Felipe grant; thence along the westerly line of said grant, to the place of beginning.

MINING LAWS OF JULIAN DISTRICT IN 1870.

At a meeting of the miners of Julian Mining District, held April 27, 1870, in pursuance of a notice given, by posting same in three public places, five days previous to said meeting, M. S. Julian acted as Chairman, and L. B. Hopkins, Secretary. The meeting being called to order, the committees appointed to revise and amend the mining laws of the district, reported the following:

Substitute for Article IV of the present laws, and the following additional laws:

ART. IV. All locations shall be recorded within ten days from the date of location, and shall have at least one day's work done on the claim prior to recording, and shall have at least one day's work done for each name on the notice or record within thirty days from date of record; and two days' work for each name so recorded done within sixty days from date of record; shall hold the claim and ledge free from relocation for one year from date of record, provided, said work be measured and recorded by the District Recorder.

ART. VI. All persons locating claims in this district shall erect a stake or monument on a prominent point on his claim, at least two feet high, upon which he shall place a notice defining the extent and boundaries of his claim, with the name of the ledge, and each owner in the same, and keep the same up permanently; and the same rule shall apply to all claims now located; and, further, that all claims that shall fail to have a stake, monument, or notice for the space of fifteen days consecutively, shall be subject to forfeiture, unless the party owning shall be able to prove sickness or other inability to comply with said law.

ART. VII. These laws can be altered or amended by a general meeting of the miners, called by a notice posted in three public places in the city, naming time, place, and object of the meeting, and signed by ten miners of the district.

ART. VIII. These laws shall take effect and be enforced from and after their passage.

On motion, the above report and laws were received and adopted for the future government of the district.

April 27, 1870.

M. S. JULIAN, Recorder and Chairman.
L. B. HOPKINS, Secretary.

Julian City, once a thriving town, was at the time of my visit somewhat dilapidated; some of the houses were empty, but a new brick building had just been erected, a ten-stamp quartz mill was being built at the Owens Mine at the edge of the town, and other signs of renewed prosperity were manifested. The town is nearly at the summit of the Santa Ysabel Mountains. On a clear day, Point Loma at San Diego, and the Coronado Islands may be plainly seen. From the Oriflamme Mine, a short distance east, the desert, sloping away to the east, is in full sight. The principal street in Julian bears N. 63° west, magnetic.

In 1871 the town had a population of five hundred, and there were one hundred occupied houses. In 1873 the excitement which followed the discovery of the district began to subside. The cause was said to be prejudice against the lower country, and threatened litigation as to the boundaries of the Cuyamaca grant. This was eventually decided in favor of the miners.

In 1870 there were two quartz mills, of fifteen stamps Washoe pattern, at work. The gold was richer on the surface. Placer mines were worked in the low hills of the Santa Ysabel Valley, but they did not pay very well.

Bullion began to be shipped from Julian in April, 1871. Up to the middle of September $10,341 had been sent forward by Wells, Fargo & Co., and $5,580 by others. The gold was worth $18 per ounce. The following table, from the report of Rosseter W. Raymond for 1870, will give a good idea of the character of the district at that time:

MILLING RESULTS OF LOTS OF ORE FROM VARIOUS MINES IN JULIAN DISTRICT.

Name of Mine.	Tons Crushed.	Value per Ton.	Value of Crushing.
Lone Star	5	$70 00	$350 00
Owens	16	51 00	816 00
High Peak	10	42 00	420 00
Hayden	19	40 00	760 00
Pride of the West	1½	31 00	46 50
San Diego	19	15 00	285 00
Forty-nine	12	12 50	150 00
Lone Star	7	7 00	49 00
Keystone	4	7 00	28 00
San Diego	51	6 00	306 00
Sherman	4	4 82	19 28
North Star	6	4 50	27 00
North America	6	4 00	24 00
Monitor	6	4 00	24 00
Shamrock	7	3 50	24 50
Hannon	3	3 50	10 50
Eagle	10	2 90	29 00
Eagle	5	2 75	13 75
Ella	3	1 25	3 75
White Fawn	3	0 37	1 11
	197½		$3,387 39
Average per ton			$17 15

At the time the prosperity of this mining district was at its heighth, the San Diego *Union* estimated yield of gold for 1871 at $175,919, and for 1872 at $488,670.

After a careful examination of Julian Mining District, I am led to the following conclusions:

The quartz veins are generally rather narrow but remarkably rich. First and last there has been an important output of bullion from the district. I have not had time to arrange statistics obtained, in shape to be of much service. Wood and water are scarce; none of the mines have yet been opened or explored sufficiently to prove their capacity to yield gold. Considering the present condition of things in California, these mines can be worked to greater advantage than when first opened. Milling near Julian City cannot be conducted without very considerable difficulty, owing to the altitude, and consequent scarcity of fuel and water, but at Banner, six miles distant by graded road and twelve hundred feet lower in altitude, there is a beautiful valley through which a considerable stream of water—the San Felipe River—flows, affording sufficient water-power to drive several small mills or one large one, during the year; the water is more abundant during the winter months.

If first class reduction works should be placed at Banner, with ample capital, and all the ores from the district be worked in them, an era of

prosperity would probably be the result which would exceed any before experienced in this district, employment would be given to many miners and tributors to the advantage of the district, the county, and State. The locality is a delightful one, and a desirable place for residence, which is not always the case where gold mines are found.

Julian City lies in sections five and six, township thirteen south, range four east, S. B. M.

BANNER DISTRICT

Is situated on sections two and three, township thirteen south, and range four east, and joins Julian on the east. It was discovered in August, 1870, by a party of men from Julian who were looking for wild grapes. A mine afterwards called the Redman was discovered on a sloping mountain side in San Felipe Cañon. BANNER DISTRICT was soon afterward organized. The district now incorporated with Julian has many advantages, the most important being the presence of water in abundance for milling and sufficient for limited water power, limited to season only, for in the winter and spring, I was informed, it is ample for any future requirements of the district. As mentioned before, Banner is twelve hundred feet lower than Julian, from which it is distant three and a half miles by trail and six miles by graded wagon road. To work the mines of the consolidated districts to the best advantage all the milling and concentration should be done by water power in San Felipe Cañon, and the ores from all the upper mines brought down by a tram road for reduction. By this plan all the present difficulties would be overcome. From appearances, ores could be supplied to such general reduction works for many years to come. There is more silver and less gold in the bullion produced in Banner than that taken from the Julian veins. In 1870, when many mines were being worked in both districts, bullion from Julian sold at the stores for $16 per ounce, while Banner bars brought only $12 to $14. The following table shows the condition of the principal mines in Banner during the early mining excitement. The information is compiled from various publications and reports:

NAME OF MINE.	Average Yield.	Width of Vein.	When Discovered.	Remarks.
Golden Chariot	Most productive in the district. 100 tons yielded $32,000; 50 tons, $8,100; 52 tons, $13,261.	2 to 4 feet.	February, 1871.	Contact vein, country slate and granite. In July, 1874, cleaned up $9,500 in 12 days, with 10 stamps.
Kentuck	$40 per ton.	16 inches.	October, 1870.	Shaft 80 feet deep.
Madden	$75 per ton.	At 80 feet, 14 inches.	September 10, 1870.	
Ready Relief	10 tons yielded $980.	From 2 to 8 feet.	August, 1870.	Tunnel 130 feet, claim 1,000 feet in length.
Redman		6 to 10 feet.	August, 1870.	First mine discovered in the district. Shaft 80 feet deep, and tunnel connecting.

At the time of my visit only one mill was running on the ores of the Ready Relief or Bailey Brothers' Mine. Some other mines were being prospected in a small way, but with what success I was not able to learn. In 1874 there were seventy-five stamps running in Julian and Banner.

When I was at Julian City there was no mill running, but at the Owens Mine, almost in the Town of Julian, a new and good ten-stamp mill was being built. The vein in this mine is small, but the quartz is rich in gold. A pile of ore has been accumulated which contained several hundred tons, and looked and prospected well; from which it is fair to predict that enough gold will be taken out to pay for the mill and leave a surplus. While the new mill is running the mine will be well prospected, and there is reason to hope and expect that considerable bodies of ore will be found. There is no special or well defined croppings to be seen on the surface. The old workings have fallen in. There is a shaft down one hundred and eighty feet in depth, well timbered, through which the ores are hoisted. The mine lies three hundred feet above the town, and very near the summit of the ridge. To the left is a gap through which the road to Banner runs. On a hill near the town, and to the left of the road, may be seen some old workings in which there are some splendid quartz croppings, but in small detached fragments, in a schistose formation dipping at a steep angle. I was struck with the resemblance of this formation to that in Findley Ridge, at Dahlonega, in Georgia, and was led to the inquiry if it would not pay to pipe it down as they do there. A full description of the methods employed in Georgia may be found in the fifth annual report of this office, folio 142.

The Owens Mine was located March 11, 1870. The old workings were quite extensive. There was a shaft two hundred and seventy-five feet, from which levels ran east and west. The first level, one hundred feet below the surface, ran east two hundred feet and west one hundred feet. The second level, two hundred feet deep, ran two hundred feet east and one hundred and eighty feet west. Third level, at bottom of shaft, ran east two hundred and sixty feet and west two hundred feet. In eight months, ending June, 1873, gold to the value of $42,319 50, was taken from nine hundred and twenty tons of quartz. The company was incorporated with a capital stock of $500,000. In 1873 there were fine hoisting works at the mouth of the shaft—now removed.

READY RELIEF MINE, BANNER.

The Ready Relief Mine, the only one now being profitably worked in old Banner District, was discovered in August, 1870, immediately after the Redman, of which it is an extension. It is generally known as the Bailey Brothers' Mine. The southerly extensions of the Ready Relief Mine are the Hubbard and the South Hubbard. The claim is one thousand by two hundred feet. The ledge is from eighteen inches to eight feet in width. The vein is interstratified with the clay slate formation. The slaty cleavage of the country rock is undoubtedly due to lateral pressure, which has also distorted and plicated the vein so that it is found in folds, which are technically called "rolls." I am inclined to the opinion that the vein was formed by solfataric action in a plastic mud before the mountains were elevated, and that the vein has become plicated by its own weight while still in a soft condition. After visiting the mud volcanoes in this county—and not many miles distant—now in action, it is not difficult to conceive such an idea. These mud volcanoes are described in the second annual

report of this office, folio 227, to which the reader is referred. The plications of the vein are unlike anything I have ever seen or read of.

The engraving conveys a good idea of one of these folds as seen at the end of the upper tunnel. The slates are highly aluminous. In the tunnels the sides are soon coated with an incrustation of alum.

The ore in the Ready Relief Mine is blue ribbon quartz, much resembling that of the Sheep Ranch Mine in Calaveras County. The gold is free. The sulphurets are concentrated and saved, but I have no information as to their value. Some of the clay slate contains gold; it resembles the ores of the Black Hills in Dakota, and those of the old Oso Mine in Mariposa County. These slates should be thoroughly prospected and cross-cuts made from both sides of the vein. It might be found that they would pay to crush in large water-power mills with economical management. The general direction of the vein is south southeast. The dip is at almost any angle, owing to the folds before mentioned.

In 1874, the mine was opened by three tunnels, one two hundred feet, the others one hundred and fifty feet each; at the end of the upper tunnel there was a shaft to the surface, one hundred and ten feet above. The mine at present is worked by an upper tunnel of five hundred feet, and a

shorter one sixty feet below, through which ores are conveyed to the mill. Owing to the uprise shaft, the ventilation in the mine is perfect.

The mill is in rather a dilapidated condition, but is still doing good work. It consists of two batteries of five stamps, and driven by steam. The stamps weigh about seven hundred pounds. Each battery is supplied with an automatic ore feeder. Below the aprons there are three Hendy's concentrators, which save a considerable quantity of sulphurets. The mill is only run ten hours per day, during which seven tons of ore are crushed. Wood costs $1 50 per cord for cutting, and $2 for hauling to the mill. The mill is forty feet below the lower tunnel, from which the ores are carried in chutes. The dump of the mine, in which the rejected vein matter is piled, contains some good ores, and I am of the opinion that it would all pay in a large, economical mill. A great deal of low grade ore could be obtained from the hill alongside of the vein. An inexpensive experiment would reveal the value of this ore, and decide if it could be made to pay or otherwise.

In 1876 one hundred tons of ore yielded $30 per ton. The present average yield is not stated, but is admitted to be satisfactory. It is claimed that the output to the present time exceeds $350,000. The gold is worth $14 50 per ounce.

Mr. Charles J. Sauer thinks the water in the south fork of San Felipe River runs twelve miners' inches in summer, and much more in winter. I visited, with Mr. Bailey, a spring which gushes from the hillside at an elevation of five hundred feet above the mill. At the time of my visit, in May, the quantity flowing was at least thirty inches, and Mr. Bailey informed me that the flow was nearly the same all the year round. With the great altitude, this water would afford power sufficient to run extensive reduction works.

The Oriflamme Mine is situated in what was formerly the Desert Mining District, now incorporated in Julian. It belongs to a Boston Company, "*The San Diego Development Company.*" Their ten-stamp mill has recently made a run which Mr. Henry M. Dow, the Superintendent, informed me yielded from $4 to $10 per ton. Water and wood are scarce, and mining and milling are conducted under difficulties. From this mine the Great Colorado Desert may be seen for many miles to the eastward. The sight is a very grand and interesting one.

The Stonewall Mine, formerly the *Stonewall Jackson*, is situated in the northern part of the Cuyamaca Grant about seven miles distant from Julian District in a direct line. By road it is considerably further. If the United States section lines were run out, it would lie in section four, township fourteen south, and range four east. It is not in the Julian District, as may be seen by referring to the map published with this. It has the reputation of being the largest vein in the mining region about Julian City. I regret that for want of time I could not visit this mine.

In 1870 the Stonewall was reported to be twenty feet wide. Dr. J. E. Fulton, one of the present owners, informed me that the width varied from six to forty feet. The country rock is said to be like that of Julian District—a mica schist with coarse granite. The ores are now being crushed in a steam-driven mill of ten stamps. I am informed that the mine has produced in nine months $85,000. The last clean-up yielded $40 per ton. The United States Mint has bought gold from this mine for $18 per ounce. The mine is opened by a vertical shaft one hundred and fifty-five feet deep, from which levels are driven. The lay of the country is such that there is no way to drain the mine by adit. Water for milling and for the steam

boiler is brought in iron pipes a mile or more, from the mountains. In 1871 the mine had a shaft one hundred feet deep, and a level at sixty feet running one hundred and eighty feet to the north and one hundred feet to the south. Stoping had not then commenced.

This promising mine has always been worked under difficulties. In 1871, the small mill then in operation could only run five hours each day for want of water. At that time the mine is said to have yielded from $12 to $20 per ton. During my stay in San Diego County I heard the mine invariably well spoken of.

CALIFORNIA MINERALS.

Mineral species known at the present time to exist in the State of California, carefully revised and corrected and brought up to date, intended to be a check list and foundation for future work. All technical or scientific descriptions have been omitted except in case of minerals not mentioned in former reports, or where some special work has been done, or some interesting feature discovered or noticed. The list has been arranged alphabetically for convenience of reference.

1. AGALMATOLITE. Minerals resembling agalmatolite occur in San Luis Obispo County, and at Greenwood, El Dorado County, the latter in a vein or stratum from six inches to a foot in thickness.

AGATE—See Quartz.

ALABASTER—See Gypsum.

2. ALBITE. Soda feldspar, a specimen in which quartz crystals are imbedded, was found in the San Lucas Mine, Inyo County. It is now in the private cabinet of Dr. Gould at San Diego. Dana gives as a locality the vicinity of the Murchie Mine in Nevada County, with gold and pyrite. The abundance of soda in the desert soils in California would indicate albite in the crystalline rocks.

3. ALTAITE. Telluride of lead, said to exist in Rawhide Ranch Gold Mine, Tuolumne County; in the Frenchwood Mine, Robinson's Ferry, Calaveras County, with petzete, calaverite, and other tellurium minerals; also in the Morgan Mine, Carson Hill, Calaveras County, in large masses, with free gold; at the Adelaide Mine and the Golden Rule Mine, in Tuolumne County, and elsewhere in the State.

4. ALUM. Occurs in mineral waters; as an incrustation, ten miles north of Santa Rosa, Sonoma County; near Newhall, Los Angeles County; near Auburn, Placer County; in thick incrustations at the Sulphur Bank Quicksilver Mines, Lake County; said to occur at Silver Mountain, Alpine County; at Howell's Mountain, Napa County; at the mud volcanoes, San Diego County, and at numerous locations, as an incrustation on rocks; I have noticed it on the bedrock laid bare by hydraulic streams, near Dutch Flat, Placer County, in a crystalline state.

AMIANTHUS—see Amphibole.

5. AMPHIBOLE. Actinolite, anthophyllite, amianthus, asbestus, hornblende, mountain cork, mountain leather, tremolite, etc.

ACTINOLITE. Abundant in counties bordering on the Bay of San Francisco; found in bowlders, or rolled masses, in Alameda and Contra Costa Counties, which show, when broken, beautiful green radiating crystals; found in rocks of the Coast Range; near Knight's Ferry, Stanislaus County; at Petaluma, Sonoma County, with garnets; on the Mariposa estate, Mariposa County, in fine needle crystals; in Quartz Eagle Gulch, Plumas County; twelve miles from Gilroy, Santa Clara County; Eureka, Humboldt County; Santa Rosa, Sonoma County; Reed's Ranch, Marin County; and in the Lone Mountain Cemetery, San Francisco.

Anthophyllite has been found in Slate Range, San Bernardino County.

Asbestus—

Butte County. Eighteen miles south of Oroville.

Calaveras County. Salt Spring Valley and Jenny Lind Hill.

Del Norte County. Exact locality not stated.

Fresno County. French Gulch, Potter Ridge Mining District, near Fresno Flat; Fine Gold Gulch.

Inyo County. Numerous localities in the Inyo Mountains.

Los Angeles County. Near Newhall.

Mariposa County. Mount Bullion and Bear Valley.

Placer County. Swiss Boy and Leed's claims, one mile below Rice's bridge.

San Diego County. Seven miles east of Elsinore, section six, township five south, range three west, S. B. M. This deposit is now being worked and boiler covering, etc., manufactured at Elsinore.

Shasta County. Exact locality unknown.

Tulare County. White River.

Yolo County. California Mine.

Hornblende—

Calaveras County. At Vallecito.

Contra Costa County. At San Pablo.

Monterey County. At Soledad.

Sacramento County. At Folsom.

Sonoma County. At Healdsburgh, and as a constituent of rocks in numerous localities in the State.

Mountain Cork has been found in Butte County, at Red Hill, and in Tuolumne County.

Mountain Leather. Amador County, in Little Grass Valley Mine, Pine Grove District, and in Mariposa and Tuolumne Counties.

Tremolite. Found white and fibrous in limestone at Columbia, Tuolumne County, and in Santa Cruz Mountains, Santa Cruz County.

6. ANDALUSITE. Found in abundance in the slates in Fresno and Mariposa Counties. In the former county, on the Chowchilla River, near the road to Fort Miller, or Millerton. In the latter, at Hornitas, at Moore's Hill, twelve miles south of Mariposa, and near the Ne Plus Ultra Mine.

Andradite—see Garnet.

7. ANGLESITE. Sulphate of lead. This is rather a common mineral in southeastern California, and specially so in Inyo County. In the Cerro Gordo it has yielded a very considerable portion of the lead bullion sent from that locality. It occurs with bindheimite and linarite and galena, at the Modoc Mine, and with geocronite and argentiferous galena and sinerite at the Santa Maria Mine, and the Eclipse Mine in the same county.

8. ANHYDRITE. Anhydrous sulphate of lime, found near Anaheim, in Los Angeles County, and in pale blue fibrous specimens in the Inyo Mountains, near Lone Pine; lately found in considerable quantity in the gypsum beds in Santa Barbara County—gray, very dense and heavy, compact to granular; shows signs of sedimentary origin.

Anhydrous Sulphate of Soda—see Thenardite.

Anthracite—see Mineral Coal.

Antimony—see Cervantite and Stibnite.

Antimony Ochre—see Cervantite.

Antimony Sulphide—see Stibnite.

9. APATITE. Phosphate of lime. According to the report of the San Jacinto Tin Mining Company of San Bernardino County, this mineral, rare in California, has been found near the company's property in San Bernardino County. No special description is given of the mineral or its occurrence.

10. ARAGONITE. Carbonate of lime, found in beautiful transparent crystals in Colusa County in the Candace Copper Mine; New Almaden Quicksilver Mine, Santa Clara County; Inyo County, Cerro Gordo Mines; Colusa County, ranch of J. M. Pugh, near Smithville.

Onyx Marble, a variety of aragonite, is found also in numerous localities, as follows:

Kern County. Six miles from Kernville.

Los Angeles County. Santiago Cañon, twenty-five miles from Santa Ana, in a ledge twelve feet thick.

Placer County. At Gold Run.

San Luis Obispo County. On section nine, township thirty-two south, range fifteen east, and at several other localities.

Siskiyou County. Near Soda Springs Hotel, and near Yreka.

Solano County. Near Suisun; near Vacaville, and elsewhere in the county.

Tehama County. In township twenty-five north, and range seven west, in a vein four feet thick.

Aragotite—see Petroleum.

Arenaceous Limestone—see Calcite.

11. ARGENTITE. Silver glance, vitreous silver, sulphuret of silver, found in Inyo County, in the Minietta Belle Mine; in the Kearsarge Mountains, near Independence, in cubical cystals; in Deep Spring Valley, at a depth of sixty feet from surface.

In *Mono County*, eight miles south of Benton.

12. ARSENIC. Metallic arsenic has been found at the Alisal Mines, twenty-five miles from the Mission of San Carlos.

Arsenical Pyrites—see Arsenopyrite.

13. ARSENOLITE. Exchequer Mine, Alpine County, after enargite; at the Armagosa Mines, San Bernardino County, in large masses.

14. ARSENOPYRITE. Mispickel. This mineral is quite abundant in California, but generally in thin seams rich in gold. The following are localities where it is found in uncommon masses, or of superior quality:

Calaveras County. Eureka Mine, with gold.

El Dorado County. With gold, near Georgetown.

Inyo County. Several localities.

Nevada County. Betsey Mine, Grass Valley.

Placer County. Near Auburn, with tellurium and gold.

San Diego County. Rich in gold.

Sierra County. North fork claim, Forest City, rich in gold.

Asbestus—see Amphibole.

Asphaltum—see Petroleum.

15. ATACAMITE. Chloride of copper. Locally given in Dana's Mineralogy, Inyo County; this is doubtful. I am familiar with the county, and have never seen or heard of a specimen being found.

Aventurine—see Quartz.

16. AZURITE. Azure copper ore, chessy copper, blue malachite, mountain blue. It is quite common in the Inyo Mountains, from the White Mountain to Coso, with cerusite, bindhermite, anglisite, and linarite; in the Modoc Mine, in Inyo County, and with chalcopyrite and bornite at Copperopolis, Calaveras County.

17. BARITE. Barytes, cawk, heavy spar, terra ponderosa, etc. This mineral is known to exist in at least six counties in the State, as follows:
Alpine. Morning Star Mine.
Calaveras. Satellite Copper Mine.
Inyo. In White Mountain Range; in a vein in Alabama Range.
Nevada. With gold, Malakoff Hydraulic Mine, North Bloomfield.
Plumas. With lead and copper ores, north arm of Indian Valley; with tetrahedrite, Irby Holt Mine, Indian Valley.
San Bernardino. Milk white and honey yellow, Calico silver mines.

18. BERNARDINITE. Near Santa Monica, Los Angeles County, described by J. M. Stillman, in American Journal of Science and Art, third series, volume 18, folio 57. It has since been found near Santa Rosa, in Sonoma County.

19. BINDHEIMITE. Hydrous antimoniate of lead. This rare mineral has been found at the Union Mine, Cerro Gordo, Inyo County, and with anglesite at the Modoc Mine, in the same county. There is some doubt as to the identity of the specimens.

20. BIOTITE. Hexagonal mica. Grass Valley, Nevada County. A specimen was seen by Professor Blake in the cabinet of C. W. Smith, Grass Valley.
Bismuth—see Bismutite.

21. BISMUTITE. Hydrous carbonate of bismuth, stream bismuth. Found at a single locality in the State, on Big Pine Creek, Inyo County, found in drift while sluicing for gold.
Bitumen—see Asphalt, under head of Petroleum.
Black Jack—see Sphalerite.
Black Sands—see Magnetite.
Blende—see Sphalerite.
Bloodstone—see Quartz.
Blue Malachite—see Azurite.
Boracic Acid—see Sassolite.

22. BORATE OF STRONTIA. Mentioned in a letter written by Dr. John A. Veatch to the California Borax Company, quoted in full in the third annual report, part 2, folio 15.

23. BORAX. Borax was first discovered in California in the waters of Tuscan Springs, in Tehama County, January 8, 1856. The water was brought to San Francisco by Dr. Trask, State Geologist, and the analysis made by L. Lanszweert. The crystals then obtained were sent to the museum of the California Academy of Science. Borax Lake was discovered by Dr. John A. Veatch, in September, 1856. This deposit was worked from 1864 to 1868, during which time it produced 1,181,365 pounds of borax. Borax fields were discovered in San Bernardino County, February 14, 1873. These deposits have been worked by the San Bernardino

Borax Mining Company, who have produced very large quantities of borax. This valuable mineral has since been found at a number of localities in the State: In Death Valley, Inyo County, 1873; at Desert Springs, called also Cane Springs, in Kern County, February 15, 1872, from whence a considerable quantity has been extracted. The dry lake in which the borates are found is situated in township thirty south, range thirty-eight east, Mt. Diablo base and meridian. Borax and the borates have been found in considerable quantities in San Bernardino County, near Calico, which deposit is at the present time being worked.

The reader is referred to former reports of this office, especially the third annual report, for information concerning this mineral and its production in the State.

24. BORNITE. Erubescite, horseflesh ore, purple copper ore, variegated copper ore, etc.

Calaveras County. At Copperopolis and Campo Seco.

Fresno County. With chalcopyrite and pyrite, at King's River.

Inyo County. Inyo Mountains.

Plumas County. Light's Cañon, Genesee Valley, and at the Siegel Mine.

Santa Clara County. Near Lexington.

Shasta County. At Copper City.

25. BRONZITE. For localities, see Enstatite.

Buhr Stone—see Quartz.

Building Stones, there not being many species, they have been described under a special heading.

26. BROMINE. Said to occur with free iodine in the serpentine rocks, at Point Lobos, near San Francisco. Report on the geology of the coast mountains, etc., J. B. Trask, State Geologist, 1884, folios 26 and 92.

Bromine occurs as bromide of potassium in the waters of San Francisco Bay, and in the bitterns or concentrated mother liquors, from which bay salt crystallizes out in the proportion of 1.090 parts in 1000 as shown in analysis made in 1879, by Fr. Gutzkow, and quoted in the second annual report of this office, folio 223.

27. CALAVERITE. Telluride of gold and silver. This mineral occurs sparingly in the mines of Carson Hill, near Angel's, at the Morgan Mine with massive gold, at the Melones Mine, and at the Golden Rule Mine, Calaveras County.

28. CALCITE. Anthraconite, arenaceous limestone, carbonate of lime, calcareous spar, calc spar, dogtooth spar, Iceland spar, limestone, lithographic stone, marble, stalactite, stalagmite, travertine, tufa, thinolite, etc. This mineral is abundant in California, and occurs in many forms. It is found not only in extensive beds, but as distinct varieties, resulting from changes well known to mineralogists. It is a common mineral in veins of silver, lead, copper, zinc, and quicksilver, and sparingly in gold mines. It would be impossible and useless to enumerate all the localities in the State, but the following are given as the most important and best known:

Amador County. Black calcite, near Volcano.

Butte County. Blue limestone and anthraconite, at Pence's ranch.

Calaveras County. *Anthraconite*, near newly discovered caves at Murphys. The odor of this mineral is remarkable. Sitting one day in the hot sun, and breaking while studying the rock, I noticed with much

interest the penetrating and actually fetid smell that arose every time a blow of the hammer was made. I was annoyed at the same time by swarms of flies, but did not immediately connect their presence with the smell. After a time the idea occurred to me that they were attracted by the odor, which I immediately proved to be the case by the following experiment: Leaving my seat, I retired to a distance and awaited the dispersion of the flies. Returning, I laid some fragments on a larger piece and crushed them quickly with rapid blows. The flies immediately reappeared and settled in large numbers on the powdered rock. After a time, the smell having gone, the flies departed as before. This was repeated a number of times, and was witnessed with interest by the parties who were visiting the cave at the time.

El Dorado County. A large deposit of limestone at the Alabaster Cave and lime works, where it is very extensively burned for lime; near Mud Springs.

Inyo County. Thinolite found in considerable quantity near Owens' Lake, and on the Mohave Desert, in the beds of ancient lakes; and in Death Valley, at Cerro Gordo; fine crystals of dogtoothspar and blue calcite occur; at Darwin, Iceland spar, very transparent and fine; at Palma Mine, fine crystals; with gold and other ores at Modoc Mine.

Kern County. With malachite and melaconite, San Amedio Ranch. Lithographic stone on section twelve, township thirty-two south, range thirty-four east, Mount Diablo meridian.

Lassen County. Several localities.

Mariposa County.

Mono County. Thinolite, valley of Mono Lake, where it has been burned to an inferior quality of lime.

Placer County. Near Clipper Gap; extensively burned to lime at Cave Valley, five miles south of Auburn.

San Bernardino County. Near Colton, burned for lime by hydrocarbon furnace, in which California petroleum is used as fuel.

San Diego County. Thinolite, Colorado Desert.

San Francisco County. Peninsula near the city, dogtooth crystals in fissures of metamorphic rocks.

Santa Clara County. Hills back of Mayfield, burned for lime. Good specimens of Iceland spar are sometimes found; with quicksilver ores in the New Almaden, Guadalupe, and Chapman Mines.

Santa Cruz County. Near Felton and Santa Cruz, extensive beds of crystalline limestone occur, which is burned in a large way for lime.

Siskiyou County. Arenaceous limestone, found in Middleton's tunnel, under the bed of the Klamath River.

Santa Catalina Island. On the coast of Los Angeles County, pink calcite is found, with quartz, etc.

Tufa, or travertine, is found in several localities, but it has not been studied.

Marbles occur in numerous localities in the State; some of them are of excellent quality, and a few are exceptionally fine.

Amador County. Near Ione, a red marble is found which resembles the Rosso Antico, so much prized in ancient Rome. This marble is fully described under the heading of Building Stones. Nine miles from Ione a white marble of good quality is found.

Butte County. A blue variety crops out for miles near Pence's Ranch; it is known to be carboniferous.

Calaveras County. Near Cave City, a beautiful marble of a pleasing, soft pearl-gray color with darker markings; takes a fine polish; is compact and without flaws; it is an elegant ornamental and desirable building stone.

El Dorado County. At Alabaster Cave a nearly white marble is found, but it has not as yet been carefully studied; a gray mottled variety from near the same locality takes a good polish, and is a good building material.

Humboldt County. Seven miles from Eureka, a handsome mottled gray marble of uniform texture; takes a high polish; soluble in acids; contains but little magnesia, and seems to be an excellent stone. It is located on the timber claim of Flanegan & Brosman.

Inyo County. Numerous marbles have been observed in the Inyo Mountains, from white to black, but little is known of them. At Big Pine, at the foot of the Sierra Nevada Range, there is a cropping of beautiful white marble, but it has never been examined chemically and may be dolomite. In Death Valley a blue limestone is found in bowlders among the float filled with what seems to be fossil coral; if cut and polished it would probably be found to be a fine marble.

Kern County. A water-worn bowlder of marble of good quality was found in the bed of Poso Creek; the source is not yet known. A brecciated marble resembling Giallo antico is found three miles from Tehachapi, and a soft yellow and really very beautiful marble is found in a valley nine miles west of the town of Tehachapi. It is found in large masses. There is one large block at the station at Tehachapi which was never shipped. The marble is fine grained and beautifully mottled. These marbles are described in detail under the head of Building Stones. They are worthy of special attention.

Los Angeles County. There are two varieties of marble known to occur in this county; one light colored, the other dark. But little is known otherwise of them.

Monterey County. Near Carmello Bay, a white compact marble is found which is said to exist in very large quantities. A company was incorporated some years ago to work it, known as the Pacific Carrara Marble Company.

Nevada County. On Bear Creek, near Colfax, a dark gray-veined marble is found. Another locality is ten miles south of Grass Valley.

Placer County. Near Clipper Gap, gray-veined marble of good quality; takes a high polish; occurs in large quantities. Analyses of two varieties are published in the fourth annual report of this office, folio 111. A white marble occurs at and near the cave, in the vicinity of Auburn.

A white saccharoidal marble is found near the iron furnaces, in section fifteen, township fifteen north, range eight east. It could be obtained in large blocks or slabs if required. An analysis may be found on folio 111, fourth annual report of this office.

A very beautiful black marble, veined with white, has been found near Colfax, on the Central Pacific Railroad. It is an excellent ornamental and building stone, and should be utilized.

A large cropping of light gray marble, with veins and markings of darker gray, has been opened in a lime quarry near Auburn. It is in very large quantity. It is compact, of uniform structure, and takes a high polish. An analysis appears on folio 111 of the fourth annual report.

Plumas County. Limestones and marbles have been found at Devil's Elbow. This office has no information as to quality or quantity.

San Bernardino County. Near Colton, in Slover Mountain, half a mile from town. The marble is white and of good quality, but I am informed that it has not yet been found of a quantity that will admit of large blocks being quarried. It is extensively burned for lime.

San Luis Obispo County. Marbles in many varieties are said to occur in this county, but this office has no special information.

Santa Cruz County. At the lime works mentioned elsewhere, a crystal-limestone is found that has some of the properties of marble.

Shasta County. Marbles are found in the Gray Mountains, along the McCloud River. No specimens have been sent to the Mining Bureau.

Tuolumne County. This county is rich in marbles and limestones. A beautiful dark marked variety is found near Abbey's Ferry; the exact locality is not known. In the bed of the Tuolumne River, at Sonora, a large water-worn outcap of a blue and white marble is laid bare in placer mining.

CARBONATE OF COPPER—see Malachite and Azurite.

CARBONATE OF IRON—see Siderite.

CARBONATE OF LEAD—see Cerusite.

CARBONATE OF MAGNESIA—see Magnesite.

CARBONATE OF SODA—see Trona.

CARNELIAN—see Quartz.

29. CASSITERITE. Binoxide of tin.

Tin has been found in at least three localities in California. In the Temescal Mountains, San Bernardino County, lies the only known deposit in the State, having a prospective value. In Plumas County, in the bed of the middle fork of Feather River, three miles above Big Bar, a single specimen was found by Mr. Thomas Lane of La Porte, and given to Professor W. P. Blake, and by him described as resembling the stream tin from Durango, Mexico. Another specimen was found some years ago near Weaverville, Trinity County, in the loose soil, and presented to Professor J. D. Whitney, then State Geologist. The vein from which it came was never found.

Grossularite, lime garnet, a common mineral in Southern California, resembles crystals of cassiterite, and has often been mistaken for it by Cornish miners. A number of reported tin discoveries have turned out to be this mineral. The temescal tin mines are in the Temescal Mountains, whence the name, on section two, township four south, range seven west, San Bernardino meridian; distant fifty-five miles east of Los Angeles, and thirty-five miles from Anaheim Landing.

CAT'S EYE—see Quartz.

30. CERARGYRITE. Chloride of silver.

Cerargyrite is rather a common mineral in some of the southern counties of the State, associated with embolite, but seldom in masses sufficiently large to form good cabinet specimens. Microscopic crystals of great beauty are not uncommon, but the mineral generally occurs in very thin crusts.

It forms the chief silver mineral in Slate Range, Inyo County. The finest microscopic crystals are found in the Modoc Chief Mine, Inyo County. Cerargyrite is a valuable silver mineral, and is easily reduced by the most simple metallurgical process.

It has lately been found in the Silver King Mine, four miles west of Redding, Shasta County. The ore contains minute, but very perfect, crystals of cerargyrite. An assay showed silver to be present to the extent of 140 ounces to the ton. The ore resembles the best from Calico District, in San Bernardino. The specimens were sent to the Mining Bureau by B. B. Miner.

31. CERUSITE. White lead, carbonate of lead, white lead ore, etc.

This mineral is very easily distinguished, and is rather common in California, seldom in crystals, but generally associated with galena, anglesite,

azurite, linarite, chrysocolla, malachite, silver minerals, and gold. Fine crystallized specimens, with the associates above mentioned, are found in the Modoc Mine, and in many other localities, in the Inyo and Coso Mountains, Inyo County; in the Russ District, in the same county, in large crystals resembling those from Siberia, and at Great Basin Mine, near Mohave River (Blake). It is a valuable ore of lead, and in certain localities an indication of silver ores. A considerable proportion of the lead ores worked at the Cerro Gordo Mines were cerusite. Thirty-two thousand tons of lead were produced in these mines.

32. CERVANTITE. Antimony ochre.

This is a rare mineral in California. It occurs with stibnite in San Emedio Mountain, Kern County. (Blake.)

33. CHALCANTHITE. Native sulphate of copper, blue vitriol.

Results from the decomposition of copper sulphide ores and is rare in nature. It sometimes occurs in old copper mines in California when the waters do not flow from the workings, and old tools such as picks, gads, hammers, etc., left by accident in the old works, have been found changed to metallic copper, or very heavily coated with that metal. Specimens in the State Museum are from the Peck Mine, Copper City, Shasta County, and from Sweetland, Nevada County.

The waters of a copper spring near Glenbrook, Lake County, deposit copper on a knife blade.

Chalcedony—see Quartz.

34. CHALCOPYRITE. Copper pyrites. This mineral is quite abundant in California, being found in greater or less quantities from north to south. It is a valuable ore of copper; but its metallurgy presents so many difficulties that it is found generally more profitable to concentrate it and ship it to England than to work it here. Under some circumstances it has been found economical to reduce it to a matte by a single furnace operation, and ship it in that condition. It is also worked somewhat extensively at Campo Seco, Calaveras County, and at Spenceville, Nevada County. The following California localities are represented in the State Museum:

Calaveras County. Campo Seco, Copperopolis, and Lancha Plana.
Colusa County. Stony Creek.
Contra Costa County. In the rocks of Mount Diablo.
Inyo County. Beveridge District.
Los Angeles County.
Mariposa County. Near Hornitos.
Nevada County. At Spenceville.
Plumas County. Bullion District and Light's Cañon.
San Bernardino County.
San Diego County.
San Francisco County. In specks in the jaspers of the peninsula.
Santa Clara County. At Lexington.
Shasta County. Copper City.

It occurs also in small quantities with ores of gold and silver, and is almost universal in its distribution over the State.

35. CHALCOSITE. Vitreous copper, copper glance.

It is found with other ores of copper in the State, more frequently in the southern counties. It is sometimes argentiferous, and merges into stromeyrite, which see. It occurs in the silver ores in Inyo and San Bernardino

Counties; in Genesee Valley (in basalt), Plumas County; in San Diego County; in Los Angeles County; at the Maris Mine, in grains and irregular masses, in syenitic granite, containing silver (Blake); in San Luis Obispo County; and in the Enterprise Mine, Bullion District, Plumas County.

Chessy Copper—see Azurite.

Chloride of Silver—see Cerargyrite and Embolite.

Chloro-Bromide of Silver—see Embolite.

Chloro-Carbonate of Lead—see Phosgenite.

Chrome Iron—see Chromite.

36. CHLOROPAL. Nontronite.

This mineral has been found recently at two localities in California, one near Hite's Cove, Mariposa County, and in lava at Bath, in Placer County. A specimen from the former gave the following reaction: Color, piscatio green; cuts like soap; easily indented or cut by the finger nail; lumps under the pestle; gives water in closed tube; with borax on platinum wire, gives iron reaction; on charcoal, in reducing, flame turns black and becomes strongly magnetic. Partly soluble in hydrochloric acid; dissolves in caustic soda, leaving a black residuum.

37. CHROMITE. Chromic iron, chrome ore, etc.

This mineral is very abundant in California. Its occurrence and production have been fully described in the fourth annual report, folio 126.

It is known to exist in at least twenty-six counties in the State, as follows. Nearly all the localtties are represented in the State Museum:

Alameda County. Near the Town of San Antonio; in Livermore Valley, nine miles southeast from section thirteen, township three south, range two east; 1,500 tons 48 per cent shipped to Philadelphia; 60 tons sold at $6; 500 tons offered at $5, without sacks.

Amador County. Near Jackson, one mile from Mountain Spring House.

Butte County. Mount Hope District, near Forbestown.

Calaveras County. French Gulch; near Domingo Creek; near Campo Seco; near Murphy's; in San Diego Gulch, on the east of the highest hill opposite the Noble Copper Mine, in very large masses.

El Dorado County. Two miles from Coloma; two miles northwest of Shingle Springs; ten miles west of Shingle Springs; near Latrobe.

Fresno County. Near the New Idria Quicksilver Mine; twenty miles from Fresno City.

Lake County. At Lower Lake; on the road from St. Helena to Knoxville; at Glenbrook, a large quantity. Mr. H. Aldrich thinks 1,000 tons could be obtained from this locality.

Los Angeles County. Lang's Station, Soledad Cañon; occurs with magnite, in the form of sand.

The Los Angeles papers assuming the mass to be chrome iron, estimate the quantity at 50,000 tons, which is without doubt a mistake. It is not uncommon in California to find chromite with magnetic sands, but not in such large proportion.

Mendocino County. At Stanley's Ranch.

Monterey County. Near San Benito River.

Napa County. Near St. Helena, in Chiles Valley; 170 tons delivered at St. Helena, sold for twelve dollars per ton.

Nevada County. Deer Creek, Coyote Diggings, near Colfax.

Placer County. Near Alabaster Cave, Michigan Bluffs, within one mile of Auburn, on section twelve, township fourteen north, range nine east, seven miles east of Iowa Hill.

Plumas County. Spanish Creek, Meadow Valley.

Sacramento County. Seven miles east of Folsom, near south fork of American River; nine miles from Folsom; 2,800 tons have been shipped from this locality.

San Francisco County. Several unimportant deposits are known on the peninsula, one on the ocean beach below outlet of Lake Merced, one on the hills south of the city.

San Luis Obispo County. Chrome iron is abundant in this county. The Flores deposit has been extensively worked. The Pick and Shovel Mine is six miles northeast of the town of San Luis. The London Mine is four and a half miles northeast of the town. Extensive mines lie five miles southeast of San Luis. Very large quantities of chrome ores have been shipped from this county. The county papers estimate the product at over twenty-eight thousand tons.

San Mateo County. Chrome ores are found in this county, on the Pacific Slope of the redwoods. The deposits are said to be large.

Santa Clara County. Five miles east of San José; Los Gatos.

Sierra County. Vicinity of the Mountain House, near Downieville; Cherokee Creek, one fourth of a mile southeast of Brandy City.

Siskiyou County. Half a mile from the town of Yreka—a high grade ore.

Solano County. Near Fairfield.

Sonoma County. Near Litton Springs, in large quantities; at Hood's ranch.

Tehama County. A large deposit has recently been found in township twenty-five north, and range seven west, by J. A. Heslwood; a company has been incorporated.

Tulare County. Deer Creek, near Plano, and ten miles from Portersville.

Tuolumne County. The Engel Mine at Yorktent, near Chinese Camp, has been worked for many years.

Chrome Spinel—see Picotite.

38. CHRYSOCOLLA. Silicate of copper. Rather an abundant mineral in southern California. It is regarded in Owens' Valley as an indication of silver mines. It is found as a blue stain on ores of copper and silver, and in the vicinity of mines of these metals. Fine specimens are found in the Copper World Mine, San Bernardino County; in the Lundy Mines, Mono County, associated with ceragyrite and cuprite, and in the Union Mine, Inyo County, and forty miles south of Colton, San Bernardino County. It occurs also near San Carlos, Inyo County; at the Eclipse Mine, same county; in the White Mountains, Mono County; in San Diego and San Luis Obispo Counties, and elsewhere in the State. It is a valuable ore of copper, for the reason that it can easily be reduced in the water jacket furnace to metallic copper.

39. CHRYSOTILE. This is a magnesian mineral, a variety of serpentine, having no economic value. It occurs in veins or seams in serpentine, and is not uncommon in the State where the serpentines occur.

40. CINNABAR. There are in this State many deposits of cinnabar. The counties most distinguished for their wealth in this mineral being Santa Clara, Fresno, San Luis Obispo, Trinity, Napa, Sonoma, and Lake, all containing mines that have been more or less, and in some of which mines are still being worked. The localities are so numerous that like those of gold it would be tedious and unnecessary to mention them all. Under the head of *Mineral Springs*, it will be seen that the influences which have led to the deposition of cinnabar, pyrite, native mercury, calcite, aragonite, quartz, sulphur, bitumen, and gold, are still in active operation, and as cinnabar is the mineral from which most of the quicksilver has been extracted in California, it is proper to give under this head the following statement of the product of that remarkable and useful metal for the years 1885–6, furnished by Mr. J. B. Randoll; by referring to the same subject in former reports, the entire yield for California may be learned:

PRODUCTION OF QUICKSILVER IN CALIFORNIA FOR THE YEAR 1885-86.

(Black figures are the production of 1886.)

	Ætna.	Napa C.	Great Western.	Guadalupe.	New Idria.	Sulphur Bank.	Redington.	Great Eastern.	Various.	Total—flasks.	New Almaden.	Grand Total—flasks.	Price in San Francisco—per flask.	
													Highest.	Lowest.
January	189	131	172	0	190	24	40	37	0	783	1,700	2,483	$33 00	$32 50
	162	**147**	**339**	**0**	**70**	**100**	**42**	**73**	**34**	**967**	**1,431**	**2,398**		
February	96	180	245	35	70	85	24	75	0	810	1,506	2,316	$32 50	$32 50
	132	**192**	**274**	**0**	**175**	**108**	**24**	**53**	**45**	**1,003**	**1,100**	**2,103**		
March	88	145	314	0	80	83	0	33	19	762	1,500	2,262	$32 50	$31 00
	209	**218**	**226**	**0**	**20**	**91**	**21**	**43**	**75**	**903**	**1,522**	**2,425**		
April	142	145	340	0	80	69	0	37	0	813	2,003	2,816	$31 00	$30 00
	328	**172**	**115**	**0**	**90**	**172**	**36**	**62**	**62**	**1,037**	**1,256**	**2,293**		
May	62	190	269	0	75	194	0	0	3	793	2,000	2,793	$29 00	$28 50
	228	**128**	**99**	**0**	**101**	**36**	**18**	**76**	**95**	**781**	**1,600**	**2,381**		
June	112	250	330	0	62	91	50	63	5	963	1,750	2,713	$30 00	$29 00
July	45	191	321	0	75	209	43	50	10	944	1,750	2,694	$30 00	$29 75
August	118	175	324	0	80	150	49	0	47	943	2,104	3,047	$29 75	$29 50
September	201	180	347	0	95	85	57		77	1,042	1,936	2,978	$30 50	$29 50
October	52	185	236	0	85	123	42	65	82	870	1,598	2,468	$30 50	$30 00
November	54	190	292	0	122	61	43	43	87	892	1,576	2,468	$30 00	$29 75
December	150	235	279	0	130	122	37	43	62	1,058	1,977	3,035	$32 00	$30 00
Totals	1,309	2,197	3,469	35	1,144	1,296	385	446	392	10,673	21,400	32,073	$32 00	$28 50
Production in 1884	2,931	1,376	3,292	1,179	1,025	890	881	332	7	11,913	20,000	31,913	$35 00	$26 00
Production in 1883	*	5,890	3,869	84	1,606	2,612	1,894	1,669	101	17,725	29,000	46,725	$28 50	$26 00
Production in 1882	------	6,842	5,179	1,138	1,953	5,014	2,171	2,124	241	24,662	28,070	52,732	$29 05	$27 35
Production in 1881	------	5,552	6,241	5,228	2,775	11,152	2,194	1,065	584	34,791	26,060	60,851	$30 75	$27 90
Production in 1880	------	4,416	6,442	6,670	3,209	10,706	2,139	1,279	1,600	36,461	23,465	59,926	$34 45	$27 55

*Production of Ætna and Napa Con. not segregated in former years.

Clay—see Kaolinite.
Coal—see Lignite.
Cobalt—see Erythrite and Millerite.
Cobalt Bloom—see Erythrite.

41. COCCINITE. Iodide of mercury.
Locality given by Dana, San Emidio Cañon, Kern County.
Colemanite—see Priceite.

42. COPPER. Copper in the metallic state has not been found in any considerable quantity in California. The following are the known localities:
Calaveras County. Found sparingly in the Keystone, Napoleon, Lancha Plana, and Union Mines. The Satellite Mine, the Lancha Plana under a new name, has produced a fine lot of specimens which were exhibited by Horace D. Randlett at a late exhibition of the Mechanics' Institute at San Francisco.
Del Norte County. With cuprite, Pearl Mine.
Napa County. Near St. Helena.
Nevada County. Meadow Lake, with cuprite.
Plumas County. At Mumford's Hill, with rhodonite.
Sacramento County. Cosumnes Mine.
San Luis Obispo County. Pieces of float copper have been found in the Coast Range, sometimes associated with cuprite; one mass weighed 37.3 pounds.
Santa Barbara County. In grains in serpentine rocks (Blake).
Shasta County. Cow Creek and Iron Mountain.
Trinity County. With cuprite.

43. COPPERAS. Coquimbite in part, hydrous sulphate of iron, occurs in several localities in the State, and is generally the result of solfataric action, as at the Sulphur Bank, in Lake County, where it is very abundant. No analysis has been made of it, so that its exact composition is unknown. Dr. Trask, in his report of 1854, fol. 56, says it is found in large quantities near the town of Santa Cruz, in such quantity that it could be extensively manufactured as an article of commerce. I formed the same opinion as to the Sulphur Bank before mentioned. A sample of saturated solution of sulphate of iron was sent to the Mining Bureau recently, leached from ground sulphurets that the party who sent it states could be obtained at the rate of seventy gallons per ton. This is only another evidence of the enormous waste that is permitted in the metallurgy of ores in California.
Copper—Blue Carbonate—see Azurite.
Copper Glance—see Chalcosite.
Copper—Green Carbonate—see Malachite.

44. CORUNDUM. According to Baron Richthoven it is found in the drift in the San Francisquito Pass, Los Angeles County.

45. CUBAN. Sulphide of copper and iron. It is said to be found on Santa Rosa Creek, San Luis Obispo County. One mass weighed 1,000 pounds. I consider this statement as doubtful.

46. CUPRITE. Red oxide of copper. Cuprite is rather a common mineral in California. The following are the most important localities:
Colusa County. Candace Mine.

Del Norte County Pearl Copper Mine, with native copper.
Kern County. San Emedio Ranch, with malachite.
Mono County. Kerrick Mine, with azurite, malachite, partzite, and native silver.
At Lundy, in microscopic crystals, with cerargyrite and chrysocolla.
On the borders of Mono Lake and at Mammoth.
Napa County. Near St. Helena, in masses of considerable size, with native copper.
Nevada County. At Meadow Lake, with native copper.
Placer County. Near Lincoln.
Plumas County. Reward Mine.
Shasta County. Peck Mine, Copper Hill, in microscopic crystals.
Trinity County. With native copper, exact locality unknown.
Tulare County. May Flower Mine, Mineral King District.
And at numerous localities in the Inyo Mountains, Mono, and Inyo Counties.
According to Blake, it occurs sparingly in thin crusts and sheets with the surface ores of the principal copper mines in Calaveras County, especially the Union and the Keystone; in Mariposa County, at La Victoire Mine, with green and blue carbonates of copper; in Del Norte County, at the Evoca, Alta, and other mines, in very good cabinet specimens, the cavities being lined with crystal; in Plumas County, and in the upper parts of most of the copper veins of the State.

47. CUPROSCHEELITE. Tungstate of lime and copper. This new and interesting mineral was first found in California in the Green Monster Copper Mine, in Kern County, about twelve miles east of White River Post Office. It is generally associated with black tormaline. A large crystal was found at this locality, which is the only one of this mineral known. In 1879 a fine specimen was sent to San Francisco from Fresno County, but the exact locality was not given.

48. DATOLITE, OR DATHOLITE. This mineral has, as yet, been found at one locality only, but from the universal distribution of boracic acid in the State, it is likely to be found elsewhere. The locality is a mining tunnel near San Carlos, Inyo County. It occurs with grossularite in fine crystals, the datholite being the matrix in which the grossularite is embedded. This mineral was first noticed by the late J. Lawrence Smith, and an account of it published in the *American Journal of Science* a number of years ago.

49. DIALLOGITE. Rhodochrosite, carbonate of manganese. This mineral is represented in the State Museum by a single specimen, No. 3584, in beautiful pink crystals, from the Colorado Mine, No. 2, Monitor District, Alpine County.

50. DIAMOND. For the details of the occurrence of diamonds in California, and of general history, the reader is referred to the fourth annual report of this office, folio 157. The following are the known localities in the State:
Amador County. A very interesting stone was found in July, 1883, by George Evans, on the surface of the ground at Rancheria, a small mining camp, about four miles northwest of Volcano. It weighs about 255 milligrams. Its length is 0.315 inches; thickness, 0.215 inches. It is irregularly globular in form, all the faces being convex. It is pale straw colored, very

brilliant, and, as far as can be distinguished even under the microscope, is without a flaw. Jackass Gulch, near Volcano, and Indian Gulch, Gopher Hill, near Fiddletown, and other localities. Diamonds have been found at Volcano in a peculiar volcanic formation, described by Professor Whitney as "ashes and pumice cemented and stratified by water." The crystals had the form of the icositetrahedron, with faces curved in the manner peculiar to the diamond.

Butte County. A fine crystal was found some years ago in the west branch of Feather River. It was about four millimeters in diameter. It was afterwards lost. A number of diamonds have been found at Yankee Hill, but the exact number is not known.

A fine diamond from the Spring Valley Mine, Cherokee, has been presented to the State Museum, No. 4033, by Mr. G. F. Williams, Superintendent. Mrs. Harris has a beautiful Cherokee rough diamond set in a ring. Mr. Harris, who was formerly Superintendent of the Spring Valley Hydraulic Mine, has another, which has been cut. Of the two, I consider the natural crystal the most interesting and beautiful. Mrs. W. C. Hendricks of Morris Ravine, near Oroville, also has a fine Cherokee diamond set in a ring.

In August of 1883 I visited Cherokee, Butte County, specially to study that celebrated diamond locality. Mr. A. McDermott, druggist of Oroville, says that a diamond was sent to him in 1862 which was as large as a small pea. It was nearly globular and obscurely crystallized and of yellow color. He does not know the subsequent history of the stone, where it was found, or the owner's name.

At Cherokee, diamonds and zircons are found in cleaning up sluices and undercurrents. The first notice of diamonds at this locality dates from 1853, the largest discovered, which was two and a quarter carats (nine grains), is now in the possession of John More. There have been from fifty to sixty found, from first to last; some were rose colored, some yellow, others pure white, and all associated with zircons, platinum, iridium, magnetite, gold, and other minerals.

El Dorado County. Mr. W. A. Goodyear is quoted in Whitney's "Auriferous Gravels of the Sierra Nevada of California" as follows: "He saw a diamond in the possession of Mrs. Olmstead, at Dirty Flat, near Placerville, which measured nine thirty-seconds of an inch maximum diameter, and weighed one and a quarter carats—$5\frac{61}{100}$ grains. It was found by Mr. Olmstead in cleaning up the sluices of the Cruson tunnel, Dirty Flat.

At the McConnell & Reed claim, on the south side of Webber Hill, a diamond the size of a small white bean was found. This diamond was discovered a few feet above the bedrock. Mr. McConnell thinks on a previous occasion he had thrown away a diamond as large as the end of his thumb, in ignorance of its true character. Two other diamonds were found in another claim, also on the south side of Webber Hill.

Three or four diamonds were found near White Rock. Mr. Goodyear purchased a crystal of Mr. Thomas Potts. It weighed half a carat—two grains; had a slight yellowish tinge, and was found in washing the gravel which came from a tunnel driven into White Rock. Near the same locality three diamonds were found in gravel by the Wood Brothers, in 1867. The largest was valued by a San Francisco dealer at fifty dollars.

An interesting letter from Placerville to the State Mineralogist, from W. P. Carpender, gives much information on this subject. It is published in full in the fourth annual report, folio 169.

Nevada County. French Gulch—one crystal weighed $7\frac{1}{2}$ grains.

Trinity County. An examination of the platinum sands of the Trinity

River was made by Professor F. Woehler, of Gottingen, who found diamonds in them. After removing gold, platinum, chromic iron, silica, rhuthenium, etc., by the usual methods, he examined the residue microscopically, and observed colorless, transparent grains, which he presumed to be diamonds. Subsequent combustion in oxygen and precipitation from solution of baryta, by the carbonic acid evolved, convinced him that the microscopic crystals were true diamonds.

DIATOMACEOUS EARTH—see Quartz.

51. DOLOMITE. Carbonate of lime and magnesia. Inyo marble.

Dolomite is rather abundant in California. The following are the most important localities at present known:

Amador County. In narrow, snow-white veins, traversing talcose and chlorite rock bearing coarse, free gold. (Blake.)

Calaveras County. In the Winter, Hill's, and other mines, with quartz and free gold, sometimes in cavities, in fine crystals. (Blake.)

Inyo County. Dolomite is very abundant in the Inyo range of mountains, from White Mountain to Coso, and in very large deposits. The White Mountain Peak is named from its white appearance. The summit, which seems to be of this rock, is often supposed to be covered with snow, when it is not. Attention has lately been called to the white variety of this marble, which resembles the finest Carrara marble, from which the name "*Inyo marble*" has been taken. A technical description of this dolomite marble has been given under the head of Building Stones.

Los Angeles County. Tejunga Cañon, San Gabriel Mountains.

Mendocino County. Exact locality unknown.

Napa County. Mount Catherine.

Plumas County. With pyrite at Mumford's Hill.

San Bernardino County. In the Armagosa Mines, with free gold; also in the wash of the Armagosa River, in white bowlders, which, broken, resemble the finest Italian marble.

San Luis Obispo County. At Morro, in nodules resembling fossil coral; from less than an inch to several feet in diameter. Some have cavities lined with crystal.

52. DUFRENOYSITE. A mineral composed of sulphur, arsenic, and lead. Said to be found in the Union Mine, Cerro Gordo, Inyo County (doubtful).

ELECTRUM—see Gold.

53. EMBOLITE. Chloro-bromide of silver. It is rather an abundant mineral in southern California, but is seldom found in masses of any considerable size, being generally disseminated throughout the other ores of silver, or occurring in crusts. It is almost always associated with cerargyrite, for which it is often mistaken. It is found in the Minnie Mine, Sweetwater Range, Mono County, and in the Indiana Mine, near Swansea, Inyo County. A large specimen of silver ore in the State Museum (brecciated), a large portion of which is covered with embolite, is from the Alhambra Mine, Calico District, San Bernardino County.

EMERALD NICKEL—see Zaratite.

54. ENARGITE. Sulpho-arsenide of copper, sometimes containing antimony, iron, silver, or zinc. It occurs at least at one place in California, where it is abundant, associated with pyrite and other minerals. It has a disposition to change to arsenious acid and sulphate of copper, a reference

to which has been made under the head of arsenolite. The locality is the Morning Star Mine, Monitor District, Alpine County, from which there are fine specimens in the State Museum. One remarkably fine specimen from the Stella Mine was presented by Lewis Chalmers. It is a nodular mass, surrounding a nucleus of pyrite. It is coated white on the surface from the decomposed mineral. The inner nucleus is in part amorphous, partly crystalline, of a pale gray color; where it joins the enargite it is pale yellow.

55. ENSTATITE. Bronzite.

Silicate of magnesia, alumina, iron, lime, manganese, etc. The variety Bronzite is found in Alameda County, in the Berkeley Hills.

56. EPIDOTE. Silicate of alumina, lime, iron, etc. Occurs sparingly in California, at Long Valley, on the Mohawk Road, Plumas County, and in Miners' Ravine, Placer County. It has been found with copper ores in Calaveras and El Dorado Counties, but the exact localities are uncertain.

57. EPSOMITE. Epsom salt, hair salt, sulphate of magnesia.

This rather rare mineral occurs in the Redington Quicksilver Mine, Napa County, in curved porous crystals several inches long, white color, nearly wholly soluble in water, gives much acid water in closed tube, and a black sublimate of sulphide of mercury which is present as an impurity. B. B. on ch. melts in its water of crystallization, and becomes pink on addition of nitrate of cobalt at a red heat.

A qualitative analysis shows it to contain alumina and traces of iron. The small residue left after solution in water was examined microscopically and found to consist of black, yellow, and transparent particles, some sulphide of iron (pyrites), and a small amount of cinnabar. The black particles proved to be magnetite, the yellow free sulphur, and the transparent, selenite—altogether an interesting association, and one that will be studied more carefully in the future.

Epsomite has been found in an old drift in Ventura County, at Rincon. The tunnel is in two hundred to three hundred feet, and the mineral forms on the roof and sides in acicular needles two inches long. Specimens have been presented to the State Museum by Dr. Stephen Bowers, of Ventura. It is very soluble in water.

ERUBESCITE—see Bornite.

58. ERYTHRITE. Arsenite of cobalt.

This rare mineral has recently been found in California and Nevada. It is found as a rose-red incrustation on a grayish earthy mineral at the Kelsey Mine, Compton, Los Angeles County. It was described by Professor William P. Blake in "Contributions to the Mineralogy of California," in the appendix to the second annual report of the State Mineralogist, 1882.

FELDSPAR—see Albite, Labradorite, and Orthoclase, and special paper on rocks and building stones.

59. FLUORITE. Fluor spar, fluoride of calcium.

Found only sparingly in small white cubes, with copper ore, at Mount Diablo, Contra Costa County (Blake).

FLUOR SPAR—see Fluorite.

FRENCH CHALK—see Talc.

FREIBERGITE—see Tehahedrite.

60. GALENA. Galenite, sulphide of lead.

Galena is a common ore of lead and very abundant in California. It is found in the northern part of the State with pyrite and blende, in the gold mines, and in the south with silver ores; sometimes disseminated through the ore, at other times in distinct veins, and in masses of considerable size. The time will come when by a proper system of concentration this mineral will be gathered and will add largely to the lead production of the world.

The following are some of the very numerous localities in the State; most of them are representated in the State Museum:

Amador County. Rising Sun Mine, near Aqueduct City.

Calaveras County. At Murphy's, in the Star of the West Mine, Blue Mountain District and Gold Hunter claim.

Inyo County. New Coso, Modoc, Brown Monster, and Hidalgo Mines, the latter showing radiated structure. In the Cerro Gordo Mines where a large quantity of lead has been produced, and at many other localities in the Inyo Mountains. All the ores containing this mineral are argentiferous.

Mariposa County. Marble Springs.

Mono County. In the May, Lundy, and Homer Districts, and with native silver and partzite, Tower Mine near Benton; there are numerous other localities in the county.

Nevada County. In several of the most noted mines with gold, and at Meadow Lake with gold and blende.

Plumas County. Light's Cañon and Granite Basin.

Sacramento County. At Michigan Bar, with blende and pyrites.

San Bernardino County. In many localities.

Santa Catalina Island.

Tehama County. At Cow Creek.

Tuolumne County. In white quartz, with coarse gold, pyrite, and blende; Soulsby Mine.

61. GARNET. Andradite.

Garnets are found in a number of localities in California, but no stones suitable for jewelry work, or which should be called gems, are known.

Garnets have been found in the following localities in the State:

Calaveras County.

El Dorado County. At Fairmount Mine, three miles from Pilot Hill, in large blocks and masses two feet thick or more (Blake); Rogers' claim, Hope Valley, with copper ores.

Fresno County. Near New Idria (chrome garnet).

Inyo County. Coso Mining District. Specimens have been brought to San Francisco, under the impression that they were tin ore.

Los Angeles County. . Mountain Meadows, with copper ores.

Marin County. Reed's Ranch, in mica schist.

Mono County. Near Mono Lake.

Plumas County. Long Valley.

San Bernardino County. Near the Temescal Tin Mines.

San Diego County. Soledad Mine, near Santa Ysabel.

Santa Clara County. Thirty miles northeast of San José, in mica schist.

Sonoma County. Mouth of Russian River—near Petaluma, associated with specular iron, pyrite, chalcopyrite, calc spar, actinolite, and steatite.

Ventura County. Pine Mountains.

62. GAY-LUSSITE. Carbonate of lime and soda, found in alkaline lakes in fine crystals. It has no present economic value. Thinolite, which

forms mountains in Nevada and elsewhere in the Great Basin, is believed to be a pseudomorph after gay-lussite; if this is so, the quantity of carbonate of soda set free must also have been very great. This subject forms the substance of several chapters in the "Geology of the Fortieth Parallel," Clarence King. Gay-lussite is found in California at Borax Lake, San Bernardino County, and probably elsewhere.

63. GEOCRONITE. Sulphide of lead and antimony, has been observed with galena in small masses in the Inyo Mountains, Inyo County. A specimen was exhibited in the California collection at the Paris Exposition of 1878.

64. GLAUBERITE. Sulphate of lime and soda, was found at Borax Lake, Lake County, in blue clay at a depth of forty feet, having been obtained in an artesian boring (Dana). It is reported also in San Bernardino County, at the borax works, and it is said to exist at the Geysers in Sonoma County.

65. GLAUCOPHANE (Wichtisite). This mineral occurs in a rock matrix, widely distributed in California, and associated with serpentine. The rock was first observed in 1877, when sections were cut for microscopic observation. A specimen was exhibited at the Paris Exposition of 1878, and when seen by M. Michel Levy was recognized as the "Mica schiste a glaucophane de Syra, Greece," figured in his "Mineralogie micro-graphique des Roches Eruptive Françaises," planche 1, Fig. 2. This rock is represented in the State Museum by No. 4259. The wall rock of the Collier Mine, six miles northeast of Murphy's, Calaveras County, and microscopic slide from near the Wall Street Quicksilver Mine, Lake County. A slide from this was exhibited in Paris.

66. GOLD. Gold exists in nearly every county in California. To enumerate all the localities in detail would be useless. All the information this office has been able to gain concerning this most valuable of all metals may be learned by consulting previous reports of the State Mineralogist, the museum catalogues, and a special paper in this volume.

A very interesting specimen of gold imbedded in a quartz crystal has been exhibited at the State Museum. The following description is the result of a careful examination of this curious and interesting association. It is from Tuolumne County, and was one of several obtained at the same locality. It is now in the private collection of Mr. J. Z. Davis.

The gold is, within and without the crystal, projecting from a perfect face. It does not fill a cavity, but extends like a diaphragm through the quartz. The length of the quartz crystal is 42 millimeters, thickness 13 and 20 millimeters; weight, 14.670 grams; specific gravity, 2.699. According to the table given in Phillips' Metallurgy of Gold and Silver, the proportion of gold is .0429, or by weight—

Gold	0.629
Quartz	14.041
Total	14.670

Attached to the large crystal are two smaller ones, of smoky quartz, joined to the larger one by the gold. One of these crystals is very minute, the other is somewhat larger; the diameter of the smaller is, in decimals of an inch, .003, the larger is .0375.

The gold is bright, crypto-crystalline, leaf-like, curved in some parts like the gold found in some quartz mines in the State, specially the Cedarberg. The large crystal of quartz is well terminated at one end; the base is shattered and irregular. At the junction of the gold with the quartz the quartz is somewhat fractured, but the gold extends into the body of the crystal into the solid quartz. The face of the crystal which appears fractured, when examined under the microscope, seems to be a confused conglomerate of imperfect crystals of quartz in which some minute half-formed crystals of gold are imbedded. It is interesting to speculate as to the manner of the formation of this crystal, and to theorize how the gold came to be imbedded in it. At first thought it would seem to be conclusive that the gold was formed first and that the quartz crystallized about it; but they may be cotemporaneous, another evidence that quartz is deposited in a gelatinous state, from which it hardens into massive and even crystalline quartz.

It has long been known that gold existed in small quantities on the peninsula of San Francisco, within the city limits. A handy panner, or one skilled in the use of the improved batea, can at any time obtain one or more colors of gold in a panful of sand from the ocean beach or the shores of San Francisco Bay. A few ounces of gold have been extracted from the black sands on the beach near Lake Merced. A small portion of this gold has been obtained, rolled out into a ribbon, and placed in the museum as a specimen of gold from San Francisco County. It has been numbered 6530 in the museum catalogue. Some day this specimen will be prized as a relic of the golden era in California. Half an ounce of gold should be bought from every county in the State while it is possible, and carefully preserved in the State Museum.

67. GRAPHITE. Plumbago, black lead, etc.

The following are the known localities in the State:

Alpine County. Near Summit City.

Calaveras County. Near Big Tree Grove, in crystalline scales (Blake), probably molybdnite, for which it is frequently mistaken.

Fresno County. At Borer Hill.

Kern County. Near Fort Tejon.

Los Angeles County. Tejunga Cañon, twenty-five miles from Los Angeles, and twelve miles from S. P. R. R.

Sonoma County. Knights Valley, Guerneville, and near Pine Flat.

Tuolumne County. One mile south of Sonora, Gold Springs.

And reported in Marin, Plumas, and Sierra Counties.

No deposit of any considerable value has as yet been found in the State, and the quality is very inferior. Some of the specimens from localities given above, may be molybdenite, and this is even probable.

Gray Copper—see Tetrahedrite and Chalcosite.

68. GROSSULARITE. Lime garnet.

Is quite abundant in California, especially in the southern counties, where it has often been mistaken for tin by Cornish miners who have seen it, and several tin excitements have had their origin in this mistake. It is found also with copper ore in the Roger's claim, Hope Valley, El Dorado County (Dana), and, with datholite, near San Carlos, Inyo County.

69. GYPSUM. Alabaster, selenite, satin spar, plaster of Paris.

Gypsum is an abundant mineral in California. It has been found in numerous localities as follows:

Alameda County. Union Salt Works, a deposit left in the tanks in the preparation of bay salt.

Kern County. With stibnite in the Antimony Mines, San Emidio, near Breckenridge, Buena Vista, and Posa Creek.

Los Angeles County. Near the entrance of Soledad Cañon, and at a locality recently discovered.

Monterey County. Several unimportant localities.

Nevada County. Near Truckee Pass.

San Diego County. One or two miles from Elsinore, near Dos Palmas Station, banks of Carizo Creek.

San Luis Obispo County. Arroya Grande Mountains.

Santa Barbara County. With anhydrite.

The deposit in Santa Barbara County is of great excellence and very extensive, possesses the further advantage of being located within two miles of Point Sal, a shipping station on the coast for this portion of the county. This gypsum is of the white or Nova Scotia variety, being a kind well suited for making plaster of Paris, and which is said to occur abundantly at only a few other points in the United States. Since the discovery three years ago, five thousand tons have been brought to San Francisco and manufactured by Lucas & Co., who inform me that the supply cannot be exhausted in many years.

Stanislaus County. Near Hill's Ferry.

Ventura County. Ojai Ranch, Lockwood Creek.

ALABASTER—

Los Angeles County. Arroyo Grande, San Luis Obispo County, and Point Sal, Santa Barbara County.

Sonoma County. In fine crystals, Santa Rosa.

San Luis Obispo County. Cholame.

SELENITE—

Kern County. Antimony mines, San Emidio; Buena Vista.

Lake County. Robinson's Ranch.

Lassen County. Near Susanville, in large slabs.

Los Angeles County. Soledad Cañon, in large slabs.

Mariposa County. Bear Valley.

San Bernardino County. At and near Calico.

San Diego County. Dos Palmas Station, Southern Pacific Railroad.

Santa Barbara County. Point Sal.

Santa Clara County. Near Gilroy.

Stanislaus County. Near Modesto.

Ventura County. Lockwood Creek.

SATIN SPAR—

San Bernardino County, and Tulare County, near White River.

70. HALITE. Common salt.

The manufacture of salt was described in a special paper in the second annual report of the State Mineralogist. Since that report was published, several new salt springs have been discovered, and in sinking wells for petroleum salt water frequently rises.

Salt is known to exist in a mineral state in the following counties of the State: Alameda, Inyo, Kern, Los Angeles, Marin, Placer, San Bernardino, San Diego, Santa Clara, and others. In Inyo, Kern, San Bernardino, and San Diego Counties, it occurs in the great deserts and in the sinks of rivers which have no outlet to the sea. In Inyo County it is abundant in Owens', Saline, and Death Valleys, associated with borax, gay-lussite, hanksite, thenardite, iron, and ulexite. In Saline Valley, rock salt was discovered in

1864, in extensive beds. Large beds of salt have recently been discovered in the Alkaline Lake or sink in the Colorado Desert, in San Diego County, which are now being successfully worked by an incorporated company under the name of the New Liverpool Salt Company.

In *Alameda County* solar salt was found by the early settlers on the shores of the bay of San Francisco.

In *Kern County* it occurs fourteen miles from Cañada de los Uvas, where the ground is impregnated with salt; also in the Tehachapi Valley.

Salt springs occur in *Inyo County*, in numerous localities.

Los Angeles County. Fourteen miles from Los Angeles.

Placer County. Near Clipper Gap, and elsewhere in the State.

71. HANKSITE. This new mineral has been fully described in the fifth annual report of this office, folio 62 to 66. It has lately been discovered that it occurs in very large quantities and in a different form at the same locality, where the hexagonal crystals were found, and that a confused mass of dogtooth crystals in the State Museum are another form of hanksite. When this became known a doubt arose whether thenardite existed at all in California, but it was found that a massive variety, called *ice* by the borax miners, gave no reaction for carbonic acid and *all* the reaction for thenardite. It will be interesting when the Winter overflow of water at the locality in San Bernardino County subsides to obtain all the varieties, and to make a careful study of them. It is my opinion that instead of being a scarce mineral, hanksite will be found in great abundance, and that it will be proved that it plays an active and important part in the metamorphosis that produces gay-lussite, thinolite, and perhaps borax. Hanksite is known to occur in California in the borax fields in Death Valley, Inyo County, and in San Bernardino County, at the original locality. There are several known localities in the State of Nevada.

72. HEMATITE. Specular iron, micaceous iron, red hematite, sesquioxide of iron.

The reader is referred to a special paper on iron ores in fourth annual report, folio 232. Hematite is found in the following counties and localities in the State:

Alameda County. Near Alameda.

Alpine County. At Monitor.

Amador County. Ione Valley, near the Amador Gold Gravel Mine, two and a half miles northeast of Jackson.

Butte County (Micaceous). Feather River, near Oroville.

Calaveras County. Near Campo Seco, opposite section three, township four north, range ten east; near San Andreas—near the big tree grove.

Del Norte County. Kelsey tunnel, fourteen miles southeast of Crescent City.

El Dorado County. Diamond Springs township.

Inyo County. Owens Valley.

Napa County. Near St. Helena.

Nevada County. Holden ledge, township fifteen north, range seven east; large quantity; 1,000 tons shipped to San Francisco.

Placer County. Clipper Gap Iron Mine, on section twenty-four, township thirteen north, and range eight east; Red Hill, on section fifteen, same township and range.

Plumas County. With magnetite, near Crescent Mills; Mumford's Hill, and Light's Cañon.

San Luis Obispo County. Harrington Iron Mine, township thirty-one south, ranges eleven and twelve east.

Shasta County. Near Shasta.

Sonoma County. Specular iron, equal to that from Elba.

73. HESSITE. Telluride of silver. A single specimen was obtained in 1854, near Georgetown, El Dorado County. It had been washed out from the gold drift, and the parent vein has never been found (Blake).

Hornblende—see Amphibole.

Hornsilver—see Cerargyrite.

Horseflesh Copper Ore—see Bornite.

Hyalite—see Opal.

74. HYDROMAGNESITE. A mineral, supposed to be hydromagnesite (no analysis), is found in the serpentines on the peninsula of San Francisco, and elsewhere in the State. It is represented by specimen No. 1320, in the State Museum.

Iceland Spar—see Calcite.

Idocrase—see Vesuvianite.

Idrialite—see Petroleum.

Ilmenite—see Menaccanite.

Iodide of Mercury—see Coccinite.

Ionite—see Lignite.

75. IODINE. Dr. Trask found free iodine and bromine in the serpentine rocks at Point Lobos, San Francisco. ("Report on the Geology of the Coast Mountains, etc., J. B. Trask, State Geologist, 1854," fols. 26 and 92.) About seventeen years ago I made an analysis of mineral water containing a large quantity of iodine. The sample was furnished by Mr. Fargo, of San Francisco, who has since informed me that the spring from which it was taken was at the entrance of Grizzly Cañon, Lake County, five or six miles from Wilbur Springs. In a letter by Dr. John A. Veatch, quoted in the third annual report of the State Mineralogist, 1883, fol. 17, he writes: "Nothing of much importance presented itself until reaching the saline district, about eighty miles south of Red Bluff. It is on one of the branches of Stony Creek. Valuable salt springs exist here. The waters contain the borates in minute quantities, and one spring was remarkable for the enormous proportion of iodine salts held in solution."

76. IRIDIUM. Iridium has been found with gold and platinum in all the stream washings or placer mines of California; also in the auriferous beach sands. As not much effort has ever been made by the miners to save it, the quantity collected in this State has not been large. During the earlier stages of gold washing, when operations were prosecuted on a more extended scale, the miners finding this troublesome stuff in their sluices, where its great weight had retained it with the gold, were at much pains to separate it from the latter, after which, being ignorant of its value, the most of it was thrown away. Afterwards, when the miners found out what it was, they began to save this metal, and small lots, finding their way to San Francisco, were sold at such prices as happened to be offered for it, there being no regular purchasers in this market.

In melting gold in the United States Mint in San Francisco, and in the bullion refineries of the State, much iridium was collected which rose to the surface of the melted gold, and was skimmed off with the flux or dross. At the San Francisco Assaying and Refining Works, under the

management of Kellogg & Hewston, large quantities were so collected. The principal localities in the State where it has been found will be given under the head of platinum.

Iridosmine—see Iridium and Platinum.

Iron Garnet—see Garnet.

Iron and Iron Ores—see Hematite, Limonite, Magnetite, and Siderite. This subject has been somewhat fully treated in the fourth annual report of this office, folio 232.

Isinglass—see Mica, Brolite, and Muscovite.

77. JAMESONITE. Sulphide of antimony, lead, iron, copper, and zinc. This mineral is represented in the State Mnseum by a single specimen, No. 2262, from Mokelumne Hill, Calaveras County.

Jasper—see Quartz.

78. JEFFERISITE. A mineral resembling mica, which is a hydrous silicate of numerous bases, principally alumina, iron, and magnesia. Specimens in the State Museum are (2126), from Susanville, Lassen County, and (4911), from Tulare County.

79. KAOLINITE. Including all varieties of clay resulting from the decomposition of feldspar. The numerous deposits of clay in the State and the condition of the pottery manufactures have been described at some length in the fourth annual report of the State Mineralogist, folio 139, to which the reader is referred for details. Clays are very abundant in the State, while some are admirably adapted for the manufacture of the finer quality of porcelain, others are useful only for the making of bricks. The following are the most important localities in the State, of the better quality; the inferior kinds are too numerous to mention:

Alameda County.

Amador County. Ione Valley, near Jackson.

Calaveras County.

Contra Costa County. Mount Diablo.

El Dorado County. Dutch Creek, twenty miles northeast of Placerville.

Humboldt County.

Inyo County. One deposit said to have an area of forty acres, ten feet thick; another opposite Independence.

Los Angeles County.

Marin County. Duncan's Mills.

Mendocino County. Near Point Arena.

Monterey County.

Napa County.

Nevada County. Seven miles southeast of Grass Valley, on section three, township fifteen north, range nine east, a large and very important deposit. Another is found on Rush Creek, three miles from Nevada City.

Placer County. Spinks' coal mine at Lincoln, one of the most important localities in the State; found also near Clipper Gap.

Sacramento County. Michigan Bar and Cook's Bar are important deposits.

San Bernardino County. In 1883 a deposit of very pure white kaolin of great value if in sufficient quantity was discovered at Calico.

San Diego County. Several large deposits have been found within six miles of Elsinore. Potteries have been established which are working the clay successfully.

Santa Clara County. Near San José.

Shasta County.

Sonoma County. Two miles from Santa Rosa.
Tehama County.

80. LABRADORITE. Feldspar.
This mineral has been observed in small quantities in street pavement blocks in San Francisco; the exact locality is not known.

81. LEAD AND LEAD ORES. See also galena, anglesite, and cerusite.
In the fourth annual report of this office, folio 244, the reader will find published a special paper on this subject. Metallic lead was said to have been found in a placer mine at Magalia, Butte County, in 1867. This was probably flattened bullets, which are very frequently if not invariably found in the clean up of hydraulic mines.

82. LENZINITE. Hydrous silicate of alumina.
MOUNTAIN BUTTER. Found in cavities in rocks at the mouth of Pine Creek Cañon, Alabama Range, Owens Valley, Inyo County. (Aaron.) This mineral is probably lenzinite.

83. LEPIDOLITE. Lithium mica.
This beautiful mineral has recently been found in California, at several localities, with erythrite and rubellite. It is a pink colored, scaly mineral, containing from two to six per cent of lithium. The California mineral has not yet been analyzed. It might, at some future time, be found profitable to extract lithium from it. The salts of lithium are principally used in fireworks and in medicine. The California localities are represented in the State Museum by Nos. 1229, San Diego County; 2773, twenty miles southwest of Colton, San Bernardino County; and 4262, with azurite, from the Half Dollar Mine, Inyo County.

84. LEUCOPYRITE. Arsenical iron.
Said to occur in Los Angeles County; exact locality not given.

85. LIGNITE. Brown coal, mineral coal, ionite, peat, etc.
One of the most pressing wants of California at the present time is extensive and accessible beds of good coal. It will be difficult, if not impossible, to compete otherwise with eastern manufacturers, who can purchase an unlimited supply of greatly superior fuel for less than one third the price paid by the same class of manufacturers on the Pacific Coast. The question of fuel becomes a very serious one when extensive manufactures on the Pacific Coast are contemplated.
While our mineral fuels of this class are neither cheap, abundant, nor of good quality, they serve a useful purpose, and are somewhat largely utilized. Even the brea, or crude asphaltum, is burned under steam boilers in some parts of the State.
As carboniferous rocks are known to exist in several parts of the State, there is reason to hope that true coal may be eventually found. The reader is referred to a special paper on the mineral coals of the Pacific Coast, on folio 265, fourth annual report of this office. The following California localities are known:
Alameda County. Corral Hollow.
Amador County. Ione Valley, in a vein of inferior quality, five to fifteen feet in thickness; several thousand tons have been burned in locomotives.
Butte County.
Calaveras County. Near Lancha Plana.

Contra Costa County. Mount Diablo, extending ten to twelve miles along the northern slope of the mountain; the most prolific locality in the State.

Fresno County. Six miles westwardly from the New Idria Quicksilver Mine.

Humboldt County. Near Eureka, on Eel River, thirty miles from Eureka, one hundred and fifty feet above the bed of the river; said to be a well defined and extensive bed of coal.

Kern County. Tejon Pass.

Lassen County. Near Bieber.

Los Angeles County. Four miles from Fulton—Santa Clara Coal Mine.

Mendocino County. Middle fork of Eel River, eight miles south of Round Valley—Willits.

Mono County. A vein six inches thick, twenty-five miles from Bodie.

Monterey County. South of Carmello Bay.

Placer County. At Lincoln, a very poor quality; it has been used, to a limited extent, for making steam.

San Benito County. Cienega del Gabilan Rancho, in the mountains east of Soledad.

San Bernardino County. Temescal Mountains, twenty-five miles west of Colton, Cajon Pass, said to be a fifteen-foot vein; if an analysis published in the San Diego *News* is correct, the coal is of superior quality.

San Diego. Croppings of coal or lignite were known in this county many years ago. R. C. Taylor, in his statistics of coal, published in 1855, but written before 1851, mentions the occurrence of coal on the seacoast, twelve miles north of San Diego, and the fact that the tooth of a saurian and amber were found with it. According to the statements of Dr. Le Conte, the vein is four feet thick. The writer also asserts that brown coal is found between San Diego and San Luis Rey (folio 497). According to the *Mining and Scientific Press*, coal occurs near the harbor of San Diego, on Point Loma (vol. 16, folio 81). A vein of lignite has been found four miles from Elsinore. It has been named the Cheney Coal Mine. It is developed to the extent of fifty feet, and is used as a cheap fuel. I have made an analysis which has not before been published.

ANALYSIS.

Fixed carbon	39.94	Inflammable	85.00
Volatile combustible matter	45.06		
Water	5.80	Non-inflammable	15.00
Ash	9.20		
	100.00		100.00

Streak, brown; does not cake or coke.

San Francisco County. Ore specimen found on Telegraph Hill had the following composition:

Combustible matter and water	75.7
Ash	24.3
	100.00

Another from the cemetery grounds, Presidio:

Fixed carbon	47.55
Volatile combustible matter	7.30
Water	4.40
Ash	40.75
	100.00
Inflammable	54.85
Non-inflammable	45.15

Small croppings of lignite are known to occur on the ocean beach.

San Luis Obispo County. Near the town, lat. 35° north; discovered 1847 (Statistics of Coal, R. C. Taylor, folio 497).

Santa Clara County. Near Lexington.

Santa Cruz County.

Shasta County.

Siskiyou County. Eight miles north of Yreka, on the road to Linkville.

Solano County. Southwestern part.

Sonoma County. Santa Rosa Valley.

IONITE—Described in fourth annual report, occurs in at least four localities, in Ione Valley, the original locality, and in San Benito County at the Coal Mine Mountains, east of Soledad. Among the asphaltum beds at Sargent's ranch, Santa Clara County, and in Los Angeles County near Petrolia, it seems to be some obscure pseudomorth after petroleum and to have a common origin.

LIME—see Calcite.

LIME GARNET—see Grossularite.

LIMESTONE—see Calcite, and special paper on Rocks and Building Stones.

86. LIMONITE. Limonite is rather an abundant mineral in California, being found in numerous localities with other iron ores in the State. The following are the principal and most important ones:

Alameda County. Five miles from the town of Alameda.

Calaveras County. Between Jenny Lind and Campo Seco, San Andreas, near the Big Trees, Sheep Ranch District, near Murphy's.

El Dorado County. Near Latrobe. For description, see Catalogue No. 4148.

Placer County. Forest Hill. In nodules resembling coprolites.

San Luis Obispo County. Harrington Iron Mine, on subdivision of Rancho Cañada de los Osos.

Santa Clara County. With psilomelane.

Shasta County. Iron Mountain Mine, seven miles from Shasta.

Sierra County. At or near Gold Lake.

Solano County. Shores of the bay, in nodules.

Tulare County. Twenty-five miles from Visalia.

YELLOW OCHRE—

Calaveras County. Near Campo Seco.

El Dorado County. Twelve miles northeast of Shingle Springs, section thirty-two, township twelve north, range eleven east, four miles east of Georgetown.

San Diego County. Two miles from Elsinore.

Santa Clara County. Near the Mission of San José.

87. LINARITE. Cupreous sulphate of lead, cupreous anglesite.

This mineral, at first mistaken for azurite, is found in considerable abundance in the silver lead mines of Cerro Gordo, Inyo County, and at the Modoc Mine, in the same county. Some of the specimens obtained are very beautiful.

88. LITHARGE. This substance has been found in San Bernardino County. It is probably a furnace product, made in prehistoric times. It has been found also in Arizona, in localities remote from the Missions, and under circumstances leading to the opinion that the furnaces, now obliterated, were erected and worked by the people who dug the irrigating canals,

and built the Casa Grande, in the valley of the Gila River, and lived in the ancient cliff dwellings.

Lithographic Stone—see Calcite.

89. LITHOMARGE. A fine grained hydrous silicate of alumina, probably sedimentary. It contains generally magnesia and lime. Specimen No. 423, in the State Museum, is from the Alpha Mine, Table Mountain, Tuolumne County; called "pipe clay;" No. 2515 is from near the Big Trees, Calaveras County; and No. 4498 from Lassen County.

Loadstone. Natural magnet—see Magnetite.

Macle—see Andalusite.

Magnesian Limestone—see Dolomite.

90. MAGNESITE. Carbonate of magnesia. Magnesite is a valuable mineral, found in numerous localities in our State. None has, as yet, been put to practical use. The market has been generally supplied from Greece. It is exported to England to the extent of from one thousand to two thousand tons annually. It is sold for thirty-two drachms (about $5 44) per ton. It is used in England for the manufacture of sulphate of magnesia. A small quantity goes to Austria, and is used in the manufacture of hydraulic lime, and a smaller quantity to France, where it is used in the manufacture of firebrick and tiles. The California mineral will be turned to account at some future time, when it will be interesting and important to know where it may be found. The known localities in the State are as follows:

Alameda County. Mount Diable Range, thirty miles south of the mountain.

Mariposa County. A heavy bed of magnesian rock, chiefly magnesite, charged with crystals of iron pyrites, accompanies the chief gold-bearing quartz vein of this county. The rock is charged also with nickel and chrome talc in green films, like the magnesite of Canada.

Monterey County. On Arroyo Seco, in a vein two feet wide. The mineral contains also silica.

Napa County. Township nine north, range five west, M. D. M.

Placer County. At Gold Run and Damascus, said to exist in large quantities.

San Luis Obispo County. At Port Harford.

Santa Clara County. On Coyote Creek, about two miles from Madrone Station, Southern Pacific Railroad, a large deposit of excellent quality.

Tulare County. Near Visalia, below Four Creeks and Moore's Creek, in solid beds of pure white massive mineral. Hard, fine-grained like unglazed porcelain. The beds are from one to six feet thick, interstratified with serpentine and talcose slates. South side of Tule River, ten miles from Portersville.

Tuolumne County. Associated with gold-bearing quartz veins and serpentine.

An artificial carbonate of magnesia is obtained as a by-product in the tanks in working the mother liquors, from the manufacture of salt by the Union Pacific Salt Company, Alameda County, and largely used in the manufacture of explosives.

Magnetic Pyrites—see Pyrrhotite.

Magnetic Sands—see Magnetite.

91. MAGNETITE. Magnetic iron ore.

Magnetite is a valuable ore of iron, and exists with other ores in numerous localities in California. The following are known localities:

Amador County. Two miles northeast of Jackson, magnetic sand, with pyrite; Sutter Creek.

Butte County. With native copper, in the Lincoln Tunnel; Ball Creek, near Oroville.

El Dorado County. Volcanoville (Blake); crystals in slate, near Boston Copper Mine, and with quartz and pyrite, Excelsior Copper Mine (Blake); two miles northwest of Shingle Springs; near Big Red Ravine, two miles from Coloma; Clarksville.

Fresno County.

Inyo County. Magnetite is found in a number of localities in the Inyo Mountains. Fine specimens of loadstone have lately been sent to the State Mining Bureau from the Slate Range, where it exists in quantity.

Los Angeles County. In the Cañada de las Uvas there is a vein, three feet thick, in limestone (Blake); also, thirty miles north of Los Angeles.

Mariposa County. East of the Mariposa estate (Blake); near Coulterville; base of Mount Hoffman.

Mendocino County. Six miles from Calpella.

Mono County. In a vein, five miles south of Benton, with steatite and gold (Aaron); Indian District. Analysis by Falkenau & Reese: Peroxide of iron, 93.00; silica, 7.00; total, 100.00; graphite and sulphide of copper, traces. Near Benton. Analysis by Falkenau & Reese: Peroxide of iron, 93.00; silica, 7.00; traces of sulphide of copper. This ore is said to be in very large quantities. Loadstone. Spur of White Mountains, half a mile south of Montgomery (Aaron).

Napa County. Near St. Helena.

Nevada County. Magnetic sands with gold and pyrite, concentration from hydraulic mines, Grass Valley.

Placer County. Utt's Ranch (Blake); near New England Mills; six miles from Auburn, large deposit; section fifteen, township thirteen north, range eight east.

Plumas County (after pyrite). Armentine Mine, with epidote and garnet (Blake); Mumford's Hill (Edman); near Gold Lake, line of Plumas and Sierra Counties; with hematite, near Crescent Mills.

San Benito County. Tres Pinos; Coast Range Mountains; fourteen miles from Hollister, in large quantities with limestone.

San Diego County. Eight or nine miles north of Mesquit Station.

Santa Barbara County (Trask).

Santa Cruz County. Near the town is an extensive bed; the needle deflected 31° on approaching it (Trask).

Shasta County. At Iron Mountain, five miles from the Sacramento River. Altitude above river, thirteen hundred feet. An abundance of wood at $2 50 per cord and plenty of water at the mine. Analysis by Kellogg, Hewston & Co.: Protoxide of iron, 11.58; sesquioxide of iron, 80.15; alumina, 1.69; silica, 4.95; water, 1.63. McCloud River; Potter's Iron Mine, seven miles from Shasta; in octahedral crystals, exact locality not known.

Sierra County. In large beds (Blake); Mohawk Valley, Sierra Iron Company.

Sonoma County. Mouth of Russian River; magnetic sands.

Trinity County. Near Weaverville (Trask).

Yuba County.

92. MALACHITE. Green carbonate of copper, mountain green. This mineral occurs with other ores of copper at numerous localities in the State.

Calaveras County. In remarkably fine specimens, with crystals of azurite, at Hughes' Mine (Blake); at Copperopolis.

Del Norte County. Low Divide.

Inyo County. At numerous localities in the Inyo and Coso Mountains.

Kern County. San Emidio Ranch, with melaconite.

Mono County. With azurite, cuprite, and partzite; Kerrick Mine, Blind Springs.

Plumas County. With azurite, gold, and quartz.

San Diego County. With azurite, cuprite, and chrysocolla; Lost Mine, thirty miles west of Colorado River.

San Luis Obispo County. Santa Rosa Creek.

Shasta County. Peck Mine, Copper Hill.

Tuolumne County. Whitman's Pass.

MALTHA—see Petroleum.

MANGANESE OXIDE—see Pyrolusite.

93. MARIPOSITE. This is a mineral of an apple green color, found with quartz, on the Mariposa estate, Mariposa County, and elsewhere on the great mother lode of the State. It has not yet been fully determined. It is referred by Dana to fuchsite. It was first described by Professor Silliman, December 2, 1867: see proceedings of the California Academy of Sciences, vol. 3, folio 380. It is represented in the State Museum by a single specimen, No. 1295, from the Josephine Mine, Mariposa County.

Quartz containing mariposite has been shipped to China from Mariposa County in considerable quantity, which mineral was the valued one is not known; as mariposite has a pleasing green color it has been thought that the Chinese either mistook it for jade or used it as a substitute.

MARBLE—see Calcite and special paper on Building Stones.

94. MARCASITE. Sulphide of iron, white pyrites. This mineral has the same composition as pyrites, but is of a white color. It is put to the same uses, such as making sulphur, sulphuric acid, etc. It is quite common as an associate of gold in California with pyrite (yellow colored), chalcopyrite, galena, sphalerite, mispickel, etc.

95. MELACONITE. Black oxide of copper. This is a rare mineral in California. It is said to occur with malachite at the San Emidio Ranch, Kern County, and in the Afterthought Mine, Shasta County. Melaconite occurs in the Satellite Copper Mine, formerly the Lancha Plana, near Campo Seco, Calaveras County, in masses of considerable size, with bornite, and containing granules of metallic copper the size of bird-shot. In the R. F., with chloride of ammonia it imparts an intense blue color to the flame. It is partly soluble in hydrochoric acid. The mineral occurs in nodules, black and earthy inside, but covered with a white incrustation.

96. MENACCANITE. Ilmenite, titaniferous iron. A single but fine crystal was found in the gold washings near Georgetown, El Dorado County. It was about an inch in diameter, with brilliant planes (Blake). Fine specimens are brought from Bill Taylor's Ranch, near Buchanan, Fresno County, twenty miles southeast of Mariposa.

97. MERCURY. Native mercury is found in many of the quicksilver mines in the State, but never in large quantities. It always occurs near

the surface of the earth, above active mines in which cinnabar has formed and is still forming. Sometimes a soft rock overlying the mines, the nature of which has not been properly studied, on being broken open is found to be permeated by native mercury in minute globules. Under the head of cinnabar the production of quicksilver in the State is given.

98. METACINNABARITE. This rare mineral is a black sulphide of mercury, described by G. E. Moore in 1870. It resembles cinnabar in composition, being like that species (Hg S), but differs from it in color, streak, specific gravity, and luster. It corresponds to the black sulphide of mercury, produced artificially by mixing the elements; while cinnabar conforms to the artificial sulphide obtained by sublimation. It occurs with cinnabar and native mercury in several quicksilver mines in California, and has lately been found in Oregon. It has never been obtained in large quantities like cinnabar, and is still considered a rare mineral. When first found it was generally thought to be amorphous, but it has since been found beautifully crystallized in the Redington Mine, Napa County, the locality where it was first discovered. Fine specimens have been obtained in the Great Western Mine, Lake County; in the California Mine, Yolo County, amorphous and in crystals.

99. METEORIC IRON. In 1866 Dr. Trask found a small fragment of iron in Honcut Creek, Butte County. It had the appearance of cast-iron, and was pronounced by Professor Brush not to be meteoric. Still it was considered remarkable at the time, that a fragment of cast-iron should have been found under the circumstances, and it is a little singular that a similar fragment has been recently sent to the State Mining Bureau, which was found on the bedrock, near Columbia, Tuolumne County. At a meeting of the California Academy of Sciences, February 19, 1866, Professor J. D. Whitney stated that Dr. J. G. Coffin had found fragments of iron in the bed of the Mohave River. At that time no meteorite had been found in California that was known to be such.

There was a rumor, a number of years ago, that there was a large mass of meteoric iron on the line of travel up the coast, a few miles north of Crescent City, Del Norte County, but it could never be traced to any reliable source. The El Dorado meteorite was found at Shingle Springs, by a blacksmith whose name is not given. It was noticed by J. H. Crossman in 1871, and placed in the cabinet of W. V. H. Cronise, where it was seen and described by Professor B. Silliman, in the *American Journal of Science and Arts* for July 18, 1873, with a figure from a photograph by Watkins of San Francisco. A short notice of it by Professor C. U. Shepard of Amherst College, appeared in the same journal of June, 1872. The weight of this meteorite was about eighty-five pounds avoirdupois. Its largest dimensions were twenty-four and twenty-nine centimeters; density, 7.875. No Widmannstattian figures were developed by etching.

The following analysis of it by J. A. Cairns, of the School of Mines, Columbia College, New York, is published:

Iron	81.480
Nickel	17.173
Cobalt	.604
	99.257

With the following elements in small proportions: aluminum, calcium, carbon, chromium, magnesium, phosphorus, potassium, sulphur.

Professor Shepard arrived at quite different results, viz.:

Iron	88.02
Nickel	8.88
Insoluble	3.50
	100.40

This meteorite still remains in San Francisco.

The *San Bernardino Meteorite*, No. 2339, State Museum, was found in 1880 in the Ivanpah Mining District, San Bernardino County, by Stephen Goddard. The weight, before cutting, was 1,870 troy ounces. Dimensions: length, 13.5 inches; width, 9.7 inches; thickness, 8 inches. Specific gravity of the mass, 7.693. It is an irregular body or mass of malleable iron. The surface is covered with concave cup-like depressions, some of which have considerable depth. The fine Widmannstattian figures on the cut face were developed by the action of nitric acid, and the smooth rim or border was protected from the action of the acid by wax, and should not be mistaken for a crust or outer shell. On one end of the aerolite may be seen distinct crystals corresponding to those developed by acid. Photographs, on a scale of one third the actual size, were taken of this specimen, both before and after cutting. Lithographs from these photographs were published in the fourth annual report. The following analysis was made in the University of California by Mr. Gustav Gehring:

University of California, Berkeley, May 17, 1884.

Analysis of the San Bernardino Meteorite, by Gustav Gehring, Assistant in Chemistry in the University of California:

Iron	94.856
Nickel	4.469
Cobalt	.261
Silica	.041
Sulphur	.004
Phosphorus	.002
Carbon in combination	.115
Graphite	.067
	99.815

Hardness, 3.75; specific gravity, 8.076.

100. MICA. Isinglass, muscovy glass, etc. See also biotite. Muscovite is abundant in the granite rocks of the State.

The following include the principal localities at which this mineral has been found in California: At Gold Lake, Plumas County; in El Dorado County; Ivanpah District, San Bernardino County; near Susanville, Lassen County; and at Tehachapi Pass, Kern County; it having been observed at many other places in the State. As little or no work has been done on any of these deposits, not much can be said in regard to their probable value, one way or the other. We have reports of mica being found in nearly all the Pacific States and Territories; also in those contiguous to the Rocky Mountains; its occurrence in some of these being abundant, and extending to many different localities.

Micaceous Iron—see Hematite.

101. MILLERITE. Sulphide of nickel. This mineral is brass-yellow, resembling chalcopyrite. It is not a common or abundant mineral, and in California has been observed only at one locality, half a mile from Cisco, Placer County.

Mineral Coal—see Lignite.

Mineral Waters—see special paper on this subject elsewhere.
Mispickel—see Arsenopyrite.

102. MOLYBDENITE. Sulphide of molybdenum.
This is a soft, black, lustrous, foliated mineral, resembling graphite, for which it is frequently mistaken. It has no special value. It is rather common in California, in the granites of the Sierra Nevada, and associated with gold in the quartz veins, and frequently with copper and silver ores.
The following are the most important localities in the State. Most of them are represented in the State Museum:
El Dorado County. Cosumnes Copper Mine, with ores of copper.
Fresno County. Speckerman's Mine, Fresno Flat.
Inyo County. Beveridge Mine; foliated; mistaken for graphite; near Independence.
Nevada County. Excelsior Mine (Dana).
San Diego County. At Campo.
Tulare County. South Fork of King's River, forty-five miles northeast of Visalia.

103. MOLYBDITE. Molybdic acid, molybdic ochre, molybdine.
According to Dana, this mineral is found in the Excelsior Mine, Nevada County, with molybdenite and gold.
Mountain Blue—see Azurite.
Mountain Butter—see Lenzinite.
Mountain Cork—see Amphibole.
Mountain Leather—see Amphibole.
Mundic—see Pyrite.
Muscovite—see Mica.
Natron—see Trona.

104. NICKEL ORES. See also Millerite and Zaratite.
Dr. Trask, in his first "Report on the Geology of the Coast Mountains, and part of the Sierra Nevada, 1854," refers to nickel ores, "in the Coast Mountains from Contra Costa to the utmost limit reached in that range, associated with chromic iron in primitive rocks. The mineral is more abundant in the serpentine rocks south of Tularcitos, and near San Antonio, Monterey County." This mineral, zaratite, or "emerald nickel," will be described under the proper head.
Nitrate of Soda—see Soda Niter.
Obsidian—see Orthoclase.
Ochre—see Limonite.
Onyx Marble—see Aragonite.

105. OPAL. Hyalite, wood opal.
Only the inferior varieties of opal are known in California, and these only at a few localities, as follows:
Alameda County. With semi-opal in Mount Diablo Range, thirty miles south of the mountain (Blake).
Amador County. At Volcano (Hyalite).
Calaveras County. A white milky variety of opal is found in Calaveras County, at Mokelumne Hill, or on the hill near that place known as Stockton Hill, on the west side of Chile Gulch. A shaft has been sunk there three hundred and forty-five feet, and the opals are found in a thin stratum of red gravel. They vary in size from a kernel of corn to the size of walnuts. Many of them contain dendritic infiltrations of manganese

oxide, looking like moss. About a bushel of these stones are raised in one day, and are said to have a market value. A white, milky variety similar to the above, and without "fire," is found with magnesite in the Mount Diablo Range, thirty miles south of the mountain. Also in the foothills of the Sierra Nevada, at the Four Creeks (Blake).

This locality is represented in the State Museum by No. 4395. They are also found near Murphy's, Calaveras County (Dana).

El Dorado County. Nine miles northeast of Georgetown.

Lake County. Kelseyville—hyalites found plentifully in cavities in basaltic lava, township ten north, and ranges five and six east.

San Bernardino County. (Hyalite). Hyalite resembles glass, and is generally found in irregular fragments. Opalized wood is wood petrified and changed to opal. It is not uncommon in the hydraulic gold mines, in magnificent specimens.

Osmium—see Iridium, with which it is invariably alloyed or associated.

Opalized Wood—see Opal.

106. ORTHOCLASE. Feldspar, common feldspar, potash feldspar, obsidian.

Orthoclase, and obsidian, a variety of the same mineral, are found in numerous localities in California.

Fresno County. *(Orthoclase)*, near Millerton, in coarse granite.

Inyo County. *(Obsidian)*, with basaltic lava.

Kern County. *(Orthoclase)*, in veins several feet thick, Tehachapi Pass.

Lake County. *(Obsidian).* When first discovered, years ago, at Clear Lake, in Lake County, a company was formed to make bottles and other glassware from it, but the enterprise was of course a failure.

Near Lower Lake, in fine specimens—black, gray, red, and variegated.

Lassen County. *(Obsidian)*, found in great abundance on the east side of Eagle Lake, a mile, more or less, from Clark's Ranch. It is found scattered over the surface and in the soil with a porous, redish colored lava.

Mariposa County. *(Orthoclase)*, in veins in granite, with molybdenite, in Yosemite Valley.

Modoc County. *(Obsidian)*, south end of Goose Lake.

Mono County. *(Obsidian)*, McBride's Ranch, near Mono Lake, in and at the base of volcanic cones.

Napa County. *(Obsidian)*, three miles west of Napa.

Plumas County. *(Orthoclase)*, at Meadow Valley.

San Diego County. *(Orthoclase)*, Hunsacker Grade, stage road from San Diego to Julian, in considerable quantities and suitable quality for the manufacture of fine pottery. It is associated with pegmatite, also useful for the same purpose; near the Owens Mine, Julian, in coarse granite. Some varieties of obsidian cut beautifully, and might be used for ornamental purposes, for paper weights, vases, bases of clocks, and similar purposes.

Osmium—see Iridium, with which it is invariably alloyed or associated.

Pandermite—see Priceite.

Partzite—see Stibiconite.

Pearl Spar—see Dolomite.

107. PECTOLITE. A single specimen was found in a bowlder or fragment at the foot of the White Mountains, near Montgomery, Mono County. Doubtful (Aaron).

108. PETROLEUM.

Under this heading also *asphaltum*, *maltha*, *brea*, *idrialite*, *bitumen*, *aragotite*.

For special paper on this subject see fourth annual report, folio 278.

Petroleum has been found in the following counties in this State, viz.: Alameda, Colusa, Contra Costa, Humboldt, Kern, Lake, Los Angeles, Mendocino, Napa, San Bernardino, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Sonoma, Tulare, and Ventura.

The most important localities are given below; for details of the occurrence see fourth annual report.

PETROLEUM—

Alameda County. Near Midway.

Los Angeles County. In Pico Cañon, near Newhall, where there are numerous wells which yield very large quantities; at Puenta; at Petrolia, near the latter, on section five, township three south, range nine west, since my visit in May, 1884, flowing wells have been struck. In October, 1885, in sinking a well in Cahuenga Valley, a flow of petroleum was struck, which according to the Los Angeles *Evening Express*, it was impossible to check.

San Mateo County. At Tunitas Creek, several wells which have produced excellent light oil.

Santa Barbara County. Oil springs under the ocean; oil seen floating on the surface of the sea; these oil springs have been described elsewhere in this report.

Santa Clara County. At Moody Gulch—extensive works—considerable high grade oil produced.

Ventura County. At Santa Paula, where large receiving tanks have been provided.

ASPHALTUM AND MALTHA—

Kern County. Near Buena Vista Lake and elsewhere, in large quantities.

Los Angeles County. La Bréa Ranch, near Los Angeles.

San Luis Obispo County. Coral de Piedra.

Santa Barbara County. Goleta Landing, seven miles west of the town of Santa Barbara, on Laguna Santos and Los Alamos Ranchos, near Carpenteria.

Santa Clara County. Sargent's Ranch, in large quantities.

Ventura County. Oil wells near Sulphur Mountain, Santa Ynez, and Kayamos Valleys, near Mission of San Buenaventura.

ARAGOTITE—

This mineral, a hydro-carbon, was found by F. E. Durand, in the New Almaden Quicksilver Mine, and, so far as known, is peculiar to the quicksilver mines of this State.

109. PETZITE. This mineral is a telluride of silver and gold. It is of too rare occurrence in California to have any practical value aside from the gold it contains, and interesting only as being an associate of gold.

An analysis of a specimen from the Stanislaus Mine, Calaveras County, afforded Kustel:

Tellurium	35.40
Silver	40.60
Gold	24.80
	100.80

While this analysis shows the mineral to be rich in gold, it is so rare that only very small specimens can be obtained, and these but seldom. It

occurs with the other tellurium minerals which constitute but a very small portion of the vein matter.

The following localities are known: Stanislaus and Melones Mines, in Calaveras County; Morgan Mine, Tuolumne County.

110. PHOSGENITE. Chloro-Carbonate of Lead.

A single specimen has been found in quartz from the Silver Sprout Mine, western slope of the Sierra Nevada, Inyo County. Straw-colored, acicular interlaced crystals in cavities (Aaron). Determination by C. Ide.

PHOSPHATE OF LIME—see Apatite.

111. PICOTITE. Chrome spinel.

Has been found by Dr. M. E. Wadsworth in the basalts of Mount Shasta; "Summary of the Progress of Mineralogy in 1882," H. C. Lewis.

PICROLITE—See Serpentine.

PLATINIRIDIUM—See Platinum and Iridium.

112. PLATINUM—See, also, Iridium.

Platinum is rather abundant in California with other metals of the group. The miners call it "white gold," and generally believe it to be more valuable than that metal, generally declining to save it when informed that it can only be sold for two or three dollars per ounce.

The following are the most important localities:

Butte County. Platinum minerals are rather abundant in this county. Considerable quantities are recovered in the clean-ups at the Spring Valley hydraulic mine. At St. Clare Flat near Pence, large quantities were found in the early days of placer mining.

Mendocino County. With iridium, cinnabar, zircons, and gold, Anderson Valley, on the Navarro River.

Plumas County. Mr. A. Hewett found several large pieces of platinum in 1851 on Nelson Creek. The largest was the size of a large bean. It is found also at Gopher and Badger Hills.

Trinity County. Found with iridium and associated metals and minerals, and in considerable quantities, at Hay Fork, a large stream. All the gold found is more or less mixed with the platinum metals; so much so that dealers deduct two dollars per ounce from the price paid elsewhere for gold dust. At North Fork of Trinity River, platinum is found in less quantities, but in larger pieces. One was once offered for sale in Marysville which weighed over two and a half ounces troy.

Although platinum occurs in the river beds, and on the banks of the streams, yet in the so called "hill claims," about half a mile only from the river, no trace of that metal has been found. In lower Trinity, near its junction with the Klamath, platinum abounds in very fine particles; and it is with this finely divided platinum that Professor Wöhler discovered diamonds.

The metal is so abundant that the miners have the utmost difficulty in separating it from the gold. The particles are so extremely fine that they can hardly be distinguished from the black sand which accompanies the gold. Heretofore no effort has been made to place the platinum in the market, except the sending to San Francisco of one hundred ounces or more, a few years ago. It could, probably, be sent to Europe to advantage. In Salmon River it is also found. In fact, it is common in the beds of the streams in Sierra, Trinity, Klamath, and Del Norte Counties.

Mr. Block of San Francisco, said that large pieces have been found on North Fork of Trinity River; one piece weighed two ounces. The miners

in washing gold in long sluices got the gold by the aid of quicksilver, and the platinum minerals remained in the riffles; with platin-iridium, in a claim three miles from Trinity Center; and with gold zircons, diamonds, and other minerals on the ocean beach, from Cape Blanco to Cape Mendocino.

Dr. S. R. Hayden, now of Chicago, was at Rich Bar, North Feather River, in 1851. He found in a placer mine he was working a piece of white metal, very heavy, about three inches long, two inches wide, and about half an inch thick, which he thinks must have been platinum.

113. POLYBASITE. A sulphide of many bases, viz.: antimony, arsenic, copper, iron, silver, and zinc.

It is a rare mineral in California, being found only in small microscopical crystals in the Morning Star and Monitor Mines, Alpine County.

114. PRICEITE. Borate of lime, pandermite, colemanite, etc.

The variety pandermite has recently been found in apparent abundance in Death Valley, Inyo County, and at Calico, San Bernardino County, and the cryptomorphic variety also at the latter locality.

COLEMANITE—

Is also a variety of priceite found recently in Death Valley in a crystalline state. As this mineral possesses certain physical properties differing from priceite, a name has been given to it to distinguish it from the soft chalky mineral found both in southern Oregon and San Bernardino County, California.

The name *colemanite* was given by the discoverer of the mineral in honor of William T. Coleman of San Francisco, who has been identified with the borax interests of the Pacific Coast from the commencement. Colemanite is now found in magnificent crystals, but good crystallized specimens are very scarce.

115. PROUSTITE. Light ruby silver ore.

Arsenical sulphide of silver, found sparingly in the Chicago Mine, Shasta County, with galena, pyrite, and quartz, between walls of granite (Aaron). No. 4951, in the State Museum, from the Oro Mine, Bodie, Mono County, shows it in crystals, with pyrargyrite in quartz.

116. PSILOMELANE. A hard black mineral, supposed to be psilomelane, is found in several localities in the State, with pyrolusite and rhodonite, but no analysis has been made to prove it. This mineral differs from pyrolusite in containing baryta and oxide of manganese, and more water. It has been found at Spanish Ranch, Plumas County, on Red Rock, Bay of San Francisco, and in quartz, Santa Ana River, Los Angeles County.

PUMICE STONE—see Orthoclase.

117. PYRARGYRITE. Dark ruby silver, antimonial sulphide of silver.

This mineral, like proustite, is rare in California. It has been found in the Exchequer Mine, Alpine County, and with proustite, in the Oro Mine, Bodie, Mono County.

118. PYRRHOTITE. Magnetic pyrites.

Found in Mariposa County, at the Iona Copper Company's tunnel, north side of the Merced River, on the trail from Bear Valley to Coulterville (Blake).

119. PYROLUSITE. Binoxide of manganese.

The known California localities are:

Alameda County.

Calaveras County. Near Angels'; Railroad Flat.

Colusa County. About two miles south of Font's Springs, township seventeen north, range seven west.

Contra Costa County. Corral Hollow—abundant.

Marin County. Near Saucelito and Tomales.

Napa County. St. Helena Mountain.

Nevada County. Sweetland.

Plumas County. Argentine, and Mumford's Hill (Edman).

San Bernardino County. With rhodonite, near Colton.

San Francisco Bay. Red Rock, San Francisco County; Bernal Heights, San Francisco; just south of St. Mary's College, Peninsula of San Francisco.

Santa Clara County. Hahn's ranch, twelve miles south of the Guadalupe Quicksilver Mine.

Sonoma County. Near Cloverdale; Santa Rosa.

Tuolumne County. Knight's Ranch, near Columbia, in botryoidal and mammillary masses, from the size of a grape to one hundred pounds in weight, on the surface of the ground; with rhodonite, two miles south of Summerville.

120. PYRITES. Pyrite, sulphuret of iron, the "sulphurets" of the gold miner, mundic, martial pyrites. See, also, Marcasite.

Of the numerous localities of pyrite in the State, the following are worthy of special mention, or are represented in the State Museum:

Alpine County. Morning Star Mine, with enargite.

Amador County. Jackson.

Calaveras County. E Pluribus Unum Mine, three miles from Murphy's (Blake).

El Dorado County. Brilliant cubes, Mameluke Mine, near Georgetown (Blake); Pilot Hill, in large cubes, with garnet-brown spar and specular iron (Blake); in crystals with gold, with quartz, both crystallized.

Inyo County. Modoc Mine.

Mariposa County. In slates, in large and perfect crystals, near Princeton Hill (Blake).

Mono County.

Napa County. With cinnabar, Redington Quicksilver Mine, very fine; in cavities in quartz, cubical crystals, Knox & Osborn Quicksilver Mine.

Nevada County. Grass Valley, massive, with chalcopyrite, San Francisco copper mine, Spenceville; massive, with gold, Meadow Lake District; taking the form of wood, with hematite, Occidental Mine, Scott's Flat; with calcite, Malakoff Mine, North Bloomfield; in lignite, Malakoff Mine, North Bloomfield.

Placer County. Globular, in calcite, near Auburn; Clipper Coal Mine, near Grizzly Bear House, Forest Hill, in large crystals (Blake); True Fissure Mine, Devil's Peak Mountain; with lignite, Spinks' Coal Mine, Lincoln.

Plumas County. Granite Basin, Mumford's Hill, in crystals, with dolomite (Edman).

San Luis Obispo County. In cavities in the Sunderland Quicksilver Mine.

Shasta County. With pyrolusite and gold, Banghart Mine; with erube-

scite and chalcopyrite, Copper City; in nodules, with sulphide of silver, very rich.

Tuolumne County. In fine crystals, Patterson Mine, Tuttletown.

121. PYROPHYLLITE. This mineral, a hydrous silicate having no economic value, but which is interesting from a scientific standpoint, is found in beautiful radiating tufts of a golden yellow color, at Greaser Gulch, or Indian Gulch, Mariposa County. It occurs in large bowlders on the surface of the ground near two prominent buttes. This locality is represented by No. 3723 in the State Museum.

122. PYROXENE. A silicate of different bases, the varieties of which are known under different names, as augite, diopside, sahlite, omphazite, hypersthene, diallage, smaragdite, etc.

This mineral enters largely into the composition of igneous rocks. In this form it is probably largely distributed in California. It is found in fine dark green crystals near Mud Springs, El Dorado County (Blake), and also in fine crystals at the Cosumnes Copper Mine, in the same county.

123. QUARTZ. The varieties are known by many names, among which are agate, amethyst, aventurine, blood stone, Brazilian pebble, buhr stone, carnelian, cat's-eye, chalcedony, chrysoprase, cairngorm, false topaz, heliotrope, jasper, mocha stone, onyx, prase, quartz and quartzite, rock crystal, siderite, silicified wood, sardonyx, etc.

Quartz is very abundant in California. It forms the principal vein matter in the gold mines, associated with blende, galena, chalcopyrite, freibergite, bornite, mispickel, pyrite azurite, and malachite, scheelite calcite, caproscheelite, dolomite, enargite, and other minerals. It would be impossible and unnecessary to enumerate all the known localities in the State. The following are the most important and interesting. The massive quartz found almost universally where the rocks are not covered with soil, is not included:

Alameda County. Hills back of Berkeley, *chalcedony.*

Alpine County. Monitor, *red jasper.* Sonora Trail, *chalcedony.* Morning Star Mine, *quartz.* Hope Valley, *rose quartz*, massive, very fine; *drusy crystals.*

Amador County. Near Volcano, *chalcedony*, *silicified wood.* Ione Valley, *diatomaceous earth.*

Butte County. North Fork of Feather River, *smoky.* Near Doon's Mill, *crystals*, fine, and *chalcedonic pebbles.* Three miles south of Cherokee Flat, Gold King Mine, with quartz, *sacchroidal quartz*, like that in the gold mines of Georgia and Brazil.

Calaveras County. Mokelumne Hill, *silicified wood.* In the gold mines, croppings, or "iron hat," *red jasper.* Murphy's, *brown jasper*, which polishes beautifully; *cat's eye.* Vallecito, *chalcedony.* Chili Gulch, Duryea's Hydraulic Mine, *silicified wood.* Near Comanche, *diatomaceous earth.* Murphy's, *chalcedony.* Near Angel's Camp, *silicified wood.* Dutch Flat, in hydraulic mines, *silicified wood*, very fine. Roseville, *silicified wood.*

Contra Costa County. Mount Diablo Coal Mine, with lignite, *silicified wood.*

Del Norte County. Crescent City beach; *chalcedony*, *jasper*, *carnelian*, *agate.*

El Dorado County. Summerfield, Mosquito Cañon, near Placerville; *cairngorm*, *rock crystal*, *smoky quartz* in crystals six inches in diameter (Blake).

Fresno County. Fresno Flat, *yellow granular quartz* containing gold, resembling that found in the gold mines of Georgia. The gold is remarkably fine.

Inyo County. Eclipse Mine, *chalcedony;* very fine. Beveridge District, *double terminated crystals, smoky quartz.* Modoc Mine, in beautiful forms. Panamint, colored with malachite. Wyoming Mine, in fine large clusters of crystals; very fine. Small Butte, in Owens Valley, *buhrstone;* good quality.

Lake County. Eclipse Mine, seven miles west of Lower Lake, *silicified wood.* Lost Spring Ranch, *diatomaceous earth.*

Los Angeles County. Between Williamson's Pass and Johnson's River, *chalcedony* in pear-shaped nodules in eruptive rocks (Blake). Santa Monica, *diatomaceous earth.* Fourteen miles south of San Pedro, *diatomaceous earth.*

Marin County. Saucelito, *jasper;* red and green.

Mariposa County. Merced River, between Horse Bend and Don Pedro Bar, *oil stone,* or novaculite, discovered in 1866, and said to be of good quality. Pine Tree Mine, *hacked quartz;* a peculiar variety of quartz which has a resinous luster and containing mariposite, has been shipped to China, said to be used in the manufacture of porcelain. There were four shipments of three to four tons each.

Modoc County. Jess Valley, *bloodstone.* Pit River, near Goose Lake, *buhrstone* in great abundance (Trask).

Mono County. Mono Lake, *silicified wood.* Bodie Mines, on silver ore in fine crystals, *chalcedony,* pink and straw colored, very fine; *hornstone.*

Monterey County. Monterey, on the beach; quartz sand, much employed for glass-making and other purposes; near Panoche's, large masses of *chalcedony;* white and delicately veined; in mammillary sheets; *diatomaceous earth* in numerous localities.

Napa County. Manhattan Mine, with cinnabar and stibnite, *chalcedony;* Mount St. Helena, *silicified wood;* near Calistoga, *silicified wood;* near St. Helena, *jasper, chalcedony.*

Nevada County. In the gold mines; often supporting native gold between the crystals (Blake); Hinchman's hydraulic mine, *quartz breccia;* Malakoff Mine, *quartzite;* Omega, *silicified wood;* Chalk Bluffs, *silicified wood* in many varieties in the hydraulic mines.

Placer County. At Lincoln, in beds several feet in thickness, *quartz sand,* very pure and white. *Silicified wood* at a number of localities. Dutch Flat, *diatomaceous earth.* Forest Hill, *silicified wood.* Gold Run, *silicified wood.* Shores of Lake Tahoe, *carnelian, agate.*

Plumas County. Rose quartz, fine. Claremont's Hill and Mumford's Hill, *jasper.* Long Valley and Spanish Creek, *agate.* Granite Basin, *quartz crystals,* very fine.

San Bernardino County. Soledad Cañon, *chalcedony.*

San Diego County. Seacoast, forty miles north of San Diego, *diatomaceous earth.* Big Tank, Colorado Desert, *silicified wood, chalcedony.*

San Francisco County. Jasper, red and green. On the seabeach, *quartz sand* with magnetite.

San Joaquin County. Staples' ranch and San Carlos ranch, *diatomaceous earth.*

San Luis Obispo County. Agate, silicified wood. Port Harford, *diatomaceous earth.*

San Mateo County. Chalcedony, jasper; Pescadero beach, *carnelian, agate, chalcedony;* San Gregorio, *diatomaceous earth.*

Santa Barbara County. Diatomaceous earth.

Santa Cruz County. Ranch of Harry Love, near San Lorenzo, there is said to be a mountain of *white quartz sand.*

Shasta County. *Hacked quartz* with gold.

Sierra County. Near Downieville, *silicified wood.*

Sonoma County. Ten miles north of Petaluma, *diatomaceous earth;* Santa Rosa, *silicified wood;* before petrefaction the wood had been pierced by worms; near Windsor, *bloodstone;* eighteen miles southeast of Santa Rosa, *diatomaceous earth.*

Tulare County. Portersville, *silicified wood;* Yokhe Valley, *rose quartz.*

Tuolumne County. Columbia, *silicified wood;* Douglasville, *chalcedony.*

QUARTZITE—see Quartz.

QUICKSILVER—see Mercury.

124. REALGAR. Sulphide of arsenic. This mineral is rare in California, being known only with arsenolite in Alpine County.

RED OXIDE OF COPPER—see Cuprite.

RED OXIDE OF IRON—see Hematite.

125. RESIN. Fossil.

In the hydraulic gold mines of California a fossil resin is frequently met with, which is probably from the coniferous trees of former growth, found in such profusion in a silicified state. It is brittle and resinous, and still retains an odor. It somewhat resembles gum dammar, but is more yellow. It has never been studied.

RETINALITE—see Serpentine.

126. RHODONITE. Silicate of manganese.

It occurs in several localities in the State, always with pyrolusite; with native copper, Mumford's Hill; Plumas County (Edman); one mile from the Southern Pacific Railroad, between Colton and San Diego; near San José, Santa Clara County; two miles south of Summersville, Tuolumne County, in considerable quantity; a large deposit of rhodonite and pyrolusite occurs two miles north of Sonora, Tuolumne County. Rhodonite has little or no economic value.

127. ROCK SOAP. This is a mineral resembling halloysite and mordenite, but believed to be a mechanical mixture of two or more minerals. It has the remarkable property of removing impurity from the skin, like soap, whence the name. There have been numerous analyses made which do not agree among themselves. A paper was published by Professor George H. Koenig, in *The Naturalists' Leisure Hours*, Philadelphia, which is very full and explicit, giving the result of considerable laboratory work. A series of analyses were made in the laboratory of the State University, which have not been published. In Professor Koenig's examination the soapy portion was separated mechanically from a sandy portion and analyzed, with the following results:

Sesquioxides of alumina and iron	14.10
Silica	73.10
Water	6.70
Not determined	6.10
	100.00

Nearly all the silica was found to be in the soluble or opaline state, and the alumina either as a hydrate, or a very basic hydrated silicate. At one time this material was manufactured into a variety of useful articles, as

salt water soap (it having been found that the presence of salt and lime did not impair its detergent properties), scrubbing, and toilet soap, and even tooth powder. Having had occasion to examine into the merits of these preparations, I am prepared to say that they served every purpose claimed for them. At the Paris Exposition of 1878, samples were shown which attracted considerable attention, and there were those who expressed an inclination to enter into their manufacture in France. At present "rock soap" is largely used in the manufacture of certain kinds of soap in California. No. 4024, in the State Museum, is a specimen from Ventura County, and No. 4794 is from San Benito County.

128. ROSCOELITE. Vanadium mica. This very rare mineral was described in the second annual report, folio 262, and a history given of its discovery.

California known localities:

The "Stuckslager," "Plum Tree," or "Sam Simms" Mine lies in section twenty-four, township eleven north, and range nine east, Mount Diablo base and meridian, somewhat more than a mile from the town of Coloma, in a southwest direction, where it was first found.

Another locality of roscoelite in the State, is section thirty-one, township eleven north, and range ten east, two miles from the Sam Simms Mine. Big Red Ravine is on this section, lying only two miles from the site of Sutter's Mill, where gold was first discovered. It was one of the earliest placer mines known in the State, and so rich did it prove, that it has paid to rework as many as seven times. It is in the bedrock of these old workings that roscoelite is found.

Recently a fine specimen of roscoelite has been presented to the State Museum, which is mixed with gold to the extent of seemingly half the bulk of the specimen. It was presented by Richard Sparling and is numbered (5768). It is from the Tip Top vein, section seven, township eleven north, range ten east, El Dorado County. There is about a foot of quartz disseminated through the vein, in small bunches, connected with which are seams of roscoelite, generally very thin, from the thickness of paper to half an inch. Occasionally a bunch of roscoelite appears, from which specimens like No. 5768 may be obtained, but these are extremely rare. Mr. Sparling says that at the Sam Simms Mine, the owners once took out of a pocket $11,000. A great deal of free gold has been washed from the sides of the hill, below the vein, which came, without much doubt, from decomposed roscoelite, and it is more than probable that the gold discovered at Sutter's Mill, in 1848, and that taken from Big Red Ravine, were from the same source. In the Tip Top there is a sheet of what seems to be sandstone; when this and the brown slate come in contact, gold and roscoelite are found.

Rubellite—see Tourmaline.

Ruby Silver—see Pyargyrite and Proustite.

129. RUTILE. Titanic acid. Is found at Long Valley, Plumas County (Edman); and frequently in acicular or capillary crystals in quartz. No. 3747 is a specimen of this character from Humboldt County, Nevada, and there are other specimens in the museum from other localities. Titanic acid has few applications in the arts; it is used in porcelain painting, and to give color to artificial teeth.

Salt—see Halite.

130. SASSOLITE. Native boracic acid.

Boracic acid, free or combined, is a common occurrence on the Pacific Coast. It has been detected in the waters of the ocean along the shores of California and Oregon. Common salt, made by evaporating the sea-water, contains more than traces of boracic acid. According to Professor W. P. Blake, it occurs in a free state in the water of Clear Lake. The discovery of this acid in mineral water in Tehama County led to the examination of other springs then known, which resulted in the finding of boracic acid in nearly all of them. It was found later in the mud volcanoes in San Diego County by Dr. Veatch, which was verified by my own observation.

Satin Spar—see Gypsum.

131. SCHEELITE. See also Cuproscheelite, tungstate of lime.

Only one locality is known in the State, the footwall of a gold mine on Howard Hill, Grass Valley, Nevada County, where it is said to occur in considerable quantity.

Schorl—see Tourmaline.

Selenite—see Gypsum.

Semi-Opal—see Quartz and Opal.

132. SEPIOLITE. Meerschaum, hydrous silicate of magnesia.

A specimen in the State Museum from the Half Dollar Mine, Inyo County, resembles sepiolite, but as yet no analysis has been made to determine it.

133. SERPENTINE. Chrysotile, picrolite, retinalite. This mineral is very abundant in California. Quicksilver and chromium ores are found in it almost universally. The following localities are represented in the State Museum:

Butte County. Near Red Hill. The bedrocks are serpentine; fine specimens of picrolite are found.

Lake County. Kelseyville.

Marin County. Very abundant.

Mariposa County. Three hundred yards northeast of the Pine Tree Mine, and elsewhere in the county.

Mendocino County. Township ten north, range ten west, foliated serpentine and picrolite found in considerable quantity.

Monterey County. Coral de Tierra.

Napa County.

Nevada Coanty. Grass Valley, in the Maryland Mine, picrolite.

Placer County. Bald Prairie; Verde antique or ophite, serpentine with carbonate of lime, has recently been found near Yankee Jim's. It is of a sea-green shade, with blotches of a darker color. It is a beautiful ornamental stone, if it can be found in sufficient quantity. The specimen sent to San Francisco was small.

Plumas County. Claremont Hill, Meadow Valley, retinalite, green and translucent.

San Francisco County. Peninsula of San Francisco, Fort Point, with aragonite; in the streets of San Francisco, Market Street Cut, and the cemeteries.

Santa Barbara County. Goleta.

Santa Clara County. New Almaden Mine, schistose, and in many other quicksilver mines in the State; Gilroy.

Shasta County. McCloud River, with *chrysotile.*

Sonoma County.

Tehama County. Township twenty-five north, range seven west, with chromic iron in large quantities.
Yuba County.

134. SIDERITE. Spathic iron, carbonate of iron.
This mineral has recently been found by J. W. Redway in quartz ledges in Tejunga Cañon, Los Angeles County, and is represented in the State Museum by No. 3712.
Silicified Wood—See Quartz.
Silicate of Copper—See Chrysocolla.

135. SILVER. While silver minerals are abundant in California, native or free silver is of rare occurrence; it is even then found only in specks or very thin sheets, covering but small surface. This is the case in Mono County in the Diana, Kerrick, and Comanche Silver Mines, where it is sometimes seen on partzite, and in the Tower Mine, near Benton. It occurs, also, in the silver ores in Inyo County, notably in the Kearsarge District, in the form of electrum (gold alloyed with silver or the reverse). It is found, also, in Bodie, in Mono County, and in Fresno County, near Millerton.
Silver Glance—see Argentite.
Slate—see Building Stones.

136. SMITHSONITE. Carbonate of zinc. Said to occur with cerusite in the Modoc Mine, Inyo County.

137. SODA NITER. This important mineral is nitrate of soda. Found only in small quantities in caves and cavities in the rocks near Calico, San Bernardino County. It is reasonable to expect from the nature of the climate that it will be found in greater quantity.
Specular Iron—see Hematite.

138. SPHALERITE. Blende, zinc blende, black jack, sulphuret of zinc.
Zinc blende is very abundant in California, disseminated through the vein matter in gold and silver mines, but has not been found in distinct veins. When concentration becomes more general in treating low grade ores, zinc will be considered worthy of attention, and will be saved and utilized. It occurs at Meadow Lake, Nevada County, in considerable masses, with galena, pyrite, and chalcopyrite; and associated with yellow copper in the Lancha Plana and Napoleon Copper Mines in Calaveras County (Blake).
It is represented in the State Museum by the following specimens: White Chief Mine, Mineral King District, Tulare County; Dennis Martin's ranch, four miles west of Menlo Park, San Mateo County; with calcite, Small Hill Mine, Santa Catalina Island.
Sphene—see Titanite.
Stalacite—see Calcite.
Stalagmite—see Calcite.
Steatite—see Talc.

139. STEPHANITE. Brittle silver ore, brittle sulphuret of silver. Found in the Morning Star Mine, Alpine County (Dana).

140. STIBICONITE. Partzite, antimony ochre, hydrous oxide of antimony. Partzite is found in abundance in Mono County. It seems to be

a mechanical mixture of stibiconite with other oxides, and is always rich in copper and silver.

Magnificent specimens with free silver are found in the Diana, Kerrick, and Comanche Mines, Blind Springs District, Mono County. Specimens may be seen in the State Museum from the Kerrick Mine, Benton, Mono County; from the Comanche Mine, Blind Springs, Mono County; and with native silver and galena, from the Tower Mine, near Benton, Mono County.

141. STIBNITE. Sulphide of antimony, antimony glance.

Stibnite is not a common mineral in California as far as known, but there are several important localities, some of which are likely to be productive. It is found in small quantities, with cinnabar, in most of the quicksilver mines of the State.

Inyo County. Panamint, in large veins.

Kern County. San Emidio Cañon, township ten north, range twenty-one west, sections nine and ten, S. B. M. This is probably the largest deposit of antimony ore in the State. It is likely to be worked to a considerable extent in the near future; preparations are being made with that end in view. Stibnite has also been found near Kernville in the same county.

Lake County. With cinnabar and chalcedony in quicksilver mines.

Mono County. Head of Bloody Cañon.

San Bernardino County. Centennial Mine, in washed bowlders.

San Benito County. At the Alta Antimony Mine, where it occurs in considerable quantity. This mine has been somewhat worked, but at the present time it has been suspended.

Santa Barbara County. (Dana.)

Tulare County. Mineral King District.

142. STROMEYRITE. Silver copper glance.

It occurs with other silver and copper ores in the White Mountains, Inyo County (Aaron), and is not uncommon in the Inyo Mountains, from White Mountains to Coso.

Sulphate of Copper—see Chalcanthite.

Sulphate of Iron—see Coquimbite.

Sulphate of Soda—see Thenardite.

143. SULPHUR.

While indications of sulphur are very common in the State, there are but few localities where the mineral occurs in any considerable quantity. The following is the most important:

Colusa County. At Sulphur Creek, where it occurs with cinnabar, petroleum, gold, and other minerals.

Inyo County. Near Little Owens Lake, said to be in considerable quantity.

Kern County.

Lake County. Near Clear Lake and Borax Lake. At this locality, known as the sulphur bank, 1,881,697 pounds of commercial sulphur were produced before it was discovered to be the croppings of a quicksilver mine.

Los Angeles County. Quantity unknown.

Napa County.

San Bernardino County.

San Diego County. At the mud volcanoes described in the second annual report of the State Mineralogist.

San Luis Obispo County.

Santa Barbara County. In the Azufre Mountains.

Tehama County.
Sulphurets and Sulphuret of Iron—see Pyrite.
Sulphurets of Silver—see Argentite.

144. SYLVANITE. Telluride of gold. This rare mineral is said to exist in the Melones and Stanislaus Mines, with other tellurium minerals.

145. TALC. Steatite, soapstone, French chalk. This in various forms is a very abundant mineral in this State, as may be seen by the following localities, mostly represented in the State Museum:

Amador County. Two miles northeast of Jackson; *soapstone* in large deposits and of excellent quality.

Calaveras County. Near Murphy's; also at Rocky Hill and Jenny Lind Hill (Trask).

Catalina Island. The *soapstone* of which the California Indians made cooking dishes, came from this island. This is stated by Abel Stearns, a well known pioneer.

Fresno County.

Inyo County. Alabama Range, a greenish, translucent variety (Aaron).

Kern County. Soapstone Mountain.

Los Angeles County. Fourteen miles below San Pedro, on the coast.

Marin County. Taylorville, Paper Mill Creek.

Mariposa County. Coulterville, *soapstone* of excellent quality, and said to be in large quantities. At Lewis (soapstone). In quartz with gold, Yosemite Mine.

Mendocino County. Township nineteen north, range ten west, said to be in quantity.

Nevada County. Grass Valley, wall rock of Maryland Mine.

Placer County. *Foliated talc* near Auburn. *Soapstone*—Stockbridge Soapstone Quarry and Works, township fifteen north, range nine east. The deposit was formerly worked for gold, which it contains in small quantity. This mineral (soapstone) which exists in large deposits, has been used extensively in lining the furnaces in the Alabaster Lime Works, near Auburn, and found very refractory.

Plumas County. Rock Island Hill.

San Diego County. *Foliated talc* with chalcopyrite.

Santa Clara County. Seven miles from Mount Hamilton.

Sonoma County. Pine Flat, *talc resembling French chalk.*

Tulare County. Tule River *soapstone* of excellent quality, suitable r use as a fine resisting material.

Tuolumne County. *Soapstone* in beds eight feet thick(?)

Yuba County.

Tchermignite—see Alum.
Telluric Gold—see Sylvanite.
Telluride of Silver—see Hessite.
Tellurium—see Altaite, Calaverite, Hessite, Petzite, and Tetradymite.

146. TETRADYMITE. Bismuth, with tellurium.

Professor Blake discovered a tellurium mineral in the Melones Mine, Calaveras County, which he thought might be tetradymite, associated with gold. According to Willard, it occurs with massive gold in the Morgan Mine, Carson Hill, and in the Melones Mine, Calaveras County. It is said, also, to be found in the Murchie Mine, Nevada County.

147. TETRAHEDRITE. Gray copper, fahlerz, freibergite.

This mineral is a double sulphide of copper and antimony, of which there are numerous varieties. When it contains silver it is named freibergite. The following are the few known localities in the State:

Calaveras County. At Coulterville and at Carson Hill, associated with gold. Freibergite rich in silver has recently been found disseminated through milk-white quartz in the Live Oak Mine. It is sometimes found in considerable masses associated with chalcopyrite and azurite. A specimen examined by me was found to be to the quartz in the proportion of five per cent, and to contain gold and silver as follows:

Gold	7.5 ounces per ton of 2,000 pounds.
Silver	256.1 ounces per ton of 2,000 pounds.

It is therefore a valuable silver ore, and can be easily concentrated. The quantity is not known.

Inyo County. In the White Mountains, on Jacob's Wonder Mine, Panament, and elsewhere in the county.

Mariposa County. With gold in the Pine Tree Mine.

Plumas County. Irby Holt Mine, Indian Valley.

Tuolumne County. Golden Rule Mine.

148. THENARDITE. Anhydrous sulphate of soda.

Thenardite is found in large quantities with hanksite, tincal, trona, gaylussite, and other minerals, at the works of the San Bernardino Borax Company. For further particulars, see third annual report of the State Mineralogist, 1883.

THINOLITE—see Calcite.

TIN ORES—see Cassiterite.

TINCAL—see Borax.

149. TITANITE. Sphene, titaniferous iron.

Titaniferous iron is found in iron sand in Spanish Creek, Plumas County (Edman). Sphene is in small hair-form crystals in the granite of the Sierra Nevada (Blake), and in albite, Fine Gold Gulch, Fresno County.

150. TOURMALINE. Rubellite, schorl.

Is a mineral almost invariably found crystallized, of all colors, from opaque black to nearly or quite transparent colorless. The usual colors are: *black* (schorl), *red* (rubellite), *blue* (indicolite), *green* (crysolite), *honey-yellow* (peridot), *colorless* (achroite).

All the tourmalines contain boracic acid, from three to ten per cent. This mineral has never been worked for boracic acid, but is probably a source of that acid in nature, resulting from the decomposition of rocks containing it.

The localities of tourmaline are not many in the State. The following are known:

Calaveras County. In white quartz, schorl.

Contra Costa County. Near Bay of San Francisco.

Fresno County. Fine Gold Gulch; schorl, with quartz and feldspar.

San Bernardino County.

RUBELLITE (rose colored tourmaline). This very interesting mineral is now observed for the first time in California in the form of long slender crystals from one sixteenth to one eighth of an inch in transverse diameter, with the usual triangular section. Color, a beautiful rose pink, contrasting

well with the matrix of white lepidolite. When ignited, the color disappears and the mineral becomes perfectly white; infusible (Blake).

San Diego County. Schorl, on the north side of San Felipe Valley in feldspathic veins. For description see Report Geological Reconnaissance of California (Blake, folio 304).

Tulare County. *Schorl* in granite on the summit of the Sierra Nevada.

Tuolumne County. Large crystals of *schorl* are found in granite on the summit of the Sierra.

Travertine—see Calcite.

Tremolite—see Amphibole.

151. TRONA. Sesquicarbonate of soda. This mineral is found with salt, thenardite, tincal, hanksite, and gay-lussite, at the works of the San Bernardino Borax Company, and is utilized to some extent in the manufacture of borax. It is also found in Death Valley, Inyo County, and at other localities in the Mojave and Colorado Deserts.

Tufa—see Calcite and Aragonite.

152. TURBITH MINERAL. Yellow sulphate of mercury. Is not found in nature. Specimens taken from the interior of the furnaces at the Sulphur Bank Quicksilver Mine, Lake County, were exhibited by T. Parrott at the Paris Exposition of 1878, and at his request were delivered to the School of Mines, Paris, at the close of the Exposition.

153. ULEXITE. Borate of lime, tiza, boronatrocalcite, natroborocalcite, tinkalzit, cotton balls, sheet cotton, etc. Ulexite is a hydrated borate of lime and soda. The history of the discovery of ulexite in Nevada is given in detail in the third annual report. The following localities are represented in the State Museum: The variety technically known as "sheet cotton," containing free boracic acid, from Death Valley, Inyo County, and borax made from it by decomposing with carbonate of soda; "sheet cotton," from Desert Springs Lake, Kern County, with boracic acid made from it by the Boracic Acid Manufacturing Company of San Francisco.

Variegated Copper Ore—see Bornite.

154. VESUVIANITE. Idocrase. Is a silicate of alumina, lime, iron, etc., first found in the ancient lavas of Vesuvius, whence the name. It has been found in the Siegel Lode, El Dorado County (Blake). Some years ago, Mr. S. S. Taylor sent a fine specimen to San Francisco from Spanish Ranch.

Vitreous Copper—see Chalcosite.

Vitreous Silver—see Argentite.

155. VIVIANITE. Among a set of samples from Brea Ranch, Los Angeles County, sent to the State Mining Bureau by Mr. J. W. Redway, of Los Angeles, was one of dark color and earthy texture, containing small nodular masses of a beautiful pale blue color, which were examined and found to be vivianite, or hydrous phosphate of iron. This mineral, which is rare in California, is interesting as leading to the hope that other phosphates, so important as fertilizers, may be found at or near the new locality. There is a specimen of vivianite in the Museum of the State University, which is said to be from a California locality, but, if my memory serves me, this is attended with some doubt. It is reported also at Young's Hill, Yuba County, and near Oroville, Butte County, but no certain information has been obtained. The Los Angeles mineral occurs with asphaltum, at

the well known Brea Ranch deposit. The specimen is marked "Gangue and Country Rock." The mass is a dark colored earthy mineral, with streaks and veins of asphaltic substance, the whole being evidently the sandy desert soil blown over liquid asphaltum and cemented by it. The vivianite is in small inclosed nodules, never larger than a pea, and generally smaller. The mineral is that variety known as blue iron earth or native Prussian blue. It is soft, pulverulent; under the microscope, crypto-crystalline; before the blowpipe, whitens for an instant, then blackens and fuses to a black magnetic globule. It is wholly and easily decomposed, by boiling hydrochloric acid; the solution reacts for iron, which, being separated, the solution gives precipitates with sulphate of magnesia and with molybdate of ammonia. In a closed tube it gives much water. The specimen has been numbered 3538, and placed in the State Museum.

Wood Opal—see Opal and Quartz.

Wood Tin—see Cassiterite.

156. WOLFRAMITE. A mineral numbered 3731 in the museum, was entered as *ilmenite*, which it was supposed to be. Quite lately a specimen was sent to Washington and was there named *samarskite*. Doubt being thus thrown on the mineral, I was induced to make a careful examination of it, and found it to be as above. The reactions obtained were as follows: Color, brown to black; luster, metallic; streak, brown red. Hardness, 4.5. Specific gravity, 7.14. Fuses with difficulty to a bead which is slightly magnetic. In closed tube shows traces of water; partly decomposed by boiling nitro-hydrochloric acid, yields a yellow solution and a voluminous yellow residue; decomposed by fusion with bisulphate of potash, hydrochlorine acid added, gives yellow solution and residue of tungstic acid. From this solution ammonia throws down a heavy precipitate of iron.

Scheelite and cuproscheelite are known in the State, but there is the first instance of the occurrence of wolframite that has come to my notice; the locality is Mariposa County, twenty miles south of Mariposa, near Buchanan.

157. WULFENITE. Molybdate of lead. This mineral is found as yet but sparingly in California, although it is abundant in Nevada and Arizona. It is represented in the State Museum by No. 5351, as small, perfect, tabular crystals, in ore from a mineral vein containing other lead minerals, six miles northeast of Cave Springs, Kern County. In Owens River Valley, Inyo County, the miners are often vexed by finding a heavy yellow mineral in the pan or horn spoon, mixed with the gold prospect, which so much resembles the noble metal that they are frequently deceived by it. It is probably molybdate of lead, the specific gravity of which is from 6 to 7.

Yellow Copper Ore—see Chalcopyrite.

Yellow Ochre—see Limonite.

158. ZARATITE. Emerald nickel, hydrate of nickel, hydrated carbonate of nickel. A rare mineral and one that is never found in large quantities; generally as a thin coating on serpentine and chromic iron. It was observed by Blake on chromic iron in Monterey County. Dr. Trask reported it also with chromic iron at Panoches, Gabilan Mountains, Cañada of San Benito, and in Alameda County. It has lately been found in Mendocino County, in township twenty north, and range fourteen west, on chrome iron. It is said to occur on bowlders of chromic iron.

159. ZEOLITE. The name zeolite applies to a group of minerals which includes at least twenty species; the name is, therefore, indefinite. They are all hydrous silicates of alumina, and generally are found in lavas and amygdaloids. There are several minerals in the State Museum from California which have been provisionally referred to the zeolites, pending future analysis and determination. In lava, North Fork Mining District, Fresno County. In lava, Eureka, Humboldt County. In cellular lava, Soledad Cañon, Los Angeles County.

Zinc Ores—see Blende, Sphalerite, and Smithsonite.

160. ZIRCON. Jargon, silicate of zirconia. Zircon has not as yet been found in place in California, but is abundant in beautiful but small crystals in alluvial sands. In cleaning up hydraulic mines it might be collected by the ton if it had any value, but zirconia is not much used in the arts. The sands and final concentrations from the hydraulic mines are very interesting, consisting as they do of gold, platinum, quartz, barite, magnetite, cinnabar, as well as zircons, and sometimes diamonds. Zircon sands are more abundant in some localities than in others; the following localities are the most important:

Arroyo Seco and Irish Hill. *Amador County;* Spring Valley Hydraulic Mine, Cherokee, *Butte County;* in splendid crystals, Picayune Flat, *Fresno County;* in the sands of the Novarro River, Anderson Valley, *Mendocino County;* and Eagle Gulch and Rock Island Hill, *Plumas County.*

INDEX.

CALIFORNIA STATE MINING BUREAU.

WILLIAM IRELAN, JR., STATE MINERALOGIST.

SIXTH ANNUAL REPORT

OF THE

STATE MINERALOGIST.

PART II.

FOR THE YEAR ENDING JUNE 1, 1886.

SACRAMENTO:

STATE OFFICE.....JAMES J. AYERS, SUPT. STATE PRINTING.

1887.

To his Excellency GEORGE STONEMAN, *Governor of the State of California:*

SIR: The Trustees of the State Mining Bureau herewith submit their report, in pursuance of the Act of the Legislature entitled "An Act supplementary to an Act entitled 'An Act to provide for the establishment and maintenance of a Mining Bureau,' approved April 16, 1880."

Respectfully,

J. Z. DAVIS,
S. HEYDENFELDT, JR.,
W. S. KEYES,
GEORGE HEARST,
Trustees.

SAN FRANCISCO, October 1, 1886.

REPORT OF THE TRUSTEES OF THE STATE MINING BUREAU.

In pursuance of the Act of the Legislature entitled "An Act supplementary to an Act entitled 'An Act to provide for the establishment and maintenance of a Mining Bureau, approved April 16, 1880,' approved March 21, 1885," his Excellency George Stoneman, Governor, appointed J. Z. Davis, Esq., S. Heydenfeldt, Jr., Esq., William Irelan, Jr., Esq., Walter E. Dean, and Hon. George Hearst, Trustees. On the thirteenth day of April, A. D. 1885, a majority of the Trustees organized as a Board, and adopted rules and regulations.

On the thirtieth day of May, A. D. 1886, Henry G. Hanks, Esq., the State Mineralogist, resigned his office, and William Irelan, Jr., Esq., was appointed in his place, and W. S. Keyes, Esq., was appointed as one of the Trustees, in place of William Irelan, Jr., Esq.

REMOVAL.

In consequence of a notice given by Alvinza Hayward, Esq., the owner of the premises, No. 212 Sutter Street, that he intended to rebuild, it became necessary to find other premises for the "Bureau," and the Trustees leased the south half of the third floor and the whole of the fourth floor of the premises known as the New Pioneer Building, on Fourth Street, south of Market, No. 24.

The large collection in the Museum of the Bureau was moved during the month of December, with scarcely any damage. The fourth floor of the premises is used for the Museum, and the south half of the third floor is divided into four rooms: one devoted to the Library, two for storage of duplicates, packing, etc., and one for the office of the State Mineralogist.

MUSEUM.

There are one hundred and twenty flat cases, sixty of which were added by the Trustees, and ten large, upright cases built in the Museum, all of which are full. Seven thousand specimens were entered, classified, and catalogued, by Henry G. Hanks, Esq., former State Mineralogist, and two thousand by the present State Mineralogist, making a total of nine thousand.

Many articles, which are not geological or mineralogical specimens, and which are not kindred to the subjects of Geology, Mineralogy, or Paleontology, have been donated to the Bureau, and as many of them are valuable, interesting, and attractive, the Trustees have deemed it advisable to accept such contributions, and give them a place in the Museum.

A complete rearrangement of the ores and economic minerals of the State, has been made, under the direction of the present State Mineralogist, and such ores and minerals are grouped according to their respective characters, as well as by counties.

FACILITIES FOR RECEIVING SPECIMENS.

Wells, Fargo & Co.'s Express, from the first creation of the Mining Bureau, have transported packages (weighing less than twenty pounds) from all parts of the State, and from the neighboring States and Territories, free of charge, and continue to do so.

The Trustees recognize and appreciate the value and importance of this generous assistance rendered to the Bureau.

VISITORS.

The visitors to the Museum of the Bureau, from March 3, 1885, to November 1, 1886, number four thousand four hundred and seventy-five, as appears by the register, which, however, does not represent the total number, as about fifty per cent of persons visiting the Bureau fail to register.

LIST OF DONORS TO THE MUSEUM OF THE BUREAU SINCE THE ISSUE OF THE FOURTH REPORT.

Acker, E. O. C.
Adams, C. J.
Adams, F.
Adams, H. H.
Adams, J.
Adams, Wm.
Aegerter, Wm.
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Brown, Mrs.
Brown, S. D.
Brownell, L. A.
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Cheever, E. E.
Cherry, Edgar
Chicago Mining Company.
Christie, J. N.
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Clark Bros.
Clark, C. J.
Clusker, C. C.
Coates, L.
Cobb, H. A.
Coffney, John
Colburn, J. E.
Coleman, J. V.
Coleman, Wm. T.
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Compton, H. T.
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Cox, Mr.
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Curtis, Samuel T.
Curtis, S. W.

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Daggett, R. M.
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Dana, Wm.
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Davis, Major J. B.
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De Landresse, H. Clerc.
Didesheimer, P. H.
Dithmer, L. A.
Dobinson & Fairchild.
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Dobler, Chas.
Dohrman, Levi.
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Downs, R. C.
Dozier, A. T.
Drake, Dr.
Dunn, R. L.
Durden, H. S.

Eagle Bird Mining Co.
Elliot, C. E.
Ellis, Captain.
Ellis, J. E.
Emerson, G. W.
Empire Mining Company.
Enright, Jas.

Eustice, J. H. L.

Fair, J. G.
Farwell, J. D.
Faulhaber, Carlos.
Febiger, Col. G. L.
Fenn, T. W.
Ferguson, J. W.
Fielding, F. E.
Fisher, J. M.
Flick, Wm.
Flinn, John.
Fraser, C.
Frecheville, Wm.

Gallagher, A. T.
Gallagher, E. A. T.
Gallanar, G. W.
Gallatin, A. B.
Garnett, Louis A.
Garnier, T. R.
Garthwaite, E. H.
George, Dr.
Germon & Co., A.
Gilbert, A. D.
Gilligan, J. E.
Gilman, J. M.
Gilson & Jno. Rabe, Messrs. Chas.
Gladding, McBean & Co.
Glass, Louis.
Glassman, J.
Goodall, J. E.
Gould & Curry Mining Co.
Grattan & Co., M.
Gray, Jas.
Gray, S. G.
Green, Dr.
Green, H.
Greenman, H.
Green, W. H.
Gregory, Samuel.
Griswold, A. H.
Gruebele, C. L.
Gumbinner, S.
Guptill, A. N.
Guyer, Henry.

Hall, J. R.
Hale, L. A.
Halsey, A.
Hamilton, John.
Hammond, M. E.
Hanckar, Cavaliere Luigi.
Harford, John.
Harrison, B. A.
Hartley, H. H.
Hatch, P.
Hatch, Thos.
Havens, Al.
Hawes, G. H.
Hayden, O.
Hayward, Col. A.
Healy, P. J.
Healy, Wm.
Hearn, Dr. F. G.
Hearn, J. S.
Heath, R. P.
Heath, Wm. McK.
Herrendeen, Captain L. N.
Herring, G. W.
Heslewood, J. A.
Heuter, G.
Heydenfeldt, Judge S.
Heydenfeldt, Jr., S.
Hill, Benjamin.
Hill, Charles.
Hine, C. T.
Hittell, Mr.
Hobart, C. O.
Holcombe, S. E.
Holiday, W. S.
Holladay, S. W.
Holm, F.
Holt, J. H.
Holtsworth, Joseph.
Homfray, Richard.
Hood, Dr. J. W.
Houghton, S. C.
Houston, W. J.
Howls, A. J.
Hubbard, M. T.
Hughes, C. B.
Hughes, D. F.
Hughes, H.
Hughes, W. B.
Huntley, H. H.
Hutchings, E. P.
Hutchings, M.
Hutchinson, W. A.

Idaho Mining Company.
Irelan, Jr., William.
Ish, James T.
Ives, J. J.

Jacott, D. M.
Jamesworth, Charles.
Jessup, W. H.
Johnston, Dr. W. D.
Johnson, G. G.
Johnson, James.
Johnson, J. F.
Johnson, J. J.
Johnson, Q.
Johnson, William.
Jones, Dr. William.
Jones, E. J.

Katz, M. D.
Keeler, Captain J. M.
Keeler, J. H.
Keeney, G. G.
Kellett, Samuel.
Kellett, William.
Kelly, Captain J. G.
Kennedy, J. F.
Kesseler, J. C.
Keyes, W. S.
Keystone Mining Co.
Klein, P. R.
Knell, A.
Knorp, A. F.
Knowlton, A. L.
Knox & Osborn.
Kunz, G. F.

Lake, W. B.
Ladd & Clement.
Landis, John.
Landresse, H. Clerc de
Lambert, T. G.
La Monte, J. D.
Lawver, A. M.
Leechman, John.
Lemoine, William.
Lent, William M.
Levy, H. M.
Lichenstein, Benjamin.
Linkton, S.
Little Gem Mining Co.
Loomis, J. W.
Love, H. P.
Loveland, H. S.
Lovelock, George.
Lowe, B. N.
Lowthan, Thomas.
Lucas & Co.
Luckhardt, C. A.
Lyle, W. S.

Mactear, James.
Maddox, P.
Maling, H. M.
Manning, J. G.
Martin, J. H.
Martin, W. H.
Martin White Mining Co.
Mason, J.
Mast, C. L.
Matthews, W. H. C.
Maxwell, James M.
Maynard, H. G.
McArdle, William.
McCarthy, W. J.
McDonald Mining Co.
McDougal, W. C.
McGeoghegan, J. T.
McKenzie, Alex.
McLeod, T. D.
McMillan, T.
McNabb, A. M.
McNamee, P. J.
McSwiney, W. B.
McTear, James.
Mellis, D. E.
Minckler, W. D.
Minckler, W. P.
Mining and Scientific Press.
Minor, B. B.
Mitchell, C. E.
Mitchell, F. D.
Misenheimer, M. A
Mollitor, S. F.
Monahan, William.
Monteverde, F. E.
Montgomery, E. L.
Mooklar, Dr. J. P.
Moor, Dr. R. E.
Moore, H. G.
Morgan, D. W. C..
Morizio, Joseph.
Morrison, W. P.
Morse, H. A.
Muths, George.

Nevada City Mining Co.
Nevills Mining Co.
Nevills, W. A.
New London Mining Co.
Newman, C.
Nichols, Mrs. H. C.
Niebur, H.
Noel & Whaley.
North Star Mining Co.

Oliver, William L.
Osborn, G. W.

Parker, Dr. W. C.
Patton, Daniel.
Patton, W. H.
Paul, A. B.
Peño, Domingo.
Pew, J. W.

Pilsbury, Mr.
Pleasants, J. E.
Plymouth Consol. Min. Co.
Pope, William.
Porter, Dr. Thomas.
Price, T. S.
Providence Mining Co.

Quimby, W. C.

Rabe, Dr. John.
Ralston, John.
Ranlett, H. D.
Rathgeb, J.
Rawlings, J. S.
Reavis, J. A.
Redway, J. W.
Reeves, Hon. Truman.
Reis, Gus.
Rhoads, J. C.
Rhodes, M. T.
Rhodes, M. G.
Rice, Judson
Richardson, J. N.
Richardson, L.
Riddell, J. R.
Roberts, A. E.
Robertson, T. F.
Robinson, Chas.
Rodgers, G. W.
Rodgers, Mr.
Ross, C. L.
Rowley, A. B.
Ruffino, S.
Russell Patent Process Co.

Safley, L.
Safley, L. J.
Saltuari, John
Schmidt, H. W.
Schneider, C. G.
Scott, W. G.
Scupham, J. R.
Senderling, J. C.
Shearer, F. E.
Shearer & Rattler.
Sherman, C. E.
Silver, Lowry
Sinton, R. H.
Smith, F. E.
Solis, Brown & Co.
Sonnenfeld, Sam.
Sonner, Ad.
Sorley, Jas.
Soto, M. A.
South Spring Hill Mining Co.
Sparling, Richard.
Spencer, E. G.
Sprague, J. W.
Staddon, Samuel.
Stevens, H.
Stewart, Wm.
Stillwagon, W. W.
Stivers, H. F.
St. John, Edgar.
Stokes, W. C.
Stone, D. C.
Stone, M. D.
Strahle & Co., Jacob.
Strain, R. R.
Strong, S.
Stump, I. C.
Sublette, Wm.
Suggett, J. H.

Tarpey, M. F.
Thomas, R. B.
Thomson, B. M.
Thorn, I. N.
Thorn, J. M.
Threlfall, T.
Towle Bros., Alta.
Trafton, Chas.
Troop, Wm.
Tubbs, Hiram.

Ulyard, Mrs. A. M.
University of Tokio, Japan.

Valentine Mining Co.
Vinzent, G. A.
Vischer, Hubert.

Walker, John.
Waller, Wm.
Walls, Henry.
Ward, A. H.
Ward, H. H.
Wasson, Hon. Jos.
Watts, Claude.
Webster, Frank.
Weldon, W. H.
Wells, W. H.
Weyl, J.
Willard, Z. A.
Williams, Ben.
Williams, F. E.
Williams, G. F.
Williams, Harry.
Williams, J. J.
Williams, L. E.
Willis, Wm.
Wilson, J. Downes.
Wilson, W. C.
Wilton, H. W.
Winegar, A. B.
Winter, J. W.
Winters, T. B.
Woodhull, D. S.
Woodley, Capt. W. J.
Wood, P. J.
Wood, R. E.
Wores, Chas. R.
Wren, Hon. Thos.
Wynants, N.

Yale, Chas. G.
Yamada, K.
Yoder, J. F.
Young American Mining Company.
Young, R. A.

LIBRARY.

A catalogue of the books and pamphlets in the library has lately been prepared, but has not yet been sent to the State Printer for publication.

Many valuable books of reference have been sent to the Bureau by our Senators and Representatives in Congress, and by Hon. J. P. Jones of Nevada.

The various departments of the Federal Government, and particularly the "United States Geological Survey," continue to send valuable books to the library of the Bureau.

A complete set of the reports of the Second Geological Survey of Pennsylvania has been kindly given to the Bureau by the Governor of Pennsylvania, and the following State Geological Survey Reports are also in the library:

Illinois, vols. 1 to 7 (vol. 5 missing).

Indiana, 1869–70–72–73–74–75–78, and 1883; also, 1 vol. of maps.

Iowa, vols. 1 and 2.

Minnesota, 1 vol. from 1872 to 1882; also the First to Twelfth Annual Reports, excepting the Second, Third, and Sixth.

Missouri, Annual Reports 1 and 2, and 1 vol. of the Survey.

New Jersey, 1868–69, and 1874; 1881–82–83–84, and 1885.

Ohio, vol. 1, two parts, and vol. 2, two parts, and 1 vol. of 1869.

The Trustees hope to procure complete sets of the reports of all the States which have made Geological Surveys.

The books in the Library number *one thousand one hundred and twenty-three*. This, however, does not include sixty pamphlet boxes of valuable unbound pamphlets.

NEWSPAPERS.

The following newspapers continue to be sent to the State Mining Bureau free:

1. Arizona *Gazette*, Phœnix, Arizona Territory.
2. California *Demokrat*.
3. Daily Grass Valley *Union*, Nevada County, Cal.
4. *Engineering and Mining Journal*, New York.
5. *Golden West*, San Francisco, Cal.
6. Humboldt *Standard*, Eureka, Humboldt County, Cal.
7. Inyo *Independent*, Inyo County, Cal.
8. *Mining Record*, New York.
9. *Mining Review*, Chicago, Ill.
10. Sierra County *Tribune*, California.
11. Ventura *Free Press*, San Buenaventura, Cal.

ACCOUNTS OUTSTANDING AGAINST THE STATE MINING BUREAU.

The following indebtedness was created by Henry G. Hanks, Esq., while State Mineralogist, prior to the thirty-seventh fiscal year, and remains unpaid. The Trustees recommend the payment of the same:

Advances made by Wells, Fargo & Co.	$3,968 00
Several small accounts for material and supplies furnished to the Bureau, amounting to	218 10

Accounts from April 1, 1885, to October 1, 1886.

Museum, library, and general expense	$4,423 76
Salary of State Mineralogist	4,500 00
Traveling expenses	989 55
Rent at 212 Sutter Street, from April 1, 1885, to December 1, 1885	1,600 00
Rent at New Pioneer Building from January 1, 1886, to October 1, 1886	2,025 00
Expense of moving	302 00
Salary of employés	2,617 00
Total for 18 months	$16,457 31

RECEIPTS.

Balance of appropriation for thirty-sixth fiscal year	$438 64
Paid into State Mining Bureau Fund, April 16, 1885	497 35
Paid into State Mining Bureau Fund, June 30, 1885	222 66
Appropriation for thirty-seventh fiscal year, July 1, 1885	10,000 00
Paid into State Mining Bureau Fund, July 13, 1885	1,284 04
Paid into State Mining Bureau Fund, October 13, 1885	753 30
Paid into State Mining Bureau Fund, January 12, 1886	1,150 05
Paid into State Mining Bureau Fund, April 13, 1886	346 30
Appropriation for thirty-eighth fiscal year, July 1, 1886	10,000 00
Paid into State Mining Bureau Fund, July 13, 1886	972 10
Total	$25,664 44

Appropriation and Mining Bureau Fund.

Total	$25,664 44

DISBURSEMENTS.

Total	16,457 31
Balance of appropriation, and in Mining Bureau Fund	$9,207 13

NEEDS OF THE BUREAU.

The appropriations made for the support and maintenance of the Bureau have always been inadequate to carry out the objects contemplated by the Act by which it was created.

The collection of ores and minerals in the Bureau is of incalculable benefit. Persons seeking to study and compare them are afforded every facility.

A record of the locality of each mineral is kept, and any one who is about to engage in any mining industry can get information of great value.

The Bureau seeks to give as much publicity as possible to all discoveries of gold and silver, as well as mineral substances, which may be useful in the arts and manufactures.

Notwithstanding the advantages which have already accrued to the State by creating the Bureau, the Trustees feel that it can be made more useful to the public, and its importance more generally felt, if sufficient means be placed at their disposal.

The material accumulating will require a gallery to be built on the fourth floor, to properly exhibit the minerals.

A Chemical Laboratory is needed, and can be built on the west side of the third floor.

Many books on Geology, Mineralogy, and Metallurgy are also needed, and should be purchased for the library, as constant application is made for them.

Adolph Sutro, Esq., some time ago, presented to the Bureau a complete set of the rocks of the Sutro Tunnel, seven hundred and eighty in number, from the main tunnel, north and south laterals, and the four shafts; and Mr. Charles Forman donated a set of the rocks of the Forman shaft of the Overman mine, in number four hundred and sixty-eight, taken from every *five* feet from surface to the two thousand three hundred and forty foot level. These are in the Bureau, and have never been determined or classified.

There are also four or five cases of lithological specimens from California, also the wall rocks of many of our gold mines. All these specimens require determination, and in order to properly classify them, microscope slides of each are needed, and the Bureau should be in a position to have this important work done under the auspices of a competent lithologist. Too much attention cannot be paid to the proper classification of the inclosing rocks of our gold quartz mines. Its importance is now universally recognized.

The average miner has generally three names for rocks—granite, slate, and porphyry—and the latter name he gives to every rock which is not slate or granite. The study of rocks congenial to the gold-bearing veins is, and has been, too long neglected.

Every effort is being made by the State Mineralogist to secure specimens of the inclosing rocks of the various mines on the coast.

In this connection it may be said that much credit is due to Melville Attwood, Esq., of this city, who is one of the oldest miners on this coast, and a thorough lithologist. He has made a special study of rocks under the microscope, and has written several valuable papers on the subject, and has frequently presented to the Bureau typical specimens of various rocks, with slides prepared for the microscope, and has also assisted in the determination of a number of wall rocks of our California gold mines.

A record of the condition of every mine, about to be closed, should be kept in the Bureau for future reference.

Sufficient assistance should be afforded to the State Mineralogist to conduct experiments much needed. The proper weight of stamps is an open question among the mining men of this coast. By reference to the report of the State Mineralogist it will be seen that the weight varies from six hundred to one thousand pounds. While it is true that some ores are much harder than others, and some more easily comminuted, yet in some mining districts, where the ore in the various mines is alike in all its characteristics, great differences will be found in the weight of the stamps.

Properly conducted, experiments carried on under the direction of the Trustees or State Mineralogist, in various mining districts, would be the proper method of ascertaining a mean weight of stamp, on a given ore.

The condition of gold after it leaves the battery without contact with quicksilver, and its condition after its separation from the quartz by rollers, should be made the subject of most careful study and microscopic examination, with a view of ascertaining its adaptability to rapid amalgamation, as well as to determine whether or no the pulp should be immediately subjected to concentration without amalgamation. in the batteries or on the outside plates, taking into consideration the percentage, composition, and character of the sulphurets.

The questions of weight and drop of stamps, use of quicksilver, size of screens, discharge of pulp, inclination of plates, condition of the sulphurets, concentration, chlorination, etc., should be investigated by actual experiment in different mining districts on the various characters of our gold-bearing quartz.

The Bureau has a large number of maps of California and of different sections of the State acquired for the purpose of facilitating the making of a good and reliable geological and mining map of the State. The Trustees recommend that such a map be commenced at once, and that every mineral deposit and mine be designated as accurately as possible.

The object which the Trustees mainly have in view, is to encourage the development of the great mineral resources of California.

The existence of the various mineral products which can be utilized in the arts and manufactures, and afford the bases of important industries in the State, have not been made known as widely as desired.

The vast importance of the gold production is beginning to be felt all over the world. No country is capable of producing *more* gold, with the same facility and rapidity, than California.

The great auriferous belt of the State, extending as it does from nearly its extreme northern boundary to its most southern counties, is acknowledged to be without parallel in the world. In the museum of the Bureau, are specimens of gold from thirty counties in the State, and this does not include all in which gold occurs.

The low grade ores, and those which are so abundant, carrying principally auriferous sulphurets, from which the gold is successfully extracted at a small cost and in an easy manner, are those which are now receiving the attention of practical miners.

This industry, contributing so materially to the welfare of the people, should receive the fostering care of the State.

The *Engineering and Mining Journal*, of January 23, 1886, published in New York by Richard P. Rothwell, M.E., and Dr. Rossiter W. Raymond, in reviewing the Fifth Annual Report of the State Mineralogist, commenting on the meagerness of the appropriations made to the support of the Bureau, says:

The once liberal expenditures of the State of California, for the thorough study and description of its mineral resources, have dwindled to an annual pittance, which is a subject for combined regret and ridicule. Whatever may have been the reason for this change, it is a pity that the reaction has gone so far to the other extreme.

It is to be deplored that our Legislatures have, for a successive number of years, seemingly ignored the importance of our mineral deposits.

Our Geological Survey failed for want of appropriations in 1873–4, and has been discontinued ever since; the Mining Bureau was not established until 1880, and has never received the financial assistance needed.

The smallest of the Colonies of Great Britain give more attention and encouragement to their mining interests than the State of California.

The *Mining and Scientific Press*, October 30, 1886, in an editorial on the "Subsidies to Mining in New Zealand," compiled from the "Mines Statement," by the Minister of Mines of New Zealand, made July 6, 1886, says:

What to us in this country seems rather a curious feature is the fact that the Government aids the miners in building roads, prospecting, etc. The cost of roads and tracks undertaken by counties in the gold fields last year amounted to £54,137 ($262,464 45), out of which subsidies paid were £35,630 ($172,805 50), and the cost of similar works undertaken and wholly paid for by the Department of Mines was £16,275 ($78,933 75). So far as the Mines Department is responsible, the total cost of such works constructed and in progress will be, when complete, £150,164 ($728,295 40). Several roads are being built to open up new mines. From time to time Government aid has been given to prospecting, with the object of developing the mineral wealth of the colony. This assistance has been extended to prospecting associations, companies working at deep levels, and laterly, under regulations made by the Governor-in-Council, based on recommendation to the Minister of Mines by the Gold-fields Committee, to the local bodies, and, under special circumstances, to individual parties engaged in prospecting in outlying districts.

Subsidies in aid of the purchase of diamond drills have been given. The Minister of Mines, however, does not believe in this, and has sent to America to try and find a light and portable machine which can bore five hundred feet.

In the last four years the total amount authorized by the Government for the construction of water-races, drainage and tailings channels, roads and tracks, diamond and other drills, and to aid prospecting in the gold fields, has been £244,447 ($1,185,567 95), and otherwise paid by way of subsidies the sum of £131,044 ($635,563 40). Last year the sum authorized for similar works was £76,804 ($372,499 40). They recognize that roads and trails are very important to open up new districts, and spend a great deal of money in this direction to encourage miners to go to new regions.

In view of these facts, the Trustees of the State Mining Bureau earnestly appeal to the Legislature, to give the aid so greatly needed, which will contribute materially to the wealth and progress of the State, and to the prosperity of her people.

The sum of *one hundred and twenty-five thousand dollars* ($125,000) for the two coming fiscal years, is respectfully suggested, as a moderate appropriation for the support and maintenance of the Mining Bureau.

Respectfully submitted.

J. Z. DAVIS,
S. HEYDENFELDT, Jr.,
W. S. KEYES,
GEORGE HEARST,
Trustees.

Note.—Walter E. Dean, Trustee, was absent from the State of California when this report was made.

San Francisco, November 17, 1886.

To Honorable George Stoneman, *Governor of the State of California:*

Sir: In accordance with the Act of the Legislature entitled "An Act to provide for the establishment and maintenance of a Mining Bureau," approved April 16, 1880, I herewith transmit my report.

Very respectfully,

WM. IRELAN, Jr.,
State Mineralogist.

October 1, 1886.

REPORT OF STATE MINERALOGIST.

On the first day of June, 1886, the present State Mineralogist was commissioned by his Excellency George Stoneman, Governor of the State of California, *vice* Henry G. Hanks, Esq., resigned.

Upon assuming the duties pertaining to the office, as prescribed by the Act of the Legislature entitled "An Act to provide for the establishment and maintenance of a Mining Bureau," approved April 16, 1880, the State Mineralogist, upon conferring with the Trustees of the State Mining Bureau, deemed it advisable to obtain such information concerning some of the leading quartz mines carrying on operations on the great auriferous belt of the State, giving such information as would be of interest to the people of the State, and particularly to those persons who are engaged in gold-quartz mining.

The time, during which the State Mineralogist was expected to give his attention to this subject, was so limited that it became impossible to gather much information or many statistics relating to this great industry of the State.

A few of the leading mines, in several of the counties, were visited in person by the State Mineralogist, and he was enabled to collect some data and gather other information from persons familiar with sections of the State which the State Mineralogist was not enabled to visit, who cheerfully gave descriptions of mining operations which were being carried on.

A number of the leading gold mines were necessarily omitted, as well as most of the mines and prospects, which are said to have a promising future. He hopes that in some future annual report he will be enabled to give a full and complete description of the condition of gold and silver mining throughout the entire State, and not be compelled to neglect a description of the localities of other valuable mineral products which exist so abundantly in California, and to report what developments are being made.

It was suggested by the Board of Trustees, that considering the shortness of time in which he would be justified in leaving the Bureau to make his observations, it would be better to chiefly confine his report to a short description of the developments made and the depths of some of the mines, and give such statistics as he could collate, showing the method of extracting the gold and description of the machinery in use.

The grade of the ore being worked in any of the mines visited by the State Mineralogist is not given, for the reason that the mine owners, in common with persons engaged in commercial business or other economic enterprises, do not wish their private affairs given to the public, and do not care to invite any inspection or publication of their books.

The State Mineralogist desires to acknowledge his appreciation of the uniform courtesy and assistance which has been rendered him by the Trustees. The Bureau is greatly indebted to J. Z. Davis, Esq., the Chairman of the Board of Trustees, who daily gives a portion of his time to its progress. Mr. Davis has the success of the Bureau at heart, and has presented many valuable ores and minerals, besides several cases of interesting conchological specimens, and many other attractive exhibits.

THE MOTHER LODE.

This very remarkable auriferous belt runs in a northwesterly and southeasterly direction, and can be traced for about one hundred miles, from the Mariposa estate, in Mariposa County, through the counties of Tuolumne, Calaveras, Amador, and into the county of El Dorado. The lode dips to the eastward at an angle of from 45° to 70° to the horizon. The walls are uniform and the gouge well defined; the vein matter is white and banded quartz, carrying a small percentage of sulphurets. The eastern, or hanging-wall, is greenstone, and the western, or foot-wall, is slate.

Professor Whitney remarks of this lode:

> It is not by any means a continuous bed or vein of quartz, but rather a series of nearly parallel belts of lenticular masses with barren intervals between them, but yet arranged nearly in the same course.

R. H. Stretch says:

> The mother lode is not, strictly speaking, a continuous vein, but rather a belt of gold-bearing rocks, situated in a line of contact between black clay slates on the west and greenstone on the east. On each side of the contact, for a limited distance, the rocks are more or less mineralized with gold, and hence we have, in many cases, a series of more or less parallel locations indicating the points at which the quartz segregations have shown themselves on the surface. When the line of contact is more nearly vertical, the quartz bodies seem to be more solidly compacted and continuous; when it is flatter they seem to be more disseminated through the lateral country rock. Usually there is quartz on the line of contact, and one or more bodies between the hanging and foot-walls.

AMADOR COUNTY.

This county is about fifty-five miles long, with an average width of twelve miles, and although it has less area than most of the other mining counties of the State, it ranks, at present, among the foremost in production of gold. It is bounded on the north by El Dorado County, and by Calaveras on the south, and through its central portion, in a northwesterly and a southeasterly direction, runs the mother lode. East of the mother lode there is a belt of limestone, entering from Calaveras County, passing Volcano and extending toward the Sierras. The formation in the southern part of the county is of a volcanic origin, whilst in the northern portion are the gold-bearing slates.

Throughout the whole extent of the auriferous belts of the county there is an unusual amount of activity, and a decided feeling of contentment, not only in the present satisfactory production of the mines, but in expectation of an enlarged future yield. Properties abandoned in the years gone by, on account of the high price of labor, and the expense of motive power consuming the production, have recently been reopened, and, by the substitution of water for steam, are now in paying condition; again the developments in the new finds are very encouraging.

PLYMOUTH CONSOLIDATED.

As a dividend-paying property, this mine is not excelled by any other on the mother lode. The mine in altitude is 1,050 feet above sea level, has a length of 4,800 feet on the lode; both hanging and foot-walls are slate; the course of the vein is north and south, dips 55° to the east, and has an average width of 30 feet. There are two water power mills on the property of 80 and 40 stamps respectively. In the larger mill the stamps weigh

750 pounds each, whilst in the smaller, the weight of each stamp is 1,000 pounds; the fall of the stamps is 7 inches, at the rate of from 90 to 100 times per minute, crushing about two tons to the stamp every 24 hours. The method of recovering the free gold is by amalgamation in the batteries and collection on the outside plates; the sulphurets are collected on Frue concentrators, and worked by the chlorination process, at the company's works, at an expense of $10 per ton.

The following is the last quarterly report of the company:

The dividend paid on October fifth by the company, was the forty-first consecutive monthly dividend, making a total of $1,775,000. It is stated that the mine has more ore developed than at any previous period in its history. At present the mills are supplied with low grade rock from the upper levels. No stoping has been done in the bottom, the ore there being reserved for future use. The entire plant, including mills, shops, etc., is in perfect running order. Level No. 6 (1,500 feet) has been opened one quarter of its length, and promises to be the best in the mine. Large masses of low grade rock have been uncovered between the 800 and 900 levels, and a new ore body is now being worked on the 800. Its full size is unknown, but appearances indicate an extensive deposit.

GOLD BULLION PRODUCED.

January, 1886	$55,683 47
February	45,611 11
March	53,897 81
April	50,778 91
May	49,502 13
June	44,166 43
July	44,566 75
August	51,528 16
September	51,812 36
Total product for nine months, 1886	$447,547 13
Operating expenses for same period	193,145 00
Profit	$254,402 13
Cash on hand, January 1, 1886	43,081 45
Amount applicable to dividends	$297,483 58
Paid dividends for quarter, Nos. 32 to 40, $25,000 each	225,000 00
Cash surplus, October 1, 1886	$72,483 58

Altitude, feet	1,050
Number of stamps	120
Weight of stamp, pounds	750–1,000
Drop of stamps, in inches	7
Drop of stamps, per minute	90–100
Duty of stamp in twenty-four hours, tons crushed	2
Depth of shaft, vertical, feet	1,500
Length of ore-shoot, feet	800
Average width of vein, feet	30
Percentage of sulphurets	1½
Value of sulphurets, per ton	$135
Number of concentrators	32

KEYSTONE CONSOLIDATED

Is situated at the southeast end of the town of Amador, about two miles northwesterly from Sutter Creek, in the Amador Mining District, and has an altitude of 1,000 feet above sea level. The consolidation includes Spring Hill, Geneva, and Garfield claims. The location was made in 1850, and has since been worked almost continuously. The eastern, or hanging wall, is a metamorphic rock called by the miners greenstone, but so far the foot or western wall is not well defined. Lying against and on the west side of the greenstone is a large vein of low grade quartz; thence westerly there are from 200 to 300 feet of argillaceous slate in which the best ore deposits

occur, thence an admixture of slate and spar in which ore does not exist. The average width of the zone is about 400 feet; the course of the vein is northwesterly and southeasterly. The hanging-wall dips easterly at an angle from 45° to 60° at the surface, and 45° at the bottom; length of the shoot is 800 feet. There are two shafts north and south; the north shaft, used for hoisting the ore from the mine, is 1,305 feet on the incline of 49°, reaching a vertical depth of 1,000 feet; the south shaft, used exclusively for pumping out the water, is 1,125 feet on an incline of from 42° to 55°, with a vertical depth of 780 feet. The nature of the ores is free milling, carrying from one and one half to one and three quarters per cent of auriferous sulphurets. The method of reduction is crushing by stamps, and of recovery is amalgamating in the battery and collecting on copper plates on the outside. On the east side of the contact is a large, poor vein of quartz, varying in thickness from 2 feet to 40 feet, which is very spotted; 200 feet west from the greenstone, in the argillaceous slates, occur the next deposits, which are irregular and confined to a northwest and southeast channel; these deposits are from 2 feet to 30 feet thick, and a better quality of ore than that which is found on the east side. The west channel is from 300 feet to 500 feet west of the greenstone, from 3 feet to 40 feet in ore of the best quality found in the mine, paying as high as $40 per ton.

The sulphurets are iron pyrites combined with a small percentage of arsenical and antimonial sulphurets, and have an assay value of $110 per ton. The method of saving the sulphurets is by Hendy concentrators, riffles, and blanket sluices, and the gold is extracted therefrom at a cost of $20 per ton to the company at the chlorination and leaching works of Barney & Voorhies, Sutter Creek.

The mill is run by water-power; contains 40 stamps of 750 pounds each, with a drop of from 7 to 8½ inches, 96 times per minute, crushing 2½ tons to the stamp in 24 hours. The batteries are both high and low discharge, with number 8 slot screens; the apron plates are 16x14 inches, and sluice plates 14 inches wide. The total length of the plates for the 40 stamps is 80 feet, with an inclination of 3½ inches in 10 feet. The amount of water used in 24 hours, in mill, is 125 inches, with a pressure of 254 feet.

Altitude of mine above sea-level, feet	1,000
Number of stamps	40
Weight of stamp, pounds	750
Drop of stamps, in inches	7–8½
Drop of stamps, per minute	96
Duty of stamp in 24 hours, tons crushed	2½
Size of screens, slot	8
Miner's inches of water used in mill in 24 hours	125
Pressure of water, feet	254
Cost of mining, per ton	$3 50
Cost of milling, per ton	75
Percentage of recovery saved in batteries	85.
Percentage of recovery saved on plates	6–7
Number of concentrators	28
Percentage of sulphurets	1½–1¾
Value of sulphurets, per ton	$110 00
Cost, per ton, of working sulphurets	$20 00
Number of men in mine	90
Number of men in mill	9
Total number of men employed in and about mine	110
Length of ore-shoot, feet	800
Length of ore-shaft on incline, feet	1,305
Vertical depth reached by ore-shaft, feet	1,000
Length of water-shaft on incline, feet	1,124
Vertical depth reached by water-shaft, feet	780

SOUTH SPRING HILL.

This property is two miles northwest of the town of Sutter Creek, and one and one half miles southeast of Amador, in the Amador Mining District, and has an altitude of 1,100 feet above sea level. It is a State of Maine incorporation, but owned principally in Massachusetts. The eastern or hanging-wall is of the same formation, metamorphic, as seen in the Keystone; the foot-wall being slate with a gouge. The dimension of the claim is 600 feet in width, by 1,800 feet in length, with a course running northerly and southerly; an easterly dip, and an average width of vein matter of 22 feet, although in places it reaches 50 feet. The mine is worked through an incline shaft, 800 feet on the incline of about 80°, reaching a vertical depth of 758 feet. The ore is free milling, with the exception of the gold contained in the sulphurets. The method of reduction is crushing by stamps, and of recovery, by amalgamation in the battery and collecting on outside plates; the sulphurets, with an assay value of $125 per ton, in gold, principally iron pyrites, are saved from the sluice tailings by the Frue, Triumph, and Hendy concentrators, and the gold extracted therefrom by chloridizing and leaching at the reduction works of Barney & Voorhies, Sutter Creek, at a cost to the company of $20 per ton.

The mill is run by water power and contains, at present, 20 stamps, although 10 additional stamps have been contracted for, to be put in place at once. The stamps weigh 750 pounds each, have a drop of from 6 to 7 inches, 90 times per minute, and crush 2½ tons in 24 hours. The batteries are low discharge with number 7 slot screens; the aprons and sluice plates are silver plated, the former being 24 feet by 48 inches, and the latter being 15 inches wide by a total length of 128 feet. The amount of water, per 24 hours, used in the mill is 70 inches, with a pressure of 325 feet. Developments and improvements during the year, from January first to August first, consist of upraise from 500 foot level to the surface, a drift of 200 feet on 700-foot level and several back drifts, new retort house; expended $2,000 on hoisting works, and under course of erection an addition of 10 stamps.

Altitude of mine above sea level, feet	1,100
Number of stamps	20
Weight of stamp, pounds	750
Drop of stamps, in inches	6–7
Drop of stamps, per minute	90
Duty of stamp in 24 hours, tons crushed	2½
Size of screens, slot	7
Miner's inches of water used in 24 hours in mill	70
Pressure of water, in feet	325
Cost of mining, per ton	$2 50
Cost of milling, per ton	65
Percentage of recovery saved in battery	60
Percentage of recovery saved on plates	30
Number of concentrators: 2 Frue, 2 Triumph, 5 Hendy; total	9
Percentage of sulphurets	1
Value of sulphurets, per ton	$125 00
Cost of working sulphurets, per ton	$20 00
Number of men in mine	40
Number of men in mill	6
Total number of men employed in and about mine	60
Length of ore-shoot, feet	475
Average width of vein, feet	22
Length of shaft, on incline, feet	800
Vertical depth reached by shaft, feet	758

The dividends of the mine are about $30,000 per month.

THE STEWART MINE,

At Sutter Creek Mining District, town of Sutter Creek, Amador County, is of peculiar interest. This vein, lead, or deposit is simply a large conglomerate of low-grade material, consisting of bunches and stringers of quartz intermixed with decomposed granite, slate, black gouge, and clay. All of this material, or stuff, as the owner terms it, on account of the impossibility of separating the good from the worthless, is passed through the mill. Sometimes bunches are found in the mass that are quite rich, yet a great portion of the deposit seems to contain but very little gold. There are no regular walls, nor any decided pitch to the formation. It was evidently thrown out, and to the east, from the chimney of ore composing the Lincoln and Mahoney Mines. An assay has never been made of the material, therefore there is no means of getting an average valuation. The owner's answer to the question as to yield, was characteristic and sensible: "I put through the mill large quantities of the stuff daily, and the clean-up, over and above expenses, is quite satisfactory." The claim is 400 feet long by 250 feet wide, with an average width of vein matter of 50 feet. The southeast end of the claim, 150 feet in length and 75 feet wide, is excavated to a depth of 80 feet. The excavating is still continued, and the whole mass passed through the mill. The mill, containing 40 stamps of 850 pounds each, with 7-inch drop of 85 times per minute, and crushing $4\frac{1}{2}$ tons to the stamp in 24 hours, is run by water power. The batteries are low discharge with No. 6 slot screens, and the sluice plates, with an inclination of three quarters of an inch to the foot, are 16 inches wide by a length for each battery of 15 feet. The recovery of the gold is by amalgamation in the batteries and collection on the outside plates. There are no assays made of the tailings, consequently it is impossible to state the exact amount of recovery, but the owner gives it as about 60 per cent in the batteries and about 40 per cent on the outside plates. The sulphurets, iron pyrites, having an assay value of $60 per ton, are saved by concentration in the English buddle, and are treated by the chlorination process at the reduction works of Barney & Voorhies, Sutter Creek, at a cost per ton to the owner of $20.

Altitude, feet	1,280
Number of stamps	40
Weight of stamp, pounds	850
Drop of stamps, in inches	7
Drop of stamps, per minute	85
Duty of stamp in 24 hours, tons crushed	$4\frac{1}{2}$
Size of screens, slot	6
Miner's inches of water used in mill in twenty-four hours	100
Pressure of water, feet	260
Cost of mining, per ton	40 cents.
Cost of milling, per ton	20 cents.
Percentage of recovery saved in battery, about	60
Percentage of recovery saved on plates, about	40
Percentage of sulphurets	$\frac{1}{4}$–1
Value of sulphurets, per ton	$60
Cost, per ton, of working sulphurets	$20
Number of men in mine	19
Number of men in mill	6
Length of ore-shoot, feet	400
Average width of vein, feet	50
Length of main tunnel, feet	400
Length of cross tunnels, feet	200
Depth of shaft, feet	150

MOORE MINE.

The mine is situated near the town of Jackson, in the Jackson Mining District, and at an altitude of 1,500 feet above the level of the sea. The course of the vein is southeasterly and northwesterly, with an easterly dip of 52 degrees. The claim is 3,200 feet long by 1,400 feet wide; length of shoot, 1,200 feet; average width of vein 16 feet, and explored depth, 500 feet. The hanging-wall is greenstone, and the foot-wall black slate. The ore, containing about 2 per cent of sulphurets, is what is termed free milling. The developments are, shaft 400 feet deep, three levels, varying in length from 200 feet to 400 feet, and a fourth level now being opened. The present explorations show an ore body 16 feet wide. The amalgamation is conducted in the batteries and by collection on outside plates. The sulphurets, iron pyrites, are recovered by concentration in buddles and worked for gold by the chlorination process at a cost of $15 per ton. The mill, run by water power, contains 10 stamps, weighing 850 pounds each, with a seven-inch drop, falling 90 times per minute, and crushes 3 tons per stamp every 24 hours. The plates, silver plated, are 48 inches wide and 20 feet in length to each battery. The hoisting works are run by steam. The developments during the year, to June twenty-seventh, are shaft 250 feet deep, two levels, and the retimbering of the old shaft. The ledge on the lower level is opening out so well in both size and quality, and the future prospects of the mine being so encouraging, the owners are taking into consideration the erection of a 40-stamp mill, and purchase of 16 Frue concentrators, and building of chlorination works.

Altitude, feet	1,500
Number of stamps	10
Weight of stamp, pounds	850
Drop of stamps, in inches	7
Drop of stamps, per minute	90
Duty of stamp in 24 hours, tons crushed	3
Size of screens, slot	6
Miner's inches of water used in mill every 24 hours	100
Pressure of water, feet	110
Cost of mining, per ton	$1 75
Cost of milling, per ton	$0 80
Percentage of recovery saved in batteries	50
Percentage of recovery saved in plates	35
Percentage of sulphurets	2
Value of sulphurets, per ton	$130 00
Cost per ton of working sulphurets	15 00
Number of men in mine	15
Number of men in mill	4
Length of ore-shoot, feet	1,200
Average width of vein, feet	10
Depth of shaft, feet	400

DOWNS MINE.

The mine is at Volcano, about twelve miles east of the mother lode, in the limestone belt region, and has an altitude of 2,250 feet above sea level. The course of the vein is northeasterly and southwesterly, with a dip of 77°. The dimension of the property is 600 feet wide by a length of 1,500 feet. The mine and machinery lay idle for some time, but at present everything above ground is in running order, and underground explorations are being carried on as speedily as possible. The property was located in 1877, and up to 1884, at which date work in the mine was discontinued, the gross receipts were $300,000—an average yield of $20 per ton. The hanging-wall is greenstone, and the foot-wall, on which lies a black putty-like

gouge one foot thick, is slate. On the property, beside the hoisting gear, is a 20-stamp, self-feeding, water-power mill; each stamp weighs 600 pounds, has a fall of 8 inches and a drop of 85 times per minute. The ore, excepting the small percentage of sulphurets, is free milling. About 75 per cent of the gold value is saved in the batteries, and about 20 per cent is saved on the outside plates. The sulphurets are recovered by means of blankets and buddles, and are ground and amalgamated in pan and barrel at a cost of $5 per ton. The apron plates are 24 by 50 inches, and the sluice plates are 16 inches wide, with a length, for each 10 stamps, of 35 feet, and an inclination of 1 inch to the foot.

Altitude, feet	2,250
Number of stamps	20
Weight of stamp, pound	600
Drop of stamps, in inches	8
Drop of stamps, per minute	85
Duty of stamp in 24 hours, tons crushed	1¼
Size of screen, slot	9 and 10
Miner's inches of water used in mill every 24 hours	28
Pressure of water, feet	520
Cost of mining, per ton	$3 00
Cost of milling, per ton	1 25
Percentage of recovery saved in batteries	75
Percentage of recovery saved on plates	20
Percentage of sulphurets	⅓
Cost per ton of working sulphurets	$5 00
Ore-shoots, two of 250 feet each and one of 60 feet, total feet	560
One shaft, feet in depth	433
One shaft, feet in depth	420
Width of vein, in feet	3–4

MAMMOTH OR NEVILL'S MINE.

This property is at Middle Bar, Jackson Mining District, at an altitude above sea level of 1,500 feet. The company's property embraces the mining claim, with an area of 2,206 feet in length by 500 feet in width, and 120 acres of timber land adjoining. The course of the vein is northwesterly and southeasterly, with an easterly dip of 75°, and an average width of 8 feet. The mine is worked through a tunnel, 3,500 feet in length by 8 feet square in the clear, which taps the vein at a depth of 800 feet from the surface. The hanging and foot-walls are greenstone and slate respectively. The sulphurets, arsenical, of which there are 4 per cent, with an assay value averaging $1,500 per ton, are recovered by buddle concentration, and worked by the chlorination process at a cost of $20 per ton. The mill contains 10 stamps, each stamp weighing 750 pounds, with a fall of 8 inches, and a drop of 90 times per minute. Water is the motive power of the mill, 70 inches being used, with a pressure of 750 feet. The plates are 52 inches wide by a length of 25 feet for each battery. At times very rich ore occurs in the vein, especially where the matrix contains a large percentage of arsenical pyrites. This ore, so largely impregnated with native gold, is reduced in the hand mortar. The developments, beside those above mentioned, are 1,600 feet of drifts, 220 feet of uprise, and 40 feet of winze, still sinking in the same rich class of ore as is worked in the hand mortar.

Altitude, feet	1,500
Number of stamps	10
Weight of stamp, pounds	750
Drop of stamps, in inches	8
Drop of stamps, per minute	90
Duty of stamp in 24 hours, tons crushed	2½
Size of screen, slot	6

Miner's inches of water used in mill, in 24 hours	70
Pressure of water, feet	750
Cost of mining, per ton	$2 00
Cost of milling, per ton	1 00
Percentage of recovery saved in batteries	30
Percentage of recovery saved on plates	20
Percentage of sulphurets	4
Value of sulphurets, per ton	$1,500
Cost per ton of working sulphurets	$20
South ore-shoot, in length, feet	300
North ore-shoot, in length, feet	600
Tunnel, in length, feet	3,500
Number of men in mine	13
Number of men in mill	2
Average width of vein, feet	8

Loyal Lead Mine, near Drytown. Ore is being crushed which averages between $7 and $8 per ton in free gold.

Mr. Mason has a very encouraging quartz prospect near Volcano; there is a well defined ledge in the tunnel, showing free gold in paying quantities.

Marlette Mine. A ditch is being constructed, to carry 100 inches of water, from the Amador Canal to the mine. Hoisting works are being erected in the tunnel, for the purpose of sinking a winze. The works are to be run by water power.

Bunker Hill. Twenty of the forty stamps are being run on the new find at the 700-foot level, and the chlorination works are in full operation.

Gover Mine is running twenty stamps on rock found north of the old shaft.

Volcano Gold Gravel Mining Company, made a clean-up for the season's run of over $19,000.

Mahoney Mine, Sutter Creek. The company commenced operations above ground, and the mill will be started on surface dirt.

The new forty-stamp mill at the Kennedy Mine is near completion, and in a very short time the stamps will be crushing ore from the mine.

ZEILE MINE.

This mine is situated in Jackson Mining District, at an altitude of 1,300 feet above the level of the sea, in a slate formation. The vein has an easterly dip, a nearly north and south course, and averages 30 feet in width, ore and vein matter included. The claim occupies 1,600 linear feet on the lode, and is worked through a nearly perpendicular shaft to a depth of 885 feet. Formation of the hanging wall is metamorphosed slate, and that of the foot-wall is soft blue slate with a gouge of decomposed talc, from a few feet to fifty feet thick.

The product of this mine demonstrates how low a grade of ore may be worked to a profit, when done systematically. The ore, when carefully assorted, with free gold and sulphurets, assays but $4 per ton. After the recovery of the free gold in the batteries, and on the outside plates, the sulphurets are saved on the Frue vanner, and are worked by the chlorination process, at the company's works.

The motive power of the machinery is water, but a steam plant is kept in place, to be used when circumstances require.

The mill contains forty stamps, of 750 pounds weight each, falling 7½ inches, with a drop of 88 times per minute, and each stamp crushing 3.37 tons every 24 hours.

The plates are: Battery, 6 by 50 inches; aprons, 30 by 58 inches; and sluice, 16 inches wide by 144 inches long; with the respective inclinations of 3, 2½, and 1¼ inches to the foot.

Altitude, feet	1,300
Number of stamps	40
Weight of stamp, in pounds	750
Drop of stamps, in inches	7½
Drop of stamps, per minute	87–88
Duty of stamp in twenty-four hours, tons crushed	3.37
Percentage of sulphurets	2½
Value of sulphurets, per ton	$100 00
Number of men in the mine	90
Number of men in the mill	5
Total number of men employed in and about mine	115
Depth of shaft, in feet	885
Average width of vein, in feet	30
Number of concentrators	16
Miner's inches of water used for stamps and concentrators in 24 hours	190
Pressure of water, in feet	150
Length of ore-shoot, in feet	400

WORKING LOW BEDS OF GRAVEL.

The following description of a method of working low beds of gravel we take from the *Mining and Scientific Press* of San Francisco:

A few miles from Ione, Amador County, in this State, is the Arroyo Seco Mine, which, as the Spanish name indicates, is situated in the bed of a "dry creek." The ground was known to be rich, but all attempts to work it failed, until J. P. Lambing took hold of the operation. The difficulty was there was no fall, and no way of getting rid of tailings. The pay dirt is about five or ten feet deep, and there is considerable stripping to do.

In order to get rid of the worthless top dirt, there is a large crane or steam derrick. The two engines to operate this are 9x16 inches, and there are two 48-inch upright boilers. They hoist from five to seven tons at a load, on the end of a boom 110 feet long. The dirt is hoisted fifty feet high, swung to one side and dumped, and the tub returned in one and a half minutes. The derrick house, containing the engines and boilers, is on tracks laid on the ground, so that it can be gradually moved up the creek as the claim is worked. With this derrick they can dump the "strippings" 110 feet on each side of the center, allowing the men to get the pay gravel.

Mr. Lambing states that this boom is much easier handled and controlled than those built by the Lakeport Derrick Company builders, who have the reputation of making the best, and it works in every way as well, and in many respects better, than those built in the Eastern States. Mr. Lambing went East to examine all there were and ascertain prices, but resolved to have his made here. In addition to the engineer one man controls the movement of the bucket and derrick, and one man on the boom attends to the dumping.

The pay dirt is washed in sluices, as shown in the engraving. The tailings, small rocks, sand, and water run into a general sump under the tall house shown in the accompanying engraving. Now these tailings and the water have to be removed, as there is no fall and no way to get rid of them except to hoist them out of the way. This is accomplished in a very simple but ingenious manner.

In the sump are two submerged centrifugal pumps, of peculiar pattern, and designed for this particular work. Each has two 11-inch discharge pipes; the capacity is 600 miner's inches of water, or 900 cubic feet per minute. These pumps have no steps or bearings made under water, the whole weight resting on two 26-inch anti-friction wheels.

On the floor above these centrifugal wheels are two 15-inch Knight water wheels fed from the main supply pipe with 68 feet head. These wheels run the submerged centrifugal pumps below and raise the sand, gravel, and water from the sump, throwing the whole debris and water into the flume seen issuing from the side of the pump-house. From this flume the gravel and rocks are shoveled out by men, the water is screened and again returned by a pipe, to be used in sluicing. Sixty-eight feet of water does the washing, pumping, and all.

These 15-inch Knight turbine wheels are giving great satisfaction. Mr. Lambing states that they were formerly running one No. 6 and one No. 8 vertical centrifugal pump with a 12-foot wheel of another pattern under 68 feet head, and 400 inches of water. They had to raise from 100 to 500 miner's inches 36 feet high, but the wheel required too much water, and the pumps so much care the present plant was substituted. Mr. Lambing has been mining for the past 34 years and used all the wheels, but he now has five Knight wheels in use, preferring them to others. This centrifugal double discharge pump will pump sand, gravel, chips, leaves, or anything that will pass through a three-inch mesh.

They have pumped up with the water sand and fine gravel as fast as two men could shovel it to the pump for hours at a time and raised it 36 feet high. These pumps have been in constant use for the past two years and it can not be seen that they are any the worse for the hard usage, though the pumps brought out from the East wore out in five months doing the same work.

There is a large amount of mining ground throughout the Pacific Coast, similar to that at the Arroyo Seco Claim, where the stripping is too deep to admit of working by the old process, but which can be perfectly worked by using these powerful steam derricks to remove the strippings. It is fortunate for the mining interests that these can be built here at the mines, and at no greater cost than they can be had from the East. This whole plant was made by Knight & Co., Sutter Creek, E. A. Rix & Co., agents, No. 20 Fremont Street, this city. Miners who know of ground of a similar character to that described will do well to note the success achieved at Arroyo Seco.

BUTTE COUNTY

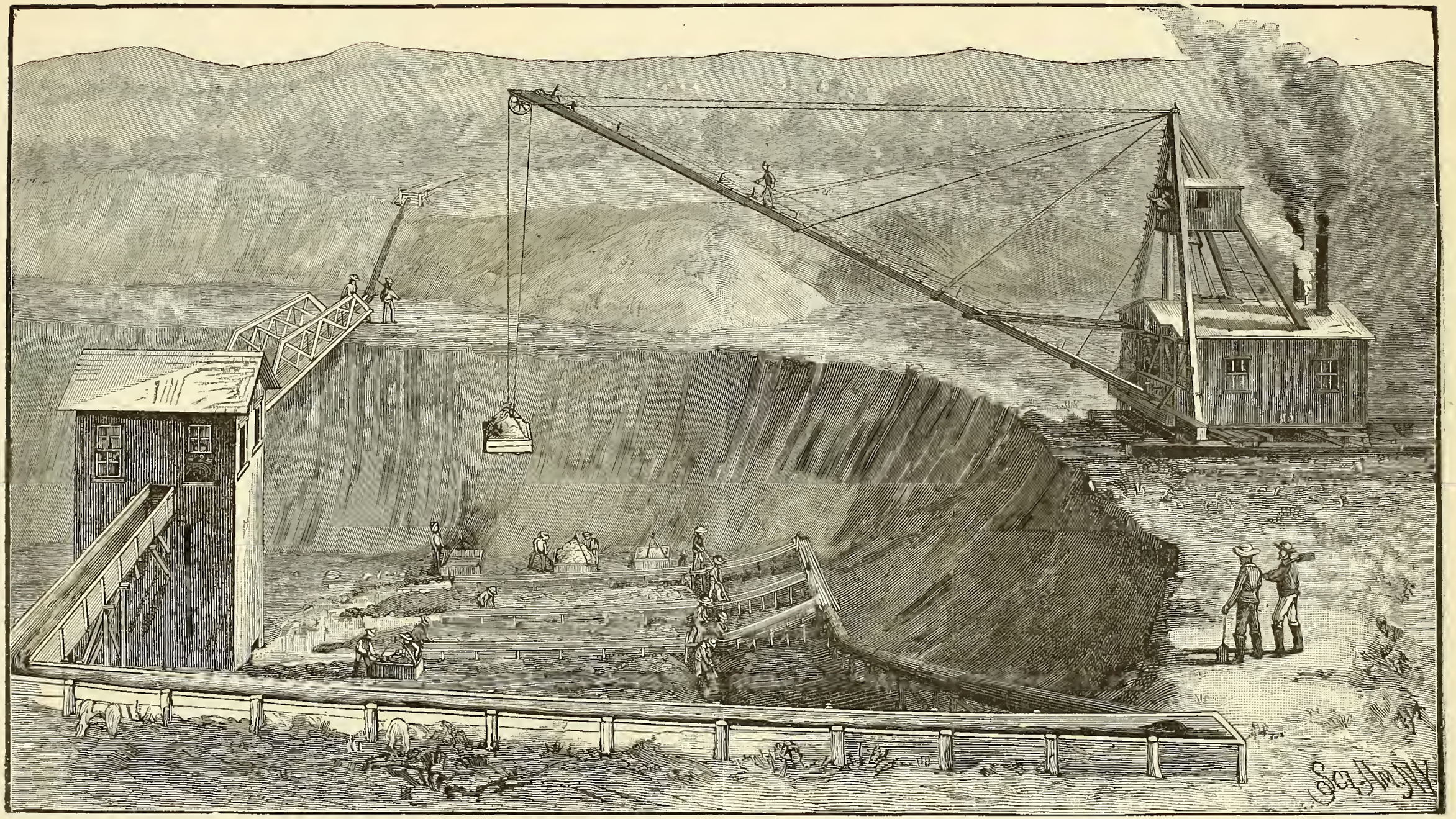
Is bounded on the northwest by Tehama, on the northeast by Plumas, on the southeast by Yuba, on the south by Sutter, and on the west by Colusa Counties. Owing to the exhaustion of the surface placers and discontinuance of hydraulicking, the mining community is thinning out, and the county is falling behind as a gold-producer. Some of the former hydraulic miners have had recourse to drift mining, but the expense is so great by the latter method that they have met with but little, if any, financial success. The geological structure in the gold-bearing section of the county is composed of metamorphic slates, sandstone, and granite. The lava bed region is largely conspicuous in the county.

At Oroville, in Feather River, a company is experimenting in working the river bed through a tubular pile, on the pneumatic principle. The miners complain, whilst subjected to the atmospheric pressure, of a depressive feeling, or lassitude, and a buzzing in the head and ears, more particularly so in the latter case when having a slight catarrh. So far the work is entirely experimental, and we await the result of the undertaking with no little anxiety.

There are a few lone miners drifting in the banks of Butte Creek; but so far none are making anything beyond reasonable wage-hire.

SPRING VALLEY HYDRAULIC GOLD MINE,

Is located at Cherokee, on the north end of Table Mountain, which is crowned by a layer of basalt between 80 and 100 feet deep. The altitude of the mine at bedrock is 1,000 feet. It is one of the largest hydraulic mines in the State, and one of the few in active operation, most of the others having been enjoined by order of the Courts. The average depth, from surface to bedrock, is about 500 feet, by 1 mile in length, and lies in part under Table Mountain, without regard to the conformity of the region in which it exists. In its early history the mine was surface worked by individual locators who held claims, according to the mining laws of the district, of 100 feet square to each locator, and the gold was recovered by means of rockers, long toms, and sluices, respectively, as they succeeded each other, but since 1858 the work has been exclusively hydraulicking. Up to the year 1870 the water supply consisted solely of the drainage of about 10 square miles of territory, on account of the property being isolated from the Sierra Nevada Range by a deep gorge of the Feather River. At this date Egbert Judson and other capitalists interested themselves with H. B. Lathrop, and built reservoirs, constructed ditches, and laid iron pipe across the above mentioned gorge, 30 inches in diameter, 13,100 feet in length, with a perpendicular depression from the grade line of 902 feet. Most of the engineers, looking upon the undertaking as a successful impossibility, advised capitalists not to invest. It is now 16 years since the pipe was placed in position, and work has been carried on without interruption, and with very little cost for repairs; this



Mining Low Ground Without Fall, at Arroyo Seco, California.

pipe furnished 2,210 inches of water every 24 hours for about 8 months of the year. Three years later, to secure a yearly supply of water, additional reservoirs and ditches were constructed, and a pipe, 30 inches in diameter, 3,780 feet in length, with a vertical depression of 630 feet, was laid. The blue gravel, from 10 to 50 feet in depth, lying on the bedrock, carries the greater quantity of gold; thence comes a layer of bowlders, apparently a separate flow, from 3 to 15 feet deep, the most valuable stratum in the mine, yielding from $1 to $8 per cubic yard, and can be removed by hydraulic streams solely; above, intermingled with layers of pipe-clay, is a deposit of fine white quartz gravel and sand, from 20 feet to 400 feet thick. In some parts of the mine the banks have a perpendicular face of 450 feet in height, and it is not an unusual occurrence in the caving for the debris to bury pipes, throwing a 7-inch stream, in position 400 feet distant. The portion of the ground containing the greater amount of gold to the cubic yard was exhausted prior to 1870, and although there are no data to approximate the yield, it is estimated at an excess of $5,000,000. The value of the gold recovered from 1870 to July, 1886, amounted to the sum of $5,008,208 62; for the same period the expenditures were as follows:

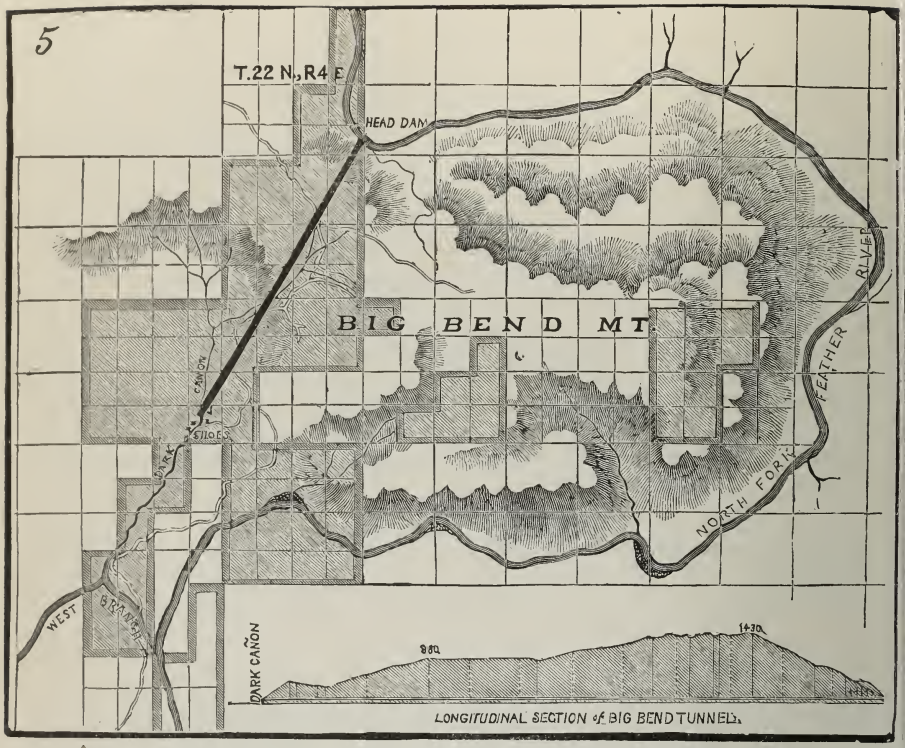
Reservoirs, ditches, and pipes	$510,820 59
Mining plant and tunnels	199,780 55
Mining ground purchased	419,396 18
Land purchased	461,435 87
Cost of debris canal	270,811 48
	$1,862,244 67

Mining expenses, including care and repair of ditches, $1,759,953 77.

The company's water is drawn from nine reservoirs occupying an area of 522 acres, passed through 94 miles of water ditches and 20,940 feet of 30-inch wrought-iron pipe. Among the items enumerated under expenditures, the amounts $461,435 87 for land purchased, and $270,811 48, cost of debris canal, is the actual expense of impounding the tailings. Much of the land originally purchased has since been sold, and about one half its cost has been recovered, yet there is still enough swamp land in possession of the company on which to convey the debris to outlast the mine. The slickens flow through a canal 32 miles long, to two restraining dams 1,800 feet wide, and 12,000 acres of tule land. The mine is worked day and night, 240 men being employed, the after dark illumination being furnished by two 8,000 candle power electric lights.

THE BIG BEND TUNNEL.

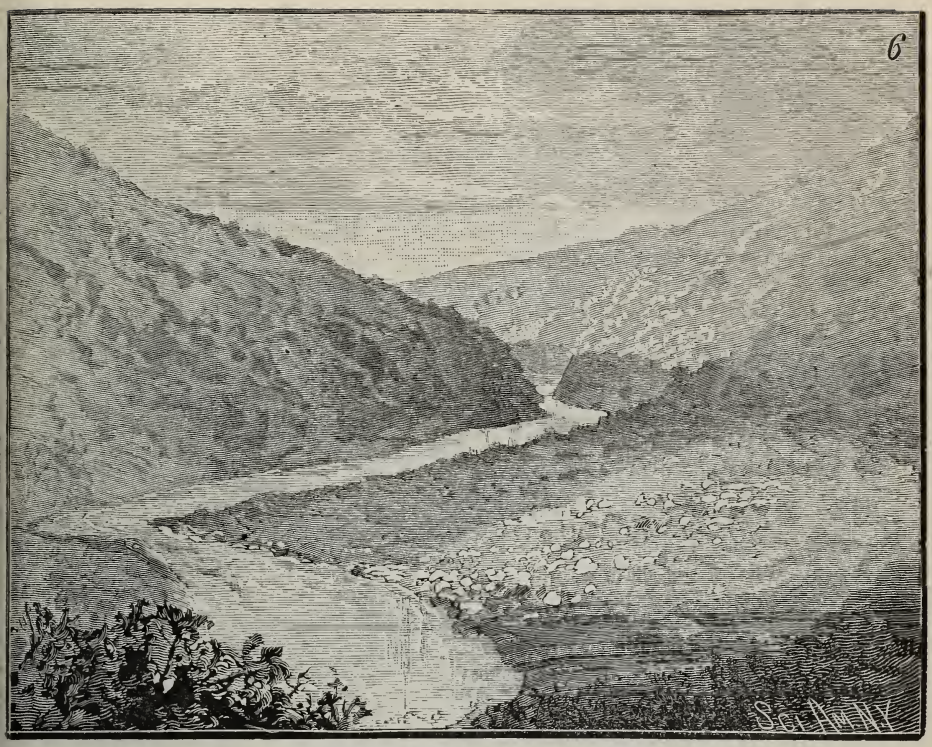
This undertaking is without a parallel among the mining ventures of the State. The bend from which the water is to be diverted has a trend not very unlike a horseshoe, with a length, following the meanderings of the water flow, of 13 miles. The purpose for which the tunnel was constructed is to convey the waters of the North Fork of Feather River from their natural course to the tributary of the river's west branch, thereby leaving bare the channel of that portion known as the Big Bend.



Map Showing Tunnel and Big Bend of Feather River.

At the time the water flow was measured, and almost to the period of the tunnel's completion, the quantity was less than for several years previous; consequently the tunnel has not the capacity to accommodate the present body of water confined within the river's banks, and it must, therefore, necessarily be enlarged to add success to the undertaking. The stockholders, however, feel in nowise low-spirited over the present condition of affairs, but look hopefully forward to the expiration of the few months necessary for the required enlargement, when they expect the river bed to yield its auriferous treasure. It is impossible, on account of the steep banks and their rocky formation, to divert the stream in any other way, that will promise a reasonable recompense, than the method adopted. The amount of precious metal concealed by this watery blanket is as yet an unknown quantity, but it is to be hoped that an enterprise so unique and so unwaveringly carried out should receive the reward it so meritoriously deserves.

On account of the formation through which the tunnel passed, slates, granite, quartz, and diorite, there were but few places necessary to secure by masonry. The mouth of the tunnel is in Dark Cañon, near the southeast corner of section eleven, township twenty-one north, range four east. From this point the tunnel runs north, 29° 30′ east, 12,007 feet, to where it taps the North Fork of Feather River. The tunnel, as it is, is 16 feet wide by 9 feet high, with a grade of 30 feet per mile, with the exception of at the head, where for 200 feet, to insure the filling, there is an increased grade. The company will at once commence the work of enlargement, to increase



View off Island Bar, Feather River.

the carrying capacity to 120,000 miner's inches of water. At the inlet, for the purpose of preventing or admitting the water flow, are 6 ponderous iron gates, worked by screws and wheels. A permanent dam, 200 feet long and 16 feet high, is in course of construction across the river just below the inlet. The dam is being built of large timbers, securely fastened to the bedrock and bolted together, after which it will be filled with rocks and covered with heavy planks. A flume for carrying the present surplus of water, not taken by the tunnel, is built from the dam down the river to a distance of 1,007 feet. This flume, 3 feet deep and 18 feet wide, carries a body of water 18 inches in depth with a flow of 10 feet per second. Along this flume the channel is bared sufficiently to allow prospecting of the river bed. Work on the tunnel began in July, 1882, and the water was turned therein in July, 1886. The cost thus far, as near as can be approximated, is $750,000.

CALAVERAS COUNTY.

The county is bounded on the northwest by Amador, on the northeast by Alpine, on the southeast by Tuolumne, and on the southwest by Stanislaus and San Joaquin Counties. Bear Mountain Ridge, a belt of metamorphic rocks, strikes northerly across the central portion of the county, reaching from the Stanislaus River to the vicinity of Calaveras River, separating the copper belt from the auriferous slates. The limestone belt

enters the southwestern part of the county, from Tuolumne, and is more extensively exposed at Murphy's.

At Angels the exploitation is on the auriferous belt about 200 feet to the east of the mother lode; it is a large vein, in talcose slates, but low grade.

THE STICKLES GOLD QUARTZ MINE

Is located in Angels' Mining District, at the north end of Angels' Camp, at an altitude of 1,800 feet above sea level. The dimension of the claim is 300 feet by 600 feet; the course of the vein is northwest and southeast, having a dip of 90° to the east and an average width of 12 feet.

The mine is worked through a three-compartment shaft 400 feet deep, the vein showing at all points. Upon the property is a wet crushing mill of 20 stamps, each stamp weighing 900 pounds, having a 7-inch fall, a drop of 80 times per minute, and crushing $3\frac{3}{4}$ tons of ore every 24 hours. Seventy per cent of the yield is recovered by amalgamation in the battery, and 30 per cent is collected on the outside plates. The sulphurets, averaging 2 per cent of the ore, are saved by Cornish buddles, and have an assay value of $120 per ton. Hoisting and pumping are done by steam power. The sluice plates, silver plated, are 4 feet wide, 11 feet long, and have an inclination of $1\frac{3}{4}$ inches to the foot. Developments in the mine consist of four levels at 60, 200, 250, and 400 feet deep, respectively. The level at the depth of 60 feet runs north and south from the shaft, in each direction 30 feet; at 200 feet the level runs south 150 feet, north 200 feet; the 250-foot level has the same course and a corresponding distance, north and south of the shaft, as the 200-foot level; the 400-foot level runs 200 feet north from the bottom of the shaft; all of these levels are on the vein, which has not been stoped out anywhere more than 30 feet above the levels.

Altitude, feet	1,800
Number of stamps	20
Weight of stamp, pounds	900
Drop of stamps, in inches	7
Drop of stamps, per minute	80
Duty of stamp in 24 hours, tons crushed	$3\frac{3}{4}$
Size of screen, slot	9
Percentage of recovery saved in batteries	70
Percentage of recovery saved on plates	30
Percentage of sulphurets	2
Value of sulphurets, per ton	$1 20
Cost of mining, per ton	1 50
Cost of milling, per ton	75
Number of men in mine	24
Number of men in mill	6
Depth of shaft, vertical, feet	400
Length of ore-shoot so far as developed, feet	400

THE UTICA MINE,

Angels, Angels Mining District. The claim is 300 feet wide by a length of 634 feet. The course of the vein is northwest and south, dipping 85 degrees to the east, and averaging in width 20 feet. The 20-stamp mill has both water and steam power. Each stamp weighs 950 pounds, drops 8 to 9 inches at the rate of 80 times a minute, and crushes 3 tons of ore every 24 hours. The plates, with an inclination of $1\frac{1}{4}$ inches to the foot, are 52 inches wide and 10 feet in length to each battery.

Number of stamps	20
Weight of stamp, pounds	950
Drop of stamps, in inches	8–9
Drop of stamps, per minute	80

Duty of stamp in 24 hours, tons crushed	3
Size of screens, slot	9
Percentage saved of recovery in battery	75
Percentage of recovery saved on plates	25
Percentage of sulphurets	2
Percentage of sulphurets, per ton	$60 00
Cost of mining, per ton	$2 50
Cost of milling, per ton	$0 60
Depth of shaft, feet	140
Miner's inches of water used in 24 hours	150
Pressure of water, feet	100
Number of men in mine	25
Number of men in mill	6

ANGEL'S GOLD MINE.

This mine, in Angel's Mining District, has not been worked for the past few months, but will shortly be again in active operation; in fact, preparatory steps have already been taken to commence work. The claim is 1,354 feet in length, by a width of 600 feet. The vein, with a north and south course, is 20 feet wide, and has an easterly dip of 15 degrees. The developments consist of two shafts 100 feet, each, in depth and 300 feet apart, connected by a level. The improvements are, two J. B. Low mills, each having a capacity of 20 tons in 24 hours, two hoisting plants, pump, air-compresser, and four Frue vanners.

DEEP LEAD PLACER MINE,

In Mokelumne Hill Mining District, was located in 1880, and has been worked continuously ever since. During the first year an incline was sunk 380 feet, to the channel, which is vertically 130 feet from the surface. Since then the developments are 2,600 feet along the channel, besides sixteen crosscuts, of an average length of 50 feet each. The perpendicular depth from the surface to the face of the present workings is about 425 feet. The course of the channel is north and south, having a width varying from 40 to 60 feet, and in length about one and a half miles. The improvements consist of an 8-stamp water-power mill, three hurdy-gurdy wheels, one being 4 feet and two being 6 feet in diameter; one water-power hoist, and one 6-inch by 5-foot stroke plunger pump. Of the water, which has 225 feet pressure, there is used for the mill 20 miner's inches, and 12 miner's inches each for the hoist and pump every 24 hours. Five per cent of the gold recovered is by the batteries and ninety-five per cent on the outside plates. Each stamp weighs 750 pounds, falls 9 inches, at the rate of from 85 to 87 times per minute, and crushes five carloads of gravel every 24 hours. Developments during the year are 700 feet of tunnel and four crosscuts of 5 feet each.

Number of stamps	8
Weight of stamp	750
Drop of stamps, in inches	9
Drop of stamps, per minute	85–87
Duty of stamp in 24 hours, carloads crushed	5
Size of screen, steel wire, meshes to the inch	5
Average value, per carload	$1 00
Percentage of recovery saved in batteries	5
Percentage of recovery saved in sluices	95
Number of men in mill	1
Number of men in mine	5
Miner's inches of water used in 24 hours:	
For mill	20
For hoist	12
For pump	12
Pressure of water, feet	225

SHEEP RANCH MINE.

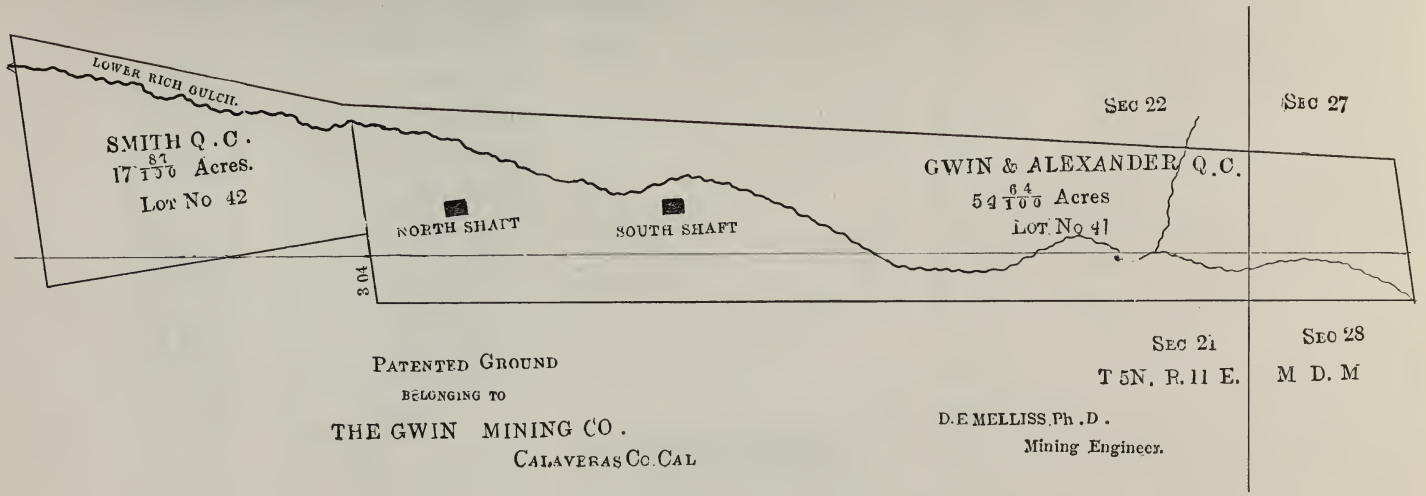
This, the principal mine in the Washington Mining District, is situated on San Antonio Creek, a tributary of the Calaveras River, at an altitude of 2,200 feet above sea level, in a slate formation. The claim is 1,600 feet in length by 200 in width; course of the vein northwesterly and southeasterly; dip easterly, and average width 12 inches. Hanging-wall is a grayish slate and foot-wall a hard black slate; the ore is a ribboned, free milling quartz. All the ore has been taken out down to the 800-foot level; the mill is at present crushing rock from the above and the 900-foot levels. During the year the shaft has been continued down 100 feet and 1,000 feet of levels have been run. The mill, wet crusher, 30 stamps, is run by steam power; each stamp weighs 800 pounds, falls 8 inches 85 times per minute, and crushes 2¼ tons of ore every 24 hours. Eighty per cent of the recovery is obtained from the batteries and 20 per cent is collected from the outside plates. The sulphurets are so low in value that it is not worth the while to save them. The apron plates having an inclination of 2 inches per foot, are 4 by 10 feet, and the sluice plates inclining 1½ inches to the foot are 15 inches wide, with a total length of 100 feet.

Altitude, feet	2,200
Number of stamps	30
Weight of stamp, pounds	800
Drop of stamps, in inches	8
Drop of stamps, per minute	85
Duty of stamp in 24 hours, tons crushed	2¼
Average width of vein, in feet	1
Depth of shaft, in feet	900
Length of ore-shoot, in feet	1,200
Size of screens, diagonal slot No.	9
Percentage saved of recovery in batteries	80
Percentage saved of recovery on plates	20
Cost of mining, per ton	$3 00
Cost of milling, per ton	$4 00
Number of men in mine	40
Number of men in mill	7
Brakemen, blacksmiths, teamsters, etc.	18

THE GWIN MINE.

The following description is contributed by D. Ernest Melliss, Ph.D., Mining and Civil Engineer, as a record of deep mining on the gold belt of California:

The mine is situated in the Mokelumne Hill or Middle Bar Mining District, six miles north of Valley Springs, Calaveras County, at an altitude of 1,300 feet above the sea. The property comprises two United States patent claims, contiguous to each other, as shown in the accompanying map. These claims cover 4,989 feet, lineal, on the mother lode, with a total surface area of 69.61 acres. The mine was taken up by the late Senator, Wm. M. Gwin, in 1867; he purchased the Alexander Mine in 1872, and the Smith Mine in 1881; the property was incorporated under the name of the Gwin Mining Company.



PATENTED GROUND
BELONGING TO
THE GWIN MINING CO.
CALAVERAS CO. CAL

D. E MELLISS, Ph. D.
Mining Engineer.

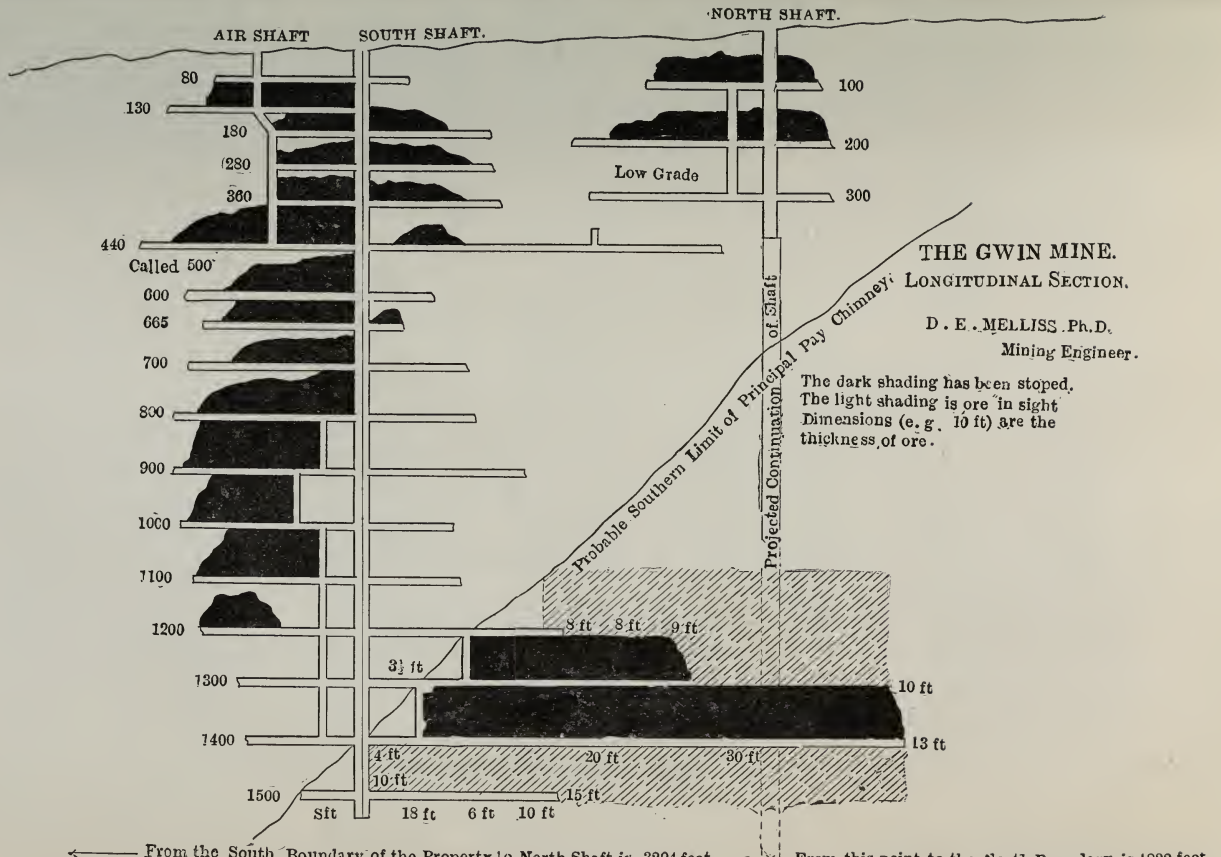
The country rock is slate; the vein strikes nearly due north, true meridian, and dips 75° to 80° to the east. The ore in the mine is white and banded quartz, carrying free gold and auriferous iron sulphurets, with occasional admixture of blende and galena. The average value in free gold is about $8 per ton of ore, although, at times, exceedingly rich bunches of auriferous quartz have been found. The sulphurets are about one and one half per cent of the ore, and the value of the concentrations is about $100 per ton. The retorted gold ranges in fineness from 850 to 875. The south shaft (see accompanying longitudinal section) has been sunk to a depth of 1,530 feet. It is an incline, and follows the foot-wall of the vein. Prior to 1877, considerable ore was taken out from the different levels above the 1,200. In April, 1877, the main ore chimney was struck, and it is on the character of this chimney, as developed by the workings in the 1,200, 1,300, 1,400, and 1,500 levels, that the value of the mine now depends.

The 1,200 level, which has been driven 370 feet to the north, strikes the pay chimney 160 feet from the shaft. No stoping of the north ore body has been done above this level. Of this level, 110 feet are in pay quartz, which is 3 feet thick at the commencement, and widens to 8 feet at the breast.

In the 1,300-foot level the chimney is struck 100 feet from the shaft; the level has been driven to a distance of 640 feet, of which 540 feet was in ore; at the breast it is 13 feet thick. The ground between the 1,300 and 1,400 levels has been taken out, as shown; the top of the stopes on the 1,200 line showing 8 to 9 feet of ore. At the 1,400 level the shoot crosses the shaft; the level has been driven 1,040 feet, all in pay ore; stoping has been done to the 1,300 level, as shown. The ore was 5 feet at the shaft, but in the length of the level widened once to 20 feet, again to 30 feet, and is 13 feet at the breast. The 1,500 level has been driven 100 feet to the south, and 370 feet to the north, all in pay ore. At the south breast the limit of the ore body in that direction has been reached; at that point it is 5 feet thick; at the north breast the ore is 15 feet thick, at the shaft 10 feet, and between that point and the north end it varies between 6 feet and 18 feet.

The mine has produced in all, over $2,000,000 of gold. The exact amount cannot be ascertained. From partial records in possession of the owner, one is enabled to glean the following details in regard to the bullion product. It may be remarked incidentally that the mine was carried on always as a family concern, the money was distributed every month as fast as procured, and no surplus was ever allowed to accumulate. Prior to 1877 no care was taken to make or preserve any records. No records at all for the years from 1867 to 1871 existed, although 40 stamps were constantly running. From April, 1877, till September, 1881, the greater portion (but not all) of the gold produced was deposited in the Pacific Bank of San Francisco.

There are records of weekly shipments of bullion (with some intervals) extending over the period from April 7, 1871, to August, 1882. In none of these statements is the bullion from sulphurets included, except in one instance, a shipment on December 24, 1874, in amount $11,565. The summary of these data is shown in the following table:


AIR SHAFT
SOUTH SHAFT.
NORTH SHAFT.
80
130
180
280
360
440
Called 500
600
665
700
800
900
1000
1100
1200
1300
1400
1500
100
200
300
Low Grade
THE GWIN MINE.
LONGITUDINAL SECTION.
D. E. MELLISS. Ph.D.
Mining Engineer.
The dark shading has been stoped.
The light shading is ore in sight
Dimensions (e. g. 10 ft) are the thickness of ore.
Probable Southern Limit of Principal Pay Chimney
Projected Continuation of Shaft
8 ft
8 ft
9 ft
3½ ft
10 ft
13 ft
4 ft
10 ft
20 ft
30 ft
15 ft
5ft
18 ft
6 ft
10 ft
From the South Boundary of the Property to North Shaft is 3294 feet.
From this point to the North Boundary is 1822 feet.

PARTIAL STATEMENT OF BULLION FROM GWIN MINE.

Date.	Part of Mine.	Amount.
April, 1871, to June 26, 1872	400 level	$90,353 00
July 8, 1872, to December 26, 1872	500 level	53,808 00
January 1, 1873, to October 5, 1873	600 level	118,551 00
November 25, 1873, to February 15, 1874	700 level	29,214 00
April 26, 1874, to August 30, 1874	800 level	81,516 00
September 25, 1874, to April 8, 1875	900 level	73,509 00
April 19, 1875, to June 24, 1876	1,000 level	80,012 00
January 30, 1876, to March 26, 1877	1,100 level	135,338 00
April 12, 1877, to October 1, 1879	1,300 and 1,400 level	446,349 00
October 9, 1879, to September 23, 1881	Above the 900 level	259,413 00
December 3, 1881, to August 4, 1882	Above the 900 level	31,083 00
Total		$1,399,146 00

The mill and hoisting works were old and entirely worn out. There were two quartz mills, one of 36 and one of 24 stamps. The stamps weighed only 500 pounds, dropping 75 times per minute. The mortars were old fashioned. The concentrators were concave buddles and sluice boxes. The 60 stamps did not have the crushing capacity of a modern 40-stamp mill. Furthermore, although there are no records relating to the subject, the character of work done in saving gold must have been very poor.

No steam is required for power either for mill or hoisting works. The Mokelumne Hill and Campo Seco Water Company's ditch passes above the mine, giving 300 feet head at the hoisting works delivered through a pipe 100 feet long. To pump and hoist from the 1,500 level, and run 60 stamps, required 180 miner's inches. The cost is about 16 cents per 24-hour inch.

Regarding the water in the mine, no difficulty was ever experienced in keeping it under control till the 1,400 was reached, with a 5-inch pump 30-inch stroke, running 8 strokes per minute. At the 1,500 a slightly increased amount was met with which the same pump could have controlled were it possible to increase the speed; this, however, could not be done, owing to the crooked condition of the shaft.

FINE GOLD MINE.

The mine is situated at an altitude of 3,000 feet above the level of the sea, in Railroad Flat Mining District, and is 1,500 feet in length by 600 feet wide. The course of the vein is north and south, dipping 70 degrees westerly, and averages 5 feet in width. The hanging and foot walls are slate, and the quartz is free milling, containing about 2 per cent of sulphurets, but not of sufficient value to pay for collecting and working. Developments on the property, beside the shaft 250 feet in depth, are three levels running north and south on the vein, from 400 feet to 600 feet in length, all of which were made during the year 1886. The machinery consists of water power, 10-stamp mill, hoisting works, and air compressor. The stamps weigh 750 pounds, drop 7 inches 100 times per minute, and crush 21 tons of ore per day. The apron plates are 4 by $4\frac{1}{2}$ feet, and the sluice plates are 16 inches wide by a length of 100 feet to each battery. The saving of the yield is about equally divided between the batteries and plates.

Altitude, feet	3,000
Number of stamps	10
Weight of stamp	750
Drop of stamps, in inches	6
Drop of stamps, per minute	100
Duty of stamp in 24 hours, tons crushed	$2\frac{1}{10}$
Size of screens, mesh	40
Miner's inches of water used in 24 hours in mill	35
Miner's inches of water used in 24 hours in hoisting works	35
Miner's inches of water used in 24 hours in compressor	35
Pressure of water, in feet	300
Cost of running, per ton	$4 00
Cost of milling, per ton	$1 00
Percentage of recovery saved in batteries	50
Percentage of recovery saved on plates	50
Number of men in mine	39
Number of men in mill	3
Total number of men employed in and about mine	47
Depth of shaft, in feet	250
Length of ore-shoot, in feet, so far as explored	200
Average width of vein, in feet	5

WILLARD MINING COMPANY.

(Contributed by F. B. Morse, E.M.)

The property belonging to the Willard Mining Company is situated in Calaveras County.

Murphys Mining District.—The altitude is about 2,200 feet above sea level. The formation is limestone and slate. The accompanying sketch marked Fig. 1 is a diagram of the formation; the line marked cc'cc being the line of contact. The apparent stratifications of the slate and limestone are conformable and run nearly east and west, the line of the contact cutting the formation. The positions of the different veins are also shown in this diagram. They consist apparently of a main opening, marked AA, and small side veins, marked BB, DD, etc., running into the main opening on either side.

The main vein, AA, is called the "Red Wing" vein. The dip of this vein, as far as known, is nearly vertical; course about 15° north of west and south of east. The dip of the side veins is about 78° to the south; course nearly east and west. We have six locations covering the different veins, five being 600 by 1,500 feet, and one being 300 by 1,500 feet.

We have opened two shoots or bodies of ore on the main opening, one marked MM and the other NN. The length of either is not fully known, but in each case is probably about 1,000 feet. The width between walls varies up to 300 feet, with a maximum width of the ore bodies of 200 feet.

The ore body MM is opened by a tunnel, marked TT, 800 feet into the hill. This tunnel crosscuts the vein. The crosscut shows both walls, at this point, to be limestone. The opening between lime walls is 300 feet. In this opening is 200 feet of vein matter, with 50 feet of birdseye porphyry on either side of the vein between it and the lime walls.

From the point marked c', the vein, going westerly, follows the contact between the lime and the slate, the north wall being lime and the south wall slate, the contact and the vein cutting the formation at an angle of about 15°.

From the point marked c'—going easterly—the contact makes a bend towards the south. The vein, however, does not follow the contact, but continues its course, cutting across the limestone, both walls now being lime. The main vein here still cuts the formation at an angle of 15°, the side veins running into it being conformable with the apparent stratification.

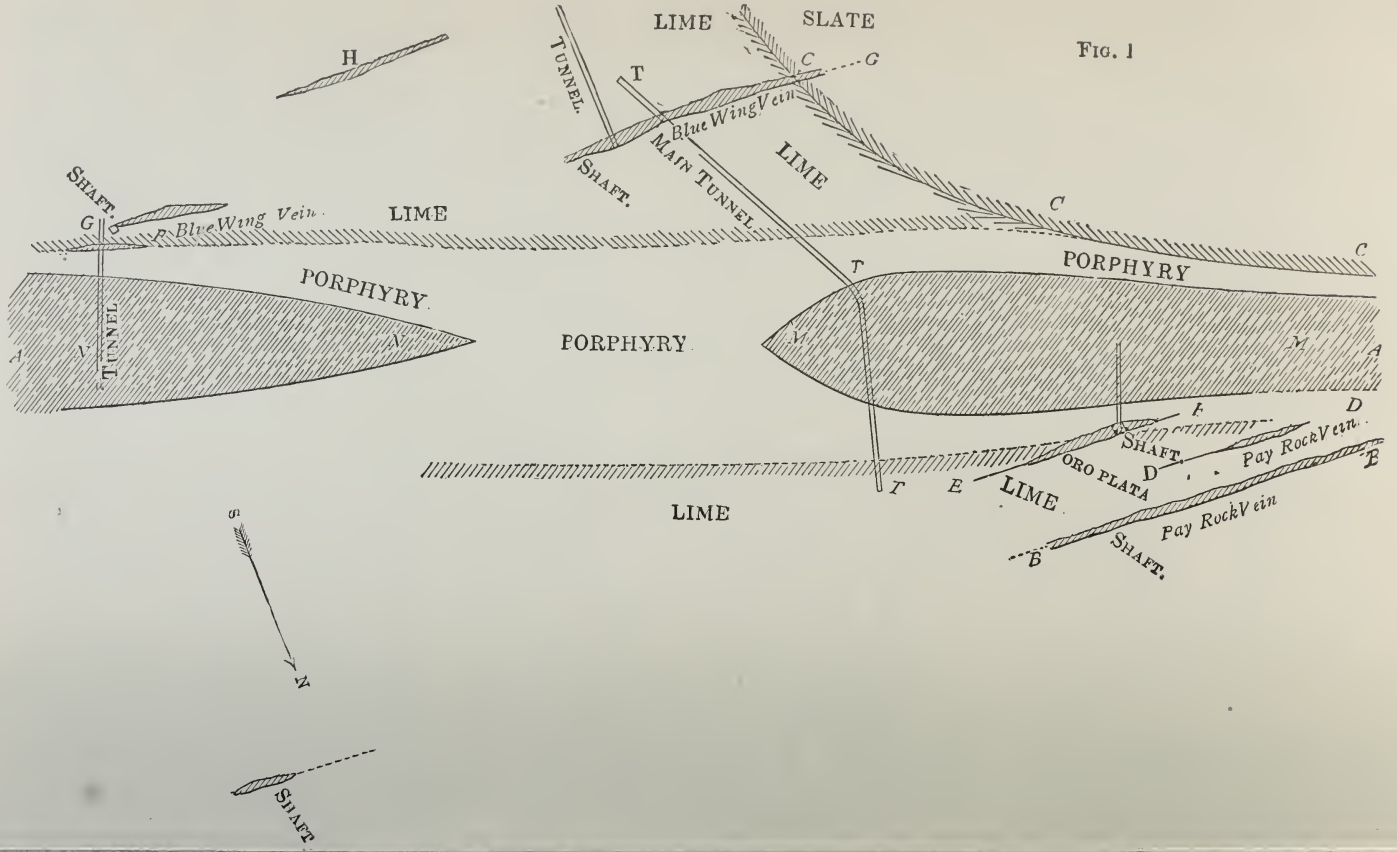

LIME
SLATE
H
TUNNEL.
T
C
G
Blue Wing Vein
SHAFT.
MAIN TUNNEL
LIME
C
SHAFT.
G
Blue Wing Vein
LIME
C
PORPHYRY
T
PORPHYRY
TUNNEL
PORPHYRY
M
M
A
A
F
D
SHAFT.
Pay Rock Vein
ORO PLATA
D
E
LIME
T
E
LIME
Pay Rock Vein
B
SHAFT.
N
SHAFT

FIG. 1

The ore in all the veins is an exceedingly hard quartz, carrying gold, silver, and what is nominally gray copper, galena, and zinc blende. This ore has several interesting peculiarities. In the first place, it carries absolutely no iron pyrites—which are found in considerable quantities in every other gold-bearing vein in our section, outside of this particular belt of veins. Again, the gray copper—or what is nominally such—is shown by analysis to contain very little sulphur—which is largely, and, in some cases, almost entirely replaced by selenium. And besides copper, the mineral carries gold, silver, lead, zinc, bismuth, antimony, iron, and manganese.

Another peculiar feature of the main vein is this: In cross-cutting the vein in the tunnel TTT, the quartz for the first 150 feet carried free gold, and the sulphurets were nominally pure gray copper, no galena or zinc blende being found. The ore assayed ounce for ounce in silver and gold; and the loose gold in the clay seams was worth about $19 an ounce. For the last 50 feet the quartz carried little or no free gold. The sulphurets were galena and zinc blende, and the loose gold was very silvery—being worth only $14 an ounce. The sulphurets here assay from 6 to 8 ounces in silver to 1 of gold.

The same peculiarity is noticed in all the side veins; those on the south side of the main opening carrying free gold and gray copper, with no galena or zinc blende; while those on the north side carry little, and in some cases, no free gold, and no gray copper, but carry galena and zinc blende assaying high in silver.

In the main opening AA the vein-matter between the porphyry walls consists of strata of quartz and porphyry. For a depth of 300 feet, in some cases, from the surface, the vein is decomposed and disintegrated, so that it bears some resemblance to a gravel-bank, though the quartz is all sharp. This decomposition has broken up the quartz into pieces from many tons weight down to fine sand, and the porphyry in many places has been changed to clay.

Our method of working this vein is by an open cut from the surface, making a funnel-shaped hole, connected by a shoot with a tunnel below, through which all the material mined is run out. The sketch marked Fig. 2 shows the present appearance of the pit and of the arrangement of the tunnel.

The tunnel is run in from the surface, so as to partly cross-cut the formation. The grade of the tunnel is about 5 inches in 12 feet, and it is wide enough to allow a track, flume, water pipe, and air pipe to run all the way in. At the end of the tunnel, and under the pit, is a chamber 9 feet by 25, and 20 feet high in the clear. This chamber is connected with the workings above, by what is now a short shoot. At the bottom of this shoot is a large gate; below the gate is a grizzly and a platform and a small bin, for loading into a car. The flume which runs through the tunnel comes in under the grizzly, and the water pipe connects with a small tank at the head of the flume.

Our method of working, in detail, is as follows: In the open cut we run powder drifts, with TT, as in bank blasting. We run the drifts in about 15 feet from the face of the bank, and the TT from 15 to 20 feet on either side, usually taking a 15-foot face to the bank, on a stope up from the bottom. We load from 150 to 300 pounds of powder (low-grade powder) in each T, and fire by battery. One such shot will dislodge from 3,000 to 4,000 tons of material, which is thrown down to the bottom of the pit and into the shoot. It is then drawn from the shoot as fast as wanted, by means of the gate. As it comes through, it passes on to a grizzly, the

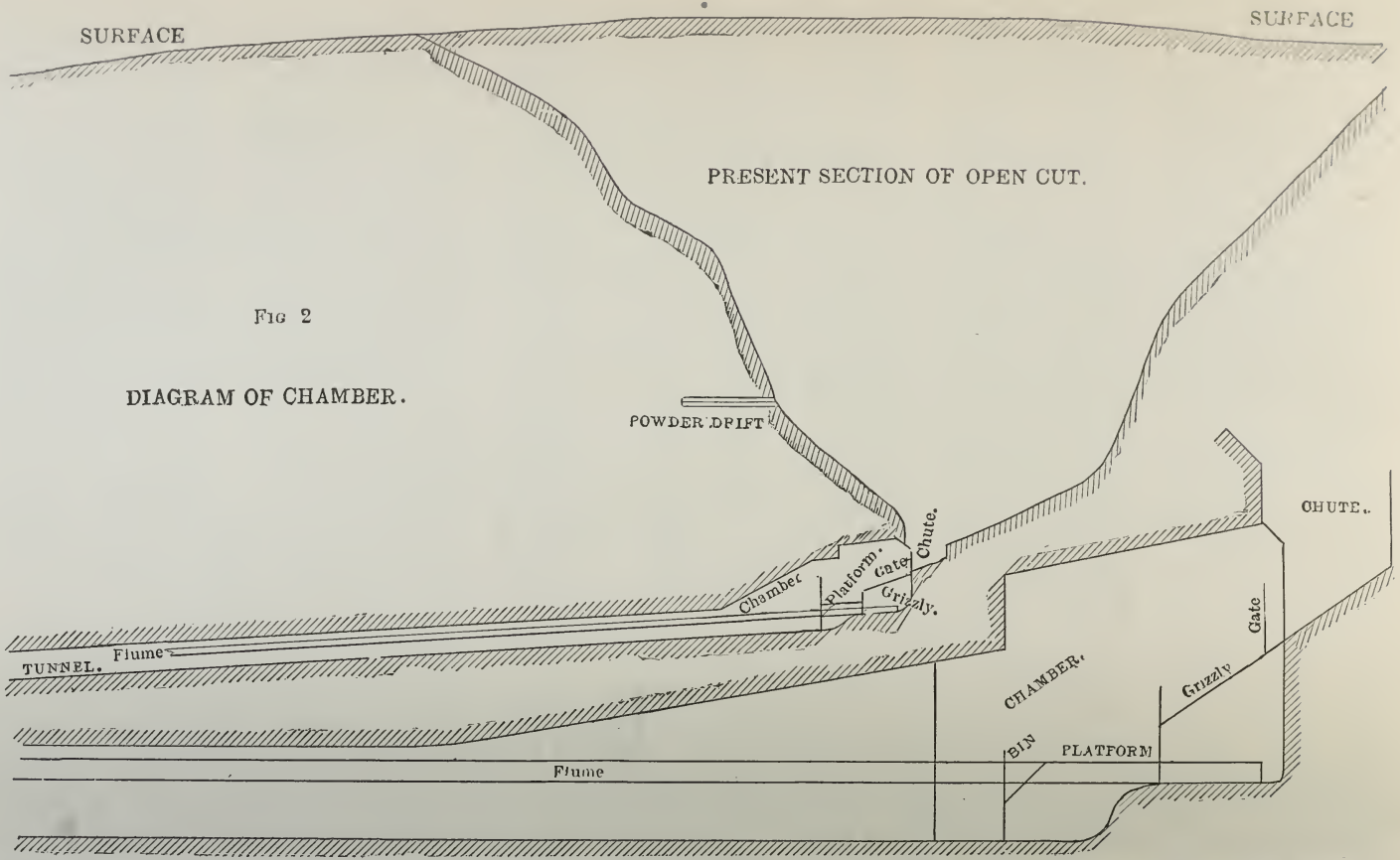


FIG 2

DIAGRAM OF CHAMBER.

bars of which are set 5 inches apart. The coarser material passes over the grizzly and on to the platform and bin below, from which it is loaded into cars and run out. What goes through the grizzly drops into a hopper below, from which it is fed into the flume.

This flume is 14 inches wide and 18 inches deep. It has a grade of 5 inches in 12 feet, and we run about 130 inches of water in it. This water carries all the material that comes into the flume out of the tunnel, and dumps it into a dump-box.

The dump-box is a large double compartment box, each compartment being 35 feet by 12, and 9 feet in the clear. It is provided with a large movable "tom-iron," and two hydraulic nozzles working under 90 feet pressure. The mine is worked on the day shift only, the quartz and dirt being run into one compartment of the box. The dump-box is run on the night shift, when the material that comes in by day is thoroughly washed free from clay, and is then run into another set of sluices, which convey the quartz direct to the mills.

At the mills the quartz-sand and dirty water are passed over a long grizzly of perforated screens. The quartz drops from this directly into the ore bins, and the sand and dirty water passes through the screens and is dropped into another flume. As the quartz goes into the mills it is also separated automatically as to size—the finer part going to the stamp mill, and the coarser to the concentrating mill. The waste water and sand that goes through the grizzlies is taken by the flume below to what is called the "plate house," where it is distributed over silvered plates.

We mine on week days only, running the mills every day. In every working day we mine about 300 tons of material. Of this about 10 per cent is run out in cars, and 90 per cent comes out in the flumes. This material is largely clay and sand, too fine to pay for further crushing. Three hundred tons of this dirt will produce 95 tons of milling quartz. This loose material—the sand and clay—all carries a considerable amount of fine loose gold, varying in size from the finer float gold up to particles the size of the head of a pin—we never find any coarser than this. This gold we save in the sluices and plate house. For this purpose we have the following arrangement of flumes, etc.: The flume from the chamber to the dump-box is 800 feet in length; grade, 5 inches in 12 feet; width, 14 inches, and is lined with block-riffles the entire way. The flume from the dump-box to mills is 300 feet long; grade, 6 inches in 12 feet; width, 24 inches, and is also lined with block-riffles. From the mills to the plate house the flume is 300 feet long; grade, 6 inches in 12 feet; width, 24 inches, and is lined with slat-riffles. These various flumes pick up about all the visible gold, so that the material that goes into the plate house is apparently nothing but sand and dirty water.

In the plate house this sand and water is divided into 6 equal parts, dropped into distributing boxes, and run over 6 aprons. These aprons are 20 feet long by 9 feet wide, with a grade of 5 inches in the 20 feet of length. Near the lower end each apron is covered with an apron of silvered plates, 9 feet square; below the silvered plates is a riffle filled with mercury, to catch loose amalgam, and below the aprons is a tank into which everything drops, to catch the loose mercury. All the water and sand is run over these aprons, each carrying about 20 inches of water. These aprons save the float gold that has escaped the sluices, and sometimes give astonishing results. We have cleaned up as high as 160 ounces of amalgam from them in a week. This gold is of the finest possible sort, and the amalgam has absolutely no grit, and is apparently almost a homogeneous

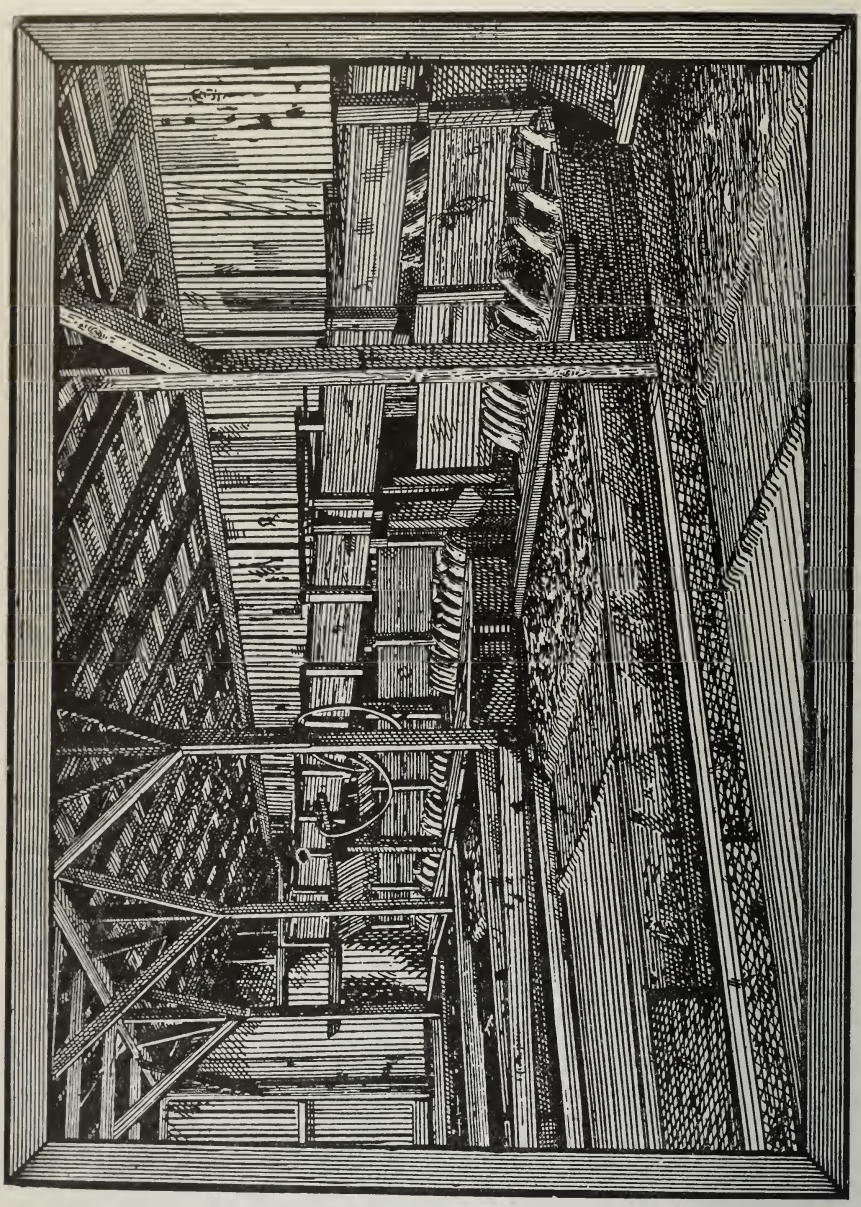


PLATE HOUSE, WILLARD MINE.

mass of hardened mercury. The water, after leaving these plates, goes to waste, the plate house being the last gold-saving apparatus we employ.

At present we are working only the main vein. A great amount of work, however, has been done on the side veins, and a number of promising bodies of high grade ore have been developed. These side-vein ore bodies vary in length from 70 to 500 feet or more; the veins average in thickness

from 2 feet to 8 feet, and the walls are hard and firm. A large amount of ore has been taken from them near the surface and worked, and we are now preparing to open and work them at a depth.

We are running two mills—a stamp mill and a concentrating mill. The stamp mill is an ordinary mill of that sort. It contains 15 stamps, in 3 batteries of 5 each, with self-feeders, ore bins, and plates. We work all the fine part of the quartz here, so no rock breaker is required; and as the fine quartz carries little or no mineral, we have no concentrators here.

The stamps weigh 750 pounds each, work under a 6-inch to 8-inch drop, and drop 96 times a minute. We crush through a No. 5 slot screen, and crush $2\frac{6}{10}$ tons to the stamp in 24 hours.

We amalgamate entirely outside. For this purpose we have silver-plated aprons below the mortars, each apron being 4 feet 4 inches wide and 12 feet 6 inches long, with a grade of $1\frac{3}{8}$ inches to the foot. Below the aprons we have 12 feet of spout plates to each apron, 18 inches wide by 12 feet long, grade $\frac{3}{4}$ of an inch to the foot. The free gold in our rock, especially in the finer rock, is very fine flour gold. It is worth $18 50 an ounce, yet an ounce of dry, hard amalgam will only retort about one fifth gold. We have experimented with crushing through every size screen from No. 9 down to No. 4, and we find that although our gold is so very fine, yet we save the most per ton in crushing coarse through a No. 5 screen, and at the same time have a largely increased capacity over a fine screen.

The coarse rock and all the sulphur-bearing rock goes to the concentrating mill. This mill is constructed on a different principle from most mills of the sort, as we use Tustin pulverizers instead of stamps for crushing the quartz. The ore first goes through a 12-inch Blake rock breaker and then drops into the ore bin, from which it is fed to the Tustin pulverizers. These pulverizers are provided with automatic self-feeders, the same as we use in the stamp mill, and they feed the same way. We crush wet and amalgamate on aprons, after which the pulp is concentrated on Frue vanners.

We run four pulverizers. These run at 20 revolutions a minute, requiring 4-horse power each. We crush through a 20-mesh steel wire screen, the capacity of each machine being from 10 to 11 tons a day on the kind of rock that comes to it. The aprons are silvered plates, 4 feet wide by 10 feet long; grade, $1\frac{3}{8}$ inches to the foot. We use 8 Frue vanners, 2 to each pulverizer. Our coarse rock carries a very small per cent of sulphurets, from $\frac{1}{16}$ to $\frac{1}{4}$ of 1 per cent. The sulphurets, however, are very high grade, some being worth, when pure, upwards of $5,000 a ton. We concentrate our rock up to from 82 to 88 per cent of the assay value, according to the kind and grade of the rock.

A comparison of the two methods of crushing shows a marked difference in results. In crushing through the battery a large amount of slimes are produced. With the pulverizer a very small quantity of slimes is made. As a consequence, with our ore, where the rock is very hard, the gold exceedingly fine, and the sulphurets soft and brittle, we find that on the same ore we amalgamate a much greater percentage of the fine gold after the pulverizers than after the stamps; and when we come to concentrate, we can save only 18 to 20 per cent of the assay value of the ore after stamps, and 85 per cent after the pulverizers. On the same ore and with same screen our pulverizer is about the equivalent of 6 to 8 stamps, according to the character of the ore.

Our sulphurets we work ourselves, by roasting and chlorination. Our roasting works consist of two "Willard" furnaces, with all necessary appurtenances. These furnaces are of a ton capacity each to the charge, and

we can roast, if necessary, from 6 to 8 tons a day. The chlorination works are of equal capacity, consisting of 11 pairs of leaching and settling tanks, with generators, etc. We roast the sulphurets, granulate them, and run them in a car to the chlorination works. After which, they are treated in the usual manner, and the gold leached and precipitated.

We run entirely by water power. We use 130 inches in the mine. In the stamp mill we use, for power and amalgamating, 80 inches, under 140-foot head. In the concentrating mill we use, for power, amalgamating, and concentrating, 100 inches, under 160-foot head.

The cost of mining is about 50 cents per ton of quartz, delivered at mill. The average cost of milling in the two mills is about 60 cents a ton.

We employ 12 men altogether about the mine, including men in the open cut at the chamber and dump-box, and car men. In the mills we employ 7 men, and at the chlorination works 2 men, making a total of 21 men, on an average.

We have done no development work the past year, but are now putting up compressor, etc., for power drills, and propose soon to open up various veins at a depth.

Altitude, feet	2,200
Number of stamps	15
Weight of stamp, in pounds	750
Drop of stamps, in inches	6–8
Drop of stamps, per minute	96
Duty of stamp in 24 hours, tons crushed	$2\frac{6}{10}$
Size of screens, Slot No.	5
Number of Tustin mills	4
Revolution of Tustin mill, per minute	20
Duty of Tustin in 24 hours, tons crushed	10–11
Size of screen in Tustin, mesh	20
Miner's inches of water used in 24 hours in stamp mill	80
Miner's inches of water used in 24 hours in Tustin mills	100
Miner's inches of water used in 24 hours in mine	130
Pressure of water in stamp mill, in feet	140
Pressure of water in Tustin mill, in feet	160
Cost of mining, per ton	50 cents.
Cost of milling, per ton	60 cents.
Number of concentrators	8
Percentage of sulphurets	$\frac{1}{4}$
Number of men in mine	12
Number of men in mill	7
Total number of men employed	21

EL DORADO COUNTY.

The county is bounded on the north by Placer; on the east by Alpine County and the State of Nevada; on the south by Amador and Alpine Counties; and on the west by Placer and Sacramento. Geologically it differs but little from Amador, Calaveras, Tuolumne, and Mariposa Counties. The belts of limestone and granite and volcanic flows, form about the same prominent features within its boundaries as they do in the counties to the south through which passes the great auriferous lode. The county is celebrated for having sent forth to the world the first authentication of gold having been found in the State. Latterly renewed activity has been displayed in developing the mineral resources of the county, consequently many rich finds have been recorded.

SPRINGFIELD MINE.

This mine, formerly known as the Church Union, is the representative mine of the county; is situated at an altitude of 1,200 feet above sea level. The dimension of the claim is 4,500 feet on the lode; course of the vein is north and south; the dip about 80° to the east, and the average width about 3 feet. On the property is a 15-stamp water-power mill, using 110 inches of water, under a pressure of 450 feet, every 24 hours. Each stamp weighs 600 pounds, falls 9 inches, at the rate of 90 times per minute, and crushes $1\frac{3}{4}$ tons of ore per diem. The ore, free milling, containing about one per cent of sulphurets, is worked after the usual method of amalgamation in batteries and collection on outside plates. The sulphurets, after collection on Frue vanners, are worked by the chlorination process at the company's works, at a cost of $10 per ton.

Altitude, feet	1,200
Number of stamps	15
Weight of stamp, pounds	600
Drop of stamps, in inches	9
Drop of stamps, per minute	90
Duty of stamp in 24 hours, tons crushed	$1\frac{3}{4}$
Miner's inches of water used in 24 hours	110
Pressure of water, in feet	450
Number of concentrators	3
Percentage of sulphurets	1
Value of sulphurets, per ton	$150 00
Cost, per ton, of working sulphurets	$10 00
Length of ore-shoot, in feet	800
Depth of shaft, in feet	1,400
Average width of vein, in feet	3

STUCKSLAGER QUARTZ MINE.

This mine, formerly known as the Sam. Sims, in Coloma Mining District, is noted as the first place in which the mineral roscoelite was found, and is worked solely as a pocket mine. A shaft has been sunk on an incline of 45° to connect with a tunnel 300 feet long. The claim is 1,500 feet long by 600 feet wide, and carries a five-foot vein; the hanging-wall is syenite, and the foot-wall is slate. The method of reduction and recovery is in the hand mortar and an arastra run by horse-power. The property was located in 1868, and from that date to the present time there have been several successive owners, all of whom have retired well recompensed.

FRESNO COUNTY.

ABBEY MINE.

This mine, owned by G. W. Grayson & Co., is situated in Fine Gold Mining District, in a formation of granite, at an altitude of 1,700 feet above the sea. The vein is about two feet in width; has an east and west course, and dips 22° to the north. The mine is worked through a shaft, which, on the incline, is 1,500 feet—reaching a perpendicular depth in the mine of 300 feet. The formation of the hanging-wall is granite, and of the foot-wall, syenite. The developments are three tunnels 200, 300, and 400 feet, respectively; a shaft 500 feet in depth, from which tunnels are run from the various levels on the vein, the longer of which is 300 feet easterly and 125 feet westerly on the vein.

The 10-stamp mill, hoisting works, and pumps are run by steam power. 80 per cent of the yield is obtained from the batteries, and 20 per cent from the outside plates. The plates are 4 feet in width, and 12 feet in length to each battery, inclining 1¼ inches to the foot.

Altitude, feet	1,700
Number of stamps	10
Drop of stamps, in inches	5
Weight of stamp, in pounds	800
Drop of stamps, per minute	96
Duty of stamp in 24 hours, tons crushed	2
Size of screens, slot	9
Depth of shaft on incline, in feet	1,500
Vertical depth, reach by shaft, in feet	300
Length of ore-shoot, as far as explored, in feet	500
Average width of vein, in feet	2
Cost of mining, per ton	$3 00
Cost of milling, per ton	$2 00
Percentage of recovery saved in batteries	80
Percentage of recovery collected on plates	20
Number of concentrators	4
Percentage of sulphurets	2½
Value of sulphurets, per ton	$225 00
Number of men in mine	30
Number of men in mill	5
Extra help about mine	15

NEVADA COUNTY.

This county, reputed to be the first in the State where quartz ledges were mined for gold, holds at the present time its prestige as one of the largest producers of the precious metal. The county is bounded on the north by Yuba and Sierra, on the south by Placer, and west by Yuba Counties, and on the east by the State of Nevada. The auriferous belt varies greatly in different sections of the county; some of the mines are in slates, some in granite, and others on the contact between granite and slate, the formation being granitoid rocks and metamorphic slates.

THE NORTH STAR MINE,

In Grass Valley Mining District, which lay idle for ten years, has been resuscitated, and is now in full operation; the owners have just incurred an expense of $80,000 for laying a pipe line, 20 inches in diameter, a distance of 2 miles, and a 40-stamp mill with all the latest attachments. The pipe will cross Wolf Creek, making considerable descent and ascent, and from the head of source to the point of discharge, will have a 250-foot fall. The capacity of the mill used at the present time is 20 stamps, and is run by water power; each stamp weighs 850 pounds, falls 7 inches at the rate of 90 times per minute, and crushes 2 tons of ore every 24 hours. The ore is that generally termed free milling, contains from 2 to 3 per cent of sulphurets composed of iron and copper pyrites, mispickel, galena, and zincblende. The sulphurets, having an assay value of $100 per ton, are saved by the Triumph concentrator and are treated by the chlorination process at a cost of $20 per ton. 80 per cent of the gold yield is recovered in the batteries and 15 per cent collected on the outside plates. The altitude is 2,400 feet above sea level, and the course of the vein is northwest and southeast, with a northerly dip of 26°.

Altitude, feet	2,400
Number of stamps	20
Weight of stamp, pounds	850
Drop of stamps, in inches	7
Drop of stamps, per minute	90
Duty of stamp in 24 hours, tons crushed	2
Percentage of recovery saved in batteries	80
Percentage of recovery saved on plates	20
Percentage of sulphurets	2–3
Value of sulphurets, per ton	$100 00
Cost, per ton, of working sulphurets	$20 00
Number of men in mine	150
Number of men in mill	——
Depth of shaft on incline, feet	1,500
Length of ore-shoot, feet	1,800
Average width of vein, feet	2
Number of concentrators	8
Cost of mining, per ton	$3 00
Cost of milling, per ton	$3 00

THE IDAHO MINE.

The Idaho Quartz Mine, in Grass Valley Mining District, paid, on the first Monday in August, its 202d monthly dividend. The first work done on the mine was a prospecting shaft, sunk on the south side of Wolf Creek, in 1864. No further developments were made until 1865, when the shaft was continued to a depth of 300 feet, from whence a drift to the westward opened into pay ore. The first dividend was paid in 1869, and, with but few exceptions, there have since been regular monthly payments. The yield of the mine, up to the present time, has been about $8,000,000, and the net profits, in dividends, to the owners, about $3,750,000. The shaft, reaching the 16th level, has a length of 2,200 feet on the incline, which is, vertically, a depth of 1,600 feet from the surface, and is being continued to reach a perpendicular depth of 1,700 feet. The ore-shoot—there being but one in the mine—is 1,200 feet in length, bearing to the eastward; in fact, all levels below the 7th have been run in that direction.

The claim is 3,100 feet, lineal, on the lode; course of the vein is north of east and south of west, dipping southerly about 65°; both foot and hanging-walls are classified as magnesian metamorphic rocks. There is a 35-stamp water-power mill on the property, each stamp having a weight of 850 pounds, falling 9 inches, dropping 72 times per minute, and crushing 2.85 tons of quartz every 24 hours. The ore is wet crushed, and when issuing from the batteries is conducted over blankets. The lighter particles are carried off by the force of the current, and the blanket savings are worked in the Attwood amalgamators, in which most of the gold is recovered. The skimmings are ground in the Knox pans. It is necessary that the blankets should be frequently washed; therefore, at intervals, the flow of the water and sand is turned from channel to channel, as the case requires, and the blanket over which the current no longer flows is taken up, and the savings washed into the tank preparatory to being fed to the amalgamator. The blanket is again relaid, the water and crushings are turned upon it, and the cleansing treatment is carried in a similar manner to the next blanket channel. Any gold that may escape the blankets is saved on the sluice plates, although the percentage so collected is not known. There is no amalgamation done in the batteries, nor any separate record kept of percentage saved by the different methods of recovery. The sulphurets, iron pyrites, and galena, $80 in value per ton are saved by the Cornish buddle and rocker, and are worked by the chlorination process at a cost of $20 per ton.

At the 1,000-foot level there are two 35 horse-power engines, run by com-

pressed air, which hoist the ore to the station, whence it is raised by water power to the surface. Formerly steam was the motive power, but since it has been substituted by water, the company saves an average of $30,000 per year.

Altitude, feet	2,500
Number of stamps	35
Weight of stamp, pounds	850
Drop of stamps, in inches	9
Drop of stamps, per minute	72
Duty of stamp in 24 hours, tons crushed	285
Size of screens, slot	5
Percentage of sulphurets	½
Value of sulphurets, per ton	$80 00
Cost per ton of working sulphurets	$20 00
Number of pans	4
Cost of mining and milling, per ton	$7 65
Number of men in mine	173
Number of men in mill	18
Number of men in and about mine	218
Vertical depth reached by shaft, about, in feet	1,700
Length of ore-shoot, feet	1,200
Average width of vein, feet	2½

THE EMPIRE MINE

Is in Grass Valley Mining District, about three fourths of a mile southeasterly from the Town of Grass Valley, and is one of the largest producers in the county. The dimension of the claim is 5,000 feet in length and 750 feet in width, being a consolidation of several mines. The altitude is 2,800 feet; course of the vein is north and south, with a westerly dip of 35°. The mill, of 40 stamps capacity, is run by water power; the stamps, weighing 850 pounds each, fall about 7 inches, at the rate of 95 times per minute, and crush 2 tons of ore every 24 hours. The number of miner's inches of water used is 80 inches in the mill, and 150 for hoisting works, pumps, and compressor. The water has a fall of 440 feet. So far there has been no adoption of style or size of screens, but a series of experiments are being conducted for the purpose of selecting the most suitable.

The developments made during the year comprise a shaft 150 feet deep and about 1,000 feet of drifts.

Of the yield of free gold, 80 per cent is saved in the batteries and 20 per cent is collected on the outside plates.

The sulphurets, iron pyrites containing a small amount of galena, varying in value from $120 to $300 per ton, are saved from the sluice tailings by the Triumph concentrator, of which there are 16 in the mill. The gold is extracted therefrom at a cost of $20 per ton, at custom works, by the chlorination process. The hanging-wall is diabase, but the formation of the foot-wall is as yet undetermined.

Altitude, feet	2,800
Number of stamps	40
Weight of stamp, pounds	850
Drop of stamps, in inches	7
Drop of stamps, per minute	95
Duty of stamp in 24 hours, tons crushed	2
Size of screens	Experimenting.
Miner's inches of water used in mill in 24 hours	80
Miner's inches of water used in hoisting works in 24 hours Miner's inches of water used in pump Miner's inches of water used in compressor	150
Pressure of water, in feet	440
Cost of mining, per ton	$3 00
Cost of milling, per ton	$0 75
Percentage of recovery saved in batteries	80

Percentage of recovery saved on plates	20
Number of concentrators	16
Percentage of sulphurets	2
Value of sulphurets, per ton	$120 00–300 00
Cost of working sulphurets, per ton	$20 00
Number of men in mine	150
Number of men in mill	8
Length of ore-shoot, feet, said to be	4,000
Average width of vein, feet	2½
Length of longest incline shaft, feet	1,600
Vertical depth reached by incline shaft, feet	600

PROVIDENCE MINE.

The mine is located on Deer Creek, 1¼ miles west of Nevada City, in Nevada City Mining District, at an altitude of 2,500 feet above sea level, in granite, contact and slate formation. Within the boundary lines of the patent are two distinct ledges running parallel to each other, each ledge averaging four feet in width. The veins have a north and south course, with an easterly dip.

In the Providence proper the shoots of ore throughout the mine vary in length from 50 feet to 400 feet, while in the Ural, or parallel ledges, the stopes are continuous, and average 250 feet in length. The Providence is opened, by one incline shaft, to a depth of 1,100 feet; the formation for 900 feet is granite, thence 900 feet of contact, followed by 1,800 feet of slate; both hanging and foot-walls change from granite to slate. There are eleven tunnels or drifts in the mine, the longest of which is 3,600 feet; in the latter the hanging-wall for the first 2,000 feet is granite; then giving way to slate, which continues the remainder of the distance; in the foot-wall the slate begins after 840 feet of granite.

The Ural vein is worked through a crosscut, 547 feet in length, run in a westerly direction, at the 600-foot level, in the foot-wall of the Providence mine. At the point where the crosscut intersected the Ural the vein is a contact, and so continues for a distance of 40 feet south, where both hanging and foot-walls become slate. The average width of the vein is 4 feet. A tunnel on the course of the ledge 584 feet in length is in quartz nearly the whole distance.

The following diagram will show the positions occupied by the Providence, Ural, and Wyoming Lodes. It will be seen that the Providence Lode and crosscut No. 1 are in granite; also, that the Ural Lode leaves the contact and runs into slate; also, a cross ledge running from the Ural into the Wyoming Lode.

The Providence Lode ran into slate on the 600-foot level, at a point 800 feet south of the incline shaft, and then became a contact vein.

Mr. Joseph Thomas, underground Superintendent of the Providence Mine, has for years, contrary to the opinions of many other persons, asserted that within the boundary lines of the company's property, to the west of the vein being worked, there existed a parallel ledge. Since he has proven the correctness of his opinion, he says that the Ural and Wyoming Lodes are parts of one and the same fissure, but that the former is lying on a big horse, and the cross ledge is running from the Ural to the Wyoming, and in going south the two will come together and form one lode.

The property has an area of 145 acres, and is in length 6,000 feet. The wet crushing 40-stamp mill uses 80 miner's inches of water every 24 hours; for pumping and hoisting 45 miner's inches are necessary, under a pressure of 380 feet. The stamps weigh 750 pounds each, fall from 6 to 8 inches, drop 93 times per minute, and crush, to the stamp, 2 tons of

ore every 24 hours. The sulphurets, assaying $130 per ton, are saved by the Frue vanner, and are worked by the chlorination process at the company's works at a cost of $6 per ton. Of the gold obtained by amalgamation 20 per cent is from the batteries and 80 per cent from outside plates. The aprons and sluice plates are silver-plated, the former being 4 feet square and the latter 16 inches wide by 14 feet long to each battery, inclining 1¾ inches to the foot.

Altitude, feet	2,500
Number of stamps	40
Weight of stamp, pounds	750
Drop of stamps, in inches	6–8
Drop of stamps, per minute	93
Duty of stamp in 24 hours, tons crushed	2
Size of screens, round punched, No.	5
Miner's inches of water used in mill in 24 hours	80
Miner's inches of water used in hoisting and pumping	45
Pressure of water, in feet	380
Cost of mining, per ton	Not stated.
Cost of milling, per ton	Not stated.
Percentage of recovery saved in batteries	20
Percentage of recovery saved on plates	80
Value of sulphurets, per ton	$130 00
Cost per ton of working sulphurets	$6 00
Percentage of sulphurets	5–6
Number of concentrators	16
Number of men in mine	93
Number of men in mill	Not stated.
Number of men in and about mine	100
Length of ore-shoot in Ural, far as worked, feet	500
Length of ore-shoots, one after the other, entire distance worked in Providence, feet	250
Average width of veins, feet	4
Depth of shaft, feet (same shaft used for Ural at 600-foot level)	1,100

CONSOLIDATED WYOMING GOLD MINE.

This location was made in 1851, and has been, with but few slight intermissions, continuously worked since that time. The consolidation embraces the Ural Mine, on the ledge of the same name, of which mention is made under Providence. The company's property is situated in Nevada City Mining District, about 1¼ miles west of Nevada City, at an altitude of 2,400 feet above the level of the sea, in contact of slate and granite. Course of the vein is northwest and southeast, dipping 26° easterly. Hanging-wall of the Ural is granite, and the foot-wall slate, whereas, in the Wyoming, both walls are slate. There is a 16-stamp water power mill on the property, using 28 miner's inches of water every 24 hours, at a pressure of 396 feet. The weight of each stamp is 800 pounds, falling 7 inches, dropping 92 times per minute, and crushing 2 tons of ore per diem. The aprons are 52 inches wide, and the sluice plates, with an inclination of 1¾ inches to the foot, are 16 inches wide, by a length of 20 feet. The sulphurets are saved on the Frue concentrator, and are worked at custom works by the chlorination process. Steam power is used for hoisting and pumping. Forty per cent of the amalgable yield is recovered in the batteries, and 60 per cent is collected on the outside plates. Dimension of claim, Ural 2,000, and Wyoming 2,270, lineal feet.

Altitude, feet	2,400
Number of stamps	16
Weight of stamp, pounds	800
Drop of stamps, in inches	7
Drop of stamps, per minute	92
Duty of stamp in 24 hours, tons crushed	2
Miner's inches of water used in mill in 24 hours	28
Pressure of water, in feet	396

Providence Mine.

Scale —100 feet to one inch.

Cost of mining, per ton	$3 50
Cost of milling, per ton	$1 00
Percentage of recovery saved in batteries	40
Percentage of recovery saved on plates	60
Value of sulphurets, per ton	Not stated.
Percentage of sulphurets	2¾
Number of concentrators	8
Number of men in mine	30
Number of men in mill	5
Number of men otherwise engaged	5
Depth of shaft on incline, feet	900
Length of tunnel, feet	3,000

NEVADA CITY GOLD QUARTZ MINE.

Is in Nevada City Mining District, about one mile west of Nevada City, and at an altitude of 2,500 feet above sea level. The course of the vein is northerly and southerly—20° to 30° west of north and 20° to 30° east of south, dipping 33° to the east—the hanging-wall being granite and the foot-wall slate. The claim covers an area of 40 acres, and is 2,500 feet lineal on the vein. The mine is worked through two incline shafts 850 and 530 feet respectively, and is opened up by 8,000 feet of tunnels or levels. From the 850-foot incline, tunnels have been driven south, averaging in length 250 feet each, on the 1, 2, 3, 4, 5, 6, and 7th levels, and are connected with each other by stopes and upraises. On the same levels north tunnels, connected by upraises and stopes, aggregating 6,000 feet, have also been driven. At the 350-foot level there is a drain tunnel 1,600 feet in length, connecting with the 530-foot incline—at the depth of 300 feet on this incline there is a level run connecting with the stopes from the 850-foot incline.

All of the machinery is run by water-power, the water being conveyed to the property through an eleven-inch iron pipe, 3,200 feet in length, under a 300 foot pressure, at a cost of 16 cents for a miner's inch for 24 hours' use. Although the mill, of 20 stamps, is run by water-power, there is a steam-power plant in place to be used in case of an accident to the waterworks. At the mouth of each incline are hoisting and pumping plants which may be run by water or steam as circumstances require. The stamps weigh 750 pounds each, fall from 7 to 9 inches at the rate of 93 times per minute, and crush about 1¾ tons of ore every 24 hours. Apron and sluice plates are silver-plated, the former being in size 4 by 5 feet, and the latter with an inclination of 1¾ inches to the foot, are 14 inches wide by a length of 12 feet to the battery. There is no separate account kept of the difference between the battery and plate savings, but merely a record kept of the general clean-up. The sulphurets, iron pyrites with an admixture of sulphides of arsenic, zinc, and lead, in value about $100 per ton, are saved by the Frue vanner, and worked by the chlorination process at a cost of $20. The developments during the year consist of drifting and crosscutting from the 850-foot incline, on 500, 600, and 700-foot levels, and opening up shoots, and the sinking of an incline 530 feet to the ore body.

Altitude, feet	2,500
Number of stamps	20
Weight of stamp, pounds	750
Drop of stamps, in inches	7–9
Drop of stamps, per minute	93
Duty of stamp in 24 hours, tons crushed	1¾
Size of screens, round punched	5
Miner's inches of water used for all purposes, per diem	105
Pressure of water, in feet	300

Cost of mining, per ton	$2 50
Cost of milling, per ton	$1 00
Percentage of recovery saved in batteries	No record.
Percentage of recovery saved on plates	No record.
Value of sulphurets, per ton	$100 00
Cost per ton of working sulphurets	$20 00
Percentage of sulphurets	2–3
Number of concentrators	8
Number of men in mine, 25; boys, 7—total	32
Number of men in mill	6
Number of men in and about mine—all told	40
Length of ore-shoots, several, averaging in feet from	100–250
Average width of vein, feet	3
Depth of No. 1 shaft on incline, feet	850
Depth of No. 2 shaft on incline, feet	530

DELHI MINE.

(Contributed by E. H. Garthwaite, E.M.)

The mine is in Columbia Hill Mining District, near the town of San Juan, and has an altitude of 2,700 feet above sea level. The formation is metamorphic slate; the country rock is traversed by numerous dykes of diabasic rock. The course of the vein is north and south, with an easterly dip of 75°. Dimension of the claim is 1,500 feet in length by 600 feet in breadth. The improvements are an 8-stamp mill, wet crushing, and run by water power. Each stamp weighs 1,000 pounds, falls 6 inches at the rate of 94 times per minute, and crushes 3½ tons per diem. The plates are 46 inches wide, 36 feet long, and have an inclination of 80°. The formation of both hanging and foot-wall is slate. The nature of the sulphurets are iron, copper, and arsenical, and have a value of from $80 to $100 per ton, and are saved by the Triumph concentrator, but as yet they have not been worked. Every 24 hours there are 30 inches of water used, with a pressure of 200 feet. Shortly after the pay streak was struck in the main tunnel, another adit was started about 200 feet lower down the hillside. At the point where the adit was started there is no outcrop of the ledge, and by a miscalculation the starting point was in the hanging-wall. The error was increased by making the tunnel bear gradually to the east, instead of toward the west, so that when the tunnel had been advanced some 500 feet, the face was quite a distance in the hanging-wall from the ledge. Then the direction of the tunnel was changed; it bore westerly, and about 900 feet from the mouth cut the ledge, which was about 2½ feet wide and quite rich. The mine is very advantageously situated for deep exploitation, being located on the south side of the Middle Yuba, where the mountains are very precipitous, and the ledge can be opened up to a depth of at least 800 feet below its upper outcroppings by means of adit levels.

Altitude, feet	2,700
Number of stamps	8
Weight of stamp, pounds	1,000
Drop of stamps, in inches	6
Drop of stamps, per minute	94
Duty of stamp in 24 hours, tons crushed	3½
Size of screens, punched	5
Miner's inches of water used in 24 hours	30
Pressure of water, feet	200
Cost of mining, per ton	$2 00
Cost of milling, per ton	$0 60
Percentage of recovery saved in batteries	33–40
Percentage of recovery saved in plates	66
Number of concentrators	4
Percentage of sulphurets	½–3

Value of sulphurets, per ton	$80 00-100 00
Number of men in mine	8
Number of men in mill	3
Width of vein varies in feet from	3–18
Length of upper tunnel, feet	1,200
Length of lower tunnel, feet	600
Length of ore-shoot, feet	200

EAGLE BIRD MINE.

This mine is situated in Washington District, at an altitude of 3,700 feet above sea level, in slate and granite formation. The vein has a northerly and southerly course, dipping 67° to the eastward. The formation of the hanging-wall is slate, and that of the foot-wall is granite. The improvements on the property are, one 20-stamp mill run by water power, Blake crusher, air compressor, and hoisting works. The stamps weigh 750 pounds each, fall from 6 to 7 inches, and drop 95 times per minute, with a crushing capacity of $1\frac{1}{2}$ tons of ore to the stamp every 24 hours. The plates, silver plated, have an inclination of $1\frac{3}{4}$ inches to the foot, are 4 feet wide, and 20 feet in length to each battery. Of the free-gold yield, the percentage saved in the batteries and collected on the outside plates is about equal. The dimension of the claim is 600 feet in width by 1,500 feet in length. Work was first commenced on the property by the sinking of a 400-foot shaft in 1873, since which time there have been five drifts run of 400, 250, 550, 350, and 175 feet in length, respectively.

Altitude, feet	3,700
Number of stamps	20
Weight of stamp, pounds	750
Drop of stamps, in inches	6–7
Drop of stamps, per minute	95
Duty of stamp in 24 hours, tons crushed	$1\frac{1}{2}$
Screens, brass wire, mesh	40
Miner's inches of water used in 24 hours	150
Pressure of water, in feet	175
Cost of mining, per ton	$2 50
Cost of milling, per ton	$0 55
Percentage of recovery saved in batteries	50
Percentage of recovery saved on plates	50
Percentage of sulphurets	$\frac{3}{4}$–1
Value of sulphurets, per ton	$100 00
Average width of vein, feet	9
Depth of shaft, feet	400
Number of men in mine	24
Number of men in mill	5

SPANISH MINE,

Is a location about three miles north from the town of Washington, in Cherry Hill Mining District, and in altitude is 4,000 feet above sea level. The property consists of 11 claims, 600 feet by 1,500 feet each, course of the vein is north and south, dip 80° to the west, and both walls are slate inclosing a vein averaging 100 feet in width. The first work done on the claim was in April, 1885, but since then the following developments have been made: tunnel No. 1, 960 feet, tunnel No. 2, 100 feet; crosscuts, driven at intervals of about 200 feet, 860 feet; drifts on the ledge, 1,040 feet; prospect shafts, 5 in all, averaging 31 feet each; 3 upraises averaging 107 feet each. There are 4 Huntington mills, run by water power, at work on the ore, reducing in the aggregate 120 tons per day; two thirds of the gold yield is recovered by amalgamation in the mill, the remaining one third being collected on the outside plates. The plates, varying, are 4, 6, and 2 feet wide, with an inclination of 2 inches to the foot and 30 feet in

length to each mill. Water is the motive power, 55 miner's inches, under pressure of 250 feet, being used every 24 hours.

Altitude, feet	4,000
Number of mills, Huntington	4
Revolutions per minute	60
Duty of the mills in 24 hours, tons ground	120
Screens—homogenous steel, ¼ inch angle slot, No.	6
Miner's inches of water used in 24 hours	55
Pressure of water, in feet	250
Cost of mining, per ton	20 cents.
Cost of milling, per ton	40 cents.
Percentage of recovery saved in mill	75
Percentage of recovery saved on plates	25
Average width of vein, in feet	100
Number of men in mine, mining	5
Number of men in mine, prospecting	12
Number of men running mills	5
Length of No. 1 tunnel, in feet	960

SIERRA COUNTY,

One of the most rugged and mountainous counties in the State, is bounded on the north by Plumas, on the south by Nevada, and on the west by Yuba and Plumas Counties, the State of Nevada forming the eastern boundary.

The greater portion of the county is covered by eruptive conglomerates, underlying which are the auriferous slates, great masses of serpentine, and ancient gold-bearing gravel channels. As the greater part of the golden harvest of this county was recovered from the auriferous deposits of the ancient channels, the following interesting descriptions will be appropriate insertions:

The Great Blue Lead of Sierra County, by C. S. Capp, quoted in Hittell's "Handbook of Mining for the Pacific States." Mr. Capp writes:

This is not one of the many petty leads, an inch or two in breadth and thickness, which, after being traced a few hundred feet, end as suddenly and mysteriously as they commence; but it is, evidently, the bed of some ancient river. It is often hundreds of feet in width, and extends for miles and miles a thousand feet below the summits of high mountains, and entirely through them. Now it crops out where the deep channels of some of the rivers and ravines of the present day have cut it asunder; and, then, hidden beneath the rocks and strata above it, it only emerges again miles and miles away. Wherever its continuity has been destroyed, the river or gulch which has washed a portion of it away was found to be immensely rich for some distance below, and the materials of which the lead is composed are found with the gold in the bed of the stream. It is evidently the bed of some ancient stream, because it is walled in by steep banks of hard bedrock, precisely like the banks of rivers and ravines in which water now runs, and because it is composed of clay which is evidently a sedimentary deposit, and of pebbles and black and white quartz, which could only be rounded and polished as they are by the long continued action of swiftly running water. The bedrock in the bottom of this lead is worn into long, smooth channels, and also has its roughnesses and crevices like other river beds. The lighter and poorer qualities of gold are found nearer to its edges, while the heavier and finer portions have found their way to the deeper places, near the center. Trees and pieces of wood, more or less petrified and changed in their nature, which once floated in its waters, are also everywhere encountered throughout this stratum. The clay and finer gravel in which these pebbles and bowlders are found to be tightly packed, is of a light blue color, which gives the name to the lead. Much of this clay is remarkably fine and free from coarser particles, and is smooth and unctuous to the touch. It is said to be strongly impregnated with arsenic, as was shown by chemical analysis, and contains large quantities of iron and sulphur in solution, for pyrites and sulphurets of iron are deposited in shining metallic crystals in every vacant crevice. Fine gold is found among this clay, and the heavier particles beneath it, upon the bedrock. This stratum varies in thickness from eighteen inches to eight or ten feet, while the whole lead varies in width from a hundred and fifty to five hundred feet. The same lead has been found at Sebastopol, four miles above Monte Cristo, and also higher up among the mountains. It appears at Monte Cristo, which is four miles above the high-lying Downieville, and over three thousand feet above it, and at Chap-

arral Hill, on the side of a deep ravine; then, at the City of Six, which is also on very high land, about four miles from Downieville, across the North Yuba. It is next found at Forest City, on both sides of a creek, and is there traced directly through the mountain to Alleghany Town and Smith's Flat, on the opposite side. There it is again cut in twain by a deep ravine. It crops out on the other side at Chip's Flat, where it has been followed by tunnels passing completely through the mountain to Centerville and Minnesota on the other side. Here it is obliterated by the Middle Fork of the Yuba, but is believed to be again found at Snow Point, on the opposite side of the river; and again at Zion Hill, several miles beyond. There is no reason for doubting that after thus reaching over twenty miles, it still extends further. Hundreds of tunnels have been run in search of it. Where the line it follows was adhered to, they have always found it, and have been well rewarded for their labor. Millions of dollars have been taken from this lead, and its richness, even in portions longest worked, is yet undiminished. As in some of the claims quartz veins and poorer paying gravel have been found, many of them may be valuable to work from the top down, as hydraulic claims.

The theory that this blue lead was once the bed of an ancient stream, is generally accepted by those familiar with it. Another evidence to support the theory is, that in many places the flattish stones in the lead lie at a peculiar inclination, and all in the same direction, as stones do in a stream of water. This theory, however, does not find universal belief. Mr. B. P. Avery wrote thus of it for the San Juan *Press*, in 1859:

Everybody in California has heard or read of the famous "blue lead," which all miners who delve for gold far up in the mountains hope to find, and think themselves lucky when they have found it, and which they pronounce to be the channel of an ancient river. This lead is always found resting on or near the bedrock, beneath diluvial strata of different colors, such as shades of red, yellow, and gray, and is itself more of a deep slate color than blue. It is generally richer in auriferous particles than the gravel lying above it, and forms the productive drift diggings for which the vicinity of Forest City is noted, as well as those of many other localities. The theory of its origin alluded to above is predicated upon these facts and assumptions: that it has been traced in a continuous line, at a certain altitude, through several counties, from ridge to ridge, at a right angle to present watercourses, across cañons thousands of feet deep; that the stratification of the lead is uniform, and different from that of adjoining deposits; that tree trunks, both in the ligneous and petrified state, are found lying in it, as though borne there by freshets; and the gold found in it is everywhere of the same character as to appearance and quality. This crude theory conforms to the general one which is popularly employed to account for the extensive alluvial deposits constituting our placer diggings. It is remarkable that the majority of our miners, who are commonly men of intelligence and practical knowledge in their pursuit, should have discarded entirely, if they ever entertained, when speculating on the origin of our gold fields, the more rational theory of marine influence, for one of purely local causes. They overlook all the facts which go to prove a total submergence of this coast at some remote period, and settle down upon the narrow idea that the immense gravel beds which contain so large a portion of our mineral wealth, and which extend at least four hundred miles north and south, having an average breadth of probably not less than sixty miles, were deposited by rivers which anciently ran here, and changed their channels from time to time, until they paved the whole country with cobble-stones. These deposits have been cut through by modern streams, running a different course, and hence the present cañons and ridges. Of the ancient rivers, the one that deposited the blue lead has alone left distinctive marks of its course. Now, unfortunately for the plausibility of this theory, the blue lead is found all the way from the summit of the Sierra Nevada to the foothills. Instead of being confined to a certain altitude, and a certain line, it exists in every altitude, on the main ridges as well as on spurs of them, and even on isolated peaks. Its color is owing to the presence of sulphuret of iron in solution, without which the gravel would not be any different from that lying above, except that the bowlders and large stones would be found in it, as they are always found at the bottom of every gravel deposit. Wherever sulphurous acid or sulphuret of iron is found, there the so called blue lead will be discovered, just as certainly as red earth and gravel will be found where the oxide of iron is present as a coloring agent. It is found at a great elevation in Sierra County, and at a low one in Nevada and Yuba. It has been struck at San Juan, and at points thirty or forty miles above it, leads of other colors intervening.

The "Dead Rivers of California," by John S. Hittell, quoted in "Raymond's American Mines and Mining." Mr. Hittell says:

A dead river is a channel formerly occupied by a running stream, but now filled up with earthy or rocky matter, and is not to be confounded with a channel that is open and remains dry during the greater part of the year because of a lack of water, or that has been abandoned by the stream for a deeper channel elsewhere. A dry river bed is *not* a dead river.

The dead rivers of California, so far as known, are on the western slopes of the Sierra Nevada, from 500 to 700 feet above the sea. They are all auriferous, and therefore they have been sought for and examined. They are not less interesting therefore to the miner than to the geologist; not less important to the statesman than to the antiquarian.

The largest dead river is known as "the Big Blue Lead," and has been traced from Little Grizzly, about latitude 39° 45′, in Sierra County, to Forest Hill, about latitude 38° 55′, in Placer County, a distance of 65 miles. The course is south-southeast, the position about 30 miles west of and parallel with the main divide of the Sierra Nevada. The elevation is 5,000 feet above the sea at Little Grizzly, and 2,800 at Forest Hill, showing an average fall of 33 feet per mile. The live rivers of the Sierra Nevada run at right angles to the course of the range, and have cut cañons from 1,500 to 3,000 feet deep, and they are separated by ridges which are from 3 to 6 miles apart, and are as high as the cañons are deep. The Blue Lead runs across these ridges from 200 to 1,000 feet below their summits. The traveler does not see any signs of a dead river in these ridges, which are as high and have the same general appearance at the Blue Lead as at other places. I shall presently tell how the miner discovers the lead, but before coming to that I want to give you a clear idea how the dead river crosses the ridges. Take a piece of common ruled cap paper; put your pen on a line, draw it up at an angle of 45° to the second line above, then down to first line at the same angle, and so on until the line made by your pen looks like eight rectangular saw-teeth, which are about an inch high. Consider those teeth as the ridges of the Sierra Nevada on the line of the Blue Lead in Sierra County, and the intervals between them as the cañons. Write over the first cañon to the left, Cañon Creek; over the next, Goodyear's Creek; and over the others consecutively, North Fork of the Yuba River, Rock Creek, Oregon Ravine, Wet Ravine, and Middle Yuba. Now draw a horizontal line across all the ridges a quarter of an inch from their tops. That line is the Blue Lead. The diagram, made as directed, represents a perpendicular section of the ridges and cañons of the Sierra Nevada, on the line of the Big Blue Lead in Sierra County, as seen from the west.

I have said that the traveler would see no sign of a dead river in riding over the country. The ridges are as high on its line as elsewhere; the cañon sides present the same appearance. Years elapsed before the miners discovered the existence of the ancient channel. But it required only a few months for the discovery that the live rivers were very rich in gold up to a certain point; that the abundance and size of the particles increased as they ascended up to that point; and that beyond or east of that point the streams were poor. Those points on the different streams were nearly in a line. Just there the ravines on the sides of the cañons were very rich, and they were comparatively poor elsewhere. The miners followed up the ravines, washing the dirt in their beds, and the dirt where the ravines were not too steep was a foot or two deep over the slate rock. At last, when the miners got near the top of the ridge, they found that the narrow shallow rock bed of the ravine suddenly disappeared, and the body of the hill was composed of gravel, which had a peculiar blue color, and part of it, a horizontal stratum about half a mile wide from east to west and five feet thick, was very rich in gold. They looked after the metal and paid little attention to anything else. As the stratum ran across the ridges from north to south, the miners followed it in with adits or tunnels, and in more than one place the tunnels met; and a few years ago it was customary for footmen passing between Monticello and Excelsior to go underground a distance of a mile rather than to climb over the hill six hundred feet high, by a path nearly two miles long. In the same manner Forest City and Alleghany were connected by a continuous tunnel; but the timbers have rotted, the roof has fallen in, and the passage is now closed.

The auriferous deposit is gravel, mixed with bowlders, clay, and sand, varying from a hundred to three hundred feet in depth; in strata distinguished from one another by differences in color, in the size of the bowlders and gravel, and in the number and size of the particles of gold. The predominant color is bluish-gray, dark at the bottom, and lighter above, with a reddish tinge in those places that have long been exposed to the air, showing the presence of iron. The material of the bowlders, gravel, and sand, is almost exclusively quartz. In the whole length of the river, as traced for a distance of sixty-five miles, assuming that the deposits of gravel average half a mile wide and two hundred feet deep, there were, counting in the portions which have been washed away by the live rivers, six billion six hundred and sixty million cubic yards of quartz and clay, and the quartz alone must have measured five billion cubic yards. In the live rivers quartz forms only a small portion of the gravel. Whence came all the quartz of the Big Blue? How did it happen that no granite, slate, porphyry, basalt, or sandstone was buried in this bed? If all the quartz veins now known in California were cleaned out to a depth of one hundred feet, they would not supply so much as is found in sixty-five miles of a river, that must have run for many hundreds of miles. The gravel is all water-worn, and rounded by long attrition. It came from far north. A piece of rough quartz, while being carried five hundred miles in the fiercest of our mountain streams, would not be worn so smooth as is every pebble in the Blue Lead. And the immense size of the bowlders implies a mighty current. Those in the lowest stratum average, in some places, a ton, and many are found of twenty tons. These are worn as smooth as the pebbles. They are not found scattered here and there, as though they had tumbled down from the banks of the river near to the spot where they are found; but they are evenly distributed in a stratum of equal thickness, across the whole bed, and for miles in length. Above that may be a stratum of bowlders of half the size, and then another stratum of larger ones. The great river handled these masses of rock with as much apparent ease, and spread them out as evenly, as if they had been no larger than pigeons' eggs.

The particles of gold are larger in size, and contain more silver at the bottom than at the top. The smaller pieces are in the upper strata, and as they have a larger surface proportionately, the silver is eaten out by the sulphurous acid which is developed in the gravel by the oxidation of pyrites. If a double eagle and twenty one-dollar pieces are thrown into a solution of vitriol, and left there for several weeks, the small pieces will, at the end of that time, contain a larger proportion of gold than the large one; and, for a similar reason, the surface placer gold is finer, chemically, than that obtained from the deeper strata. As a general rule the deep gold is 900 fine, or is worth $18 60 per ounce, and the surface gold is 920 fine, and is worth $19 per ounce, in the Big Blue Lead. The gold and gravel are deposited as in live rivers. There are banks, bars, eddies, ripples, rapids, and falls. There is little gold in the rapids and much in the eddies. The richest places have contained as much as fifty dollars to the cubic yard of the lower stratum; or, if the large bowlders were left out of the estimate, to two or three cubic feet. The space between the bowlders is filled with sand, clay, and gravel, which contains the gold. In the upper strata there are from fifty cents to two dollars to the cubic yard. The bed is of slate rock, and the banks are from fifty to three hundred feet high; but there are few places where they have been examined, for nowhere has all the gravel been washed away across the channel.

But how was it possible that the bed of a large river could be filled three hundred feet deep with gravel? When the miners in 1850, 1851, and 1852, flumed the live rivers of California, and took the gold from their beds, they found a deposit of gravel that did not average more than five feet deep on the bedrock, in streams that ran in cañons one thousand feet deep; and it is strange that the Big Blue should have filled its bed with gravel. Yet this filling up is not without an analogue in our day. Under the influence of hydraulic washing, Bear River and Yuba River have, within the last fifteen years, begun to fill up with gravel, and their beds have, for miles, risen seventy feet or more above the levels of 1853. This gravel is auriferous, and it is deposited in strata, and the arrangement and general appearance resemble those of the Big Blue Lead. The filling up began down in the valley, and as it ascended the current became less rapid, and lost the power to carry away the gravel. In Bear River, below Dutch Flat, the bed rises two feet per month during the chief washing season, from February to September, and in the remaining four months it falls on account of the stoppage of washing, and of the winter floods which carry away perhaps half of the accumulation of the summer. Some persons claim that various camps on parts of dead rivers in Plumas County are on the Big Blue Lead, and others think that portions of a dead river, near Placerville, belong to the same stream. I do not accept these theories, but if they are true, the Big Blue River has been traced about one hundred and ten miles. In the northern part of Plumas County the river is buried under deep beds of lava and basalt, and south of Placerville it is probably below the level of the live streams, and thus cannot be found by any system of mining or mode of prospecting now in use. Even in places where it is above the level of the live streams it may be covered on the sides of the cañons by slides of rock or of barren dirt or gravel, and the miner might spend thousands of dollars in a vain search for treasures not ten feet from his drift, as many have done, and some accident, luck, or perseverance afterwards proved the proximity of the rich deposit. In several cases the lead was found by calculation. The miner took his position on a hillside, on a line and on a level with other mining camps, and in a few days he found a fortune; and others have spent years working on a similar plan without success. The river must have taken bends on the north side of Rock Creek and Oregon Ravine, and twelve years of searching have not revealed the position of the bends. But why did the Big Blue River die, and leave nothing but its gravel and its gold to tell the story of its existence and of its greatness? The main cause must have been the subsequent rise of the Sierra Nevada. Suppose that a range of mountains, seven thousand feet high, were upheaved thirty miles east of the Mississippi; that the bed of that stream were on the mountain side three thousand feet above the sea, and that thirty miles west the country retained its present level; the result would be that the present Mississippi would soon be a dead river; it would be cut across by streams running down the mountain side, and pouring into a new Mississippi, thirty miles or more west of the present one. We know that the Sierra Nevada has been upheaved; that a large stream ran on what is now the mountain side, and that it has been succeeded by a new river farther west, and we must infer that the death of the old and the birth of the new river were caused by the upheaval.

Many of the hills crossed by the Big Blue are capped with lava and basalt, which covered much of the country from near the summit of the range to about three thousand feet above the sea. It seems then that the river filled its bed with gravel; the mountains began to rise, and volcanoes broke out along the divide; the lava ran down and covered the land to the line of the dead river and beyond it; the mountains rose still higher, and the waters running down their sides cut through the lava and made deep cañons, and washed away two thirds or three fourths of the dead river, and scattered its gold among the living waters. The descent of thirty-three feet per mile observed between Little Grizzly and Forest Hill would make a terrific current in a stream half a mile wide. The Sacramento is a lively river, yet its grade is only five feet in a mile. But no ordinary current could have carried the large quartz bowlders of the Big Blue Lead from distant regions and distributed them evenly over the river bed. It is possible, however, that in the lifting up of the mountains the relative elevations have been altered, and that the present grade differs from that of the Big Blue while it was alive.

A question suggests itself whether the great dead river was the predecessor of any live

stream; but to this no satisfactory answer can now be given, and it is doubtful whether time and research will ever furnish one. The Big Blue was parallel to the Sacramento, and has, to a certain extent, been succeeded by it; but it drained a much larger district than the Sacramento does, or the rainfall of the country was much greater in the era of its exisence. The Sacramento does not carry one fourth of the water which ran in the Big Blue—probably not one tenth. If we could ascertain that the quantity of rain had not altered, then we would be justified in presuming that the Columbia River, which would about fill the bed of the Big Blue, instead of turning westward at Walla Walla, originally continued southward, until the lifting up of Shasta and Lassen, and the adjacent ridges, stopped its course and compelled it to break through the Cascade Range at the Dalles. With our present limited knowledge we are not justified in calling the Big Blue River either the Dead Sacramento or the Dead Columbia.

Some persons have argued that the Big Blue Lead was never a river, but only a lacustrine or alluvial deposit. This theory, however, is untenable. The Big Blue Lead has all the marks which a dead river should have. It has a long course, a width nearly uniform, a course nearly straight, some bends with eddies on the inner side, a peculiar quartz, unlike any found in the neighboring ridges, or in the streams to the eastward, and abundance of quartz which no place now known to us could have supplied, and which came, probably, from a distant northern region, now covered with lava; water-worn gravel, which must have been carried far; flat stones, pointing down stream, as a current would place them; strata of coarse and fine gravel, which must have been deposited in a stream; a uniform descending grade; the coarse particles of gold, which could not have been distributed so evenly over a wide channel, except in a strong current; an immense quantity of gold, which required ages to scatter through a deposit three hundred feet deep; driftwood, unmistakably water-worn; trunks of trees, with the butts up stream; tributary brooks, and a number of other evidences, which would require more space for their description and explanation than I could spare. To say that the Big Blue is not a dead river is equivalent to saying that the bones of the mastodon never belonged to a living animal, but were formed under geological influences exclusively.

If this were the only dead river in the State, the proof would be less conclusive; but there are a dozen others. One, which runs southwestwardly, and may be called the Dead Brandy River, appears at La Porte, Brandy City, Camptonville, and North San Juan, and is marked by the same general characteristics, save that the gravel is finer, the pebbles in the upper strata being generally not larger than a pigeon's egg.

In Tuolumne and Calaveras Counties we have the Dead Stanislaus, or Tuolumne Table Mountain, which runs from near Silver Mountain, in Alpine, to Knight's Ferry, and there disappears. It is covered by a bed of basalt, which flowed as lava from a volcano and filled up the ancient bed; and this basalt has resisted the wear of the elements, and now stands as a mountain forty miles long, a quarter of a mile wide, and eight hundred feet high, the softer adjacent slate rock having been wasted and washed away. Under this mountain lies a dead river rich in gold. A similar table mountain of basalt, covering an auriferous dead river, which I call the Dead Cherokee, after its chief mining camp, extends seventy miles from Lassen's Peak to Oroville. At Bangor, in Butte County, is a small dead river, seventy feet below the general surface of the ground, and covered with ordinary soil and gravel. There are also dead rivers at Smartsville, Mokelumne Hill, and San Andreas. The Big Blue and the Dead Brandy are distinguished by the depth of their gravel and by the absence of pebbles of eruptive origin in it; and others have either short courses or shallow deposits of gravel; and the quartz forms a much smaller percentage of the gravel. In the dead rivers at Cherokee, Bangor, and Smartsville, a large proportion of the bowlders and pebbles is of lava and basalt, as if the streams had been formed after the commencement of the volcanic era. But different as is the material of the gravel, the fluvial origin of the deposits is similar and indubitable in all of them, when they are studied together.

SIERRA BUTTES MINE.

This property, in the Sierra City Mining District, is situated on the southern slope of the Sierra Buttes Mountain, whose peaks rise 4,700 feet above the lower works, and 8,800 feet above sea level. The altitude of the croppings is 6,400 feet, and that of the lower tunnel is 4,100 feet. The dimension of the claim is 11,000 feet in length by 600 feet in width; the vein has a general east and west direction, with a dip to the north of 41°, and averaging in width 20 feet. Work was first begun on the mine in 1850, and has been unremitting in dividends up to the present date. There are two water-power wet-crushing mills on the property, of 50 and 60 stamps, respectively; but only one, that of 60 stamps, is being used at present. The stamps weigh 850 pounds, fall 8 inches, strike 86 times per minute, and each stamp crushes $2\frac{1}{3}$ tons of ore every 24 hours. The water supply, drawn from several lakes, is brought around the mountain-side, a distance of $7\frac{1}{2}$ miles, in flumes to the mine. The main flume, 7

miles in length, is fed by several tributaries, which tap the sources of supply. The sulphurets are collected on the Frue vanner, and are treated at the company's works by the chlorination process. The property is now, and has been since 1870, owned and worked by an English company. The mine is worked through a series of nine tunnels.

Altitude of croppings, feet	6,400
Altitude of lower tunnel, No. 9, feet	4,100
Number of stamps working	60
Weight of stamp, in pounds	850
Drop of stamps, in inches	8
Drop of stamps, per minute	86
Duty of stamp in 24 hours, tons crushed	$2\frac{1}{3}$
Size of screens, slot	7
Width of apron plates, in feet	4
Width of sluice plates, in inches	15
Total length of plates, in feet	240
Number of concentrators	24
Miner's inches of water used	320
Pressure of water varies, in feet	60–620
Cost of mining, including dead work, per ton	$3 98
Cost of milling, per ton	$0 $37\frac{3}{4}$
Percentage of recovery saved in batteries	73
Percentage of recovery saved on plates	27
Percentage of sulphurets	$\frac{1}{2}$
Value of sulphurets, variable, per ton	$90 00–550 00
Cost per ton of treating sulphurets	$16 40
Average width of vein, in feet	20
Number of men in mine	210
Number of men in mill	10
Total number of men employed	290
Length of ore-shoots:	
Willoughby, feet	250
Tinney, feet	70
Bonanza, feet	210
Mammoth, feet	800
Length of No. 6 tunnel, in feet	4,850
Length of No. 7 tunnel, in feet	5,050
Length of No. 8 tunnel, in feet	5,200
Length of No. 9 tunnel, in feet	7,200

THE YOUNG AMERICA CONSOLIDATED MINING COMPANY.

The company's property is in Sierra City Mining District, about seven miles north of Sierra City, and has an altitude of 7,400 feet above the sea. The consolidation is 6,000 feet in length by 500 feet wide. The vein has an easterly and westerly course, a northerly dip of 45°, and averages $5\frac{1}{2}$ feet in width. The formation of the hanging-wall is diabase, the same in character as that which formed the hanging-wall of the rich auriferous shoot in the Eureka Mine at Grass Valley; also identical with the rocks forming the walls of the richest mines in Venezuela.

The mill occupies a site 3,200 feet from the mine—in this distance the perpendicular height of the mine above the mill is 900 feet. The ore is conveyed to the mill by an elevated tramway in buckets of 100 pounds capacity. At present it requires the work of two men to fill the buckets in transit, but that duty will soon be performed automatically by an invention of Mr. Busch, the foreman of the mine. The consolidation contains within its environs four lakes—the smaller one, three fourths of a mile below the mill, is used to impound the tailings; the higher one, directly under the snow-capped Buttes, feeds the waters of the melting snow to the reservoir, which furnishes the mill with power. The gross proceeds of the mine and mill, for the year ending August 15, 1886, amounted to $294,000. For the first three months of the year there were but ten stamps, then ten more were added, making a crushing capacity of

20 stamps up to July 6, 1886; then an additional ten were put in place, and lastly, on August 18, forty stamps were dropping on the quartz of the mine. Owing to the favorable location, this mine can be opened by tunnels to a depth of about 1,600 feet. During the year the company has built a dam, separating the two larger lakes, 175 feet long, 25 feet high, and 52 feet at the base, at a cost of $8,000.

Altitude, feet	7,400
Number of stamps	40
Weight of stamp, in pounds	750
Drop of stamps, in inches	7
Drop of stamps, per minute	80
Duty of stamp in 24 hours, tons crushed	2
Average width of vein, in feet	5½
Size of screens, slot	7
Width of apron plates, in inches	48
Width of sluice plates, in inches	15
Total length of plates, in feet	800
Miner's inches of water used, per diem	30
Pressure of water, in feet	230
Cost of mining, per ton	$2 00
Cost of milling, per ton	$0 75
Percentage of recovery saved in batteries	95
Percentage of recovery saved on plates	5
Number of men in mine	50
Number of men in mill	8
Total number of men employed	90
Length of No. 1 tunnel, in feet	960
Length of No. 2 tunnel, in feet	1,160
Length of No. 3 tunnel, in feet	75
Depth of shaft on incline to No. 2 tunnel, feet	606
Length of ore-shoot, so far as explored, in feet	625

ALASKA MINE,

Is located at Pike City, at an altitude of 3,800 feet above sea level, and is one of the most prosperous mines in the county. The course of the vein is northeast and southwest, averaging 3 feet in width, with nearly a vertical dip. The claim is 4,200 feet, linear measurement, and is worked through a shaft 457 feet in depth. Levels are run at a depth of every 100 feet, the two longest being 2,000 feet each in length, and are still being extended. The developments made during the year are 1,500 feet of levels and 300 feet of upraises. Formation of the foot-wall is slate, and of the hanging-wall, slate and porphyry. The mill is 40-stamp, run by steam. Each stamp weighs 850 pounds, falls 7 inches at the rate of 86 times per minute, and crushes 2¼ tons every 24 hours. The apron plates are 30 by 52 inches, sluice plates 24 inches wide by 14 feet in length to each battery, pitching 1¼ inches to the foot.

The sulphurets are principally iron pyrites, but not of sufficient value to save; 65 per cent of the yield is saved in the batteries, and 35 per cent is collected on the outside plates.

Altitude, feet	3,800
Number of stamps	40
Weight of stamp, in pounds	850
Drop of stamps, in inches	7
Drop of stamps, per minute	86
Duty of stamp in 24 hours, tons crushed	2¼
Size of screens	No. 6
Cost of mining, per ton	$3 50
Cost of milling, per ton	$0 75
Percentage of recovery saved in batteries	65
Percentage of recovery saved on plates	35
Number of men in mine	70

Number of men in mill	9
Total number of men employed in and about mine	100
Vertical depth of shaft, in feet	457
Average width of vein, in feet	3
Length of ore-shoot, in feet	2,000

TUOLUMNE COUNTY.

KELTZ GOLD QUARTZ MINE.

This property, occupying an altitude of 2,000 feet above sea level, in Tuolumne Mining District, is in a slate formation, of which both walls have the same character. The claim has an area of 1,500 feet by 600 feet; and the course of the vein is northeast and southwest, with an easterly dip from 30–40 degrees, and is about 2 feet wide. The ore is reduced in a 10-stamp water power mill, and 85 per cent of the gold recovery is saved in the batteries, whilst 15 per cent is collected on the outside plates. The sulphurets, averaging in value $200 per ton, are saved by the Cornish buddle; but the cost of extracting the gold is not yet known, as the concentrations are, for the present, held in reserve. The outside plates, two to each battery, are 14 inches wide by a total length of 48 feet, and an inclination of 1 inch in 14 inches.

Altitude, feet	2,000
Number of stamps	10
Weight of stamp, pounds	650
Drop of stamps, in inches	6
Drop of stamps, per minute	85
Duty of stamp in 24 hours, tons crushed	1
Size of screen, slot No.	9
Miner's inches of water used in mill in 24 hours	12
Pressure of water, in feet	500
Cost of mining, per ton	Not given.
Cost of milling, per ton	$0 75
Percentage of recovery saved in batteries	85
Percentage of recovery saved on outside plates	15
Percentage of sulphurets	2
Value of sulphurets, per ton	$200 00
Number of concentrators	1
Number of men in mine	12
Number of men in mill	2
Average width of vein, in feet	2
Length of ore-shoot, in feet	400
Length of adit level, in feet	355
Depth of shaft, in feet	300

SOULSBY GOLD QUARTZ MINE.

The mine is situated in Tuolumne Mining District, at an altitude of 2,880 feet above the level of the sea, in a granite formation, both walls being of the same. The claim is 3,200 feet, linear measurement. The course of the vein is north and south and almost vertical, but at times dipping slightly to the east, and is 12 inches wide. The percentage of sulphurets is very variable, sometimes reaching as much as 20 per cent, although the assay value seldom changes from about $50 per ton. The method of saving the sulphurets is in the Morris canvas-covered sluices, after which they are worked for the gold by pan amalgamation. The cost of extraction and the percentage recovered are not given.

The batteries save 90 per cent and the outside plates 10 per cent of the yield of free gold. For the collection of gold on the outside there is a double run of electro-silvered copper plates, 16 inches wide, with a total length of 32 feet and an inclination of 1 inch in 14.

Altitude, feet	2,880
Number of stamps	15
Weight of stamp, in pounds	750
Drop of stamps, in inches	6
Drop of stamps, per minute	85
Duty of stamp in 24 hours, tons crushed	1
Size of screen, brass wire	60
Miner's inches of water used in mill in 24 hours	50
Pressure of water, in feet	350
Cost of mining, per ton	Not given.
Cost of milling, per ton	$0 75
Percentage of recovery saved in batteries	90
Percentage of recovery saved on plates	10
Number of men in mine	30
Number of men in mill	3
Average width of vein, in feet	1
Depth attained by deepest shaft, in feet	730

THE BUCHANAN MINE.

The property consists of a consolidation of four claims, each 600 feet wide by a length of 1,500 feet. Both walls are schist, but at the lower level the hanging wall is a dyke—probably a diorite. The course of the vein is north, 70° east, and dips from 53° to 64° northeast; the average width being about 5 feet. The mine is worked to a depth of 500 feet, through an almost vertical shaft. The mill, containing 20 stamps, is run by steam power; the stamps weigh 850 pounds each, have a fall of from 7 to 7½ inches 90 times a minute, and crush, each, 2 tons of ore every 24 hours. Two of the batteries contain inside plates, where two thirds of the gold yield is recovered from the 10 stamps; the other 2 batteries do not contain inside plates. Of the outside plates the upper ones are 4 feet wide by 6 feet long, with an inclination of 5°, and are made of soft copper. The lower plates are 3 feet 8 inches wide, and, together with the upper plates, form a total length, to each battery, of 10 feet 11 inches, with an inclination of 6°. Seven inches below the lower end of the plates, are movable soft copper-lined boxes, 7 inches wide by 20 inches in length, and 1 inch deep. Following are troughs, inclining 5°, with silvered plates, 18 inches wide by a length of 16½ feet. The pulp on leaving the plates flows into the movable boxes, and thence into the sluices. Between the upper and lower plates there is a wooden space, 2½ inches wide.

Number of stamps	20
Weight of stamp, in pounds	850
Drop of stamps, in inches	7–7½
Drop of stamps, per minute	90
Duty of stamp in 24 hours, tons crushed	2
Size of screens, No.	8
Percentage of recovery saved in batteries	2/3
Percentage of recovery saved on outside plates	1/3
Percentage of sulphurets	1
Value of sulphurets per ton,	$120 00—$260 00
Number of concentrators, Frue	8
Number of men in mine	9–15
Number of men in mill	7
Length of ore-shoot, in feet	200
Depth of shaft, in feet	500

TABULAR STATEMENT OF MILLS.

Name and Locality of Mill.	Water or Steam Power	No. of Stamps.	Weight of each Stamp, pounds.	Drop of Stamps in Inches	Drop of Stamps per Minute	Number of Tons Crushed per Stamp in 24 hours	Number of Screens.
Amador County.							
Plymouth Consolidated.	Water	80	750	7	90–100	Av. 2	
Plymouth Consolidated.	Water	40	1,000	7	90–100		
Keystone	Water	40	750	7–8½	96	2½	8 slot.
South Spring Hill	Water	20	750	6–7	90	2½	7 slot.
Stewart	Water	40	850	7	85	4½	6 slot.
Moore	Water	10	850	7	90	3	6 slot.
Downs	Water	20	600	8	85	1¼	9 and 10 slot.
Mammoth Tunnel	Water	10	750	8	90	2½	6 slot.
Zeile	Water	40	750	7½	87–88	3 37/100	4 slot.
Calaveras County.							
Stickles	Water	20	900	7	80	3¾	9 slot.
Utica	Water	20	950	8–9	80	3	9 slot.
Deep Lead	Water	8	750	9	85–87	Carloads, 5	5 mesh.
Sheep Ranch	Steam	30	800	8	85	2¼	9 slot.
Fine Gold	Water	10	750	6	100	2 1/10	40 mesh.
Oro Plata, stamps	Water	15	750	6–8	96	2 6/10	5 slot.
Oro Plata, Tustin Mill*	Water						20 mesh.
El Dorado County.							
Springfield	Water	15	600	9	90	1¾	
Fresno County.							
Abbey	Steam	10	800	5	96	2	9 slot.
Nevada County.							
North Star	Water	20	850	7	90	2	Experimenting.
Idaho	Water	35	850	9	72	2 85/100	5 slot.
Empire	Water	40	850	7	95	2	Experimenting.
Providence	Water	40	750	6–8	93	2	5 round punched.
Con. Wyoming	Water	16	800	7	92	2	
Nevada City	Water	20	750	7–9	93	1¾	5 round punched.
Delhi	Water	8	1,000	6	94	3½	5 round punched.
Eagle Bird	Water	20	750	6–7	95	1½	40 mesh.
Spanish †	Water						6 slot.
Sierra County.							
Sierra Buttes	Water	60	850	8	86	2⅔	7 slot.
Young America	Water	40	750	7	80	2	7 slot.
Alaska	Steam	40	850	7	86	2¼	6 slot.
Tuolumne County.							
Soulsby	Water	15	750	6	85	1	60 brass wire.
Keltz	Water	10	650	6	85	1	9 slot.
Buchanan	Steam	20	850	7–7½	90	2	8 slot, 8 wire.

* Four mills; revolutions per minute, 20; number of tons crushed per mill in 24 hours, 10–11.
† Four Huntington Mills; revolutions per minute, 60; number of tons crushed per mill in 24 hours, 30.

CONCLUSION.

The Mining Bureau having received so many inquiries for a description of the mining machinery in use at the mines, the State Mineralogist deemed it necessary to make himself acquainted with the practical details thereof by personal inspection as far as possible, and by contribution where circumstances would not admit of individual attention. All of the information has been carefully gathered, and that portion pertaining to the inquiries received at the Bureau has been especially tabulated

One of the chief difficulties, for reasons heretofore given, has been to collect a correct statement of the value per ton of the ore worked at the mills; therefore mention is only made of that of the smallest assay value to show how low a grade can be profitably treated when done systematically.

Since the report has been made ready for the press there has been received at the Bureau the "Mines Statement of the Minister of Mines of New Zealand," from which the following is an extract:

"During my occupancy of the office I have the honor to hold in connection with mines, I have felt the want of a hand-book that, at a glance, would give to the inquirer every information in respect to mining companies and claims, the mode of working, and the class of machinery used in different mining districts, the area of ground, the number of miners employed, and the amount of capital invested in plant and machinery.

"Following my instructions the Department has been engaged in collecting material necessary for compiling such work, and, when ready, I propose to issue illustrative maps with it, so that it will afford every possible information in relation to the industry. I cannot pretend that I shall be able to present for information a perfect work or guide, for difficulties have already been encountered in collecting reliable materials on which to frame the book; but, notwithstanding, I hope within a few months to be able to supply a much needed want."

It would seem from the above that the same difficulties in obtaining information exist elsewhere, and that the identical requests were made as have been received at the Bureau; therefore for these reasons the State Mineralogist has deemed it advisable to add to his report the contributions annexed, also inserting the United States mining laws and regulations thereunder for ready reference, and other matter and tables which are constantly needed.

BULLION PRODUCTION OF MINES OF CALIFORNIA,

For the twelve months ending January 1, 1886.

(Combined reported and unreported production, from the Report of the Director of the Mint, 1885.)

County.	Gold.		Silver.		Total.
	Reported.	Unreported.	Reported.	Unreported.	
Amador	$1,835,591 23	$310,000 00	$406 40		$2,145,997 63
Butte	422,568 50	250,000 00		$3,700 00	676,268 50
Calaveras	397,538 23	130,000 00	2,558 20		530,096 43
Colusa	40,000 00		5,000 00		45,000 00
Del Norte	24,390 00	15,000 00	9 18		39,399 18
El Dorado	383,353 85	35,000 00			418,353 85
Fresno	67,500 00	7,000 00	2,456 00		76,956 00
Humboldt	20,130 37	9,600 00			29,730 37
Inyo	7,498 04	17,500 00	59,961 49	13,500 00	98,459 53
Kern	22,003 00	50,000 00			72,003 00
Lassen	7,500 00	7,500 00	150 00		15,150 00
Los Angeles		22,500 00	445 00	1,500 00	24,445 00
Mariposa	87,177 00	62,000 00	100 00		149,277 00
Merced		10,000 00			10,000 00
Modoc		60,000 00			60,000 00
Mono	477,860 41	5,000 00	88,349 49	3,500 00	574,709 90
Napa			5,000 00		5,000 00
Nevada	1,138,873 68	1,439,000 00	4,835 43		2,582,709 11
Placer	507,801 51	398,500 00	411 43		906,712 94
Plumas	688,307 71	152,000 00			840,307 71
Sacramento	253,522 00	100,000 00			353,522 00
San Bernardino	3,000 00	20,000 00	2,283,436 37	80,000 00	2,386,436 37
San Diego	71,125 00	20,000 00		2,000 00	93,125 00
San Joaquin		2,500 00			2,500 00
Shasta	236,004 75	181,000 00	9,123 38	100,000 00	426,228 13
Sierra	1,060,380 97	373,500 00	10 54		1,433,891 51
Siskiyou	119,658 70	219,000 00			338,658 70
Stanislaus	18,660 00				18,660 00
Trinity	175,347 69	162,800 00	10 00		338,157 69
Tulare		7,500 00			7,500 00
Tuolumne	149,503 34	171,400 00	1,273 00	200 00	322,376 34
Yuba	132,448 73	75,000 00			207,448 73
Totals	$8,347,744 71	$4,313,300 00	$2,463,535 91	$104,500 00	$15,229,080 62

NUMBER OF INCORPORATED COMPANIES.

From the Government Roster issued by the Hon. Thomas L. Thompson, Secretary of State, it appears that from July 1, 1884, to July 1, 1886, there were filed in his office two hundred and six (206) articles of incorporation of companies for mining and milling purposes.

U. S. PATENTS.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFICE,
WASHINGTON, D. C., November 13, 1886.

HENRY S. DURDEN, *Esq., Acting Secretary State Mining Bureau, San Francisco, California:*

SIR: I am in receipt of your letter of the twenty-eighth ultimo, requesting the total number of mines in the State of California for which patents have been issued.

In reply, I refer you to the following table showing the number of mineral and coal patents issued for claims in the State of California up to this date, as compiled from the records of this office:

Sacramento Land District	870
Stockton Land District	273
Susanville Land District	18
Shasta Land District	135
San Francisco Land District	87
Marysville Land District	162
Visalia Land District	18
Bodie Land District	152
Los Angeles Land District	43
Humboldt Land District	51
Total number of mines patented in the State of California	1,809

Very respectfully,

WM. A. I. SPARKS,
Commissioner.

HYDRAULIC MINES ENJOINED.

C. E. Sexey, Esq., of the Anti-Debris Association, has furnished the State Mineralogist with a partial list, showing twenty-three hydraulic mines which have been enjoined.

WELLS, FARGO & CO.'S STATISTICS.

WELLS, FARGO & COMPANY,
SAN FRANCISCO, December 31, 1886.

DEAR SIR: The following is a copy of our annual statement of precious metals produced in the States and Territories west of the Missouri River (including British Columbia, and receipts by express from the west coast States of Mexico) during 1886, which shows aggregate products as follows: Gold, $30,773,759; silver, $53,776,055; copper, $9,276,755; lead, $9,185,192. Total gross result, $103,011,761.

As stated hitherto, the facilities afforded for the transportation of bullion, ores, and base metals, by the extension of railroads into mining districts, increase the difficulty of verifying the reports of the products from several important localities; and the general tendency is to exaggeration when the actual values are not obtainable from authentic sources; but the aggregate result, as shown herein, we think may be relied on with reasonable confidence as approximately correct.

States and Territories.	Gold Dust and Bullion by Express.	Gold Dust and Bullion by other Conveyances.	Silver Bullion by Express.	Ores and Base Bullion by Freight.	Total.
California	$12,579,356	$628,678	$918,403	$563.948	$14,690,385
Nevada	1,739,959	----------	5,502,596	1,927,365	9,169,920
Oregon	451,907	250,000	1,310	----------	703,217
Washington	139,694	25,000	----------	----------	164,694
Alaska	394,975	50,000	----------	----------	444,975
Idaho	1,816,500	300,000	2,602,000	3,015,000	7,733,500
Montana	2,100,000	500,000	7,840,000	10,400,000	20,840,000
Utah	19,140	----------	3,080,759	5,531,696	8,631,595
Colorado	3,500,000	----------	5,750,000	15,750,000	25,000,000
New Mexico	104,784	50,000	279,909	3,387,178	3,821,871
Arizona	583,827	100,000	1,371,083	4,048,468	6,103,378
Dakota	2,405,250	200,000	251,437	----------	2,856,687
Mexico (west coast States)	469,490	----------	1,627,204	12,000	2,108,694
British Columbia	692,845	50,000	----------	----------	742,845
	$26,997,727	$2,153,678	$29,224,701	$44,635,655	$103,011,761

The gross yield for 1886, shown above, segregated, is approximately as follows:

Gold	$29\frac{87}{100}$	$30,773,759
Silver	$52\frac{21}{100}$	53,776,055
Copper	$9\frac{00}{100}$	9,276,755
Lead	$8\frac{92}{100}$	9,185,192
Total		$103,011,761

Annual Products of Lead, Copper, Silver, and Gold in the States and Territories West of the Missouri River, 1870–1886.

Year.	Production, as per W. F. & Co.'s statements, including Amounts from British Columbia and West Coast of Mexico.	Product after deducting Am'ts from British Columbia and West Coast of Mexico.	The Net Product of the States and Territories West of the Missouri River, exclusive of British Columbia and West Coast of Mexico, divided, is as follows:			
			Lead.	Copper.	Silver.	Gold.
1870	$54,000,000	$52,150,000	$1,080,000	----------	$17,320,000	$33,750,000
1871	58,284,000	55,784,000	2,100,000	----------	19,286,000	34,398,000
1872	62,236,959	60,351,824	2,250,000	----------	19,924,429	38,177,395
1873	72,258,693	70,139,870	3,450,000	----------	27,483,302	39,206,558
1874	74,401,045	71,935,610	3,800,000	----------	29,699,122	38,466,488
1875	80,889,057	76,703,433	5,100,000	----------	31,635,239	39,968,194
1876	90,875,173	87,219,859	5,040,000	----------	39,292,924	42,886,935
1877	98,421,754	95,811,582	5,085,250	----------	45,846,109	44,880,223
1878	81,154,622	78,276,167	3,452,000	----------	37,248,137	37,576,030
1879	75,349,501	72,688,888	4,185,769	----------	37,032,857	31,470,262
1880	80,167,936	77,232,512	5,742,390	$898,000	38,033,055	32,559,067
1881	84,504,417	81,198,474	6,371,902	1,195,000	42,987,613	30,653,959
1882	92,411,835	89,207,549	8,008,155	4,055,037	48,133,039	29,011,318
1883	90,313,612	84,639,212	8,163,550	5,683,921	42,975,101	27,816,640
1884	84,975,954	81,633,835	6,834,091	6,086,252	43,529,925	25,183,567
1885	90,181,260	87,311,382	8,562,991	7,838,036	44,516,599	26,393,756
1886	103,011,761	100,160,222	9,185,192	9,276,755	52,136,851	29,561,424

The exports of silver during the past year to Japan, China, the Straits, etc., have been as follows: From London, $26,519,328; from Marseilles, $956,650; from Venice, $——; from San Francisco, $16,558,612. Total, $44,034,590, as against $56,109,949 last year. Pounds sterling estimated at $4 84.

UNITED STATES OF MEXICO.

Product of Gold and Silver in the Republic of Mexico from 1877 to 1886.

Years.	Gold.	Silver.	Total.
1877–1878	$661,385	$21,451,785	$22,113,170
1878–1879	662,524	21,405,330	22,067,854
1879–1880	474,632	23,383,448	23,858,080
1880–1881	380,301	23,583,135	23,963,436
1881–1882	382,752	24,009,525	24,392,277
1882–1883	380,419	22,921,921	23,302,340
1883–1884	420,000	24,240,000	24,660,000
1884–1885	385,000	25,037,356	25,422,356
1885–1886	450,000	26,000,000	26,450,000
Totals	$4,197,013	$212,032,500	$216,229,513

Exhibit of Coinage of Gold, Silver, and Copper in the Republic of Mexico, from the first of July, 1872, to the thirtieth of June, 1886, indicating approximately the Precious Metal product of the country for the years named.

Years.	Gold Dollars.	Silver Dollars.	Copper Dollars.
1872–1873	813,415	19,680,811	22,814
1873–1874	866,743	18,846,067	15,966
1874–1875	862,619	19,386,958	21,712
1875–1876	809,401	19,454,054	30,654
1876–1877	695,750	21,415,128	9,035
1877–1878	691,998	22,084,203	41,364
1878–1879	658,206	22,162,987	16,300
1879–1880	521,826	24,018,528	14,035
1880–1881	492,068	24,617,395	42,258
1881–1882	452,590	25,146,260	11,972
1882–1883	407,600	24,083,921	----------
1883–1884	355,724	22,812,000	----------
1884–1885	312,600	23,265,814	----------
1885–1886	425,000	25,850,000	----------
Totals	8,449,164	317,964,419	226,110

SUMMARY—TOTALS.

Gold	$8,449,164
Silver	317,964,419
Copper	226,110
Grand total	$326,639,693

Exhibit of the Coinage of Mexico from the Establishment of the Mints in 1537 to the end of the Fiscal Year of 1884–1885.

Dates of Coinage.	Gold.	Silver.	Copper.	Total.
Colonial Epoch.				
Unmilled coin from 1537 to 1731	$8,497,950	$752,067,456	$200,000	$760,765,406
Pillar coin, 1732 to 1771	19,889,014	441,629,211		461,518,225
Bust coin, 1772 to 1821	40,391,447	888,563,989	342,893	929,298,329
Totals	$68,778,411	$2,082,260,656	$542,893	$2,151,581,960
Independence.				
Iturbide's Imperial bust, 1822–1823	$557,392	$18,575,569		$19,132,961
Republic eagle, 1824 to June 30, 1873	45,040,628	740,246,485	$5,235,177	790,522,290
Totals	$45,598,020	$758,822,054	$5,235,177	$809,655,251
Republic.				
Eagle coin, July 1, 1872, to June 30, 1886	$8,449,164	$317,964,419	$226,110	$326,639,693

SUMMARY.

Colonial epoch, from 1537 to 1821	$2,151,581,960
Independence, from 1822 to 1872	809,655,251
Republic, from 1872 to 1886	326,639,693
Total	$3,287,876,904

The exhibits of production and mintage indicate a steady development of the mining interests of the United States of America, and also of Mexico, and with the increasing facilities of railway communications fostering every department of industry, the outlook for a continued growth in the product of precious metals is flattering.

JOHN J. VALENTINE,
Vice-President and General Manager Wells, Fargo & Co.

SAN FRANCISCO MINT.

COINAGE OF THE SAN FRANCISCO MINT FOR THE YEAR ENDING JUNE 30, 1886.

Gold, 1,455,550 standard ounces	$27,080,000 00
Silver, 42,051$\frac{32}{100}$ standard ounces	49,066 20
Total value	$27,129,066 20

TABLE OF CHARGES.

Mint of the United States at San Francisco, on all bullion (or coin) not required to be parted or refined:

For each melt of 1,000 ounces or less	$1 00
For each melt over 1,000 ounces	One tenth of 1 cent per ounce.

PARTING AND REFINING CHARGES.

PARTING GOLD AND SILVER OR REFINING GOLD.

Rate per ounce gross.

Bullion containing less than 200 M gold	2 cents.
Bullion containing from 200 M to 399½ M gold	3 cents.
Bullion containing from 400 M to 699½ M gold	4 cents.
Bullion containing 700 M and over gold	6 cents.
Bullion containing over 100 M base metal, additional	½ cent.

And in addition to the above, on deposits requiring parting (except silver purchases) or refining gold:

For each deposit of 1,000 ounces or less	$1 00
For each deposit over 1,000 ounces	One tenth of 1 cent per ounce, gross.

For gold coin or standard gold bars the rate per ounce charged will be imposed only on the number of ounces required to be refined to raise the whole to standard.

Silver allowed the depositor is calculated on the basis of refining the gold to 990 M.

REFINING SILVER.

Rate per ounce, gross.

Bullion containing less than 897 M silver	2 cents.
Bullion containing 897½ M to 979½ M silver	1½ cent.
Bullion containing 980 M to 997 M silver	1 cent.

In addition to the above, on silver deposits requiring refining (except purchases) a charge on each deposit of—

1,000 ounces or less	$1 00
Over 1,000 ounces	One tenth of 1 cent per ounce, gross.

For standard or sterling bars the rate per ounce will be imposed only on the number of ounces required to be refined to raise the whole to the fineness of such bars.

Silver bullion below 997½ fine, not containing gold, deposited for fine bars, is subject to a refining charge.

Silver bullion deposited for bars, will be computed at $1 per standard ounce. Silver parted from gold deposits will be purchased at the rate fixed by the Director of the Mint, which at present, per ounce, is,

TOUGHENING CHARGE.

Gold bullion	½ to 2 cents per ounce, gross.
Silver bullion	¼ to 1 cent per ounce, gross.

ALLOY CHARGE.

On the number of ounces of copper required to reduce the bullion to a standard, 2 cents per ounce, Troy.

BAR CHARGE.

On bullion deposited for fine bars not required to be parted or refined, and for standard, sterling, or unparted bars:

Bars of fine gold, per $100 value	10 cents.
Bars of standard gold, per $100 value	10 cents.
Bars of fine silver, per ounce	¼ cent.
Bars of standard silver, per ounce, standard	½ cent.
Bars of sterling silver, per ounce	½ cent.
Bars of unparted bullion, per ounce, gross	½ cent.

No deposit of bullion is received of less than one hundred dollars, or so base as to be deemed unsuitable for the operations of the Mint.

TABLES FROM REPORT OF THE DIRECTOR OF MINT.

From the report of the Director of the Mint, upon the production of the precious metals in the United States, during the calendar year 1885, the following tables are published, from the compilation of the Treasury Department, Bureau of the Mint:

Statement showing the Value and Character of the Gold and Silver used in the Arts and Manufactures during the Calendar Year 1883, as reported by the persons and firms who had been addressed.

GOLD.

Manufactures.	Number Manufactur'g.	United States Coin.	Stamped United States or Refinery Bars	Old Jewelry, Plate, and other Old Material.	Foreign Coin.	Native Grains, Nuggets, etc.	Wire, or Rolled Plate.	Total Gold.
Watch-cases	32	$575,812	$2,976,550	$38,101	$1,508	$520	$5,817	$3,598,308
Watch-chains	14	374,997	286,884	1,907	600	135,410	27,202	827,000
Dental supplies	7	700	33,437	3,775	----------	----------	----------	37,912
Pens	14	14,578	90,325	6,100	5,227	2,134	27,560	145,924
Instruments	45	68	----------	3,568	----------	621	942	5,199
Leaf	51	178,424	792,551	57,498	6,816	6,700	42,835	1,084,824
Plate	219	379,291	67,928	5,500	590	8,933	66,626	528,868
Spectacles	41	192,400	7,169	8,830	1,315	4,987	727	215,428
Chemicals	27	7,438	7,685	3,551	550	207	12,180	31,611
Jewelry and watchmakers' supplies	11	24,498	13,983	9,123	----------	1,569	30,054	79,227
Jewelry and watches	2,273	3,125,738	2,861,149	738,688	177,794	541,306	458,745	7,905,163
Totals	2,734	$4,875,587	$7,137,661	$876,641	$194,400	$702,387	$672,688	$14,459,464

SILVER.

Manufactures.	United States Coin.	Stamped United States or Refinery Bars.	Old Jewelry, Plate, and other Old Material.	Foreign Coin.	Native Grains, Nuggets, etc.	Wire, or Rolled Plate.	Total Silver.	Total Silver and Gold.
Watch-cases	$35,200	$1,777,193	$31,937	$219	$1,000	$50	$1,845,599	$5,433,907
Watch-chains	524	14,768	----------	----------	6,790	1,462	23,544	850,544
Dental supplies	450	6,060	----------	----------	----------	228	6,738	44,650
Pens	216	4,254	100	1,655	505	----------	6,730	152,654
Instruments	931	3,752	693	755	864	6,995	13,990	19,189
Leaf	11	22,697	4,107	300	835	18,933	46,883	1,131,707
Plate	16,856	1,710,515	40,761	7,690	8,495	281,977	2,066,294	2,595,162
Spectacles	3,631	16,461	1,254	205	250	1,981	23,782	239,210
Chemicals	9	375,429	35,554	500	1,580	3,347	416,419	448,030
Jewelry and watchmakers' supplies	245	4,806	800	----------	1,505	975	8,331	87,558
Jewelry and watches	158,564	616,237	106,745	142,949	49,733	23,992	1,098,220	9,003,383
Totals	$216,637	$4,552,172	$221,951	$154,273	$71,557	$339,940	$5,556,530	$20,015,994

Statement showing Value and Character of the Gold and Silver used in the Arts and Manufactures during the Calendar Year 1885, as reported by the persons and firms addressed.

GOLD.

Manufactures.	Number Addressed.	Replied.	Manufacturing.	United States Coin.	Stamped United States or Refined Bars.	Foreign Coin.	Old Jewelry, Plate, and other Old Materials.	Native Grains, Nuggets, etc.	Wire or Rolled Plate.	Total.
Chemicals	341	219	39	$32,040	$13,903	----------	$6,063	$29	$4,341	$56,376
Platers	634	348	226	257,741	218,831	$801	178,510	24,295	15,537	695,715
Gold pen manufacturers	34	22	11	7,433	34,886	2,867	990	3,526	6,753	56,455
Gold and silver leaf	72	51	46	58,150	527,453	2,000	31,050	19,700	39,001	677,354
Dental and surgical instruments	154	98	47	3,970	149,186	100	14,942	2,400	4,188	174,786
Spectacles and opticals	383	217	79	52,707	62,420	642	16,269	314	2,291	134,643
Miscelleneous	106	73	27	116,604	44,168	8,000	17,337	1,000	3,835	190,944
Jewelry and watches	6,330	3,352	2,232	2,298,733	5,183,187	164,503	582,554	451,629	485,241	9,165,847
Totals	8,054	4,380	2,707	$2,827,378	$6,234,034	$178,913	$847,715	$502,893	$561,187	$11,152,120

SILVER.

Manufactures.	Number Addressed.	Replied.	Manufacturing.	United States Coin.	Stamped United States or Refined Bars.	Foreign Coin.	Old Jewelry, Plate, and other Old Materials.	Native Grains, Nuggets, etc.	Wire or Rolled Plate.	Totals.
Chemicals	----------	----------	----------	$91	$305,165	----------	$73,561	$106	$2,165	$381,088
Platers	----------	----------	----------	32,824	1,990,587	$25,434	43,191	12,798	157,922	2,262,756
Gold pen manufacturers	----------	----------	----------	55	3,191	----------	249	558	5	4,058
Gold and silver leaf	----------	----------	----------	----------	21,881	----------	708	20	23,512	46,121
Dental and surgical instruments	----------	----------	----------	4,682	107,717	1,401	7,057	4,450	2,494	127,801
Spectacles and opticals	----------	----------	----------	2,587	42,424	155	2,750	210	942	49,068
Miscellaneous	----------	----------	----------	838	5,330	----------	268	70	1,017	7,523
Jewelry and watches	----------	----------	----------	92,567	1,360,308	35,718	117,629	85,060	28,716	1,719,998
Totals	----------	----------	----------	$133,644	$3,836,603	$62,708	$245,413	$103,272	$216,773	$4,598,413

CONSUMPTION OF GOLD IN THE INDUSTRIAL ARTS IN THE UNITED STATES.

FISCAL YEAR.	Estimate of Director of the Mint. Consumption of United States Gold Coin.	Estimate by Mr. Muhleman, of consumption of Gold Coin and Bullion.
1874		$12,600,000
1875		12,900,000
1876		13,900,000
1877	*$30,000,000	15,300,000
1878		15,200,000
1879		15,900,000
1880		16,700,000
1881	3,300,000	17,800,000
1882	2,700,000	18,000,000
1883	2,500,000	17,500,000
1884	4,875,000	17,000,000
1885	5,000,000	15,600,000
Totals	$48,375,000	$188,400,000

*Includes short estimates for 1881–1882, and 1883.

*ANNUAL INDUSTRIAL CONSUMPTION OF GOLD AND SILVER BY THE PRINCIPAL NATIONS OF THE WORLD, FROM LATEST AUTHORITY.

COUNTRIES.	Population.	Gold. (Fine ounces.)	Value.
United States (Burchard)	58,000,000	626,925	$13,000,000
England (mean of several authorities)	36,000,000	546,550	11,500,000
France (Dumas)	37,000,000	401,875	8,600,000
Germany (Soetbeer)	45,000,000	385,800	8,200,000
Switzerland (Lardy)†	2,846,000	321,500	6,600,000
Austria-Hungary (Nibauer)	37,800,000	----------	----------
Other countries (Soetbeer)	230,000,000	450,100	9,500,000
Totals	446,646,000	2,732,750	$57,400,000

COUNTRIES.	Silver. (Fine ounces.)	Coining Value, $1.2929.	Total Value of Gold and Silver.	Per Capita.	
				Gold.	Silver.
United States (Burchard)	3,697,250	$4,000,000	$17,000,000	$0 22.4	$0 07
England (mean of several authorities)	2,604,150	3,000,000	14,500,000	32	08.3
France (Dumas)	2,411,250	2,800,000	11,400,000	23.8	07.5
Germany (Soetbeer)	2,636,300	3,000,000	11,200,000	18.2	06.6
Switzerland (Lardy)*	835,900	1,000,000	7,600,000	2 31.8	35
Austria-Hungary (Nibauer)	835,900	1,000,000	1,000,000	-------	02.9
Other countries (Soetbeer)	3,697,250	4,000,000	13,500,000	04.1	01.7
Totals	16,718,000	$18,800,000	$76,200,000		

*Consumption as cited by Ottomar Haupt. "L'Histoire Monétaire de Notre Temps;" Paris, pp. 21, 22.

†According to the census of Switzerland of 1870, the annual production of watches in that country for that year was 1,600,000, representing a total value of 88,000,000 francs. Thirty-seven thousand nine hundred and sixty-nine persons were reported to be engaged in the business of watch-making in the four cantons of Switzerland famous for that industry. Larousse Dictionnaire Universel, vol. 14, p. 1221.

PRODUCTION OF QUICKSILVER IN CALIFORNIA FOR THE YEAR 1885.

Compiled by J. B. Randol, New Almaden, California.

	Ætna.	Napa C.	Great Western.	Guadalupe.	New Idria.	Sulphur Bank.	Redington.	Great Eastern.	Various.	Total—flasks.	New Almaden.	Grand Total—flasks.	Price in San Francisco—per flask. Highest.	Price in San Francisco—per flask. Lowest.
January	189	131	172	0	190	24	40	37	0	783	1,700	2,483	$33 00	$32 50
February	96	180	245	35	70	85	24	75	0	810	1,506	2,316	32 50	32 50
March	88	145	314	0	80	83	0	33	19	762	1,500	2,262	32 50	31 00
April	142	145	340	0	80	69	0	37	0	813	2,003	2,816	31 00	30 00
May	62	190	269	0	75	194	0	0	3	793	2,000	2,793	29 00	28 50
June	112	250	330	0	62	91	50	63	5	963	1,750	2,713	30 00	29 00
July	45	191	321	0	75	209	43	50	10	944	1,750	2,694	30 00	29 75
August	118	175	324	0	80	150	49	0	47	943	2,104	3,047	29 75	29 50
September	201	180	347	0	95	85	57	0	77	1,042	1,936	2,978	30 50	29 50
October	52	185	236	0	85	123	42	65	82	870	1,598	2,468	30 50	30 00
November	54	190	292	0	122	61	43	43	87	892	1,576	2,468	30 00	29 75
December	150	235	279	0	130	122	37	43	62	1,058	1,977	3,035	32 00	30 00
Totals	1,309	2,197	3,469	35	1,144	1,293	385	446	392	10,673	21,400	32,073	$32 00	$28 50
Production in 1884	2,931	1,376	3,292	1,179	1,025	890	881	332	7	11,913	20,000	31,913	$35 00	$26 00
Production in 1883	*	5,890	3,869	84	1,606	2,612	1,894	1,669	101	17,725	29,000	46,725	28 50	26 00
Production in 1882		6,842	5,179	1,138	1,953	5,014	2,171	2,124	241	24,662	28,070	52,732	29 05	27 35
Production in 1881		5,552	6,241	5,228	2,775	11,152	2,194	1,065	584	34,791	26,060	60,851	30 75	27 90
Production in 1880		4,416	6,442	6,670	3,209	10,706	2,139	1,279	1,600	36,461	23,465	59,926	34 45	27 55

SAN FRANCISCO, December 31, 1885.

* Production of Ætna and Napa Con. not segregated in former years.

PRODUCTION OF QUICKSILVER IN CALIFORNIA IN THE YEAR 1886.

Compiled by J. B. Randol, New Almaden, California.

	Ætna.	Napa C.	Great Western.	Guadalupe.	New Idria.	Sulphur Bank.	Redington.	Great Eastern.	Various.	Total—flasks.	New Almaden.	Grand Total—flasks.	Price in San Francisco—per flask.	
													Highest.	Lowest.
January	162	147	339	0	70	100	42	73	34	967	1,431	2,398	$32 50	$32 00
February	132	192	274	0	175	108	24	53	45	1,003	1,100	2,103	32 50	32 50
March	209	218	226	0	20	91	21	43	75	903	1,522	2,425	33 00	32 50
April	328	172	115	0	90	172	36	62	62	1,037	1,256	2,293	33 00	33 00
May	228	128	99	0	101	36	18	76	95	781	1,600	2,381	34 00	33 00
June	276	123	126	0	110	113	19	71	78	916	1,806	2,732	36 00	34 00
July	345	138	138	0	95	98	24	64	127	1,029	1,572	2,601	37 00	36 00
August	313	74	156	0	105	119	35	76	84	962	1,240	2,202	37 00	36 75
Totals	1,993	1,192	1,473	0	766	837	219	518	600	7,598	11,527	19,135	-------	-------

HYDROMAGNESITE, FROM LIVERMORE, CALIFORNIA.

(Analyzed and contributed by F. Gutzkow, E.M.)

Moisture	.75
Silica, Alumina, Ferric oxide	1.25
Lime	Trace.
Magnesia	43.00
Carbonic acid	36.30
Water (in combination)	18.70
	100.00

Calculated for the pure mineral:

Magnesia	43.88	4 MgO
Carbonic acid	37.04	3 CO_2
Water (in combination)	19.08	4 H_2O
	100.00	

MINE DRAINAGE.

(By Chas. G. Yale.)

The principal methods employed for extracting water from mines in California and on the Pacific Coast, generally are: Cornish pumps, bailing tank, steam (or compressed air) pumps, and hydraulic pumps. For shallow mines, where there is little water, iron water buckets are used. The best form is made barrel-shaped, for use in shafts or winzes, where there are no guides—this shape preventing them from catching on projecting timbers or rocks. The water bucket has a fixed bale, as this bucket does not turn over, but is emptied by lowering until a spindle in its bottom rests on the bottom of the water box, when the spindle opens the valve in bucket bottom. This valve opens automatically when filling, and automatically closes when the bucket begins to rise. Oval and cylindrical bailing buckets are also made for work in vertical shafts, and are arranged with shoes for wooden shaft guides. They are sometimes arranged for rope guides, also. Rectangular baling tanks are also made, arranged for self-dumping. These tanks are so constructed as to discharge themselves on arriving at the station, without reversing the engine, and there is no man required to let the water out. Such tanks are made for wooden shaft guides.

Water skips are of the same character for inclined shafts. The bale is attached to a pivot back of the center of gravity, so that it will tip when it is run over the dumping track. The dumping is accomplished by making the rear wheels with a projecting face of smaller diameter, which catches on the dumping track and elevates the back end, and the skip is thus tipped to a proper angle for dumping. When lowering, the rear wheels must necessarily pass down first, returning the skip to its proper position. These and self-dumping skeets can be used for ore and water both, or either. The self-dumping skeets are designed for use in vertical shafts. For sinking purposes they are very handy, for they can be shoveled into or bailed into. In many cases, pumping from the bottom of a shaft while sinking can be dispensed with, as the water and dirt can be put into the skeet at the same time. These skeets are made with steel or iron boxes, and with single or double bar frames, made of Norway iron. They are self-dumping. The following tables show the various sizes, capacities, and

weights of the forms of tanks referred to, as given by the Risdon Iron Works of San Francisco:

Oval Bailing Tanks.					Cylindrical Bailing Tanks.			
Lesser Diameter. Inches.	Greater Diameter. Inches.	Height. Inches.	Capacity. Gallons.	Weight. Pounds.	Diameter.	Height.	Capacity. Gallons.	Weight.
30	40	60	245	875	30	60	180	775
32	42	72	330	1,050	30	66	198	820
36	48	84	490	1,400	30	72	216	865
42	48	96	650	1,750	36	60	265	1,350
42	54	96	700	1,950	36	66	290	1,400
					36	72	315	1,460
					36	78	340	1,530

Rectangular Self-Dumping Bailing Tanks.					Ore and Water Skips.		Self-Dumping Skeets.	
Width. Inches.	Length. Inches.	Height. Inches.	Capacity. Gallons.	Weight. Pounds.	Capacity. Cubic Feet.	Weight. Pounds.	Contents. Cubic Feet.	Weight. Pounds.
32	42	72	420	1,400	10	500	20	1,700
36	48	84	620	1,800	15	700	30	2,000
42	48	96	820	2,400	20	900	40	2,400
42	54	96	940	3,000			50	2,600
42	60	108	1,180	4,000			60	2,800
							70	3,000

Tanks of this character will handle a great deal of water, and can be replaced by cages when not needed. They are too simple to get out of order often and are readily repaired. In many places they are preferred to pumps, and are frequently kept in readiness as a substitute for Cornish pumps when the rods of the latter break.

Local practice varies greatly as to the means adopted for handling water. Some one form of pump does well in the first of the mines of the camp useing one, and others follow the example set. Cornish pumps are more frequent in older mining districts than in newer ones, and in larger mines than in smaller ones.

In the earlier history of mining on this coast, neither great depths nor great quantities of water had to be considered. A simple hurdy-gurdy water wheel, driven by a jet from a high head, was the prime mover. A pump-bob of simple construction and a bucket-lift, all of wood, was the shaft work. Many a rig like this may still be seen running in the smaller mines. In the quartz mines steam power was used, mainly geared engines, driving a line of plunger pumps. As the mines increased in depth, and larger quantities of water had to be handled, large engines and heavy gears came into vogue. In draining very great depths, the heavy weight of the pit-work, which is of so much importance in any direct-acting system, proves the destruction of the geared system; since in working geared pumping engines at great depths with heavy pit-work, the speed must be very slow. Geared engines for great depths have, therefore, the pumps very large and are run at very slow motion, otherwise frequent breakages would condemn the whole system.

For deep mine pumping the Cornish bucket and plunger pumps are very extensively used. They are driven from the surface by a system of gear-

ing directly connected with the engine shaft. The main gear is connected to the head of the bob, by a pitman, one end of which engages into a wrist-pin set into one of several bosses cast on to the arms of the main gear, so placed as to give any desired throw to the pumps. Where the depth of the shaft is so great that one pump is insufficient to raise the water to the surface, a system of two or more pumps is made use of, the lowest one pumping into a tank station at a convenient height above it, from which the pump next overhead in its system takes its suction and discharges either into a similar tank or directly out at the surface.

For depths below 300 or 400 feet, and for the handling of large volumes of water, the pumps generally preferred are those termed "Cornish bucket" or "Jack-head," and the plunger pumps. In the jack-head pump the working bucket is packed with leather, which is secured to the body of the bucket by a brass ring. The suction chamber is bolted directly to the lower end of the working barrel, and has the suction pipe and wind-bore bolted to its lower flange. The "goose-neck" bolts on the top of the barrel, and has a bonnet and stuffing box through which the bucket rod passes. The upper clack sets on the branch of the goose-neck, with the column bolted on its upper flange. The clack chambers have doors, through which the clacks are removed for repairs. A door is sometimes made in the goose-neck, through which the working bucket may be taken out without taking off the bonnet from the top.

Jack-head pumps are best adapted for lifting water from cisterns or permanent sumps, although they are frequently used in sinking.

The common lift pump is different from the jack-head pump in that it has no goose-neck. The bucket-piece is bolted on the top of the working barrel, with a door for the removal of the bucket. On this, in a direct line, is set the column, with the pump-rods inside of it. The working bucket is the same as that for the jack-head pump. Of course there is only one clack. The advantage of these pumps in sinking is that the bucket can be lifted through the column for repairs while the whole pump is submerged in water.

The connecting rods through which the pump takes the motion are made of heavy timbers, strapped at the joints with iron plates and bolted through, and connect at the upper end with the pitman attached to the nose-piece of the bob. This pitman is furnished either with a cross-head or guide rollers, to keep it in position. The usual speed at which these pumps is run is about 12 strokes per minute.

The following table giving sizes, capacity, and horse power required for the various sizes of Cornish pumps, is furnished by the Pacific Iron Works, San Francisco:

Diameter of Plunger, in inches.	Length of Stroke, in feet.	Number of Strokes per Minute.	Gallons per Minute.	Horse power for each 100 feet Lift.
4	4	18	40	1
6	6	14	92	2
8	8	12	188	3½
10	8	12	294	5½
12	8	12	390	7½
14	8	12	576	11
16	8	12	752	14
18	8	10	793	16

The pumps employed in the deep shafts on this coast are all of the same general character, and do not differ materially in principle from

those used in deep mines in other countries. They are, as stated, either lifting pumps or force pumps. In a complete set of deep pumps the two kinds are combined, the former being applied to raising the water from the bottom of the shaft to the height adapted to the capacity of a single pump; the latter forcing the water upward to the stations, or to the point of discharge. The following descriptions of lifting and force or plunger pumps, from Hague's volume on "Mining Industry," in Clarence King's report on the United States Geological Exploration of the Fortieth Parallel, are very clear:

The lifting pump consists of a cast-iron cylinder or "working barrel," from 8 to 12 inches in diameter and from 8 to 12 feet long, smoothly turned inside, on which a closely fitting piston, that has an upward opening valve, may be made to move up and down by means of a rod to which it is attached. At the bottom of the cylinder is a valve opening upward, by means of which the water, once drawn from below into the cylinder, is retained there. Below the cylinder is the suction pipe, dipping below the surface of the water to be lifted. Above the cylinder is an iron pipe or column of elevation, in which the water is raised, by the upward movement of the piston, to any desired height. When the piston in the cylinder is moved upward, its valve remaining closed and the lower end of the suction pipe being immersed in the water, the pressure of the exterior air causes the water to rise in the suction pipe and to pass through the retaining valve, at the bottom of the cylinder, in accordance with the well-known principle involved in all suction pumps. On the downward stroke of the piston the retaining valve at the bottom of the cylinder closes, while the valve in the piston opens and the water passes through the piston. On the succeeding upward stroke the water now above the piston is lifted by it, while a new supply is drawn into the cylinder in the manner just described, to be lifted by the next upward stroke.

The pipe or column in which the water is raised above the piston is sometimes placed upon and directly over the cylinder, in which case the rod to which the piston is attached passes up through it, and is connected above with the motive power. But commonly the pipe, or column of elevation, is fixed at one side and connected by a short horizontal or curved piece with the cylinder, the top of which is then fitted with a stuffing box. The piston-rod then passes through the latter, and is then connected with the main pump-rod working on the shaft, from which it receives its motion.

The column may be of any desired height to which the strength of the material is adapted. As the lifting pump is generally only employed at the bottom of the shaft to raise the water to the force or power pump above, the height of the column varies with the circumstances. In shafts where sinking is in progress, the column of the lifting pump is constantly being extended as the shaft deepens, until a sufficient depth (200 feet or more) has been attained for the establishment of a force or plunger pump, when the lifting pump is detached from the column, the force pump put in its place at a suitable distance above the bottom, and the lifting pump again employed for sinking deeper with a short but gradually extending column.

The force pump or plunger pump forces the water upward in its column of elevation by the descent of the piston or plunger. This pump consists of a cast-iron cylinder or "plunger case," usually 10 or 12 feet long and from 8 to 12 inches in diameter, in which a solid cylindrical piston, nearly as long as the cylinder, is caused to play with an upward and downward motion; the piston passes through a stuffing box at the top of the cylinder, and is then connected with the pump-rod that gives it motion. Below the cylinder is a side or branch pipe connecting the cylinder with a valve-

chamber and the column of elevation. The valve in this chamber retains the water drawn through it from the wind-bore, or suction pipe, which is immersed in the cistern. The valve at the bottom of the column of elevation opens for the passage of the water into the column, and closes to retain it there. When the piston ascends the valve opens and the space in the cylinder, below the piston, fills with water; when the piston descends the valve closes and the other valve opens and the column of water is forced upward to the point of discharge to any desired height.

The piston or plunger of the force pump is a smoothly turned cylinder, 8 to 12 inches in diameter, and 10 to 12 feet long. It is cast hollow, of iron, about one inch in thickness. In order to attach it to the pump-rod, by which it is set in motion, a suitable stick of timber considerably larger than the piston is made to fit snugly into the inside of the cylinder, or hollow piston, entirely occupying the interior space; being driven tightly in it is wedged at the bottom. The top, projecting above the end of the cylinder, is then attached to the main pump-rod.

Another method is to have the plunger cast with a stout flange at the upper end, by means of which a head of cast-iron is bolted to it, carrying two uprights with a stout iron pin. To the end of the pump-rod is securely attached an iron stub-end, which is furnished with a strap, boxes, jib, and key, forming a connecting link such as is commonly used for attaching the connecting rod of an engine to the crankpin. By means of this link the pump-rod is attached to the pin in the head that is bolted to the plunger, as just described.

The plunger-case and valve chambers rest upon stout timbers, which are firmly established in the shaft in the most substantial manner. The column rests upon the valve chamber, and is itself further supported by timbers fixed at intervals in the shaft, and so arranged as to embrace the pipe directly under the flange by which the sections of the column are joined together, and furnish a bearing for these to rest upon. The pump column generally used at the more important pumping works, is a pipe having a diameter of 10, 12, or 14 inches. The best pipe column is of wrought iron, though cast pipe is very common.

It will be seen from the foregoing that the force pump performs its work of raising the water on the downward stroke of the piston, while the lifting pump does its duty on the upward stroke. The force pumps need to be very firmly set, and are, therefore, only employed where they can be permanently and solidly established in a position easily accessible for repair and not very liable to be submerged. The lifting pumps are well adapted to work in the bottom of the shaft, their method of construction and operation fitting them to draw water from the very bottom of the shaft without the use of a cistern, and to be extended, foot by foot, as the sinking proceeds; not requiring to be placed with so much care as the plunger pumps, and having the advantage also of being operated as well, even when the water rises above them in the shaft.

In order to extend the pump in depth as the sinking proceeds, the working parts of the pump, namely, the suction pipe and working barrel, being suspended by heavy chains to a turret or windlass fixed at the station above, are detached, with the connecting pipe, from the bottom of the column and lowered 10 or 12 feet, sufficiently to allow of introducing another length of pipe under the column, already in place; this additional length having been attached to the column, the working parts are again connected with the column thus extended, and are continued in operation until the sinking has so far progressed as to require the addition of another length of pipe, when the above described proceeding is repeated. In some

mines the suction pipe dipping into the sump is a stout piece of suction hose of diameter equal to that of the short iron pipe below the working barrel, to which it is closely fitted and attached. It has the advantage of flexibility and may be more easily protected against injury from blasting than iron pipe. The lifting pump discharges into a cistern from which the force pump takes its supply to be raised to the surface or to the next station above.

The motion of the piston, or plunger, in its cylinder, is imparted to it by the pump-rod, a continuous piece of timber, which is suspended in the shaft alongside the column, extending from the surface to the bottom of the mine, and to which the plungers are attached. The pump-rod is composed of timbers 6, 8, 10, or 12 inches square, or even larger, joined to each other so as to form a continuous piece. The method of joining the sections composing the rod varies in different mines. Sometimes they are joined by a simple splice, and strapped on four sides with long iron plates. In other mines the sections are joined in a more complicated manner by a beveled splice and key, and then strapped. In other cases the square ends of the sections are brought together without any splice, and joined simply by means of iron straps. Sometimes the straps are so formed that a key can be inserted. When these keys are driven in as tightly as possible, so as to bring the ends of the timbers closely together, and so prevent any lost motion in the action of the rod, the two straps for the remaining two sides are put on and bolted together.

The motion of the rod is communicated to it from the engine by means of an oscillating "bob" on the surface. These bobs are made of various forms, but correspond generally to the form of the "walking beam" of the old style marine engine. The method of connection with the engine also varies. The pumping engine drives, by means of the piston, the pump wheel, to one side of which is attached, by means of a wrist-pin, one end of the pitman. As the wheel is set in revolution by the engine, the pitman receives a reciprocating motion, the length of the stroke being determined by the distance of the wrist-pin from the center of the wheel. The other end of the pitman being connected to the kingpost of the bob, causes that to oscillate, giving to the pump-rod in the shaft an upward and downward motion. The upper section of the rod is usually connected to the "nose" of the bob and the next lower section of the rod by means of a strap and boxes, so as to allow for the vibration caused by the angular motion of the bob; deeper in the shaft the sections are joined together as described above, forming one continuous piece, which is guided in its movement by timbers so arranged as to prevent vibration of the rod. Timbers are also placed in the shaft at frequent intervals to prevent the rod from falling far in case of breakage, by furnishing support to the catching pieces attached to the rod for this purpose. The length of stroke, or upward and downward movement of the rod, varies from 3 or 4 to 7 or 8 feet, and the number of strokes per minute from 3 or 4 to 10 or 12, according to size and character of pump and duty required of it.

The weight of this pump-rod in most cases considerably exceeds that of the water to be raised, so that, descending by its own gravity, it exerts sufficient force to raise the column of water without requiring additional power from the engine. For the next stroke, however, the engine must lift the total weight of the rod to the required height. In order to prevent the too rapid descent of the rod and to equalize the work of the engine on either stroke, counter-weights are attached to the opposite end of the oscillating bob at the surface. The descending rod must raise the counter-weight, which, on the reverse stroke, assists in lifting the rod. For deep shafts, as

the rod increases in length and weight, additional counter-weights are applied, by establishing at various stations in the shaft similar oscillating bobs, attached at one end to the rod and bearing at the other a heavily weighted box. Angle bobs are used to change direction of motion, in changing from a vertical to an incline shaft. They are of various forms.

It is unnecessary in this instance to go into any description of the numerous forms of engines which are employed to drive this pumping gear. Different makers claim special advantageous features, and no one type is in exclusive use. The ordinary single-geared pumping engine has the pinion placed on the engine shaft, gearing into the spurwheel, to which a pitman rod is attached. In the double-geared engine two pinions are placed on an engine shaft and the pitman rod-pin is placed between the two spurwheels, thus adapting it for very heavy work. The simplest form of direct acting engines consists of a single high pressure cylinder connected directly to the main-bob; the king-post of this is larger than the nose piece, so as to give the engine leverage on the pumps. The valve gear is generally so arranged and adjusted that steam can be cut off at any portion of the stroke, or the stroke of the piston can be shortened. In some of the horizontal direct-acting compressed engines the pitman is connected directly to the crosshead and king-post, the connections between king-post and flywheel being made by two side rods.

Sometimes two lines of pump rods are used in the same shaft, working a double line of pumps from the same bob, in which case no counterbalance is necessary. Often, too, there is a double line of plunger pumps, when the main pump-rod extends down between the pumps to the next set below, and so on until the bottom pump is reached. An angle plate is attached to each side of the rod by bolts common to both, and to each of which the pump plungers are attached.

The ordinary surface bob is made principally of wood. The irons for the king-post and nose-piece are each made on two pieces, with sockets for angle-braces, and securely bolted together by bolts running through the timber. The saddle-plate is made in three pieces, and made to admit of the trunnion shaft being placed on a line with the nose and tail-pins. The trunnion shaft is made of hammered iron, and secured by running through the beam, and being keyed to the side and saddle-plates. The whole is drawn together by wrought-iron straps and turnbuckles. The back of the beam is extended to admit of a box being attached, to be filled with old iron, rocks, or other heavy substances, for a counterbalance. These bobs are sometimes made wholly of iron. The balance bobs, made for use under ground, also vary in form. Those interested in forms of bobs and methods of connection to engine, may see excellent illustrations of various forms in one of the business circulars issued by the Union Iron Works of San Francisco.

Recently, in this State, steam has been displaced by water power for running the pumping rig of several important mines.

It may be well to cite some examples of Cornish pumping rigs in California to illustrate capacity, etc. The examples are all taken from actual works in California mines:

A.—Cornish pumping rig driven by 80-horse power engine, which also hoists. In summer, pumps 4 hours in 24; in winter, constantly. Capacity, 14,000 gallons per hour; rod 1,000 feet. One 8-ton counterbalance at surface.

B.—Cornish pumping rig driven by 8-foot hurdy-gurdy wheel, using 12 inches of water at 400 feet fall. Capacity, 3,500 gallons; rod, 450 feet. One 3-ton counterbalance.

C.—Rig driven by hurdy-gurdy under-wheel, using 24 inches of water in summer, and 35 inches (about 30 h. p.) with 400 feet fall. Capacity, 10,000 gallons per hour. Rod, 410 feet; one 4-ton counterbalance. In winter a Hooker pump, with capacity of 10,000 gallons, is also used.

D.—Myers' cut-off Cornish pumping engine, 75 h. p. Rod, 500 feet. Two counterbalances weighing 11 tons.

E.—Compound Cornish engine, double acting, with two rods down to 400 feet, and single rod for 200 feet below; capacity, 22,500 gallons per hour. One 10-ton counterbalance.

F.—Cornish engine, 110 h. p. Capacity, 10,000 gallons per hour. Rod, 1,300 feet. Lever bobs, with counterbalances, together weighing 14 tons.

G.—Cornish engine, 80 h. p. Rod, 1,300 feet; two counterbalances, 2 tons each.

H.—Cornish rig run by water power. Jackhead pump operated by 400 feet of rod. One counterbalance.

I.—Cornish rig run by hoisting engine. Capacity, 30,000 gallons. Rod, 900 feet. One 4-ton counterbalance.

J.—Cornish pumping rig run by hoisting engine. Capacity, 6,000 to 7,000 gallons per hour; 500 feet force; 300 feet lift; one 1½-ton counterbalance.

Those desiring to examine details of very large rigs of this kind may see descriptions of those in use on the Comstock, Nevada, in volume XIII of the Census Reports, 1880, page 149.

A form of pumping apparatus recently introduced in California, is the Knight hydraulic pumping engine. It is specially designed for pumping water out of mines to any depth where there is water pressure above the drain tunnel. The hydraulic engine (or wheel) can be bolted to the shaft timbers at the drain tunnel, and a pump-rod run down to a special plunger pump made for use in connection with the Knight engine. By using this engine at the drain tunnel the gears, bob, etc., below, are saved. Both the engine and pump can be set on the same bed-plate if desired, and the whole apparatus secured in the shaft below the surface in drain tunnel. After operating the engine, the water is exhausted into the discharge pipe of the pump. The only gain in this is the doing away with the pump-rod. Nothing is gained in power.

Steam force or plunger pumps are now much more largely used than formerly, having been much improved and specially adapted for mining purposes. There are many forms kept on sale by various makers, among the best known being the Knowles, Blake, Dow, Hooker, Worthington, Cameron, Cope & Maxwell, and Deane. These and similar pumps are made in great variety of form and size, but are more or less similar in general appearance and design, the different makers, however, adopting details of construction originating from their special experience, or from their experience arising in practice under different conditions of use. For opening up mines, re-prospecting abandoned ones, working them under bond, temporarily, etc., the steam pumps are very advantageous. A steam pumping rig has the advantage of greatly reduced first cost over the Cornish system, and lately the makers of steam pumps claim equal economy with that plan. There is no doubt of one thing, that twice the number of mines have been opened lately, with steam pumps, than would have been the case had expensive Cornish rigs been absolutely necessary, the plant of steam pumps costing so much less originally. By their use a mine can be opened and tested. Moreover, there are many locations which it would not pay to test if steam pumps could not be obtained to do it with.

For a few thousand dollars a boiler and steam pump can be procured to drain a mine while prospecting it, when a Cornish rig of same capacity would cost four or six times as much.

The horizontal plunger pumps are mainly used for station pumps, and are made to raise the water on a single lift as high as 1,000 feet. The particular advantages of the direct acting system are the first cost, ready means of placing in position, etc., especially for prospecting purposes. The steam is brought down the shaft in jacketed pipes, and the pipe column brought up to the surface, the pump being below. The best makers now construct these pumps so the parts are readily accessible, muddy water can be raised, and have otherwise perfected them greatly.

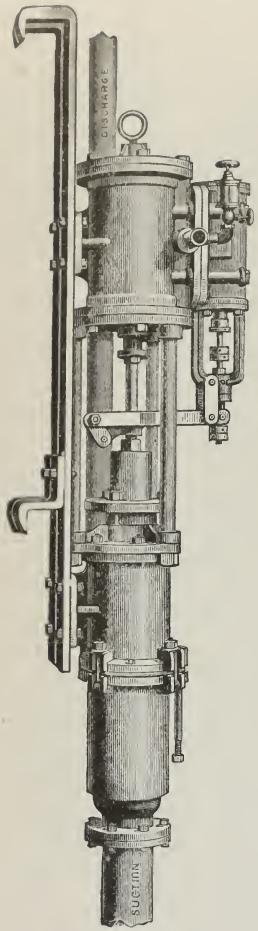
A class of vertical sinking steam pumps has come into use quite largely of late, having been much improved. Their peculiar feature is the special adaptability for shaft sinking purposes. They are of comparatively light weight, portable, and require a very limited space for operation. A steady continuous stream of water is thrown and there is very little jar. As an illustration of this class of pumps engravings are here given of the Dow double-acting vertical sinking pump. They operate in any position, whether suspended from the ringbolt attached to the steam cylinder head, hanging on timbers by means of the adjustable dogs founded for the purpose, or placed horizontally. The plunger barrel easily removed for substitution. A peculiarity of this pump is the suction condensers, the utility of which is an important consideration in sinking a shaft, as it not only consumes exhaust steam, avoiding the use of exhaust pipes leading out of the mine, or the damaging effect on the timbering if allowed to escape into the shaft, but is so constructed as to increase the efficiency of the pump by doing more work with a given amount of steam. A large one of this style was put in the Alaska Mine, Sierra County, not long since, to drain a flooded shaft which the other steam pumps were unable to do. A rig of this kind answers very well and its first cost is not great.

A recent application to vertical pumps of this class, by Mr. James E. Dow, of San Francisco, is a governor, so that if the water is lowered so air gets in, the pump cannot "run away" and be damaged. This new feature is an important one. With speed governor, and suction condenser, this type of pumps is greatly improved. None of these attachments are complicated, and may be managed by any ordinary mechanic. These and other improvements are overcoming former objections, and the modern "sinker" is a very convenient appliance. The engravings show two views.

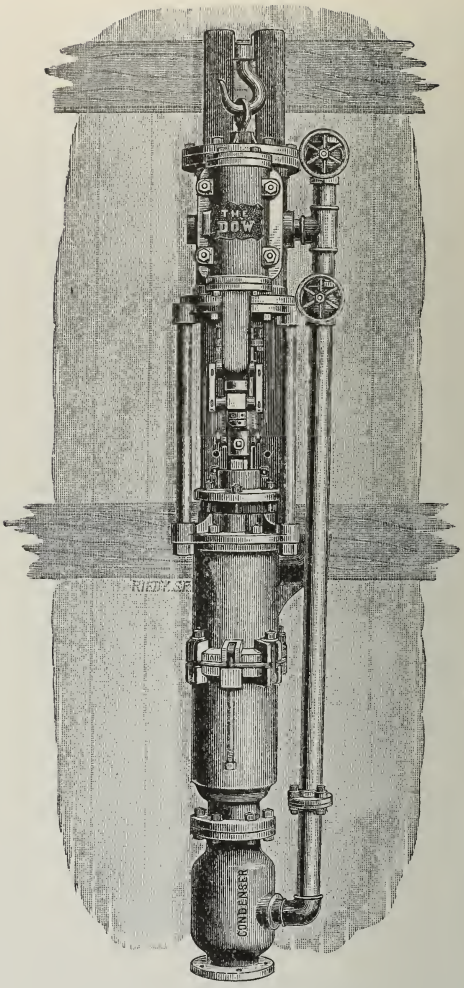
To give an idea of the data and prices of such pumps, the following table is appended:

Steam Cylinder.	Bucket.	Plunger.	Stroke.	Gallons per Stroke.	Capacity per Minute at Ordinary Speed.
$6\frac{1}{2}$	6	$4\frac{1}{4}$	10	.61	100 strokes, 61 gallons.
8	6	$4\frac{1}{4}$	10	.61	100 strokes, 61 gallons.
10	7	5	12	1.02	100 strokes, 102 gallons.
10	$8\frac{1}{2}$	6	12	1.47	100 strokes, 147 gallons.
12	$8\frac{1}{2}$	6	12	1.47	100 strokes, 147 gallons.
12	10	7	18	3.00	60 strokes, 180 gallons.
14	10	7	18	3.00	60 strokes, 180 gallons.
14	12	$8\frac{1}{2}$	18	4.42	60 strokes, 265 gallons.
16	12	$8\frac{1}{2}$	18	4.42	60 strokes, 365 gallons.
18	12	$8\frac{1}{2}$	18	4.42	60 strokes, 265 gallons.
18	14	10	24	8.16	50 strokes, 408 gallons.
20	14	10	24	8.16	50 strokes, 408 gallons.

Sizes of Pipes.				Space Occupied.	Weight.	Price.
Steam.	Exhaust.	Suction.	Delivery.			
1	$1\frac{1}{2}$	4	$2\frac{1}{2}$	17 × 20 × 74	850	$450 00
$1\frac{1}{4}$	2	4	$2\frac{1}{2}$	17 × 21 × 74	900	475 00
$1\frac{1}{2}$	2	4	3	20 × 24 × 82	1,500	650 00
$1\frac{1}{2}$	2	5	4	23 × 26 × 82	1,900	700 00
2	$2\frac{1}{2}$	5	4	23 × 28 × 82	2,200	775 00
2	$2\frac{1}{2}$	6	5	27 × 29 × 122	3,000	900 00
$2\frac{1}{2}$	3	6	5	27 × 32 × 122	3,400	1,000 00
$2\frac{1}{2}$	3	8	6	29 × 33 × 122		
$2\frac{1}{2}$	$3\frac{1}{2}$	8	6	29 × 34 × 124		
3	4	8	6	29 × 36 × 124		
3	4	10	6	33 × 39 × 150		
$3\frac{1}{2}$	$4\frac{1}{2}$	10	6	34 × 40 × 150		



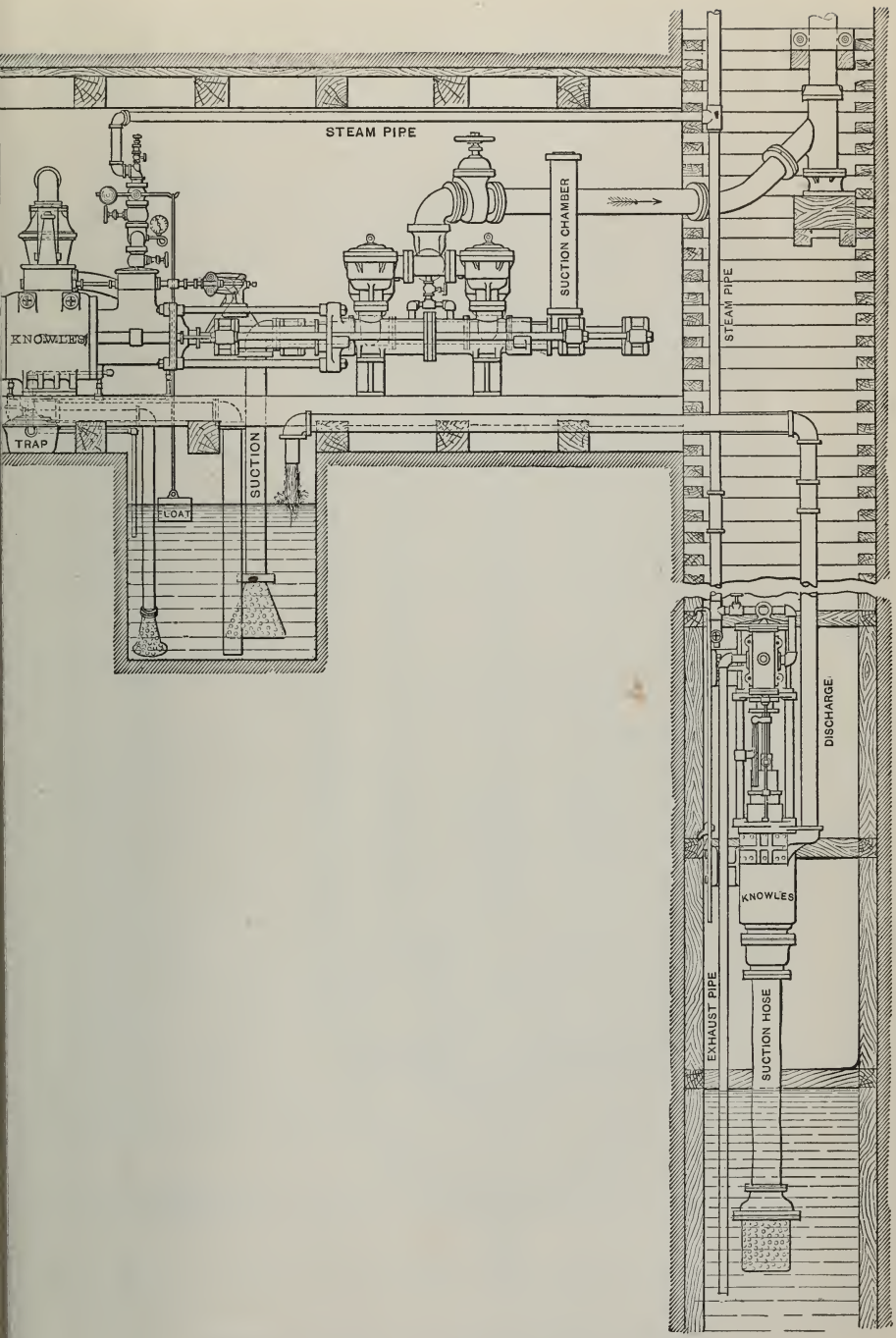
Side View.



Suction Condenser Attached.

VERTICAL DOUBLE-ACTING SINKING PUMP.

As illustrating the application of ordinary steam pumps to mines a sketch is here given showing a pumping station with the cistern, pumps, etc., the sinking pump being shown in the bottom of the shaft, where the suction hose extends into the shaft. The steam is brought down in jacketed pipes to operate the sinking pump, which takes the water up to the cistern in the station where the horizontal plunger pump is placed. This is operated, as the diagram shows, lifting the water from the cistern in the station to another similiar station above, where another pump is placed, or directly to the surface or point of discharge, according to height. In these Knowles pumps the exhausted steam is condensed by the water in the sump or cistern, as the pipes show; but recently another condensing feature has been attached. Many mines on this coast are provided with this sort of pumping rig.



Position of Station and Sinking Pump in Shaft.

In the very deepest mines on this coast, such as those on the Comstock, Nevada, it was found the weight of the pit work became so enormous that finally the rate of speed, which is determined by the weight of the mass set in motion, had to be decreased beyond all practicable working limits. The question then presented itself: What system of pumping can be adopted that will meet all difficulties that are ever present where heavy pumping works have to be constructed, and also meet the peculiar difficulties to be encountered in developing the great gold and silver bodies of ore in the Sierras? When the hydraulic system was suggested it was at first condemned, owing to the fact that it had never been tried, except in Europe, where mines of small depths had been drained. Finally, however, the managers of the Combination shaft decided to try it, and since then it has been successful on the Comstock, and several plants have been built.

The general plan of this system will be rendered plain to the reader by the accompanying drawings, and the following description, written by Robert S. Moore of the Risdon Iron Works, San Francisco:

By referring to the drawings of the general plan, it will be seen that the mine to which this system is applied, is 2,400 feet deep; also, that the water to be pumped is to be raised from the 2,400 level to a height of 800 feet and discharged into the Sutro Tunnel, through which it is run off. Upon the 2,400 level is erected a pair of hydraulic pumping engines (marked *P* in the drawing), which receive their pressure water through supply pipes from the surface. By these two pumps (as will be fully explained hereafter) the drain water is raised through discharge column to the Sutro Tunnel, and the water used in doing the work of pumping is sent back through the return pipe to a reservoir, *N*, on the surface. Upon the surface there is a cast-iron accumulator, *A*, which is 60 feet high and 25 inches in diameter. In this accumulator there are but 20 feet of water, the remaining space being occupied by air.

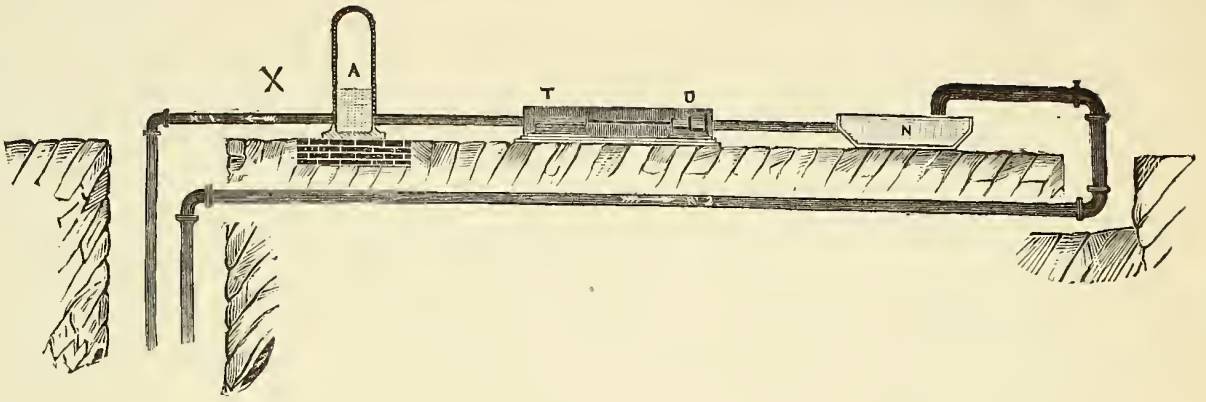
This air is kept constantly at a certain pressure by means of plunger pumps, *T*, which in turn are operated by a compound steam engine, *O*. These pumps, which supply the accumulator with water and keep it at a pressure great enough to run the two underground pumps, *P*, take their suction from the reservoir, *N*, into which the return water is discharged.

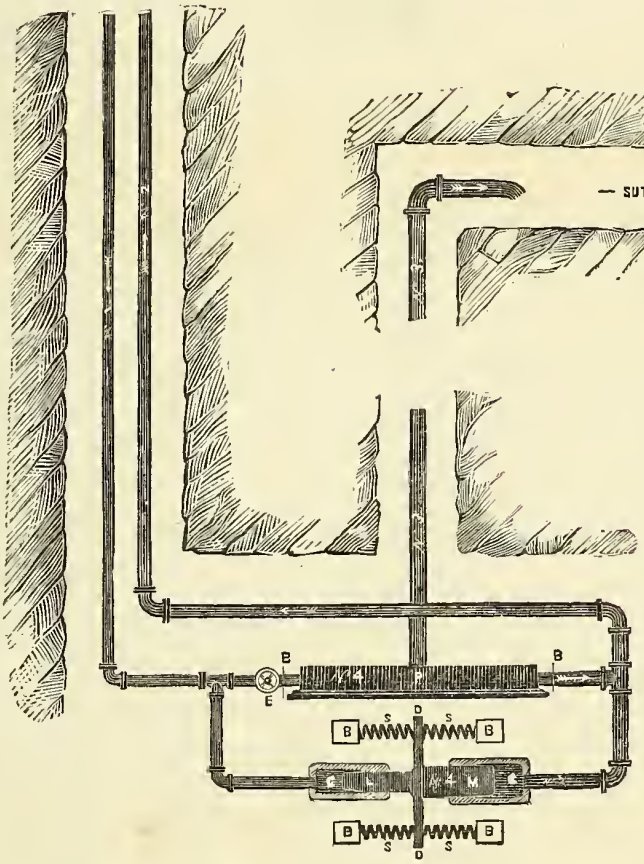
Now, since this pipe which supplies the pumps, *P*, is of such great length, and moreover, since the whole mass within it must be put in motion and brought to rest again during each stroke of the pumps, *P*, it is evident that some mechanical contrivance must be introduced for the purpose of lessening the jar in the pipes caused by the sudden stoppage of such an immense mass of water. The arrangement by which this end is accomplished, will be readily understood by referring to the drawings. It is constructed as follows: Let *E* (in general plan) be the valve which shuts off supply water from *P*. Close to the underground pumps there are firmly fixed two cast-iron cylinders, *C* and *C*, in which the plungers, *L*, *M*, carrying the crosshead, *D D*, are free to move. On either side of the arm, *D D*, are strong springs, *S*, *S*, held in position by the abutments, *B*, *B*. Now, when water in supply and return pipes is at rest, the arm, *D D*, is exactly in the middle between the cylinders, *C* and *C* (since the plungers, *L* and *M*, are so proportioned that the total pressure on *L* is precisely equal to total pressure on plunger, *M*). But after the underground pump, *P*, has completed its stroke, and the total mass of water in the supply pipe has to be brought from a velocity=*v* to a velocity equal to zero, the inertia of this mass (due to velocity *v*) is supposed to be gradually reduced to zero by the plunger, *L*, *M*, being forced (on account of extra pressure on *L*) over to the right side. The distance it travels to the right depends, of course, upon the extra pressure produced by checking the velocity of supply water, and also upon the strength of the springs, *S*, which begin to be compressed as soon as *L M* begins to move. Now, after the crosshead has been forced over by this extra pressure to its maximum extent (the water in the three columns also coming to rest at this moment), the compressed springs, *S*, will immediately react to place the crosshead and plungers in their central position, ready to again take up the inertia of the mass in supply column on the return stroke of the pumps.

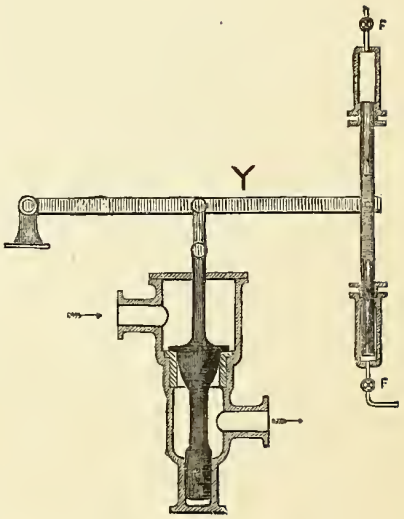
Thus, the object of these springs, *S*, *S*, is not only to assist the water in the return column in taking up the inertia of the water in the supply column, but chiefly to replace the plungers, *L*, *M*, in their central position after the masses in the three columns have come to rest.

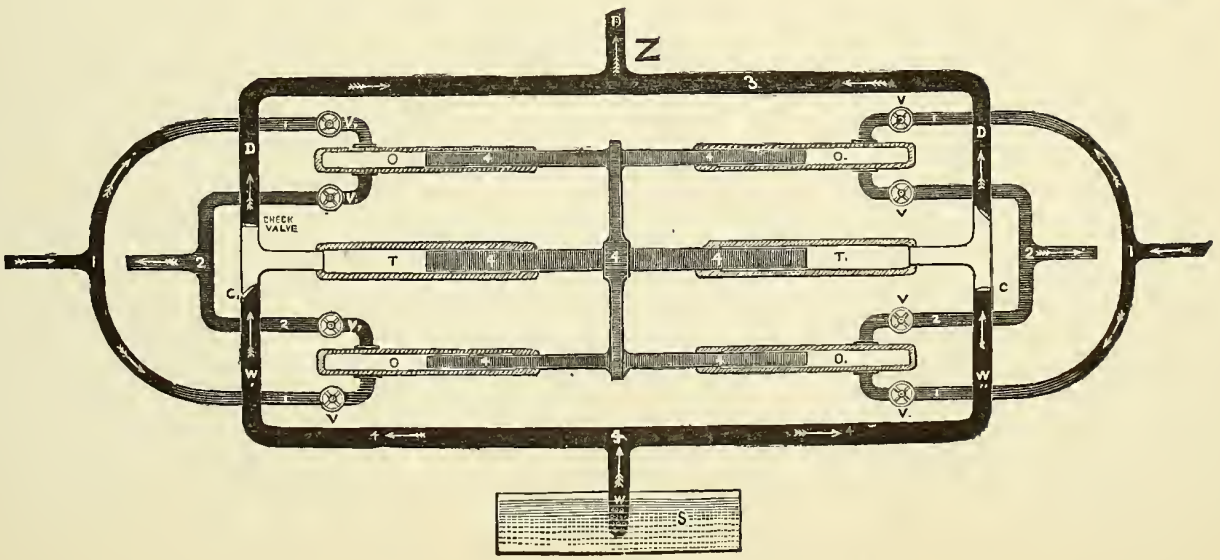
The general arrangement of the system having been described, an account will now be given of the manner in which the work is performed by the pumps, *P*. In the drawing I have shown in detail that portion of the undergound pumps lying between the lines, *B* and *B*, on the general plan, leaving out, of course, that portion already explained for taking up the inertia of the supply water.

There are two of these underground pumps, situated on the 2,400 level of the mine, but since they are similar and work independently of each other, it is necessary to describe but one of them. They both take their supply water through the valve, *E*. Acting inde-









Hydraulic System of Draining Mines.

pendently, as they do, they will not necessarily commence and finish their strokes at the same time. But, in order to discuss the system under its extreme conditions, I will consider the two pumps as working together, thereby making the velocity of the supply water and the inertia of the moving masses a maximum.

Therefore, in each pump, let *O, O,* and *O, O,* see detail drawing, be the four pressure cylinders, and *T* and *T* the pump cylinders for raising the drain water to the Sutro Tunnel. Let *V* and *V* be the valves leading to the pressure cylinders from the supply and return pipes, and let the plungers be connected with a crosshead (as shown in drawing), so that when any movement of the plunger, *O O,* takes place, the plunger, *T T,* will be carried along also.

Now, let us follow the operation of these pumps, first assuming, however, that the pressure of the water in the supply pipe is great enough to produce motion of the plungers, *O, O.*

First, suppose the valves, *V,* to be opened (valves, *V,* remaining closed). The two plungers, *O O,* will be forced over to the right, carrying with them the larger plunger, *T T.* While *T* travels to the right, the space left by it is immediately filled with drain water coming through the suction pipe, *W.* Now, suppose valves, *V,* be closed and the stroke finished, the valves, *V,* are then opened, and the pressure of the supply water against the plungers, *O,* forces them to the left, and the water remaining in cylinders, *O,* is forced through the valves, *V,* into the return pipe, and thence into reservoir, *N,* upon the surface. At the same time, the water which was drawn into cylinder, *T,* on preceding stroke, is now forced (on account of the check valve, *C,* closing) through *D* into discharge column, *D,* and thence 800 feet into the Sutro Tunnel. Again, while this stroke to the left is being made, the space left by plunger, *T,* is being filled with drain water through suction pipe, *W.* At the completion of this stroke, valves, *V,* are closed and valves, *V,* are opened, the crosshead and plungers again move to the right, and the waters remaining in the cylinders, *O,* is again forced through return column into reservoir, *N.* At the same time, the water in cylinder, *T,* is forced upward (on account of check valve, *C,* being closed) through *D* into *D,* and thence to Sutro Tunnel. When crosshead and plungers are again over to the extreme right, valves, *V,* are closed and valves, *V,* opened, and thus the operation continues, the valves, *V* and *V,* being worked automatically by means of tappets carried by the crosshead. The number of strokes made by these pumps evidently depends upon the pressure of water in the supply pipe, and also upon the rapidity with which the valves, *V* and *V,* are opened and closed.

In the preceding, I have followed the action of but one underground pump, but, as I have said before, the two are alike in every respect, and both draw their water from and discharge it into the same columns.

From the above remarks, it will be seen that the sole object of these two underground pumps is to raise the drain water from the 2,400 level of the mine to the Sutro Tunnel, a distance of 800 feet. The object of the accumulator, *A,* upon the surface, is to accumulate the water within it, under a pressure great enough to work the pumps, *P,* and the object of the compound steam engine and pumps, *T* (on the surface), is to supply the accumulator with exactly the same amount of water taken from it, to run underground pumps. Furthermore, it will be noticed that the same amount of water which is used to run these pumps, *P,* is returned to reservoir on the surface, from whence it is forced into the accumulator by pumps, *T,* to be used over and over again.

Right here it might be well to mention the fact, that the surface pumps, *T,* were constructed with a capacity great enough for two more pumping engines, similar to those just described (*P*), so that when a depth of 1,000 feet more was reached, this extra set of pumps would be put in at the 3,400 level, and the process go on as before.

The above description, by Mr. Moore, explains the action of the hydraulic pumps on the Comstock. Since it was written the pumps have been running several years, and the springs (marked *S* on the diagram) have been replaced by air chambers, so that the concussion of water lost in discharge, pressure, and return columns, has been overcome by means of air chambers erected on the same station with the pumps. It was found impossible to properly regulate the springs to work as efficiently as the air chambers have done. The population of Virginia City decreased so rapidly that the water company were enabled to supply the Combination Shaft with water to run their pumps. Instead of the accumulator and surface engine being required, they were only kept as a reserve in case of a failure of the water supply. After the shaft had been sunk considerably in depth, two more pumps were added on the 2,600-foot level, and later on two extra additional ones at the 3,000-foot level, which raised 4,000,000 gallons of water daily to the Sutro Tunnel, a direct lift of 2,400 feet of hot water, at a temperature of 140 degrees. In all there were six pumps, which have been running constantly, without a single stop, this last number of years. It is

only in October last that they were shut down, by order from the companies, because deep prospecting was found unprofitable. They are now submerged in several hundred feet of water. The Risdon Iron Works have built several other pumps on this same style, and all have worked successfully. These pumps have lately been introduced in England, at some large collieries there, and are also working satisfactorily.

WEIGHT OF QUARTZ MILLS.

As many miners have no information of the details of weight of the parts of quartz mills, the following statement concerning five, ten, and twenty-stamp gold mills has been obtained from the Joshua Hendy Machine Works, San Francisco. Of course the weights of the ore-feeders and the concentrators depend upon the pattern used, but the figures given will afford a basis upon which miners can estimate what freights have to be paid.

MEMORANDA OF WEIGHTS OF FIVE-STAMP QUARTZ MILL (GOLD).

Rock-breaker	4,500 lbs.
Ore feeder ("Challenge")	750 lbs.
Mortar, for 750-lb. stamps	4,000 lbs.
Dies, 100 lbs. each, five	500 lbs.
Shoes, 110 lbs. each, five	550 lbs.
Stems, 340 lbs. each, five	1,700 lbs.
Bossheads, 200 lbs. each, five	1,000 lbs.
Tappets, 100 lbs. each, five	500 lbs.
Cams, 150 lbs. each, five	750 lbs.
Cam shaft	350 lbs.
Concentrators ("Triumph"), 2,275 lbs. each, two	4,550 lbs.
Clean-up pan	800 lbs.
Revolving barrel	1,200 lbs.
Batea	200 lbs.
Retort	75 lbs.
For pulleys, piping, belting, bolts, etc.	2,400 lbs.
Total	23,825 lbs.

MEMORANDA OF WEIGHTS OF TEN-STAMP GOLD QUARTZ MILL.

Rock breaker	5,200 lbs.
Ore feeder ("Challenge") 750 lbs. each, two	1,500 lbs.
Mortar for 750-lb. stamps, 4,000 lbs. each, two	8,000 lbs.
Dies, 100 lbs. each, ten	1,000 lbs.
Shoes, 110 lbs. each, ten	1,100 lbs.
Stems, 340 lbs. each, ten	3,400 lbs.
Bossheads, 200 lbs. each, ten	2,000 lbs.
Tappets, 100 lbs. each, ten	1,000 lbs.
Cams, 150 lbs. each, ten	1,500 lbs.
Cam-shaft, 13′ 6″x4′ 1″	700 lbs.
Concentrators ("Triumph"), 2,270 lbs. each, three	6,810 lbs.
Clean-up pan	800 lbs.
Revolving barrel	1,200 lbs.
Batea	200 lbs.
Retort	100 lbs.
Pulleys, piping, belting, bolts, etc.	5,300 lbs
Total	39,810 lbs.

MEMORANDA OF WEIGHTS OF TWENTY-STAMP GOLD QUARTZ MILL.

Rock-breaker	10,300 lbs.
Ore-feeder ("Challenge"), 750 lbs. each, four	3,000 lbs.
Mortar for 800-lb. stamps, 4,500 lbs. each, four	18,000 lbs.
Dies for 800-lb. stamps, 125 lbs. each, twenty	2,500 lbs.
Shoes for 800-lb. stamps, 120 lbs. each, twenty	2,400 lbs.
Stems for 800-lb. stamps, 360 lbs. each, twenty	7,200 lbs.
Bossheads for 800-lb. stamps, 210 lbs. each, twenty	4,200 lbs.
Tappets for 800-lb stamps, 110 lbs. each, twenty	2,200 lbs.
Cams for 800-lb. stamps, 165 lbs. each, twenty	3,300 lbs.
Cam shaft	1,700 lbs.
Clean-up pan	1,000 lbs.
Revolving barrel	1,400 lbs.
Batea	200 lbs.
Retort	300 lbs.
For pulleys, belting, piping, bolts, etc.	12,600 lbs.
Total	70,300 lbs.

The Pacific Iron Works of San Francisco also furnish data to this report on both silver and gold mills, as follows:

TEN-STAMP FREE ORE SILVER MILL.

One 4 feet by 12 feet grizzly.
One 8 by 10 Blake crusher.
Two automatic ore feeders.
One 10-stamp battery, 750 to 800 pound stamps.
Four 5-foot combination amalgamating pans.
Two 8-foot settlers.
One 3-foot clean-up pan.
One amalgam safe and strainer.
One quicksilver elevator, with tanks, pipes, etc.
Two traveling crabs for battery and pans.
One 14-inch silver retort.
One melting furnace.
Shafting, pulleys, boxes, etc., for mill.
Belting for mill.
Pipes and fittings complete.
One Duncan concentrator for saving quicksilver and amalgam.
Weight of the above, 87,000 pounds.

Power required:

One 50-horse power engine.
One 50-horse power boiler.
One 50-horse power feed-water heater.
One No. 3 steam pump.
Steam and water connections.

Weight of the above, 24,500 pounds.
Total weight of the above, 111,500 pounds.

TWENTY-STAMP FREE ORE SILVER MILL.

One 4 feet by 12 feet grizzly.
One 8 by 10 Blake crusher.
Four automatic ore feeders.
Two 10-stamp batteries.
Eight 5-foot combination pans.
Four 8-foot settlers.
One 4-foot clean-up pan.
One quicksilver elevator, with tanks, pipes, etc.
Three traveling crabs and track for batteries and pans.
Two amalgam safes and strainers.
Two 14-inch silver retorts.
One melting furnace.
Shafting, pulleys, boxes, etc., for entire mill.
Belting for entire mill.
Pipes and fittings for mill.
One Duncan concentrator, for saving amalgam and quicksilver.
Weight of the above, 180,000 pounds.

Power required:

One 100-horse power engine.
Two 50-horse power boilers.
One 80-horse power feed water heater.

One No. 4 steam feed pump.
Steam and water connections.
Weight of the above, 50,000 pounds.
Total weight of the above, 230,000 pounds.

Grizzly, 4 feet by 12 feet, weighs about 2,000 pounds.
8 by 10 Blake crusher weighs about 8,000 pounds.
Automatic feeder weighs about 700 pounds.
Battery, ten stamps, weighs about 27,000 pounds.
5-foot pan, combination, weighs about 6,200 pounds.
8-foot settler weighs about 6,000 pounds.

TEN-STAMP GOLD MILL.

One grizzly, 4 feet by 10 feet.
One 8 by 10 Blake crusher.
Two automatic ore feeders.
One 10-stamp battery, 750 pound to 800 pound stamps.
One traveling crab for battery.
Sixty square feet of silver-plated copper plate, No. 14 gauge, plated 1 ounce of silver to the square foot.
Shafting for mill.
Battery, pipes, and fittings.
Belting for mill.
One gold retort.
Weight of the above, 37,500 pounds.
Power required:
One 25-horse power engine.
One 30-horse power boiler.
One 20-horse power feed water heater.
One No. 2 steam pump.
Steam and water connections.
Weight of the above, 10,500 pounds.
Total weight of the above, 48,000 pounds.

TWENTY-STAMP GOLD MILL.

One grizzly, 4 feet by 12 feet.
One 8 by 10 Blake crusher.
Four automatic ore feeders.
Two 10-stamp batteries, 750 pound to 800 pound stamps.
Two traveling crabs for batteries.
One hundred and twenty square feet silver-plated copper plates, No. 14 gauge, plated 1 ounce of silver to the square foot.
Shafting for mill.
Battery pipes and fittings.
Belting for mill.
One gold retort.
Weight of the above, 72,000 pounds.
Power required:
One 50-horse power engine.
One 50-horse power boiler.
One 50-horse power feed water heater.
One No. 3 steam pump.
Steam and water connections.
Weight of the above, 24,500 pounds.
Total weight of the above, 96,500 pounds.

TWENTY-STAMP GOLD MILL.

Many communications having been received by the State Mineralogist for component parts of gold mills, he deemed it advisable to publish in his report the following specifications, kindly furnished to Trustee W. S. Keyes, E.M., by J. Hamilton:

SPECIFICATIONS OF TWENTY-STAMP GOLD QUARTZ MILL FOR THE BUCHANAN MINE, TUOLUMNE COUNTY, CALIFORNIA.

One (1) *Grizzly*, to be made of $\frac{3}{4}$-inch by $2\frac{1}{2}$-inch wrought iron, 12 feet long, 4 feet wide; spaced 2 inches between the bars, and secured by three $\frac{3}{4}$-inch bolts, and cast-iron thimbles and washers; also end bars.

Rock Breaker.—One Blake crusher, fitted with two flywheels, 4 feet in diameter, and one (1) pulley, 30 inches in diameter, and 12-inch face crank-shaft, to have out-board bearings; holding-down bolts for each, to be long enough for 14-inch timbers; all caps for boxes to be fitted to use zinc oil cups, and "Albany" lubricating compound.

Battery.—Four (4) single discharge gold mortars, each weighing about 5,000 pounds; the bottoms to be 6½ inches thick; well planed; the screw frame bearings to be planed also; the bases to be 26 inches wide, 3 inches thick, and cored for eight (8) mortar bolts 1½ inches in diameter; the feed mouth to be 26 inches long and 3½ inches wide, at the smallest part; the mortars to be well finished, and to be 56 inches long, and about 52 inches high.

Mortar Bolts.—Thirty-two (32) mortar bolts, 1½ inches in diameter, and 36 inches long; nuts on both ends, and thirty-two (32) 4-inch square countersunk washers for the lower ends; one (1) wrought-iron wrench; jaw designed for the nuts of mortar bolts; arm to be 6 feet long, slightly curved, made of 1-inch by 2½-inch iron.

Stamp Dies.—Stamp dies, 7 inches deep, 8½ inches in diameter, with square bases, having beveled corners, and all made to properly fit the mortars, and to be cast of the best car-wheel iron; stamps to weigh 850 pounds each.

Shoes.—Twenty (20) stamp shoes, 8½ inches in diameter, 7½ inches long; to be cast of the best car-wheel iron.

Heads.—Twenty (20) stamp heads, 8½ inches in diameter, 18 inches long; keyholes to be 1⅝ inches by 3 inches; one (1) key for driving out shoes and stems, and to be made as may be directed.

Tappets.—Twenty (20) double-faced gib tappets, made of the best steel faces, 9 inches in diameter; tappets to be 12 inches long; bands or flanges turned, and each to have gibs and three (3) steel keys, and all to be marked; keys to be boxed for shipment.

Cams.—Twenty (20) double-armed cams, made of best steel; ten (10) to be right, and ten (10) to be left-handed; hubs on one side, and to be strongly banded with ¾-inch by 2-inch wrought-iron bands, well shrunk on; the faces of the cams to be well smoothed, and to be fitted to 5½-inch cam shafts, and to be properly marked.

Feeders.—Four (4) Hendy Challenge ore feeders, complete with all latest improvements; also, twenty (20) steel keys for same, to be marked and fitted, and properly boxed for shipment; the cams to be about 32 inches long, with 2½-inch face, and struck to give an 8½-inch drop if required.

Corner Boxes.—Six (6) corner boxes, for 5½-inch cam shafts; cored for 1-inch bolts; backs to be planed true, and bearings to have a strip running lengthwise, and the balance of the bearings to be well babbitted and bored; the ends to be faced; the cap to be solid, bored, but not babbitted, unless required, and bored with three (3) ⅝-inch holes each, for using "Albany" compound.

Cam Shafts.—Two (2) cam shafts, 5½ inches in diameter, and 14 feet 6 inches long, and key-seated between bearings.

Jack Shafts.—Four (4) jack shafts to be 3 inches in diameter and 59 inches long, with eight (8) bearings for same, and to be made of cast-iron.

Stems.—Twenty (20) stamp stems 3¼ inches in diameter, 14 feet long; turned and tapered off both ends for heads; made of rolled iron.

Latch-sockets.—Twenty (20) open latch-sockets; all to be well lined with heavy leather.

Guides.—Four (4) complete sets of best white oak guides. The lower guides to be 16 inches wide and 4 inches thick, and the upper to be 14 inches wide and 4 inches thick; bored for 3¼-inch stamp stems, and to be 10 inches between centers; all to be 60 inches long.

Cam-shaft Pulleys.—Two (2) wood pulleys, 72 inches in diameter, with 16-inch faces and 6-inch thickness of wood between the flanges, and to be made of the best kiln-dried sugar pine; to be turned and well bolted to 40-inch diameter cast-iron sleeves; flanges for 5½-inch cam shaft; the flanges to be faced.

All of the keys for this mill to be made of the best steel.

Overhead Crabs.—One (1) crab for battery having flanged wheels 7 inches in diameter and 2-foot face; the axles to be 1½ inches square and long enough to set the wheels 10 inches between the flanges; the boxes to be 1¼ inches thick, and all made of the best wrought iron.

Piping, etc.—All piping, hose, valves, bibs, cocks, ells, tees, unions, etc., to be furnished as per detailed bill. All necessary bolts, belts, nuts, and washers, also copper plate for battery and aprons, to be furnished of proper weight, and as shown on drawings, ⅛-inch thick, not plated; also, silver-plated copper plate, 20 inches wide and 20 feet long.

Belting—One (1) main driving belt, to be about 55 feet long, 20 inches wide, and made of the best 5-ply rubber of the "Boston Belting and Packing Co's" manufacture, patent stretched.

Battery Belts.—One hundred and ninety (190) feet of the best 5-ply rubber, 16 inches wide.

Rockbreaker Belt—Ninety (90) feet of 4-ply rubber, 12 inches wide.

Boxes for Shafting.—All boxes to be planed on the bottom and faced on the ends, and to be well babbitted, and the caps to be bored with ⅝-inch holes, for Tatum & Bowen's lubricating compound. Two (2) steel collars and set-screws for each.

Shafting and Pulleys.—One (1) main battery line shaft to be made in two lengths, 4 inches in diameter, 20 feet long, and 3½ inches diameter, 20 feet long, coupled together with solid coupling. One (1) countershaft for driving rock breaker, 3 inches diameter, 20 feet long; both shafts fitted with all necessary bearing boxes, and holding down bolts for 14-inch timbers.

Pulleys.—One (1) main driving pulley to be fitted to engine crank shaft at mine, to be 48 inches diameter, 21-inch face.

One (1) pulley for main battery line shaft, to be 72 inches diameter, 21-inch face, 4-inch gauge.

One (1) pulley to drive crusher countershaft, 40 inches diameter, 12½-inch face, 4-inch gauge.

One (1) pulley to drive battery, 34 inches diameter, 16½-inch face, 3½-inch gauge.

One (1) pulley to drive crusher, about 40 inches diameter, 12½-inch face, 3-inch gauge.

One (1) pulley on crusher countershaft, 26 inches diameter, 12½-inch face, 3-inch gauge.

Tighteners.—Two (2) battery tighteners, 16 inches diameter, 20-inch face, with racks, pinions, frames, hand-wheels, pawls, and pawl plates, complete for stopping and starting the batteries.

One (1) rock breaker tightener complete, as above specified, for stopping or starting the crusher.

All necessary bolts for batteries and building, and all necessary belt rivets for securing the belts. All belting used in this mill to be of Boston Belting Co.'s manufacture, best quality and patent stretched.

All castings to be made of good material, smooth and free from blow-holes or other imperfections. All keys to be made to fit and properly marked.

Mortars are to be cast from selected patterns or drawings, which will be furnished.

Should anything be lacking to complete this mill which has not been specified, it must be supplied the same as if fully mentioned.

Everything to be delivered on the ground (at company's expense), and timbers to be cut according to plans to be supplied.

NOTE.—The company already had an engine and boiler. The building, also, over the mill was built by the company. The cost of the above material was $5,985, and of the labor, $2,300. Save a slight change in the tappets, the work was satisfactorily done, and the mill crushed over two tons per stamp, of hard quartz, every 24 hours.

The total cost of grading, building, machinery, etc., was a little short of $15,000.

CONCENTRATION OF GOLD AND SILVER ORES ON THE PACIFIC COAST.

(By J. M. ADAMS, E.M.)

This article is based entirely upon the practical experience of the writer, who, since first becoming connected with the mining interest, has ever sought to draw attention to the great importance of a correct system of concentration.

In 1867 he came to California, en route to Silver City, Idaho, where he was engaged for some time in mining and milling the ores of gold and silver.

As a part of his studies in the Mining School, of which he is a graduate, he labored over Rittinger's Aufbereitenskunde, and obtained from it a fair book knowledge of the dressing and concentration of ores, as practiced in Europe. But the conditions are so different in this country, labor is so much higher, etc., that he has found the appliances advocated by Rittinger of but little benefit, as for example:

Mr. Liebenan, a bright, intelligent, and industrious young German, who had graduated from Freiburg, consumed a large part of the year 1867 endeavoring to concentrate economically with shaking tables, etc., the ores of Flint District, about eight miles from Silver City, Idaho.

The mineral present at the ores was largely tetrahedrite, or gray copper ore, containing a high percentage of silver, the gangue being a hard white quartz. Mr. Liebenan, however, failed, partly because the German method required so much labor, which was very high in Idaho; still he obtained a fair percentage of the mineral in high grade concentrations, and would probably have made a success, if he could have used the perfect automatic concentrators now in use in the mining sections of the United States. As it was, Liebenan failed, and drifted away to other fields, finally dying, poor fellow, in the prime of life, in Venezuela.

In one of the mills at Silver City, of which the writer had charge, he attempted to save part of the loss in the tailings with Hungerford concentrators and Evans' corrugated riffles, using them below the agitators, but he found the uneven discharge and varying proportion of sand and water so injurious, that satisfactory results could not be obtained; furthermore, neither were very effective appliances for saving sulphurets.

He used siphons and other means to draw from the agitators, in the endeavor to obtain uniform supply for the concentrators, but all that was saved was a little quicksilver and amalgam, not enough to pay for the wear and tear of the Hungerfords, which are similar to the Hendy concentrators, which are described on another page. The use of sluices with blankets also proved unsatisfactory.

In 1867 the writer stopped for a day at Grass Valley, where he found at the Eureka Mine, in successful operation, a "wonderful and secret process" for extracting the gold from the sulphurets, called "chlorination."

Sluices were being used below the mill to save the sulphurets. Concentration of ores is simply the separation of the heavy from the light, and is performed sometimes on dry ore, but generally water is used, especially in California, where it is practiced principally on the ores of gold and silver, which are either native or associated with, or part of various metalliferous minerals; the gold and silver, as well as the minerals, being much heavier than the gangue or vein matter in which they occur.

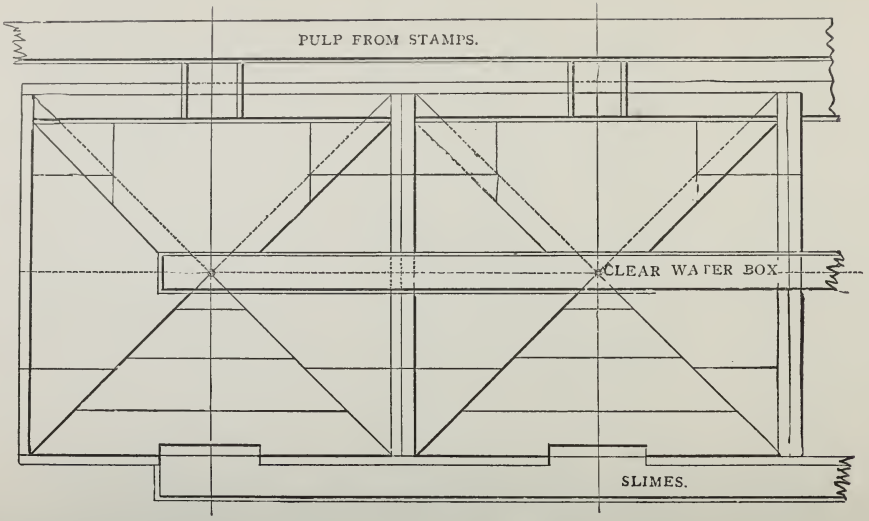
They are freed to a large extent from the gangue by crushing or pulverizing to a proper degree of fineness, and according, as the concentrating work is more or less perfect, the separation is made of the heavy or valuable part of the ore from the gangue. Occasionally the lightest—or finest—part of the crushed ore is very rich, and is worth saving by itself.

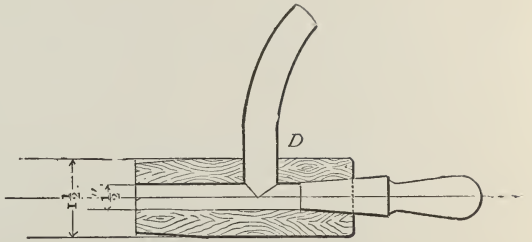
In dry concentration this is the dust, and is separated and saved if of sufficient value.

In wet concentration this light portion is the slime, and if rich enough to be saved the pulp is passed through a pointed box (as per cut and description below). The slimes pass off from the top, to be settled and saved, the balance discharging from the bottom to the concentrator, for separation and saving of the mineral.

In some cases it is preferable to put the pointed box below the concentrator, and thus separate from the tailings and save the rich slimes. As a rule, however, most of the money in the slimes exists as finely divided sulphurets, which are caught and saved with the balance of the sulphurets by the best concentrators, so that there then is only an occasional ore whose slimes need segregation and saving.

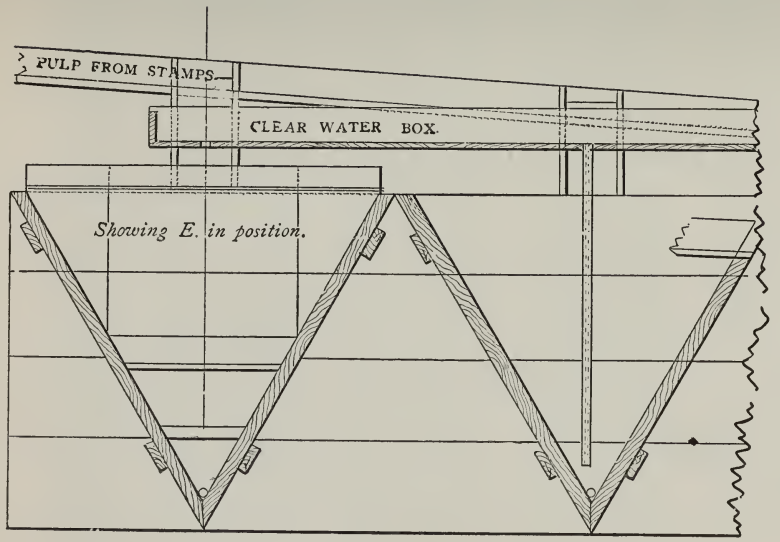
I have, however, deemed it best to give the following description and cut of the pointed box:

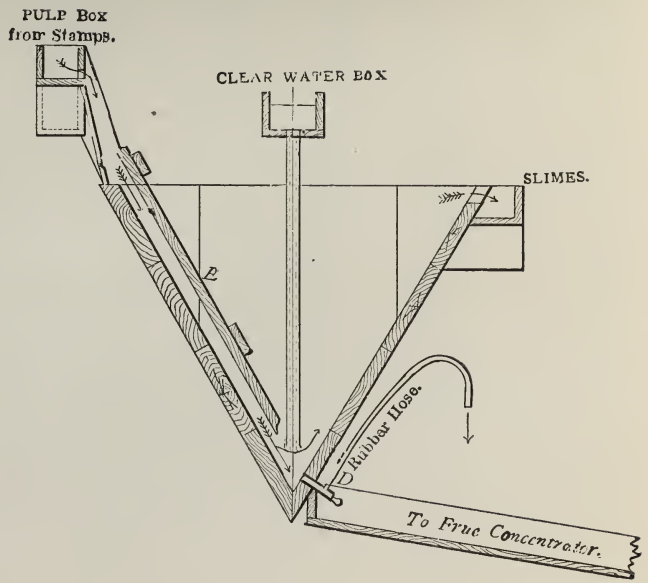




POINT BOX.

Scale, $\frac{1}{2}'' = 1'$


PULP FROM STAMPS.
CLEAR WATER BOX.
Showing E. in position.


PULP Box
from Stamps.
CLEAR WATER BOX
SLIMES.
E
Rubber Hose.
To Frue Concentrator.

Several forms are in use. Their dimensions vary according to the duty required. In some cases it is desired to save and settle together all the pulp, including the slimes, when there is too much water present for subsequent concentration. In such event the pointed box should be about 6 feet deep, and 3 feet by 7 feet at the top, the longest sides sloping till they meet at the bottom.

Such a box will settle and save about six tons of ore in twenty-four hours, discharging it automatically and continuously from the bottom by a siphon hose, with the proper amount of water for subsequent concentration.

This form is used when the tailings from pan amalgamation are to be concentrated, after leaving the settlers and agitators, for they contain a large excess of water, which must be gotten rid of, so that the tailings are of the proper consistency for concentration.

The accompanying cut shows a form of point box used in cases where the slimes are to be separated from the pulp and saved. Each box is 40 inches square at the top, and 40 inches deep, coming to a point at the bottom; and one box will handle from 6 to 10 tons of pulp in twenty-four hours, making a good separation.

The pulp from the battery, entering the box at the top, is confined by partition *E*, until it passes into the box proper, near its bottom. Clear water is conveyed from above through a half-inch pipe, which delivers it into the box at the bottom. Care must be taken that this pipe is kept full, so that no air bubbles are carried through it, as they create agitation, and cause sand, etc., to pass off with the slimes.

The amount of clear water needed varies, so it is a good plan to have a cock in the pipe just below the clear water box, or else partially close, with a wooden plug, the opening of the pipe in the clear water box. At D is a hollow plug, and to it is attached a piece of hose, which is used as a siphon, so that the pressure is lessened and too violent discharge of the pulp is prevented.

Without the siphon hose, $\frac{2}{8}$ inches opening would not be too small, while with it $\frac{3}{8}$ inches opening is about right, and the end of the hose is plugged accordingly. Inasmuch as foreign coarse material occasionally gets into the box (prevented as much as possible by a screen over the top), it is advisable to use in place of the hollow wooden plug shown, a $1\frac{1}{2}$-inch iron tee with one end plugged, and with $\frac{3}{4}$ inch side outlet, attaching the siphon hose by nipple.

Thirty-five years ago, concentration in California consisted simply in saving the placer gold, and the appliances used were the rocker and sluice. Various grades were given to the sluice; its bottom was formed in various ways, some using plain riffle bars, some preferring blocks of wood sawed across the grain; others liked boards, full of round holes, undercurrent riffles, etc. Sometimes quicksilver was used to catch the gold; sometimes none was used.

When gold was discovered in quartz in California, and reduction works for the same were to be constructed, Californians knew nothing of the required means, and had to adopt the old square wooden stem Cornish stamp, the arrastra, etc., but with our ingenuity, native to Americans, improvements were rapidly made, and to-day American (United States) machinery for mining and reduction of gold and silver ores is the best in the world.

The old fashioned stamp was replaced by the round iron stemmed stamp, revolving as it is lifted by the cam, and with cams, tappets, shoes, and dies of cast-steel, the wear has been reduced to a minimum, and the

present standard American stamp mill is a very different crushing appliance from the clumsy stamps first used by us.

Most of the quartz veins worked in early days were either much decomposed on the surface, or were clean quartz containing the bright yellow gold. As depth, however, was attained, the decomposed ores changed, and sulphurets of iron and copper, with galena, blende, and other minerals, were found. The ore did not yield as much of its gold as the surface ore; there was some gold in the tailings, and further examinations showed that a large part of the loss was in the sulphurets, hence we began to realize that there was money in the sulphurets, and two problems arose:

First—How to save the sulphurets.

Second—How to realize the money contained in them after they were saved.

In regard to the second problem it was soon known, that if rich enough they could be sold to parties who would send them to ——— ———, or other smelting works in Europe, while in some cases quite a proportion of the gold could be saved by thorough amalgamation in pans or barrels, and about 1867 it was proved that a high percentage of the gold could be profitably extracted from the sulphurets by roasting and chlorination.

As regards the first problem, "How to save these gold-bearing sulphurets," here the necessity of concentration became apparent, as the only economical method was by taking advantage of their greater weight and separating them accordingly.

Labor being very high, automatic concentrators became a desideratum, stimulating the inventive faculties of many who were engaged in mining. Various machines were devised and tested; most of them proved to be of little value, and the appliances in general use for saving sulphurets in California in 1875 were few in number, being as follows:

The sluice with blankets or burlaps.

The sluice with riffles and the buddle.

The raising gate.

The Hendy concentrator.

The grade of the sluice, using blankets or burlaps, was generally about $\frac{1}{2}$ inch to the foot. A double set was used; the blankets or burlaps in one set being taken up and washed, while the other set was in use. By very frequent washings the sulphurets were obtained fairly clean, but this took so much labor that they were seldom washed, and the ordinary product contained much sand, and the sulphurets contained were coarse, the finer sulphurets passing off, although nearly equal in quantity and frequently much richer than the coarse sulphurets.

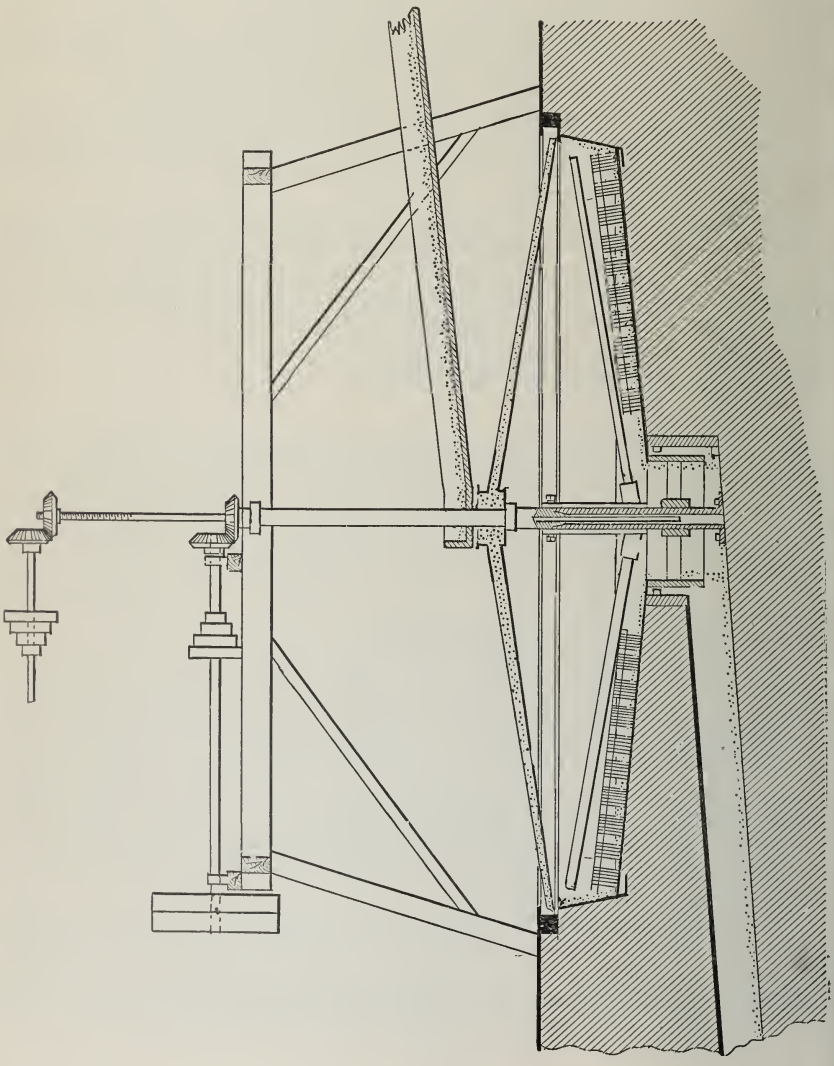
The grade of the sluice with riffles was about $\frac{3}{4}$ inch to the foot, and was generally of the following type: Two sets are used; each riffle is formed by a half-inch strip of wood, fitting across the sluice, and about ten feet from the next riffle. At stated periods, according to the amount to be collected (varying in different ores), another strip is placed on top of the previous one, and this is continued until the sluice is nearly full at each riffle, when the tailings from the mill are turned into the other set of sluices for similar treatment, and the material accumulated in the first set of sluices is collected, and further concentrated in a buddle, of which there are several styles.

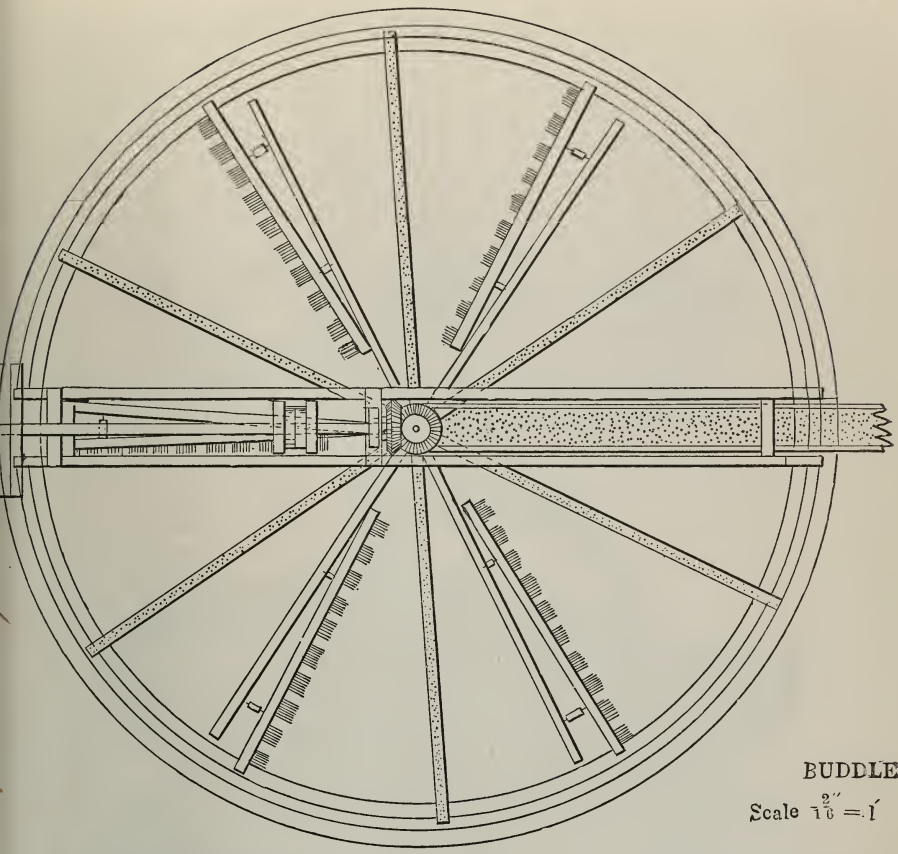
The accompanying cut shows one used frequently, and may be described briefly, as follows: It is circular, with concave bottom, and the discharge for the tailings is in the center, where there is a hollow iron cylinder, shown in the cut, with its top or rim even with the bottom of the buddle. In this position everything will flow out of the buddle, but this ring or

cylinder is attached to an upright spindle and by the gear at the top is gradually raised, retaining in the buddle the sulphurets as they accumulate, and constantly raising the discharge of the tailings; the arms, also, from which the brushes hang, are gradually raised at the same time by the mechanism.

The material to be buddled is delivered from above the center through six pipes at the periphery of the buddle. Very little water is used, and there is no agitation except that made by the brushes, which are constantly moving around the circle, resting on the pulp, and being dragged around by the arms.

By means of the step pulleys above, the gradual raising of the discharge cylinder and of the brushes are regulated as required for the material operated on. When the buddle is full of sulphurets, it is stopped and cleaned out.



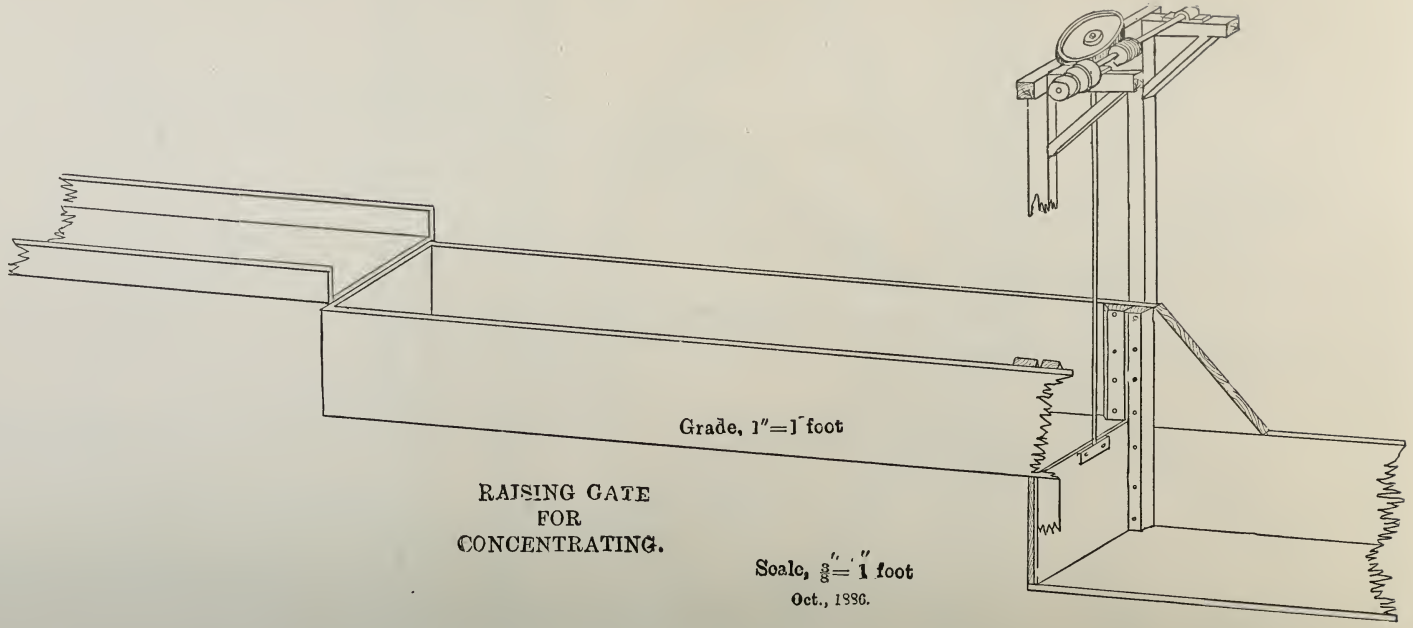


BUDDLE

Scale $\frac{2''}{1'0} = 1'$

This system of sluice with riffle and buddle does very fair work if carefully attended to, but requires a large amount of labor, and does not save the *finest* sulphurets.

The raising gate may perhaps be best described as the sluice with riffles, improved by having the riffle raised gradually by machinery. The accompanying cut shows the raising gate *down, or open*; by the gear above it is gradually raised, the speed being changed at will by the step pulley.



RAISING GATE
FOR
CONCENTRATING.

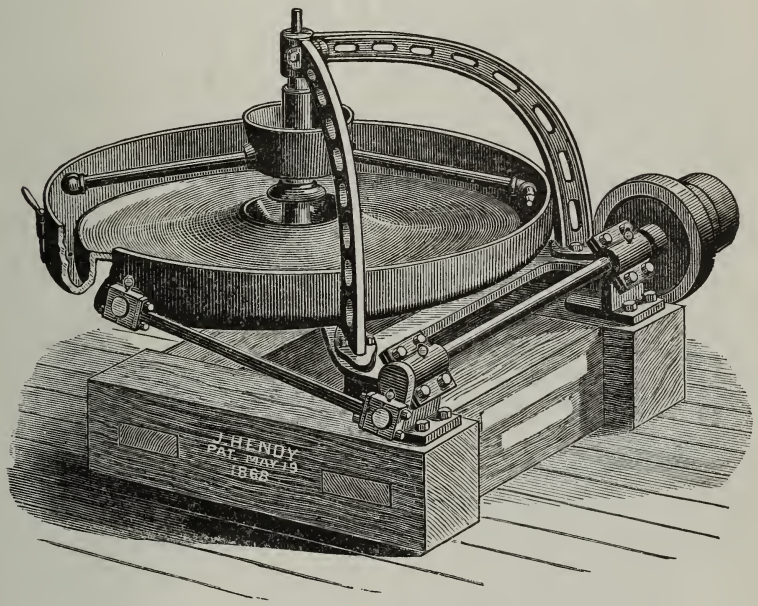
Scale, $\frac{3}{32}$″=1 foot

Oct., 1886.

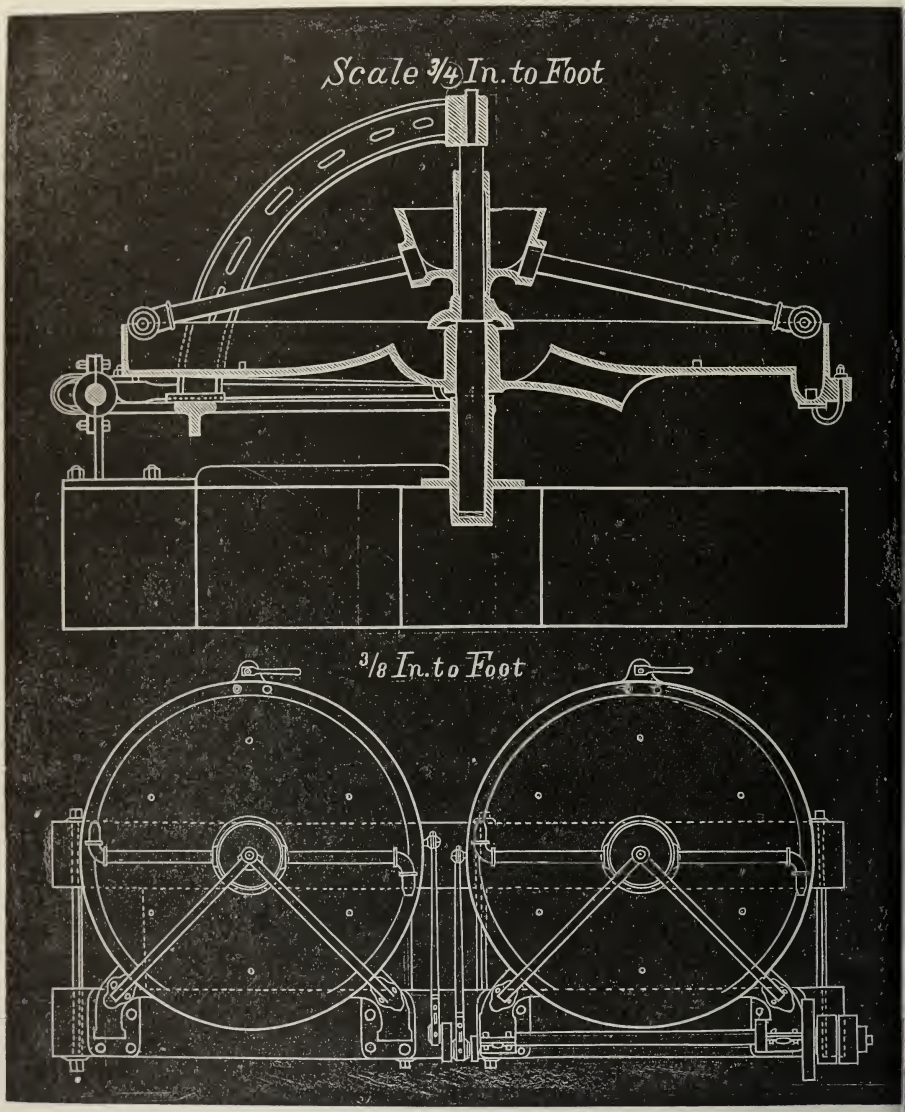
It saves some labor, but its work is about the same as the sluice with riffles, described above.

The Hendy concentrator was used very extensively for several years. The cut shows it to be circular, and of iron; the bottom is slightly convex, and at its periphery is a circular or annular trough, deeper than the main bottom. By the crank shaft it is given a short, quick, vibrating motion, horizontally, turning on its center as a pivot. The pulp is delivered into the bowl above the center, and is conveyed by two arms or pieces of pipe, and delivered on the concentrator at its periphery.

A depth of about 3 inches of material is kept in the concentrator; the heaviest settling to the bottom, and being moved gradually by centrifugal force towards the outside of the pan, where it collects in the annular trough, and discharges from a spout. The concentrations, still containing much sand, are passed through a third machine, and reasonably clean sulphurets obtained. The tailings pass off at the center of the machine, through the bottom.



Hendy Concentrator.



HENDY CONCENTRATOR.

At the Keystone Mill of forty stamps the pulp is passed through these concentrators, and their tailings pass over sluices with riffles.

In 1875, the writer, with his partner, commenced the arduous task of convincing the mining men of the coast that there was a heavy loss passing away from all the concentrating appliances in use, and that even a perfect concentrator needed proper conditions and proper care to secure its most efficient work. In most cases it was difficult to convince parties that their loss was really so great, and frequently we would be told that if a concentrator was good for anything, it should run itself and need no attention whatever.

The concentrator advocated by the writer as embodying the most correct principle in a good mechanical appliance (subsequently improved and perfected), was the Frue vanner, or ore concentrator; and after three years' constant work, and an expenditure of $30,000, success was attained, and the mining public were largely convinced of the importance of proper concentration of the gold and silver ores of the Pacific Coast.

The word "silver" is used because many of the sulphurets contain a large proportion of silver as well as gold. In the vicinity of Nevada City the production of sulphurets was more than doubled by using the vanners, and similar success attended their introduction and use elsewhere. Its success stimulated others to invent concentrators, so that many new concentrators have been brought before the public, many of them possessing merit, and almost all of them claiming superiority over the vanner.

Nevertheless, the sales of the vanner increase every year, and up to date amount to nearly $1,000,000.

The attention of the public is being drawn more and more every year to the importance and benefit of concentration, and even the low grade silver and gold ores of the Comstock Vein (Virginia City, Nevada), are being successfully and economically concentrated. These ores yielded no profit under the old method of amalgamation.

In former times the necessity of sizing even finely crushed ores was strongly insisted on to properly prepare the ore for concentration, but sizing is rarely found advisable with the concentrators now in use.

In some of the mining districts of this State the ore is very heavy with sulphurets, containing twenty per cent and over. Much of this can be separated by coarse crushing with rolls, etc., and jigging, and this method of treatment is advisable, as there is thus avoided a heavy loss of sulphurets in slime, which would occur if the original ore was finely crushed at first. The tailings from the jigs will still contain much sulphurets, locked up in the gangue, and should be finely crushed and passed over the vanner or some other concentrator.

Occasionally an ore is found in which the silver exists partly as chloride and partly as refractory sulphurets. Formerly such an ore was crushed dry, roasted, chloridized, and amalgamated, but even $30 ore would yield scarcely any profit, and the reduction works were very expensive.

For several years the writer contended that the proper method of treating such ore was by concentration first, and amalgamation without roasting of the tailings from the concentrators. In this manner the expensive dry crushing is replaced by wet crushing, which also doubles the capacity of the mill. The refractory part of the ore is saved by itself in such small compass that it can be either sold or shipped to smelters, or treated at the mill with small expense. The tailings from the concentrators do not need roasting, so that this great expense is saved, as well as the cost of the furnaces.

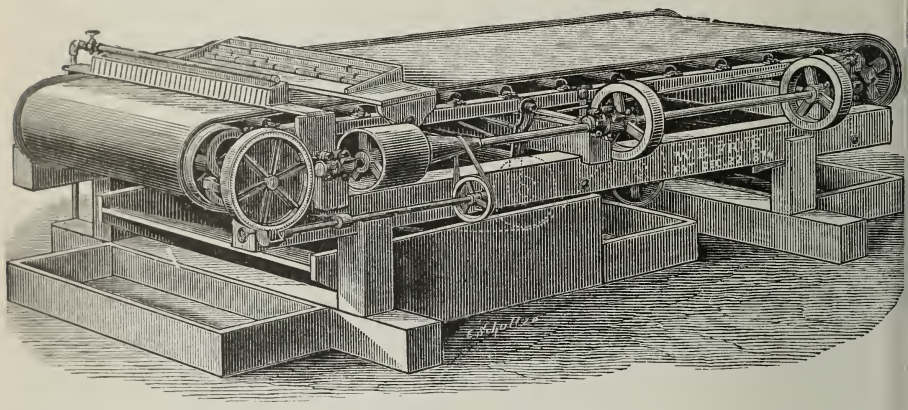
In some localities, ore worth only $6 a ton, can be made to pay by this method, while $30 ore would not pay by the old method of dry crushing, chloridizing, etc.

It is very important that the concentration is made before the amalgamation, for several reasons. The tailings from the concentrator contain no base mineral to trouble amalgamation or cause loss of quicksilver, and the Boss continuous process of pan amalgamation can be used with advantage and economy. If amalgamation should be used before concentration, the sulphurets are ground, and a large part is thereby made so fine that it cannot be saved on any concentrator; too much water, also, is with

the tailings, and there is an uneven discharge from the settlers and agitators.

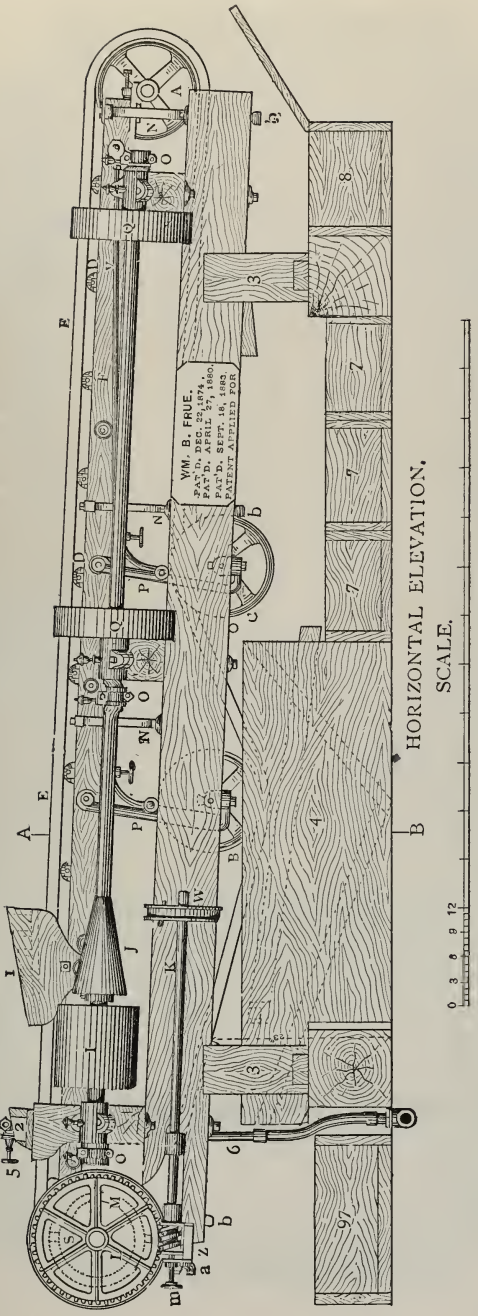
After advocating this method for several years, the writer at last succeeded in having it adopted five years ago by Mr. Randolph, acting for Mr. Alexander R. Shepherd, in the mines of Batopilas (Chihuahua, Mexico), and it is in successful operation there to-day. It is now used also at several mines in the United States.

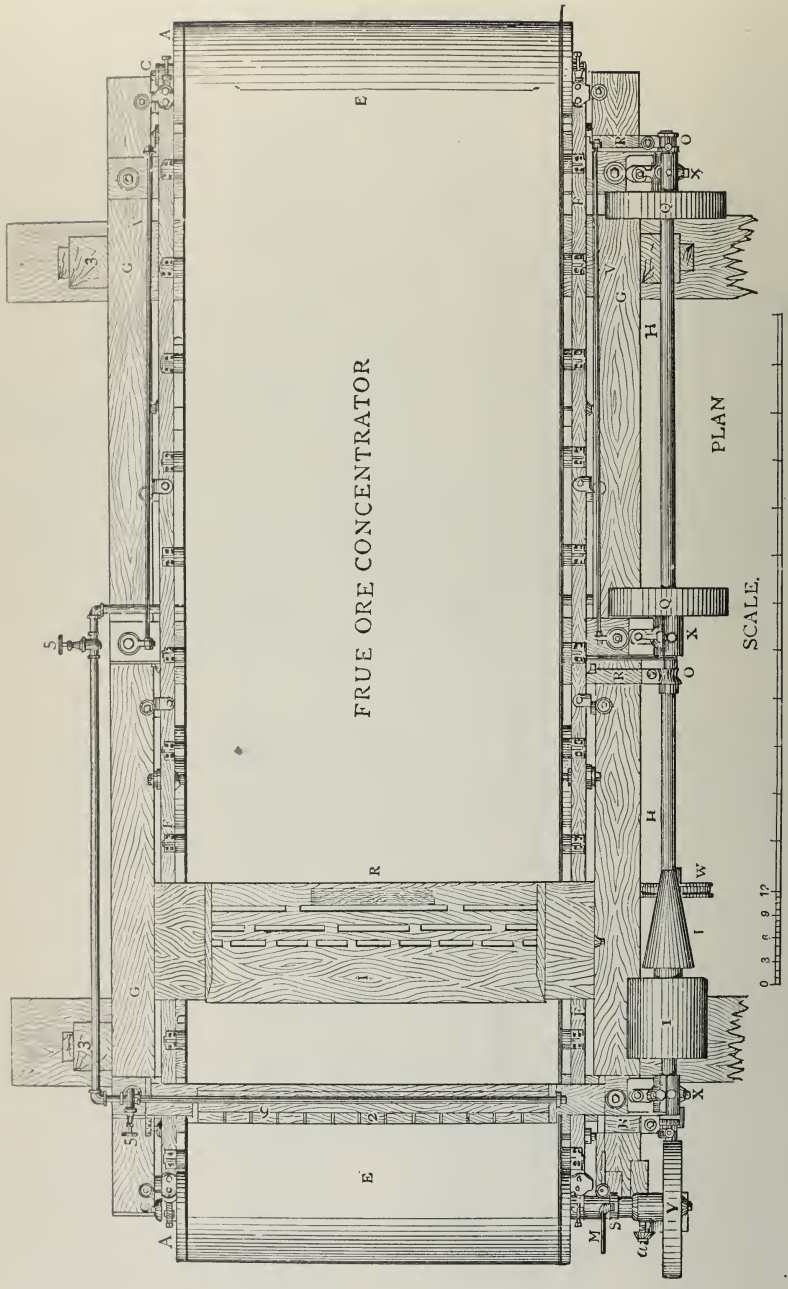
The Frue vanner is familiar to thousands of mining men. The accompanying cut shows it in perspective, as manufactured several years ago.



FRUE CONCENTRATOR.

Since then many modifications and improvements have been made, but it is in the main as represented, and consists of an endless traveling rubber belt, with raised sides, moving slowly up hill, forming an inclined table (about $\frac{1}{4}$ inch to the foot being the grade, subject to change according to the ore), and having a short lateral motion of 1 inch, given by a crank shaft running from 180 to 200 revolutions a minute.


WM. B. FRUE.
PAT'D. DEC. 14, 1875.
PAT'D. APRIL 2, 1878.
PAT'D. SEPT. 16, 1882.
PATENT APPLIED FOR
HORIZONTAL ELEVATION.
SCALE.
0 3 6 9 12
Inches Practical


FRUE ORE CONCENTRATOR
PLAN
SCALE.
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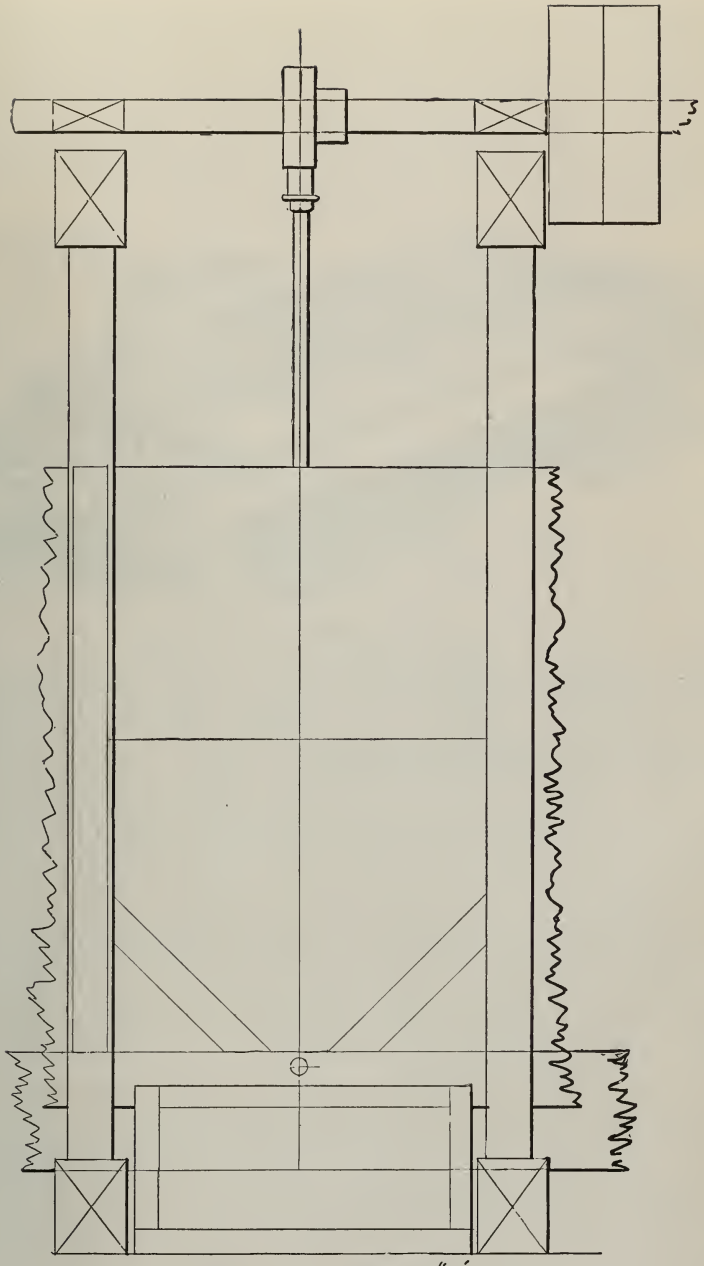
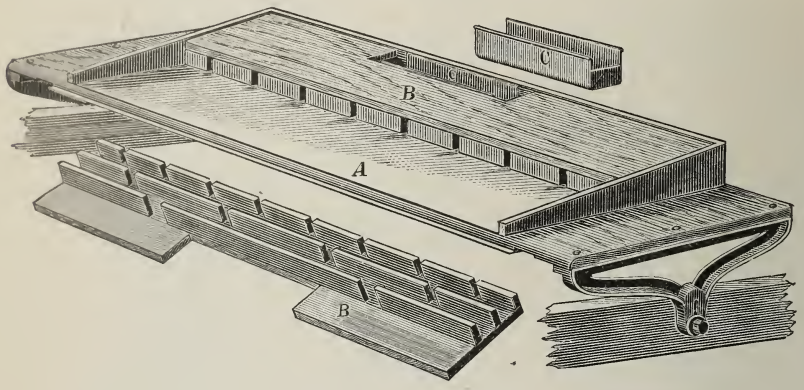


JIG SCALE $\frac{3}{4}$"=1'

It can be further understood by the cut of the working drawing, which shows most of the improvements, except the present form of the ore spreader, which is as per cut below, and was devised, so that for gold ores, a silver-plated copper plate could be placed over the entire surface of the spreader, the top board *B*, with blocks attached being put on the plate; also the copper well *C*, in which is caught quicksilver which may escape from the main plate above; when the plate is to be cleaned, the top board and blocks are removed; this is only done occasionally.



Frue Ore Spreader.

The ore with water is delivered on the belt by means of the spreader No. 1, in working drawing, which shakes with the table, and distributes the pulp uniformly across the belt. A small amount of clean water is distributed by No. 2, which is a wooden trough in which is a perforated pipe. A depth of three-eighths to one-half inch of sand and water is constantly kept on the table. The main shaft, *H*, should be given the proper speed for each kind of ore, and once established, it should be kept uniform; this speed will be between 180 and 200 revolutions of the crank shaft per minute, with one inch throw.

The up-hill travel or progressive motion varies from 3 feet to 12 feet a minute, according to the ore, and the grade or inclination of the *table* is from 3 inches to 6 inches in 12 feet, varying with the ore. The inclination can be changed at will, by wedges at the foot of the machine. The motion, the water used, the grade, and the up-hill travel should be regulated for every ore individually, but once established no further trouble will be experienced in the manipulation.

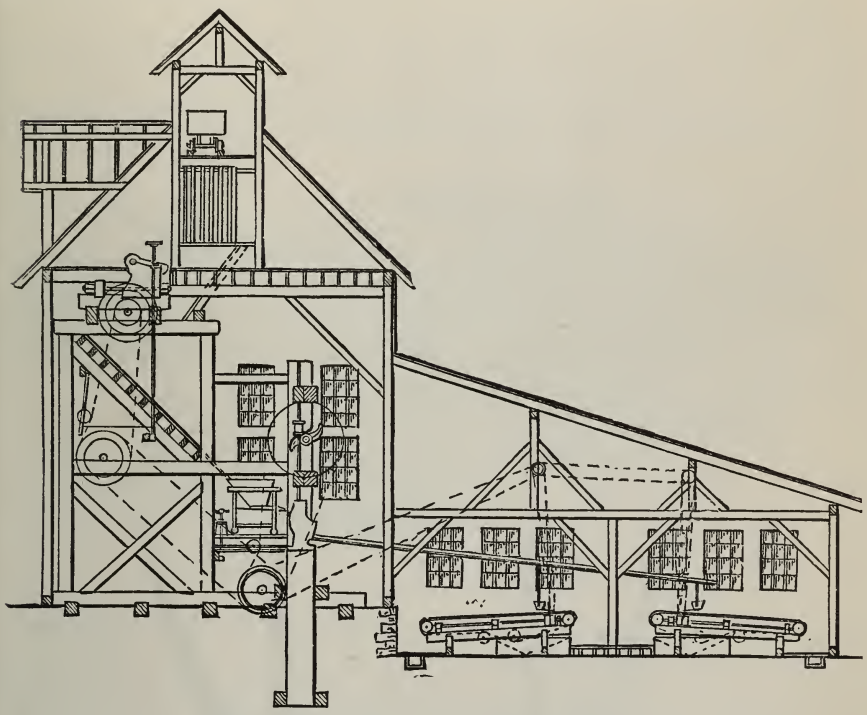
The main body of the belt suffers hardly any wear, as it merely moves its own weight slowly around the freely revolving rollers.

For one machine, ½ inch of water (miner's measure), or 6⅔ gallons a minute, including the water used in crushing, is as large an amount as is ever needed on any material, while on some ores 3 gallons will answer; and by returning the water from the settled tailings ½ gallon will keep up the loss.

The boiler for a 5-stamp mill with 2 concentrators consumes 1 gallon a minute, hence where water is very scarce 2 gallons a minute can supply 5 stamps, 2 Frue vanners, and the boiler.

As regards the capacity of the Frue vanner, about 6 tons per 24 hours passing a 40-mesh screen is as much as it is advisable to treat. If the battery of 5 stamps does its duty, the quantity crushed is largely in excess of 6 tons. For this reason, the best practice is to put 2 Frue vanners to 5

stamps, if the stamps are heavy and the sulphurets high grade and difficult to save; and in such event the pulp is divided, one half passing on each. The machines are generally placed in a double row, on the same level, head to head, as per cut of mill.



Mill Showing Frue Concentrator in Place.

In many cases 3 vanners to 10 stamps will yield entirely satisfactory work, and where the gangue is light, or the stamps not heavy, one vanner treats all the ore crushed with 5 stamps, and does perfect work; *e. g.*, in the Empire mill of 80 stamps, at Plymouth, in Amador County, 16 Frues are concentrating all the ore crushed by the 80 stamps, and the tailings assay merely a trace. No sizing of the ore is needed; the pulp passes directly from the stamps on the copper plates (if used), and thence on the vanners.

In running the machine the point of greatest importance is regularity; regularity in speed; regularity in the delivery of pulp on the belt, and regularity in the supply of clear water. The necessity of this is obvious to any one who thinks of the work to be done by an automatic machine.

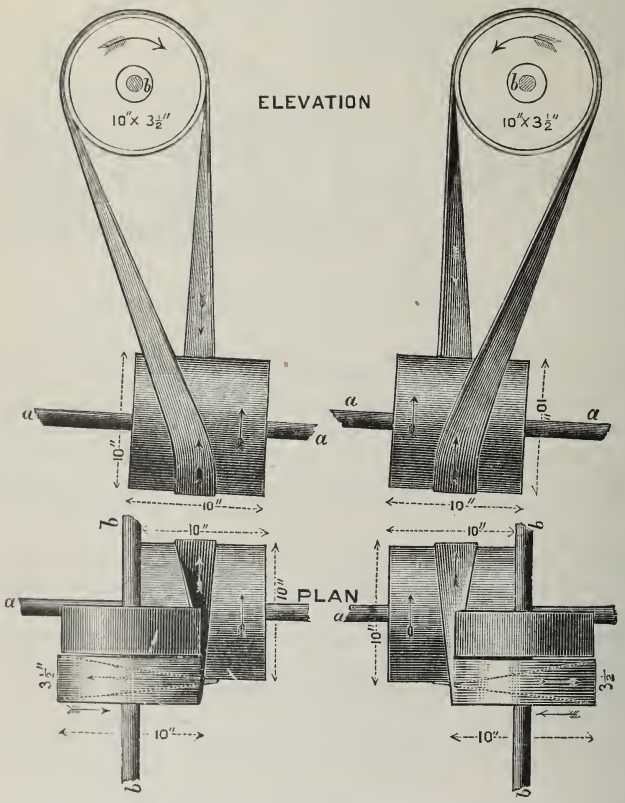
With hand labor the judgment of man regulates the means employed in conformity with varying conditions; but in a machine, the object of which is to supersede hand labor, it becomes obvious that having once adjusted the movements to effect a certain object under certain conditions, the desired result can only be attained by the maintenance of the necessary conditions.

In this concentrator, supposing the inclination of the belt to be fixed for a certain class of material, the regulation of the work to be accomplished is effected by three things, viz.: the speed with which the belt revolves, the

rapidity of the side shake, and the supply of clear water at the head. Having adjusted these three conditions to a given feed delivered on the belt, that feed should remain constant, and the result, both in the richness of mineral collected and in the poverty of the tailings, will be continuously maintained.

The countershaft to drive the Frue concentrators is placed parallel with the cam shaft and main line shaft of the mill, and is, therefore, at right angles to the crank shaft and pulley of the vanner. This necessitates the use of a quarter-twist belt, and the proper placing of this countershaft is very important, for with it properly set, the quarter-twist belt runs as well, as true, and with as little wear as if it were a straight belt; while if not properly set, it will run off the pulley.

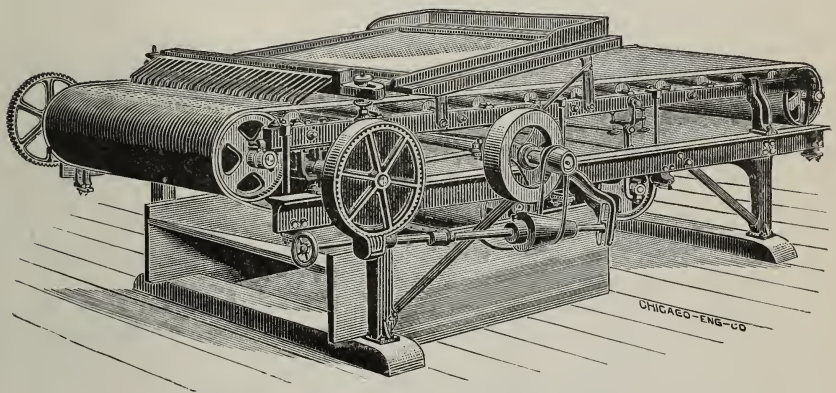
As this is not generally understood, even by good mechanics, the accompanying cut is given to illustrate the placing of this countershaft; *a a* is the crank shaft of the concentration; *b b* is the countershaft; on *b b* are one tight and one loose pulley; the belt is shown on the tight pulley. The crank shaft is not horizontal. The rule is as follows: "In placing the countershaft and its pulley, the pulley should be set so that the side from which the belt leaves it is in line with the square of the crank shaft of the concentrator at that point."



Countershaft for Frue Concentrator.

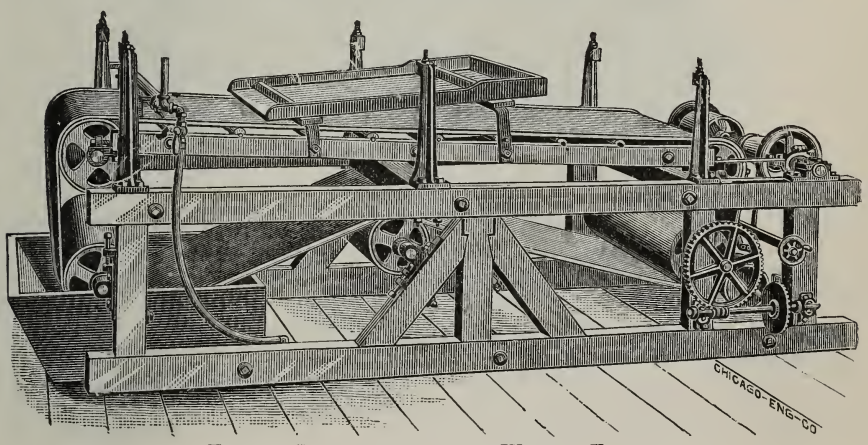
The Embrey concentrator is similar in most respects to the Frue vanner, differing chiefly in the direction of the shake, which is longitudinal. Not many of them have been put in use in California, as the Frue Company owns the Embrey patent, and believing the vanner to be the best machine, they have not pushed the Embrey.

Two forms of the Embrey machine are made, one compact in form, with crank shaft passing under the shaking frame, and supporting, by the latter, the whole weight of the belt and two underhanging rollers. This form is in fact identical with the vanner, except that the crank shaft is placed at right angles to the length of the belt, instead of parallel to same, and it is made with iron or wood frame, as preferred.



Embrey Concentrator, with Iron Frame.

The second form, and the one most desirable for economy in running, is arranged with the driving shaft at the lower end of shafting frame, so that while running all parts can be regulated, and any play taken up, and the shaking frame does not carry the hanging rollers, which are supported by the main frame, and carry about one half of the main belt. The shaking frame and mechanism is thus relieved of the weight of the two lower rollers, and nearly one half of the weight of the heavy belt, an important point, considering the high speed necessary on the end shake machine.



Embrey Concentrator, with Wooden Frame.

The only advantage of the first form over the second is in saving a little floor space for the same length of working belt.

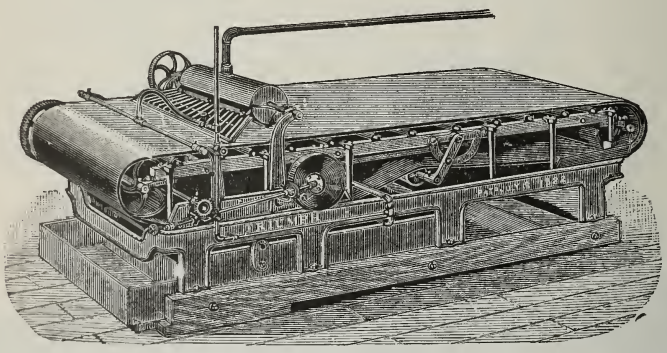
The advantages of the second form are in reduced power required, reduced wear and tear, and greater accessibility of working parts while in motion.

The accompanying cuts show the two forms of the Embrey, as they were made some time ago. Since they were engraved several improvements have been made, but time did not permit later cuts to be made. A few of the improvements consist in mechanism, for regulation of the progressive motion from in front of the machine; and the carrying or shaking frame is now supported from below, in the wooden frame machine, and not from above, as in the cut. Silvered copper plates on the ore distributor are used, when needed, to save amalgam.

If on the same belt both end and side shake mechanism be applied alternately, with the same conditions of feed and speed, it will be found that at a speed of 180 to 200 revolutions per minute, and the ordinary slight inclination of the belt, a perfect separation of clear mineral can be made on most ores with the vanner. If the end shake be substituted now, other conditions being the same, it will be found impossible to keep back the sand from passing over the mineral, even with excessive use of clean water at the head; and a separation can only be accomplished by increasing the speed to 235 or 240 revolutions, and increasing the speed naturally increases the wear and tear very materially.

The Embrey is in use in several mills in Colorado, Montana, the Southern States, etc., and at the Anaconda Copper Mine in Montana, the wooden-frame Embrey is preferred to any other concentrator. One of its patented points is the use of the vibrating water distributor.

The Triumph concentrator (see cut) is very much like the Embrey, which is the earlier machine.



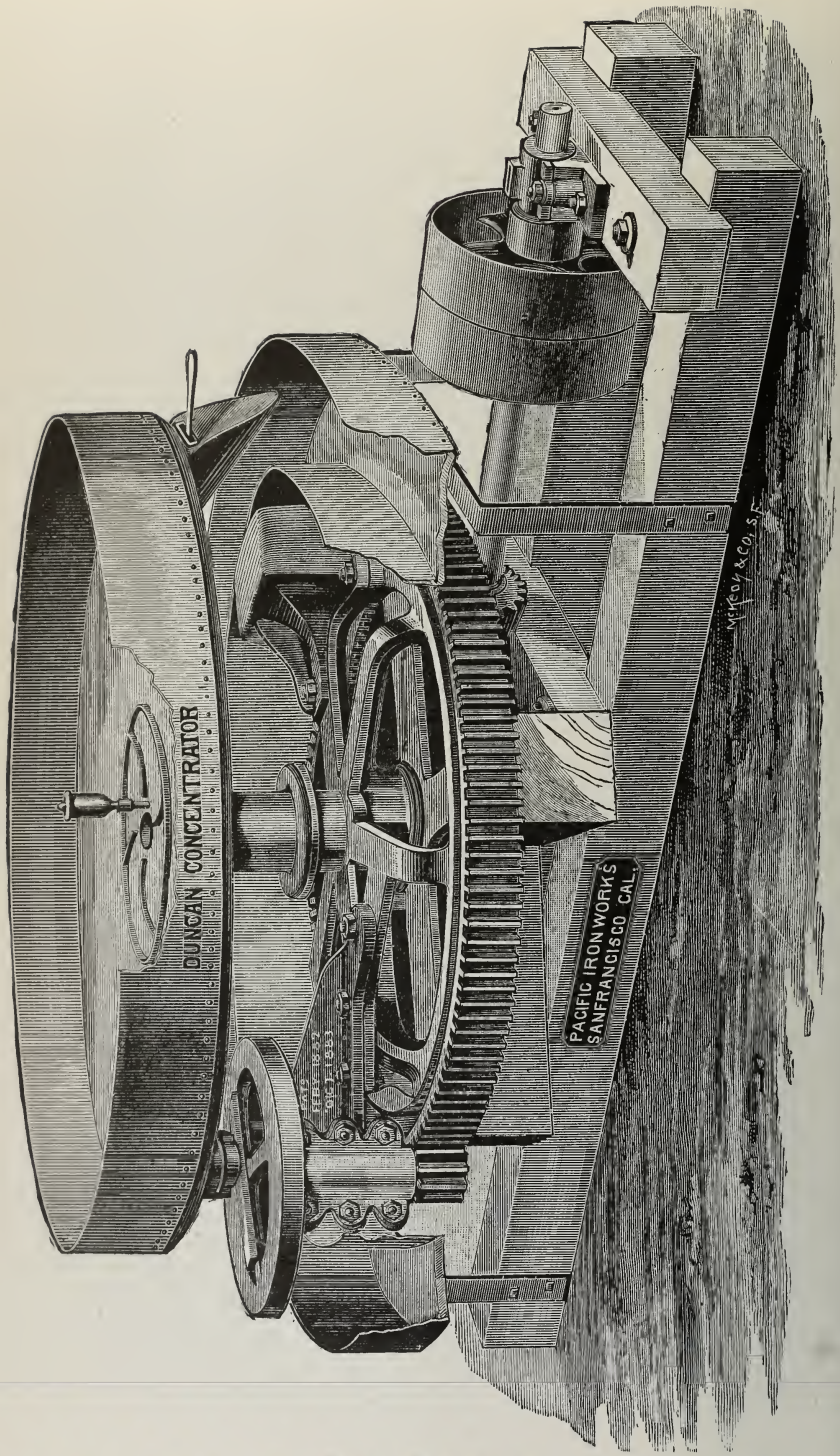
Triumph Concentrator.

It is a rubber belt, inclined, shaking longitudinally, and revolving slowly. Its crank shaft, like the Embrey, revolves from 235 to 240 times a minute, in order to make the separation of the mineral from the sand. Its main novelty is the use of a friction roller to regulate the forward motion of the belt, instead of a cone pulley, which is used in the vanner and Embrey machines. It has also an amalgam saver, consisting of an iron trough in which turns slowly a horizontal shaft, with stirrers. Quicksilver is kept in this trough. The shaking table is supported on upright springs, and the main frame is of cast-iron. It is a neat looking machine,

and can do good work. Many machines have been sold. It is in use at the Empire Mill (Grass Valley), and is liked.

The Duncan ore concentrator, like the Hendy concentrator, is circular in form, and of iron. Its principle is an ingenious combination of movements, imitating the process of panning by hand. "The agitation resulting from this movement causes the mineral to settle to the bottom around the outside of the pan, where it is held by centrifugal force, until discharged through the gates, while the gangue is held in suspension, and gradually carried by the force of the current to the central discharge. The pan, by this centrifugal motion, making, say eight and a half revolutions per minute, causes the pulp to flow around over its surface to the extent of about three revolutions, or equal to a distance of some thirty feet before it is discharged, thereby giving the sulphurets or other mineral time to settle before the gangue passes off.

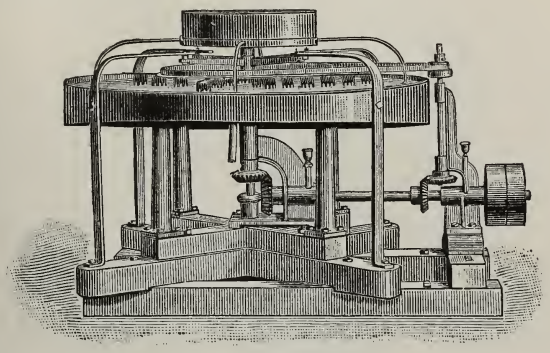
"The wrist-pin, on the balance-wheel, is made adjustable, so that the motion of the pan can be varied to adapt it to the requirements of different classes of ore."



Duncan Concentrator.

The foregoing is the description given by the manufacturers and owners of the Duncan concentrator. It is well made and many have been sold. Its weight is about 1,750 pounds, and it requires to run it about ½-horse power.

Shaw's disk concentrator and amalgamator is of recent introduction, and its merit therefor is not yet settled. It is described as follows by the inventor (please see cut also):



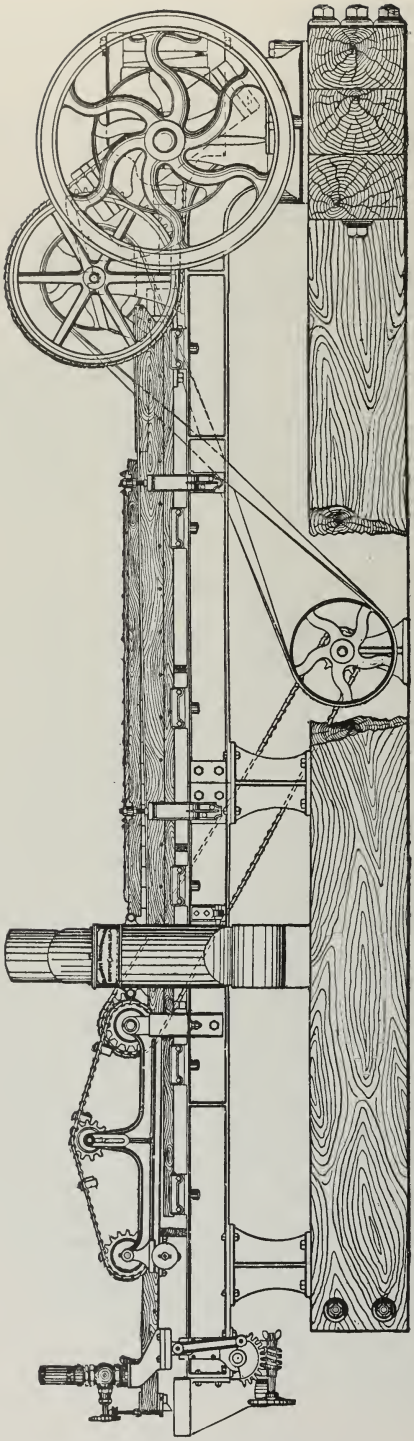
Shaw Concentrator.

In this machine there is a circular copper disk in the shape of a very shallow cone, with the apex turned downward, to which an eccentric motion of about one half inch throw is communicated by a vertical spindle, which is geared even to a light horizontal shaft, running from 250 to 300 revolutions per minute. The disk does not revolve, being subject only to the eccentric motion, the result being the panning motion, considered so desirable in all concentrating appliances. At work the pulp is received from the mill in the round pan with a perforated bottom supported over the center, passing in the form of rain onto the vibrating disk; the revolving stirrers keep the pulp active, thus allowing the heavier particles contained therein to percolate to the bottom. Coming in contact with the surface of the disk, they move at once towards the center, where a small screen is provided for their egress. The pulp composed of the worthless sands and water pass over the periphery of the disk and are carried off by means of the circular trough provided for that purpose.

In order to assist or retard the motion of the pulp towards the periphery, a number of revolving radial arms are provided, to which are secured at short intervals small notched stirrers of sheet copper, which dip into the pulp to within about a quarter of an inch of the face of the pan or disk. These revolving stirrers regulate the discharge of the pulp; they are set like wings and can be adjusted at different angles so as to throw the pulp out more or less rapidly as desired.

It can also be used as an amalgamator by replacing the screen in the center by a close fitting plug and quicksilvering the disk, but it is not intended to be used for its double purpose at the same time.

It is claimed to save the sulphurets clean with little loss, and to have capacity from 5 to 8 tons in 24 hours.



Golden Gate Concentrator.

GOLDEN GATE SULPHURET CONCENTRATOR.

[From a printed description issued by the company.]

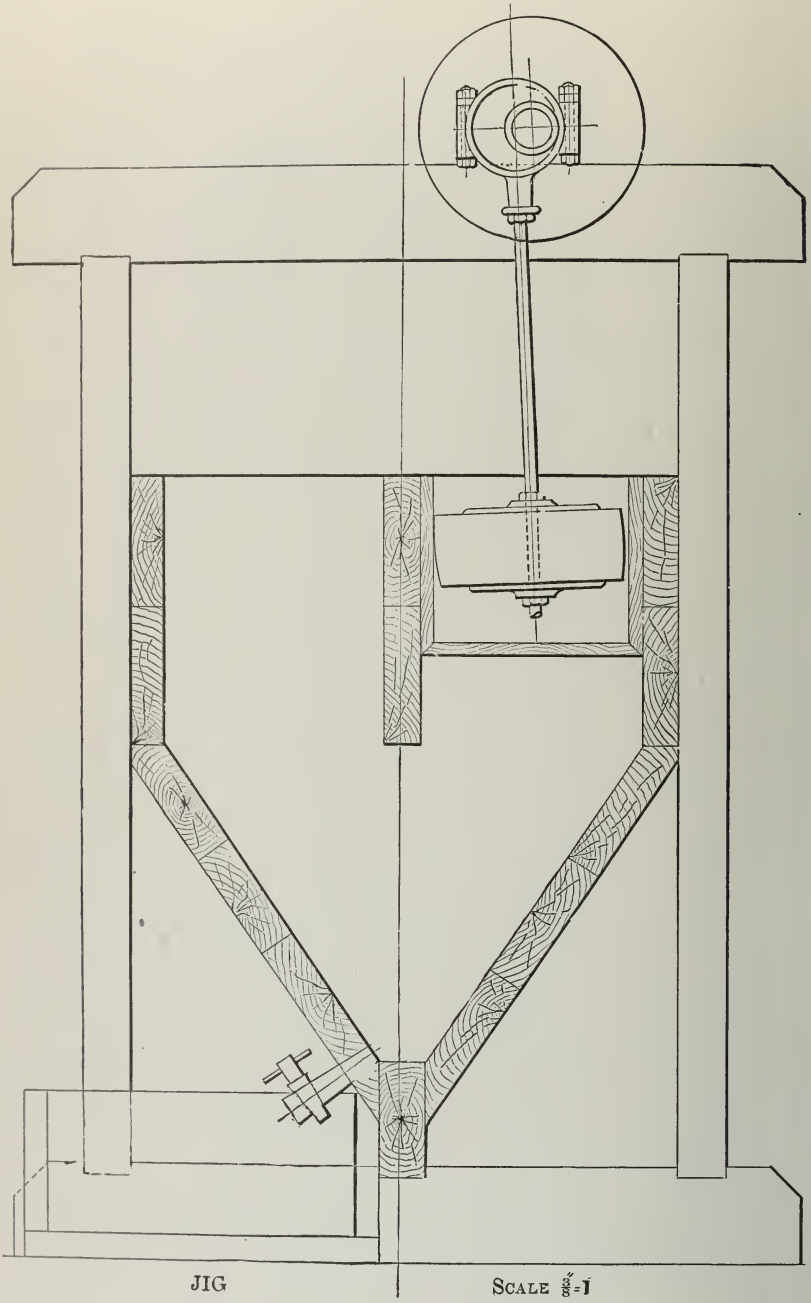
The Golden Gate sulphuret concentrator consists of a tray about eleven feet in length, resting upon a stout iron framework, upon which it has a longitudinally reciprocating movement. This reciprocating movement varies in speed in such manner as to cause the pulp, fed upon the tray at one end, to travel slowly over its surface towards the other end, and the pulp is, by the shaking motion, kept in a loose condition, so that the mineral may settle out of the gangue upon the surface of the tray. The tray proper consists of two distinct parts, forming, however, one continuous surface; one part, being designed for the settling of the mineral, is horizontal, and has hardly any perceptible current of water, thus allowing the fine mineral to settle out of the water and reach the bottom of the tray; the other part has an adjustable inclination upwards from its junction with the horizontal part, and over this part the current of wash water flows, which washes away the gangue from the mineral. At the junction of the horizontal with the inclined part of the tray, and extending across its width, is a "protecting plate," set somewhat above its surface, and parallel thereto. Above the protecting plate is an "exhaust pipe," within which a vacuum, sufficient to sustain a column of four or five inches of water, is constantly maintained by a small exhaust fan. On the lower side of the "exhaust pipe," above the "protecting plate," are openings into which the gangue and water are drawn, by the vacuum maintained, being then discharged over each side of the machine into the waste sluice.

The operation of the sulphuret concentrator is as follows:

The crushed ore, with a suitable amount of water, is fed onto the horizontal part of the tray, through the "distributor" shown at the extreme left of the figure. The peculiar motion communicated to the tray causes the pulp to slowly travel towards the "protecting plate," and at the same time keeps the pulp in a loose condition, allowing the heavier mineral to sink to the bottom, so that, on arriving at the plate, the pulp is separated into distinct layers, with the mineral at the bottom, the heavy gangue above the mineral, and the light gangue and water at the top; the plate having been properly adjusted for the ore, allows all the mineral, with some of the gangue, to pass under it, while the larger part of the gangue, and all the surplus water, pass *above* the plate, and on arriving at the exhaust pipe, are instantaneously drawn off and discharged over the sides of the tray into the waste sluice. That portion of the pulp which has passed under the plate, now consisting largely of mineral, continues on up the inclined part of the tray, where it can be freed from that part of the gangue which is still mixed with it, by a current of water flowing down from the head of the tray, this gangue and wash water being taken away by the exhaust pipe, as before explained.

The machine is very well made and of large capacity. It is in successful operation at the Brunswick Mill, Carson River, Nevada where six of them are handling the product of 56 stamps, crushing 160 tons of ore a day, and is also in use in other places.

There are possible problems in concentration in California requiring coarse crushing; this has already been discussed, and consequently the accompanying cut of one of the most approved styles of jigs should be of interest.



JIG Scale $\frac{3}{8}$=1'

Dry concentration is not discussed in this article, because it is little used in California, and in fact is rarely adopted if water can be obtained in sufficient quantity for wet concentration, because the latter gives uniformly better results with less cost, and less wear and tear.

In conclusion, I will state that these notes have been written hurriedly, as but little time was given me in which to prepare them. I have attempted, however, to be fair and just in my statements and criticisms.

CHLORINATION.

(By Wm. Irelan, Jr., State Mineralogist.)

This method of extracting gold from the auriferous sulphurets is recognized in the metallurgical circles of the old world as the Plattner process, and is so called in honor of the inventor. The honor of its introduction and successful adaptation to the working of our sulphuretted residues is due to the well known mining engineer and metallurgist Mr. G. F. Deetken, by whom it was first brought into this country.

Owing to the expense of manipulation, cost of material, and other obstacles, Mr. Deetken had much to contend with, but his well known skill and scientific ability enabled him to reach a successful issue and to become a metallurgical benefactor.

Since the demonstration of its successful workings on our concentrated sulphurets, a general knowledge of the manner of its application has been distributed by means of our scientific and other papers; also, books have been written by two of our well known metallurgists, in which the whole process is explicitly dealt with.

The first of the above mentioned works on the subject was issued by the late G. Kustel, in the year 1868, new edition 1880; and the latest exhaustive description is from the pen of Charles Howard Aaron, in 1881. Both authors were at the time of writing practically engaged in working the sulphurets of the State by this method.

The subject is inexhaustible, and of vital interest to the mining industry of our gold-bearing sections.

This article is not intended to give the detailed manipulations of the process, as the works above cited were written especially as working descriptions, and can be purchased of any of the booksellers.

THE ROAST.

This is the most important of any part of the process, and upon its completeness depends the success of the operation; therefore, too much care cannot be exercised in this branch of the operation.

In roasting, the point to be attained is the complete oxidation of the baser metals whose soluble salts would become precipitants for gold in the leaching vat. If the concentrated sulphurets have become lumpy, it will be necessary to recrush them, that the roast may secure complete oxidation.

It frequently happens that too much material is put into the furnace at one time: Mr. Aaron advises, for the reverbratory, from ten to twelve pounds for every square foot of hearth as the correct charge. The furnace should be fired up several hours before being charged with the dry sulphurets, and the heat should be of a degree just sufficient to ignite the sulphur after the material has been evenly spread over the hearth. Too great a heat will matte the easily fusible sulphides, thereby necessitating a withdrawal of the charge from the furnace and a repulverization. The presence of galena requires a low temperature and continual stirring. Mr. Deetkin discovered that the presence of lime and magnesia, owing to their

affinity for chlorine, were a detriment to the chlorination of the roasted ore, but he overcame this difficulty by an addition of salt to the charge in the furnace toward the completion of the roast. The roasting in all cases should be done at a gentle heat until the sulphur ceases to burn, which point is indicated by the disappearance of the characteristic blue flame, and the absence of scintillation on being raked. The heat is now increased and held at a high temperature until a thorough oxidation of the baser metals takes place. This can be ascertained by agitating, in a glass, a small quantity of the roast with water, allowing to settle, and adding to the clear decantation a few drops of the solution of ferrocyanide of potassium. If a dark blue precipitate is given, sulphate of iron is present; if brownish red, it indicates the presence of the corresponding copper salt; if both copper and iron are present, as soluble salts, the two colors will unite, forming a dirty greenish-blue mass; in either case the oxidation is incomplete, and the roasting must be continued until a further test does not give any of the described reactions.

Many operators continue the roasting to the oxidation of the iron only, but although it takes a longer time and a greater heat, it is advisable to also destroy the copper sulphate, as soluble metallic salts in the leaching vat react upon the iron oxide, which in turn precipitates the gold.

If the concentrated sulphurets contain silver, the Patera and Plattner processes should be combined. The silver is chloridized in the furnace by the addition of salt during the roasting. After the gold is washed from the ore, the silver chloride is leached out by a solution of hyposulphite of soda.

On the completion of the roast, the ore is drawn from the furnace to the cooling hearth, and, after a time, is sprinkled with water until moist enough to adhere when pressed in the hand.

THE LEACHING VAT.

In Europe the leaching is done in earthen or porcelain jars or tubs, wooden vats being condemned on account of their absorbing power. Mr. Deetkin overcame this difficulty by coating the vats on the inside with pitch and tar. The vat is circular, and has a perforated false wooden bottom, which is raised about an inch from the real bottom. This false bottom is covered, first, with a layer of coarse, barren quartz; then a layer of smaller pieces; and, lastly, a covering of clean quartz sand. Sometimes the sand is covered with gunnysacks or perforated boards. The damp roasted pulp is sifted into the vat and spread evenly and loosely until within about three inches of the top. The chlorine gas is now introduced through an opening in the bottom of the tank until it rises to the surface of the ore, which will be known by dense white fumes of chloride of ammonium being given off when a rod or stopper moistened with ammonia is held close to and above the charge. At this point the cover is put in place and carefully luted with some suitable tenacious substance that will not crack in drying. The chlorine is continued until the space above the ore is filled with the dense yellowish-green vapor; then the plug hole in the cover is stopped and the vat and contents are left at rest for from one to two days, at the expiration of which time the gold should be converted into a soluble chloride. Before leaching, the plug in the cover should be removed and the ammonia test applied. If there are no resulting white fumes, the ore must be again subjected to the chlorine, and so continued until the ammonia reaction is given.

The chlorine is generated in a leaden vessel from a mixture of common

salt, peroxide of manganese, sulphuric acid, and water. The reaction chemically given is: 2 (Na Cl) + 2 (H_2 SO_4) + Mn O_2 = Na_2 SO_4 + Mn SO_4 + $(H_2O)_2$ + 2 Cl.

Care must be taken in using the chlorine gas that no muriatic acid enters the leaching vat, for, beside attacking the oxides of the metals, should there be an imperfect roast the sulphides would be attacked, eliminating sulphuretted hydrogen gas, which would precipitate the gold from the chloride solution. The chlorine is deprived of the muriatic acid after leaving the generator on its course to the vat by passing the gas through water.

LIXIVIATION AND PRECIPITATION OF THE GOLD.

The ore being thoroughly chlorinated the cover is removed and water run into the vat until it rises above the surface of the mass. After a few minutes, when the water has had sufficient time to permeate all the ore, and still covers the surface, the plug at the bottom of the vat is removed and the liquor conducted to the settling tank into which has been put the precipitant for gold—a solution of sulphate of iron. A continuous flow of water must be admitted into the leaching vat, and at no time during the operation, which lasts several hours, should the water be permitted to fall below the surface of the ore. At intervals a glass full of the liquor, after having left the leaching vat, should be taken and thereto a little of the sulphate of iron solution added; if gold were present a bluish-black precipitate would be given. In the event of any precipitate resulting from the unity of the two solutions the washing is not finished but must be continued until the precipitant added to a freshly taken portion of the liquor does not give any reaction, or at the most only a faint coloration.

After a thorough stirring of the contents in the settling tank, the precipitate is allowed to subside, and a glass full of the clear liquid taken, to which is added a little of the sulphate of iron solution; if a dark coloration is given, more sulphate of iron must be added to the liquor in the tank. Or, if on the addition of a few drops of gold solution to a little of the clear liquid from the tank no reaction is given, it is a confirmation of the former test that there is a deficiency of sulphate of iron.

Should the roasted ore contain chloride of silver, it is leached with a solution of hyposulphite of soda after extraction of the gold by water. The liquor is run into a tank set aside for this especial purpose, in which the silver is thrown down by a solution of calcium sulphide, as sulphide of silver. The outflow of the silver solution should be conducted slowly, by the closing at intervals of the discharge pipe, as the silver salt is not so readily extracted by its solvent as is the gold.

The presence of silver in the hyposulphite is known by the sweet taste of the liquid; but when it can be no longer detected in this wise, a little of the outflow is caught in a glass and a few drops of the calcium sulphide solution added; if a dark precipitate is given, it is reasonable to suppose that the silver has not been entirely extracted, although other metallic salts, giving similar reactions, are also washed out by the same solvent. The only recourse at this point is to apply the confirming tests for such soluble compounds, as it is almost impossible to decide by the coloration which metals may be present. After the silver precipitate in the settling vat has subsided, a little of the calcium sulphide is added to the clear solution, and if a dark coloration is the result, it is evident that more of the precipitant must be added.

After the tests have shown a thorough precipitation of the gold and silver, the tanks are left undisturbed until the suspended precipitates have settled.

The silver precipitate will settle in a few hours, when the clear solution may be drawn off, the silver sulphide collected, conveyed to a filter, washed thoroughly with hot water, pressed, dried, and then roasted in a furnace—first, at a heat just sufficient to drive off the greater part of the sulphur; at this point the temperature should be increased to a dull red, and so continued for several hours, or until the greater part of the silver becomes metallic.

The partly metallized substance is placed with borax and iron scraps in a black lead crucible and fired until thoroughly melted; enough iron should be added that it does not all disappear in the operation. If an iron rod immersed in the molten mass, and allowed to remain a few minutes, shows no signs on removal of having reduced in size—the iron scraps should be removed, the matte and slag skimmed off, and the metal poured.

GOLD.

The contents in this tank should remain at rest for at least forty hours, for under that time a complete precipitation and settling of the gold can not be insured. When the gold has all settled at the bottom of the tank, the clear liquid is drawn off, the gold collected, filtered, washed several times with hot dilute hydrochloric acid, and lastly, with hot water, until all traces of acidity are removed. The gold is now dried, melted in a black lead crucible with borax, skimmed, base metals in a measure removed by the addition of niter, a little at a time, reskimmed, and poured.

The importance of saving sulphurets and working them by this process is shown in the annual statement of the Sierra Buttes Mine. From 1872 to 1885 the sulphurets were collected by the Hendy concentrator, and after exposure to atmospheric oxidation, were worked in the combination Stephenson-Patton pan. In 1885, the company erected chlorination works, at a cost of $5,000, by which they have added a yearly profit of $60,000 to the yield of the mine.

The ore of the Zeile Mine is crushed with special reference to saving the sulphurets; the crushings being sized to pass through a No. 4 slot screen, as finer particles would be more difficult of concentration.

MINERAL PRODUCTS OF THE UNITED STATES, 1885.

The following condensed statement of the mineral production of the United States in the calendar year 1885 is from advance proof sheets of a report shortly to be issued by the United States Geological Survey. This volume will be the third of the series known as "Mineral Resources" reports, prepared by the Division of Mining Statistics and Technology.

Coal.—The total commercial product of coal of all kinds in 1885, exclusive of that consumed at the mines, known as colliery consumption, was 95,834,705 long tons, valued at $152,915,108. Of this 32,265,421 long tons were Pennsylvania anthracite, valued at $72,274,544; while of other coals, including bituminous, brown coal, lignite, and small lots of anthracite produced outside of Pennsylvania, the production was 63,569,284 long tons, valued at $80,640,564 at the points of production. The total production, including colliery consumption, was: Pennsylvania anthracite, 34,228,548 long tons; all other coals, 64,840,668 long tons; making the total absolute production of the coal mines of the United States 99,069,216 long tons, valued as follows: Anthracite, $76,671,948; bituminous, $82,347,648; total, $159,019,596. The total production (including local consumption) of anthracite was 1,052,792 tons in excess of that of 1884, and its value was $10,320,436 greater. The total production of bituminous coal was 8,889,871 tons less than in 1884, but its value was $4,930,582 greater. The total production of coal of all kinds shows a net loss in tonnage of 7,837,079 long tons compared with that of 1884, but a gain in value of $15,251,018, the increase in value being due to an average increase of twenty-five cents per long ton. The total value is about the same as that of 1883.

Coke.—The total production of coke in 1885 was 5,106,696 short tons, valued at the ovens at $7,629,118. Of this Pennsylvania produced 78 per cent, or 3,991,805 tons, valued at $4,981,656. The remainder was produced by fourteen States and Territories. The maximum production of coke in the United States was reached in 1883, when 5,464,721 tons were made. This declined in 1884 to 4,873,805 tons. The production of 1885 shows a gain upon that of 1884, being within 360,000 tons of the make in 1883.

Petroleum.—The total production was 21,842,041 barrels of 42 gallons, of which the Pennsylvania and New York fields produced 20,776,041 barrels. The total value, at an average price of 87⅞ cents per barrel, was $19,193,694. The production showed a decrease of 2,247,717 barrels and $1,282,600 in value from 1884.

Natural gas.—No record is kept of the yield in cubic feet. The amount of coal displaced by gas in 1885, was 3,161,600 tons, valued at $4,854,200. In 1884 the coal displaced was valued at $1,460,000. The yield has increased tenfold since 1883.

Iron.—The principal statistics for 1885 were: Domestic iron ore consumed, 7,600,000 long tons; value at mine $19,000,000. Imported iron ore consumed, 390,786 long tons; total iron ore conumed, 7,990,786 long tons; pig iron made, 4,044,526 long tons, a decrease of 53,343 tons as compared with 1884; value at furnace $64,712,400, or $9,049,224 less than in 1884. Total spot value of all iron and steel in the first stage of manufacture, excluding all duplications, $93,000,000, a decline of $14,000,000 from 1884.

Gold and silver.—The mint authorities estimate the value of the gold produced in 1885 at $31,801,000, an increase of $1,001,000 over 1884. The production of silver is similarly estimated at $51,600,000, an increase of $2,800,000 over 1884.

Copper.—The production in 1885, including 5,086,841 pounds made from imported pyrites, was 170,962,607 pounds, valued in New York at $18,292,999, at the average price of 10.7 cents per pound. The increase in pounds over 1884 was 25,740,667; in value $503,312.

Lead.—Production, 129,412 short tons. Total value, at an average price of $81 per short ton at the Atlantic coast, $10,469,431, a decline of 10,485 tons and $67,611 in value from the product of 1884. The production of white lead is estimated at 60,000 short tons, worth, at 5¼ cents per pound, $6,300,000.

Zinc.—The production of metallic zinc in 1885 was 40,688 short tons, valued at $3,539,856 at an average value of 4.35 cents per pound, an increase of 2,144 tons and $117,149 in value over 1884. Zinc was also made from the ore directly into zinc white (zinc oxide) to the extent of 15,000 short tons, valued at $1,050,000.

Quicksilver.—Production, 32,073 flasks (of 76½ pounds net), or 160 flasks more than in 1884. Total value, at an average price of $30 53 per flask at San Francisco, $979,189, an increase of $42,861 over 1884. The production of quicksilver vermilion was about 600,000 pounds, the same as in 1884, but the price advanced to 52 cents per pound, making the total value $312,000.

Nickel.—The production of metallic or "grain" nickel was 245,504 pounds, valued at $169,397. In addition, matte and ore containing 32,400 pounds of nickel were exported. Total value of all nickel, $190,000.

Cobalt.—The amount of cobalt oxide was 8,423 pounds, valued at $19,373. The total value of cobalt in ore, matte, and the above oxide was $65,373.

Manganese.—The production of manganese ore was 23,258 long tons, valued at $190,281. Manganiferous iron ore, 3,237 long tons, valued at $17,318. Total value, $207,599.

Chromium.—The production of chrome iron ore was 2,700 long tons, valued at $40,000. The consumption for making potassium and sodium bichromates increased markedly, due to imports of chrome iron ore from Asia Minor.

Tin.—Probably 200 tons of "black tin" ore were made at the concentrating works at the Etta Mine in Dakota. No smelting works have yet been erected.

Platinum.—The amount of crude platinum mined in 1885 was about 250 troy ounces, valued at $187 50 (?). This is exclusive of about 300 ounces of iridosmine, for pointing pens.

Aluminum.—The production of metallic aluminum increased from 1,800 troy ounces in 1884 to 3,400 ounces in 1885, valued at $2,550. Aluminum bronze, containing 10 per cent aluminum, was made to the amount of about 4,500 pounds, valued at $1,800.

Building stone.—Value, $19,000,000; about the same as in 1884.

Brick and tile.—The demand and consequent production increased to an estimated value of $35,000,000 in 1885.

Lime.—With the price constant at 50 cents per barrel at the kilns, the production increased from 37,000,000 barrels in 1884 to 40,000,000 in 1885.

Cement.—The production of cement from natural rock increased to 4,000,000 barrels of 300 pounds each, but was valued at only $3,200,000. Artificial Portland cement amounted to 150,000 barrels of 400 pounds each,

with a total value of $292,500. The total production of cement of all kinds was 4,150,000 barrels, valued at $3,492,500, against $3,720,000 in 1884.

Precious stones.—The value of American precious stones produced in 1885, was $69,900. This includes $42,800 for stones sold as specimens and souvenirs, and $27,100 for stones to be cut into gems. Besides this, gold quartz, with an estimated value of $140,000, was sold for specimens, and for ornaments and jewelry.

Millstones.—The trade in millstones of all kinds has decreased markedly from the introduction of roller mills. The total value of the Esopus millstones in New York, and Cocalico stone in Pennsylvania, did not exceed $100,000 in 1885.

Grindstones.—Estimated value of product for 1885, $500,000.

Phosphates.—With the exception of a local consumption of about 1,000 tons in North Carolina, the total production of phosphate rock came from South Carolina, and amounted to $437,856 long tons of washed rock for the calendar year 1885, valued at $2,846,064, at an average value of $6 50 per ton.

Gypsum.—The estimated production of land plaster in 1885, was 100,600 short tons; of calcined plaster, 72,000 tons; total, 172,800; valued at $959,600. The above includes 75,100 tons from native stone, the remainder being imported from Nova Scotia.

Salt.—The total production in barrels of 280 pounds, was 7,038,653; exceeding the yield of 1884 by 523,716 barrels. The total value of all salt produced was $4,930,621, an increase of $732,887, which was due partly to the increased value of the Michigan product, and partly to the large increase in the production of western New York.

Bromine.—The production increased slightly, being about 310,000 pounds, against 281,100 in 1884. The total value, at an average of 29 cents per pound, was $89,900, an increase of $22,436 above the previous year.

Borax.—Production, limited to California and Nevada, 8,000,000 pounds; value, at 6 cents per pound for concentrated, $480,000. While the product increased by 1,000,000, the fall in price lowered the total value by $10,000.

Sulphur.—Tho production was only about 700 tons, worth about $18,000.

Pyrites.—About 49,000 long tons were mined, valued at $220,500. In addition 47,500 tons were imported.

Barytes.—The production was about 15,000 tons, valued at $75,000, in the unground condition, as taken from the mines.

Mica.—The production decreased in the West, owing to the inferior value of the sheets obtained. The whole product, excluding waste, was 92,000 pounds, valued at $161,000.

Feldspar.—Production, 13,600 long tons, valued, before grinding, at $68,000.

Asbestus.—The amount mined was about 300 short tons, valued at $9,000.

Asphaltum.—The production remained constant at about 3,000 tons, with a spot value of $10,000.

Mineral Waters.—The sales amounted to $1,312,845, from 9,148,401 gallons; the value is slightly less than in 1884. The great decrease in the number of gallons is due to the exclusion of the water from artesian wells in Madison, Wisconsin, which is used as the regular city supply. A large local consumption is also excluded.

Totals.—The statements made in the last report in regard to the total mineral product require little change for the year 1885. The statistics have been compiled with a view to giving information on those points which are of most interest and utility, and are presented in the form usual in the several branches of trade statistics. Comparing the totals given since 1882, a continuous decrease in value is noted in 1883 and 1884, being marked in the latter year. The year 1885 shows, on the other hand, an increase, due, no doubt, in part to more complete returns and closer estimates, but indicating, nevertheless, a more profitable business year, which would be still more apparent if the last half were compared with the corresponding period in 1884, since in many important branches of trade, prices increased towards the end of the year.

METALLIC PRODUCTS OF THE UNITED STATES IN 1885.

	Quantity.	Value.
Pig iron, spot value—long tons	4,044,525	$64,712,400
Silver, coining value—troy ounces	39,910,279	51,600,000
Gold, coining value—troy ounces	1,538,376	31,801,000
Copper, value at New York City—pounds*	170,962,607	18,292,999
Lead, value at New York City—short tons	129,412	10,469,431
Zinc, value at New York City—short tons	40,688	3,539,856
Quicksilver, value at San Francisco—flasks	32,073	979,189
Nickel, value at Philadelphia—pounds	277,904	191,753
Aluminum, value at Philadelphia—troy ounces	3,400	2,550
Platinum, value, crude, at New York City—troy ounces	250	187
Total		$181,589,365

* Including copper from imported pyrites.

NON-METALLIC MINERAL PRODUCTS OF THE UNITED STATES IN 1885 (SPOT VALUES).

	Quantity.	Value.
Bituminous coal, brown coal, lignite, and anthracite, mined elsewhere than in Pennsylvania—long tons*	64,840,668	$82,347,648
Pennsylvania anthracite—long tons†	34,228,548	76,671,948
Petroleum—barrels	21,842,041	19,193,694
Building stone		19,000,000
Lime—barrels	40,000,000	20,000,000
Salt—barrels	7,038,653	4,825,345
Cement—barrels	4,150,000	3,492,500
South Carolina phosphate rock—long tons	437,856	2,846,064
Limestone for iron flux		1,694,656
Mineral waters—gallons sold	9,148,401	1,312,845
Natural gas		4,854,200
Zinc, white—short tons	15,000	1,050,000
Concentrated borax—pounds	8,000,000	480,000
New Jersey marls—short tons	875,000	437,500
Mica	92,000	161,000
Pyrites	49,000	220,500
Gold quartz souvenirs, jewelry, etc.		140,000
Manganese ore—long tons	23,258	190,281
Crude barytes—long tons	15,000	75,000
Ocher—long tons	3,950	43,575
Precious stones		69,900
Bromine—pounds	310,000	89,900
Feldspar—long tons	13,600	68,000
Chrome iron ore—long tons	2,700	40,000
Asbestus—short tons	300	9,000
Slate ground as a pigment—long tons	1,975	24,687
Sulphur—short tons	715	17,875
Asphaltum—short tons	3,000	10,500
Cobalt oxide—pounds	68,723	65,373
Total		$239,431,991

* The commercial product, that is, the amount marketed, was only 63,569,284 tons, valued at $80,640,564.
† The commercial product, that is, the amount marketed, was only 32,265,421 tons, valued at $72,274,544.

RÉSUMÉ OF THE VALUES OF THE METALLIC AND NON-METALLIC MINERAL SUBSTANCES PRODUCED IN THE UNITED STATES IN 1885.

Metals	$181,589,365
Mineral substances named in the foregoing table	239,431,991
Total	$421,021,356
Estimated value of mineral products unspecified	7,500,000
Grand total	$428,521,356

SUMMARY OF THE MINERAL PRODUCTS OF THE UNITED STATES, CALENDAR YEARS 1882, 1883, 1884, AND 1885.

PRODUCT.	1882.		1883.	
	Quantity.	Value.	Quantity.	Value.
Metallic.				
Pig iron, spot value—long tons	4,623,323	$106,336,429	4,595,510	$91,910,200
Silver, coining value—troy ounces	36,197,695	46,800,000	35,733,622	46,200,000
Gold, coining value—troy ounces	1,572,186	32,500,000	1,451,249	30,000,000
Copper, value at New York City—pounds.	91,646,232	16,038,091	117,151,795	18,064,807
Lead, value at New York City—short tons	132,890	12,624,550	143,957	12,322,719
Zinc, value at New York City—short tons	33,765	3,646,620	36,872	3,311,106
Quicksilver, value at San Francisco—flasks	52,732	1,487,042	46,725	1,253,632
Nickel, value in Philadelphia—pounds	281,616	309,777	58,800	52,920
Antimony, value at San Francisco—short tons	60	12,000	----------	----------
Platinum, value (crude) at New York City—troy ounces	200	600	200	600
Aluminum, value at Philadelphia—troy ounces	----------	----------	1,000	875
Total value metallic products	----------	$219,755,109	----------	$203,116,859
Non-Metallic (Spot Values).				
Bituminous coal—long tons	60,861,190	$76,076,487	68,531,500	$82,237,800
Pennsylvania anthracite—long tons	31,358,264	70,556,094	34,336,469	77,257,055
Petroleum—barrels	30,053,500	23,704,698	23,400,229	25,740,252
Lime—barrels	31,000,000	21,700,000	32,000,000	19,200,000
Building stone	----------	21,000,000	----------	20,000,000
Salt—barrels	6,412,373	4,340,140	6,192,231	4,211,042
Cement—barrels	3,250,000	3,672,750	4,190,000	4,293,500
Limestone for iron flux—long tons	3,850,000	2,310,000	3,814,273	1,907,136
South Carolina phosphate rock—long tons	332,077	1,992,462	378,380	2,270,280
New Jersey marl—short tons	1,080,000	540,000	972,000	486,000
Borax—pounds	4,236,291	338,903	6,500,000	585,000
Mica—pounds	100,000	250,000	114,000	285,000
Ocher—long tons	7,000	105,000	7,000	84.000
Soapstone—short tons	6,000	90,000	----------	----------
Crude barytes—long tons	20,000	80,000	27,000	108,000
Precious stones	----------	75,000	----------	74,050
Gold-quartz souvenirs, jewelry, etc.	----------	75,000	----------	115,000
Pyrites—long tons	12,000	72,000	25,000	137,500
Manganese ore—long tons	3,500	52,500	8,000	120,000
Chrome iron ore—long tons	2,500	50,000	3,000	60,000
Asbestus—short tons	1,200	36,000	1,000	30,000
Graphite—pounds	425,000	34,000	575,000	46,000
Cobalt oxide—pounds	11,653	32,046	1,096	2,795
Slate ground as pigment—long tons	2,000	24,000	2,000	24,000
Sulphur—short tons	600	21,000	1,000	27,000
Asphaltum—short tons	3,000	10,500	3,000	10,500
Corundum—short tons	500	6,250	----------	----------
Pumice-stone—short tons	70	1,750	----------	----------
Feldspar—long tons	----------	----------	14,100	71,112
Zinc-white—short tons	----------	----------	----------	----------
Bromine—pounds	----------	----------	301,100	72,264
Mineral waters—gallons sold	----------	----------	7,529,423	1,119,603
Natural gas	----------	215,000	----------	475,000
Total value non-metallic mineral products	----------	$227,461,580	----------	$241,049,889
Total value metallic products	----------	219,755,109	----------	203,116,859
Estimated value of mineral products unspecified	----------	8,000,000	----------	8,000,000
Grand total	----------	$455,216,689	----------	$452,166,748

SUMMARY OF THE MINERAL PRODUCTS OF THE UNITED STATES, ETC.—Continued.

PRODUCTS.	1884.		1885.	
	Quantity.	Value.	Quantity.	Value.
Metallic.				
Pig-iron, spot value—long tons	4,097,868	$73,761,624	4,044,525	$64,712,400
Silver, coining value—troy ounces	37,744,605	48,800,000	39,910,279	51,600,000
Gold, coining value—troy ounces	1,489,949	30,800,000	1,538,376	31,801,000
Copper, value at New York City—pounds	147,805,407	18,106,162	170,962,607	18,292,999
Lead, value at New York City—short tons	139,897	10,537,042	129,412	10,469,431
Zinc, value at New York City—short tons	38,544	3,422,707	40,688	3,539,856
Quicksilver, value at San Francisco—flasks	31,913	936,327	32,073	979,189
Nickel, value at Philadelphia—pounds	64,550	48,412	277,904	191,753
Antimony, value at San Francisco—short tons				
Platinum, value (crude) at New York City—troy ounces	150	450	250	187
Aluminum, value at Philadelphia—troy ounces	1,800	1,350	3,400	2,550
Total value metallic products		$186,414,074		$181,589,365
Non-Metallic (spot values).				
Bituminous coal—long tons	73,730,539	$77,417,066	64,840,668	$82,347,648
Pennsylvania anthracite—long tons	33,175,756	66,351,512	34,228,548	76,671,948
Petroleum—barrels	24,089,758	20,476,294	21,842,041	19,193,694
Lime—barrels	37,000,000	18,500,000	40,000,000	20,000,000
Building stone		19,000,000		19,000,000
Salt—barrels	6,514,937	4,197,734	7,038,653	4,825,345
Cement—barrels	4,000,000	3,720,000	4,150,000	3,492,500
Limestone for iron flux—long tons	3,401,930	1,700,965		1,694,656
South Carolina phosphate rock—long tons	431,779	2,374,784	437,856	2,846,064
New Jersey marls—short tons	875,000	437,500	875,000	437,500
Borax—pounds	7,000,000	490,000	8,000,000	480,000
Mica—pounds	147,410	368,525	92,000	161,000
Ocher—long tons	7,000	84,000	3,950	43,575
Soapstone				
Crude barytes—long tons	25,000	100,000	15,000	75,000
Precious stones		82,975		69,900
Gold quartz souvenirs, jewelry, etc.		140,000		140,000
Pyrites—long tons	35,000	175,000	49,000	220,500
Manganese ore—long tons	10,000	120,000	23,258	190,281
Chrome iron ore—long tons	2,000	35,000	2,700	40,000
Asbestus—short tons	1,000	30,000	300	9,000
Graphite				
Cobalt oxide—pounds	2,000	5,100	68,723	65,373
Slate ground as a pigment—long tons	2,000	20,000	1,975	24,687
Sulphur—short tons	500	12,000	715	17,875
Asphaltum—short tons	3,000	10,500	3,000	10,500
Corundum				
Pumice stone				
Feldspar—long tons	10,900	55,112	13,600	68,000
Zinc-white—short tons	13,000	910,000	15,000	1,050,000
Bromine—pounds	281,100	67,464	310,000	89,900
Mineral waters—gallons sold	10,215,328	1,459,143	9,148,401	1,312,845
Natural gas		1,460,000		4,854,290
Total value non-metallic mineral products		$219,800,674		$239,431,991
Total value metallic products		186,414,074		181,589,365
Estimated value of mineral products unspecified		7,000,000		7,500,000
Grand total		$413,214,748		$428,521,356

MINERAL PRODUCTS OF THE UNITED STATES, CALENDAR YEARS 1882, 1883, 1884, AND 1885.

PRODUCTS.	1882.		1883.		1884.		1885.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Metallic.								
Pig iron, spot value (*a*)—long tons (*b*)	4,623,323	$106,336,429	4,595,510	$91,910,200	4,097,868	$73,761,624	4,044,525	$64,712,400
Silver, coining value (*c*)—troy ounces	36,197,695	46,800,000	35,733,622	46,200,000	37,744,605	48,800,000	39,910,279	51,600,000
Gold, coining value (*d*)—troy ounces	1,572,186	32,500,000	1,451,249	30,000,000	1,489,949	30,800,000	1,538,376	31,801,000
Copper (*e*) value at N. Y. City—pounds	91,646,232	16,038,091	117,151,795	18,064,807	147,805,407	18,106,162	170,962,607	18,292,999
Lead, value at N. Y. City—short tons	132,890	12,624,550	143,957	12,322,719	139,897	10,537,042	129,412	10,469,431
Zinc, value at N. Y. City—short tons	33,765	3,646,620	36,872	3,311,106	38,544	3,422,707	40,688	3,539,856
Quicksilver, value at San Fran.—flasks (*f*)	52,732	1,487,042	46,725	1,253,632	31,913	936,327	32,073	979,189
Nickel (*g*), value at Philadelphia—lbs.	281,616	309,777	58,800	52,920	64,550	48,412	277,904	191,753
Antimony, value at San Francisco—short tons	60	12,000	(*h*)		(*h*)			
Platinum, value (crude) at New York City—troy ounces	200	600	200	600	150	450	250	187
Aluminum, value at Phila.—troy ounces			1,000	875	1,800	1,350	3,400	2,550
Total value metallic products		$219,755,109		$203,116,859		$186,414,074		$181,589,365
Non-Metallic (spot values).								
Bituminous coal (*i*)—long tons	(*j*) 60,861,190	$76,076,487	(*k*) 68,531,500	$82,237,800	(*l*) 73,730,539	$77,417,066	(*m*) 64,840,668	$82,347,648
Pennsylvania anthracite—long tons	(*n*) 31,358,264	70,556,094	(*o*) 34,336,469	77,257,055	(*p*) 33,175,756	66,351,512	(*q*) 34,228,548	76,671,948
Petroleum—barrels (*r*)	(*s*) 30,053,500	23,704,698	23,400,229	25,740,252	24,089,758	20,476,294	21,842,041	19,193,694
Lime—barrels (*t*)	31,000,000	21,700,000	32,000,000	19,200,000	37,000,000	18,500,000	40,000,000	20,000,000
Building stone		21,000,000		20,000,000		19,000,000		19,000,000
Salt—barrels (*u*)	6,412,373	4,340,140	6,192,231	4,211,042	6,514,937	4,197,734	7,038,653	4,825,345
Cement—barrels (*v*)	3,250,000	3,672,750	4,190,000	4,293,500	4,000,000	3,720,000	4,150,000	3,492,500
Limestone for iron flux—long tons	3,850,000	2,310,000	3,814,273	1,907,136	3,401,930	1,700,965		1,694,656
S. Carolina phosphate rock (*w*)—long tons	332,077	1,992,462	378,380	2,270,280	431,779	2,374,784	(*x*) 437,856	2,846,064
New Jersey marls—short tons	1,080,000	540,000	972,000	486,000	875,000	437,500	875,000	437,500
Borax—pounds	4,236,291	338,903	6,500,000	585,000	7,000,000	490,000	8,000,000	480,000
Mica—pounds	100,000	250,000	114,000	285,000	147,410	368,525	92,000	161,000
Ocher—long tons	7,000	105,000	7,000	84,000	7,000	84,000	3,950	43,575
Soapstone—short tons	6,000	90,000	(*h*)		(*h*)			
Crude barytes—long tons	20,000	80,000	27,000	108,000	25,000	100,000	15,000	75,000
Precious stones		75,000		74,050		82,975		69,900
Gold-quartz souvenirs, jewelry, etc.		75,000		115,000		140,000		140,000

Pyrites—long tons	12,000	72,000	25,000	137,500	35,000	175,000	49,000	220,500
Manganese ore—long tons	3,500	52,500	8,000	120,000	10,000	120,000	23,258	190,281
Chrome iron ore—long tons	2,500	50,000	3,000	60,000	2,000	35,000	2,700	40,000
Asbestus—short tons	1,200	36,000	1,000	30,000	1,000	30,000	300	9,000
Graphite—pounds	425,000	34,000	575,000	46,000				
Cobalt oxide—pounds	11,653	32,046	1,096	2,795	2,000	5,100	(*y*) 68,723	65,373
Slate ground as a pigment—long tons	2,000	24,000	2,000	24,000	2,000	20,000	1,975	24,687
Sulphur—short tons	600	21,000	1,000	27,000	500	12,000	715	17,875
Asphaltum—short tons	3,000	10,500	3,000	10,500	3,000	10,500	3,000	10,500
Corundum—short tons	500	6,250	(*h*)		(*h*)			
Pumice-stone—short tons	70	1,750						
Feldspar—long tons	(*h*)		14,100	71,112	10,900	55,112	13,600	68,000
Zinc-white—short tons	(*h*)		(*h*)		13,000	910,000	15,000	1,050,000
Bromine—pounds	(*h*)		301,100	72,264	281,100	67,464	310,000	89,900
Mineral waters—gallons sold	(*h*)		7,529,423	1,119,603	10,215,328	1,459,143	9,148,401	1,312,845
Natural gas		215,000		475,000		1,460,000		4,854,200
Total value non-metallic mineral products		$227,461,580		$241,049,889		$219,800,674		$239,431,991
Total value metallic products		219,755,109		203,116,859		186,414,074		181,589,365
Estimated value of mineral products unspecified (*z*)		8,000,000		8,000,000		7,000,000		7,500,000
Grand total		$455,216,689		$452,166,748		$413,214,748		$428,521,356

a. By "spot" value is meant value at the point of production.
b. "Long" tons are tons of 2,240 avoirdupois pounds; "short" tons are tons of 2,000 avoirdupois pounds.
c. $1.2929 per troy ounce.
d. $26.6718 per troy ounce.
e. Including copper made from imported pyrites.
f. Of 76½ avoirdupois pounds net.
g. Including nickel in copper-nickel alloy.
h. Not reported.
i. Including brown coal and lignite, and small lots of anthracite mined elsewhere than in Pennsylvania.
j. The commercial product, that is, the amount marketed, was only 57,963,038 tons, worth $72,453,797.
k. The commercial product, that is, the amount marketed, was only 65,030,171 tons, worth $78,036,205.
l. The commercial product, that is, the amount marketed, was only 66,809,356 tons, worth $70,149,824.
m. The commercial product, that is, the amount marketed, was only 63,569,284 tons, valued at $80,640,564.
n. The commercial product, that is, the amount marketed, was only 29,120,096 tons, worth $65,520,216.
o. The commercial product, that is, the amount marketed, was only 31,793,027 tons, worth $71,534,311.
p. The commercial product, that is, the amount marketed, was only 30,718,293 tons, worth $61,436,586.
q. The commercial product, that is, the amount marketed, was only 32,265,421 tons, valued at $72,274,544.
r. Of 42 gallons.
s. From the Pennsylvania and New York fields only; the outside production was very small. For 1883, 1884, and 1885 the figures are complete for the whole United States.
t. Of 200 pounds.
u. Of 280 pounds net.
v. Of 300 pounds for natural cement, and 400 pounds for artificial Portland.
w. Year ending May 31.
x. Calendar year.
y. Including cobalt oxide in ore and matte.
z. Including, where not specified in the table, fire-clay, kaolin, potter's clay, common brick clay, terra cotta, building sand, glass sand, limestone used as flux in lead smelting, limestone in glass making, iron ore used as flux in lead smelting, marls (other than New Jersey), gypsum, tin ore, antimony, iridosmine, mill buhrstone and stone for making grindstones, novaculite, corundum, lithograph stone, talc and soapstone, quartz, feldspar, fluorspar, nitrate of soda, carbonate of soda, sulphate of soda, native alum, ozocerite, mineral soap, strontia, infusorial earth and tripoli, pumice-stone, sienna, umber, zinc-white, bromine, and mineral waters.

U. S. MINING LAWS.

An Act granting the right of way to ditch and canal owners, over the public lands, and for other purposes. (Approved July 26, 1866. U. S. Stats., v. 14, p. 251.)

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, That the mineral lands of the public domain, both surveyed and unsurveyed, are hereby declared to be free and open to exploration and occupation by all citizens of the United States, and those who have declared their intention to become citizens, subject to such regulations as may be prescribed by law, and subject also to the local customs or rules of miners in the several mining districts, so far as the same may not be in conflict with the laws of the United States.

SEC. 2. *And be it further enacted*, That whenever any person, or association of persons, claim a vein or lode of quartz, or other rock in place, bearing gold, silver, cinnabar, or copper, having previously occupied or improved the same according to the local customs or rules of miners in the district where the same is situated, and having expended in actual labor and improvements thereon an amount not less than one thousand dollars, and in regard to whose possession there is no controversy or opposing claim, it shall and may be lawful for said claimant, or association of claimants, to file in the local Land Office a diagram of the same, so extended, laterally or otherwise, as to conform to the local laws, customs, and rules of miners, and to enter such tract and receive a patent therefor, granting such mine, together with the right to follow such vein or lode, with its dips, angles, and variations, to any depth, although it may enter the land adjoining, which land adjoining shall be sold subject to this condition.

SEC. 3. *And be it further enacted*, That, upon the filing of the diagram as provided in the second section of this Act, and posting the same in a conspicuous place on the claim, together with a notice of intention to apply for a patent, the Register of the Land Office shall publish a notice of the same in a newspaper published nearest to the location of said claim, and shall also post such notice in his office for the period of ninety days; and after the expiration of said period, if no adverse claim shall have been filed, it shall be the duty of the Surveyor-General, upon application of the party, to survey the premises and make a plat thereof, indorsed with his approval, designating the number and description of the location, the value of the labor and improvements, and the character of the vein exposed; and upon the payment to the proper officer of five dollars per acre, together with the cost of such survey, plat, and notice, and giving satisfactory evidence that said diagram and notice have been posted on the claim during said period of ninety days, the Register of the Land Office shall transmit to the General Land Office said plat, survey, and description, and a patent shall issue for the same thereupon. But said plat, survey, or description shall in no case cover more than one vein or lode, and no patent shall issue for more than one vein or lode, which shall be expressed in the patent issued.

SEC. 4. *And be it further enacted*, That when such location and entry of a mine shall be upon unsurveyed lands, it shall and may be lawful, after the extension thereto of the public surveys, to adjust the surveys to the limits of the premises according to the location and possession and

plat aforesaid; and the Surveyor-General may, in extending the surveys, vary the same from a rectangular form to suit the circumstances of the country and the local rules, laws, and customs of miners; *provided*, that no location hereafter made shall exceed two hundred feet in length along the vein for each locator, with an additional claim for discovery to the discoverer of the lode, with the right to follow such vein to any depth, with all its dips, variations, and angles, together with a reasonable quantity of surface for the convenient working of the same, as fixed by local rules; *and provided further*, that no person may make more than one location on the same lode, and not more than three thousand feet shall be taken in any one claim by any association of persons.

Sec. 5. *And be it further enacted*, That, as a further condition of sale, in the absence of necessary legislation by Congress, the local Legislature of any State or Territory may provide rules for working mines involving easements, drainage, and other necessary means to their complete development; and those conditions shall be fully expressed in the patent.

Sec. 6. *And be it further enacted*, That whenever any adverse claimants to any mine, located and claimed as aforesaid, shall appear before the approval of the survey, as provided in the third section of this Act, all proceedings shall be stayed until final settlement and adjudication, in the Courts of competent jurisdiction, of the rights of possession to such claim, when a patent may issue as in other cases.

Sec. 7. *And be it further enacted*, That the President of the United States be and is hereby authorized to establish additional land districts, and to appoint the necessary officers under existing laws, wherever he may deem the same necessary for the public convenience in executing the provisions of this Act.

Sec. 8. *And be it further enacted*, That the right of way for the construction of highways over public lands, not reserved for public uses, is hereby granted.

Sec. 9. *And be it further enacted*, That whenever, by priority of possession, rights to the use of water for mining, agricultural, manufacturing, or other purposes, have vested and accrued, and the same are recognized and acknowledged by the local customs, laws, and the decisions of Courts, the possessors and owners of such vested rights shall be maintained and protected in the same; and the right of way for the construction of ditches and canals for the purposes aforesaid is hereby acknowledged and confirmed; *provided*, *however*, that whenever, after the passage of this Act, any person or persons shall, in the construction of any ditch or canal, injure or damage the possession of any settler on the public domain, the party committing such injury or damage shall be liable to the party injured for such injury or damage.

Sec. 10. *And be it further enacted*, That wherever, prior to the passage of this Act, upon the lands heretofore designated as mineral lands, which have been excluded from survey and sale, there have been homesteads made by citizens of the United States, or persons who have declared their intention to become citizens, which homesteads have been made, improved, and used for agricultural purposes, and upon which there have been no valuable mines of gold, silver, cinnabar, or copper discovered, and which are properly agricultural lands, the said settlers or owners of such homesteads shall have a right of preëmption thereto, and shall be entitled to purchase the same at the price of one dollar and twenty-five cents per acre, and in quantity not to exceed one hundred and sixty acres; or said parties may avail themselves of the provisions of the Act of Congress, approved May twentieth, eighteen hundred and sixty-two, entitled "An Act

to secure homesteads to actual settlers on the public domain," and Acts amendatory thereof.

SEC. 11. *And be it further enacted*, That, upon the survey of the lands aforesaid, the Secretary of the Interior may designate and set apart such portion of the said lands as are clearly agricultural lands, which lands shall thereafter be subject to preëmption and sale as other public lands of the United States, and subject to all the laws and regulations applicable to the same.

An Act to amend "An Act granting the right of way to ditch and canal owners over the public lands, and for other purposes." (Approved July 9, 1870. U. S. Stats., v. 16, p. 217.)

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, That the Act granting the right of way to ditch and canal owners over the public lands, and for other purposes, approved July twenty-sixth, eighteen hundred and sixty-six, be and the same is hereby amended, by adding thereto the following additional sections, numbered twelve, thirteen, fourteen, fifteen, sixteen, and seventeen, respectively, which shall hereafter constitute and form a part of the aforesaid Act:

SEC. 12. *And be it further enacted*, That claims, usually called "placers," including all forms of deposit, excepting veins of quartz, or other rock in place, shall be subject to entry and patent under this Act, under like circumstances and conditions, and upon similar proceedings, as are provided for vein or lode claims; *provided*, that where the lands have been previously surveyed by the United States, the entry in its exterior limits shall conform to the legal subdivisions of the public lands, no further survey or plat in such case being required, and the lands may be paid for at the rate of two dollars and fifty cents per acre; *provided further*, that legal subdivisions of forty acres may be subdivided into ten-acre tracts; and that two or more persons, or association of persons, having contiguous claims of any size, although such claims may be less than ten acres each, may make joint entry thereof; *and provided further*, that no location of a placer claim, hereafter made, shall exceed one hundred and sixty acres for any one person or association of persons, which location shall conform to the United States surveys; and nothing in this section contained shall defeat or impair any bona fide preëmption or homestead claim upon agricultural lands, or authorize the sale of the improvements of any bona fide settler to any purchaser.

SEC. 13. *And be it further enacted*, That where said person or association, they and their grantors, shall have held and worked their said claims for a period equal to the time prescribed by the statute of limitation for mining claims of the State or Territory where the same may be situated, evidence of such possession and working of the claims for such period, shall be sufficient to establish a right to a patent thereto under this Act, in the absence of any adverse claim; *provided, however*, that nothing in this Act shall be deemed to impair any lien which may have attached in any way whatever to any mining claim, or property thereto attached, prior to the issuance of a patent.

SEC. 14. *And be it further enacted*, That all ex parte affidavits required to be made under this Act, or the Act of which it is amendatory, may be verified before any officer authorized to administer oaths within the land district where the claims may be situated.

SEC. 15. *And be it further enacted*, That Registers and Receivers shall

receive the same fees for services under this Act, as are provided by law for like services under other Acts of Congress, and that effect shall be given to the foregoing Act according to such regulations as may be prescribed by the Commissioner of the General Land Office.

SEC. 16. *And be it further enacted*, That so much of the Act of March third, eighteen hundred and fifty-three, entitled "An Act to provide for the survey of the public lands in California, the granting of preëmption rights, and for other purposes," as provides that none other than township lines shall be surveyed where the lands are mineral, is hereby repealed, and the public surveys are hereby extended over all such land; *provided*, that all subdividing of surveyed lands into lots less than one hundred and sixty acres may be done by county and local surveyors at the expense of the claimants; *and provided further*, that nothing herein contained shall require the survey of waste or useless lands.

SEC. 17. *And be it further enacted*, That none of the rights conferred by sections five, eight, and nine of the Act to which this Act is amendatory shall be abrogated by this Act, and the same are hereby extended to all public lands affected by this Act; and all patents granted, or preëmption or homesteads allowed, shall be subject to any vested and accrued water rights, or rights to ditches and reservoirs used in connection with such water rights as may have been acquired under or recognized by the ninth section of the Act of which this Act is amendatory. But nothing in this Act shall be construed to repeal, impair, or in any way affect the provisions of the "Act granting to A. Sutro the right of way and other privileges to aid in the construction of a draining and exploring tunnel to the Comstock lode, in the State of Nevada," approved July twenty-fifth, eighteen hundred and sixty-six.

UNITED STATES MINING LAWS, AND REGULATIONS THEREUNDER.

DEPARTMENT OF THE INTERIOR,
GENERAL LAND OFFICE, October 29, 1881.

GENTLEMEN: Your attention is invited to the Revised Statutes of the United States and the amendments thereto in regard to mining laws and mining resources. Title XXXII, Chapter VI.

SECTION 2318. In all cases lands valuable for minerals shall be reserved from sale, except as otherwise expressly directed by law.

SEC. 2319. All valuable mineral deposits in lands belonging to the United States, both surveyed and unsurveyed, are hereby declared to be free and open to exploration and purchase, and the lands in which they are found to occupation and purchase, by citizens of the United States and those who have declared their intention to become such, under regulations prescribed by law, and according to the local customs or rules of miners in the several mining districts, so far as the same are applicable and not inconsistent with the laws of the United States.

SEC. 2320. Mining claims upon veins or lodes of quartz or other rock in place bearing gold, silver, cinnabar, lead, tin, copper, or other valuable deposits, heretofore located, shall be governed as to length along the vein or lode by the customs, regulations, and laws in force at the date of their location. A mining claim located after the tenth day of May, eighteen hundred and seventy-two, whether located by one or more persons, may

equal, but shall not exceed, one thousand five hundred feet in length along the vein or lode; but no location of a mining claim shall be made until the discovery of the vein or lode within the limits of the claim located. No claim shall extend more than three hundred feet on each side of the middle of the vein at the surface, nor shall any claim be limited by any mining regulation to less than twenty-five feet on each side of the middle of the vein at the surface, except where adverse rights existing on the tenth day of May, eighteen hundred and seventy-two, render such limitation necessary. The end lines of each claim shall be parallel to each other.

SEC. 2321. Proof of citizenship, under this chapter, may consist, in the case of an individual, of his own affidavit thereof; in the case of an association of persons unincorporated, of the affidavit of their authorized agent, made on his own knowledge, or upon information and belief; and in the case of a corporation organized under the laws of the United States, or of any State or Territory thereof, by the filing of a certified copy of their charter or certificate of incorporation.

SEC. 2322. The locators of all mining locations heretofore made or which shall hereafter be made, on any mineral vein, lode, or ledge, situated on the public domain, their heirs and assigns, where no adverse claim exists on the tenth day of May, eighteen hundred and seventy-two, so long as they comply with the laws of the United States, and with the State, Territorial, and local regulations not in conflict with the laws of the United States governing their possessory title, shall have the exclusive right of possession and enjoyment of all the surface included within the lines of their locations, and of all veins, lodes, and ledges throughout their entire depth, the top or apex of which lies inside of such surface lines extended downward vertically, although such veins, lodes, or ledges may so far depart from a perpendicular in their course downward as to extend outside the vertical side-lines of such surface locations. But their right of possession to such outside parts of such veins or ledges shall be confined to such portions thereof as lie between vertical planes drawn downward as above described, through the end-lines of their locations, so continued in their own direction that such planes will intersect such exterior parts of such veins or ledges. And nothing in this section shall authorize the locator or possessor of a vein or lode which extends in its downward course beyond the vertical lines of his claim to enter upon the surface of a claim owned or possessed by another.

SEC. 2323. Where a tunnel is run for the development of a vein or lode, or for the discovery of mines, the owners of such tunnel shall have the right of possession of all veins or lodes within three thousand feet from the face of such tunnel on the line thereof, not previously known to exist, discovered in such tunnel, to the same extent as if discovered from the surface; and locations on the line of such tunnel of veins or lodes not appearing on the surface, made by other parties after the commencement of the tunnel, and while the same is being prosecuted with reasonable diligence, shall be invalid; but failure to prosecute the work on the tunnel for six months shall be considered as an abandonment of the right to all undiscovered veins on the line of such tunnel.

SEC. 2324. The miners of each mining district may make regulations not in conflict with the laws of the United States, or with the laws of the State or Territory in which the district is situated, governing the location, manner of recording, amount of work necessary to hold possession of a mining claim, subject to the following requirements: The location must be distinctly marked on the ground so that its boundaries can be readily traced. All records of mining claims hereafter made shall contain the

name or names of the locators, the date of the location, and such a description of the claim or claims located by reference to some natural object or permanent monument as will identify the claim. On each claim located after the tenth day of May, eighteen hundred and seventy-two, and until a patent has been issued therefor, not less than one hundred dollars' worth of labor shall be performed or improvements made during each year. On all claims located prior to the tenth day of May, eighteen hundred and seventy-two, ten dollars' worth of labor shall be performed or improvements made by the tenth day of June, eighteen hundred and seventy-four, and each year thereafter, for each one hundred feet in length along the vein until a patent has been issued therefor; but where such claims are held in common, such expenditure may be made upon any one claim; and upon a failure to comply with these conditions, the claim or mine upon which such failure occurred shall be open to relocation in the same manner as if no location of the same had ever been made, provided that the original locators, their heirs, assigns, or legal representatives, have not resumed work upon the claim after failure and before such location. Upon the failure of any one of several coöwners to contribute his proportion of the expenditures required hereby, the coöwners who have performed the labor or made the improvements may, at the expiration of the year, give such delinquent coöwner personal notice in writing, or notice by publication in the newspaper published nearest the claim, for at least once a week for ninety days, and if at the expiration of ninety days after such notice in writing or by publication such delinquent should fail or refuse to contribute his proportion of the expenditure required by this section, his interest in the claim shall become the property of his coöwners who have made the required expenditures.

Sec. 2325. A patent for any land claimed and located for valuable deposits may be obtained in the following manner: Any person, association, or corporation authorized to locate a claim under this chapter, having claimed and located a piece of land for such purposes, who has, or have complied with the terms of this chapter, may file in the proper Land Office an application for a patent, under oath, showing such compliance, together with a plat and field-notes of the claim or claims in common, made by or under the direction of the United States Surveyor-General, showing accurately the boundaries of the claim or claims, which shall be distinctly marked by monuments on the ground, and shall post a copy of such plat, together with a notice of such application for a patent, in a conspicuous place on the land embraced in such plat previous to the filing of the application for a patent, and shall file an affidavit of at least two persons that such notice has been duly posted, and shall file a copy of the notice in such Land Office, and shall thereupon be entitled to a patent for the land, in the manner following: The Register of the Land Office, upon the filing of such application, plat, field-notes, notices, and affidavits, shall publish a notice that such application has been made, for the period of sixty days, in a newspaper to be by him designated as published nearest to such claim; and he shall also post such notice in his office for the same period. The claimant at the time of filing this application, or at any time thereafter, within the sixty days of publication, shall file with the Register a certificate of the United States Surveyor-General that five hundred dollars' worth of labor has been expended or improvements made upon the claim by himself or grantors; that the plat is correct, with such further description by such reference to natural objects or permanent monuments as shall identify the claim, and furnish an accurate description, to be incorporated in the patent. At the expiration of the sixty days of publication

the claimant shall file his affidavit, showing that the plat and notice have been posted in a conspicuous place on the claim during such period of publication. If no adverse claim shall have been filed with the Register and the Receiver of the proper Land Office at the expiration of the sixty days of publication, it shall be assumed that the applicant is entitled to a patent, upon the payment to the proper officer of five dollars per acre, and that no adverse claim exists; and thereafter no objection from third parties to the issuance of a patent shall be heard, except it be shown that the applicant has failed to comply with the terms of this chapter.

Sec. 2326. Where an adverse claim is filed during the period of publication, it shall be upon oath of the person or persons making the same, and shall show the nature, boundaries, and extent of such adverse claim, and all proceedings, except the publication of notice and making and filing of the affidavit thereof, shall be stayed until the controversy shall have been settled or decided by a Court of competent jurisdiction, or the adverse claim waived. It shall be the duty of the adverse claimant, within thirty days after filing his claim, to commence proceedings in a Court of competent jurisdiction, to determine the question of the right of possession, and prosecute the same with reasonable diligence to final judgment; and a failure so to do shall be a waiver of his adverse claim. After such judgment shall have been rendered, the party entitled to the possession of the claim, or any portion thereof, may, without giving further notice, file a certified copy of the judgment-roll with the Register of the Land Office, together with the certificate of the Surveyor-General, that the requisite amount of labor has been expended, or improvements made thereon, and the description required in other cases, and shall pay to the Receiver five dollars per acre for his claim, together with the proper fees, whereupon the whole proceedings and the judgment-roll shall be certified by the Register to the Commissioner of the General Land Office, and a patent shall issue thereon for the claim, or such portion thereof as the applicant shall appear, from the decision of the Court, to rightly possess. If it appears from the decision of the Court that several parties are entitled to separate and different portions of the claim, each party may pay for his portion of the claim, with the proper fees, and file the certificate and description by the Surveyor-General, whereupon the Register shall certify the proceedings and judgment-roll to the Commissioner of the General Land Office, as in the preceding case, and patents shall issue to the several parties, according to their respective rights. Nothing herein contained shall be construed to prevent the alienation of a title conveyed by a patent for a mining claim to any person whatever.

Sec. 2327. The description of vein or lode claims, upon surveyed lands, shall designate the location of the claim with reference to the lines of the public surveys, but need not conform therewith; but where a patent shall be issued for claims upon unsurveyed lands, the Surveyor-General, in extending the surveys, shall adjust the same to the boundaries of such patented claim, according to the plat or description thereof, but so as in no case to interfere with or change the location of any such patented claim.

Sec. 2328. Applications for patents for mining claims under former laws now pending may be prosecuted to a final decision in the General Land Office; but in such cases, where adverse rights are not affected thereby, patents may issue in pursuance of the provisions of this chapter; and all patents for mining claims upon veins or lodes heretofore issued shall convey all the rights and privileges conferred by this chapter where

no adverse rights existed on the tenth day of May, eighteen hundred and seventy-two.

SEC. 2329. Claims usually called "placers," including all forms of deposit, excepting veins of quartz or other rock in place, shall be subject to entry and patent, under like circumstances and conditions, and upon similar proceedings, as are provided for vein or lode claims; but where the lands have been previously surveyed by the United States, the entry in its exterior limits shall conform to the legal subdivisions of the public lands.

SEC. 2330. Legal subdivisions of forty acres may be subdivided into ten-acre tracts; and two or more persons, or associations of persons, having contiguous claims of any size, although such claims may be less than ten acres each, may make joint entry thereof; but no location of a placer claim, made after the ninth day of July, eighteen hundred and seventy, shall exceed one hundred and sixty acres for any one person or association of persons, which location shall conform to the United States surveys; and nothing in this section contained shall defeat or impair any bona fide preemption or homestead claim upon agricultural lands, or authorize the sale of the improvements of any bona fide settler to any purchaser.

SEC. 2331. Where placer claims are upon surveyed lands, and conform to legal subdivisions, no further survey or plat shall be required, and all placer mining claims located after the tenth day of May, eighteen hundred and seventy-two, shall conform as near as practicable with the United States system of public land surveys, and the rectangular subdivisions of such surveys, and no such location shall include more than twenty acres for each individual claimant; but where placer claims cannot be conformed to legal subdivisions, survey and plat shall be made as on unsurveyed lands; and where by the segregation of mineral lands in any legal subdivision a quantity of agricultural land less than forty acres remains, such fractional portion of agricultural land may be entered, by any party qualified by law, for homestead or preëmption purposes.

SEC. 2332. Where such person or association, they or their grantors, have held and worked their claims for a period equal to the time prescribed by the statute of limitations for mining claims of the State or Territory where the same may be situated, evidence of such possession and working of the claims for such period shall be sufficient to establish a right to a patent thereto under this chapter, in the absence of any adverse claim; but nothing in this chapter shall be deemed to impair any lien which may have attached in any way whatever to any mining claim or property thereto attached prior to the issuance of a patent.

SEC. 2333. Where the same person, association, or corporation is in possession of a placer claim, and also a vein or lode included within the boundaries thereof, application shall be made for a patent for the placer claim, with the statement that it includes such vein or lode, and in such case a patent shall issue for the placer claim, subject to the provisions of this chapter, including such vein or lode, upon the payment of five dollars per acre for such vein or lode claim, and twenty-five feet of surface on each side thereof. The remainder of the placer claim, or any placer claim not embracing any vein or lode claim, shall be paid for at the rate of two dollars and fifty cents per acre, together with all costs of proceedings; and where a vein or lode, such as is described in section twenty-three hundred and twenty, is known to exist within the boundaries of a placer claim, an application for a patent for such placer claim which does not include an application for the vein or lode claim shall be construed as a conclusive declaration that the claimant of the placer claim has no right of possession

of the vein or lode claim; but where the existence of a vein or lode in a placer claim is not known, a patent for the placer claim shall convey all valuable mineral and other deposits within the boundaries thereof.

SEC. 2334. The Surveyor-General of the United States may appoint in each land district containing mineral lands as many competent surveyors as shall apply for appointment to survey mining claims. The expenses of the survey of vein or lode claims, and the survey and subdivision of placer claims into smaller quantities than one hundred and sixty acres, together with the cost of publication of notices, shall be paid by the applicants, and they shall be at liberty to obtain the same at the most reasonable rates, and they shall also be at liberty to employ any United States Deputy Surveyor to make the survey. The Commissioner of the General Land Office shall also have power to establish the maximum charges for surveys and publication of notices under this chapter; and, in case of excessive charges for publication, he may designate any newspaper published in a land district where mines are situated, for the publication of mining notices in such district, and fix the rates to be charged by such paper; and, to the end that the Commissioner may be fully informed on the subject, each applicant shall file with the Register a sworn statement of all charges and fees paid by such applicant for publication and surveys, together with all fees and money paid the Register and the Receiver of the Land Office, which statement shall be transmitted, with the other papers in the case, to the Commissioner of the General Land Office.

SEC. 2335. All affidavits required to be made under this chapter may be verified before any officer authorized to administer oaths within the land district where the claims may be situated, and all testimony and proofs may be taken before any such officer, and, when duly certified by the officer taking the same, shall have the same force and effect as if taken before the Register and Receiver of the Land Office. In cases of contest as to the mineral or agricultural character of the land, the testimony and proofs may be taken as herein provided, on personal notice of at least ten days to the opposing party; or, if such party cannot be found, then by publication of at least once a week for thirty days, in a newspaper to be designated by the Register of the Land Office, as published nearest to the location of such land; and the Register shall require proof that such notice has been given.

SEC. 2336. Where two or more veins intersect or cross each other, priority of title shall govern; and such prior location shall be entitled to all ore or mineral contained within the space of intersection; but the subsequent location shall have the right of way through the space of intersection, for the purposes of the convenient working of the mine. And where two or more veins unite, the oldest or prior location shall take the vein below the point of union, including all the space of intersection.

SEC. 2337. Where non-mineral land, not contiguous to the vein or lode, is used or occupied by the proprietor of such vein or lode for mining or milling purposes, such non-adjacent surface ground may be embraced and included in an application for a patent for such vein or lode, and the same may be patented therewith, subject to the same preliminary requirements as to survey and notice as are applicable to veins or lodes; but no location hereafter made of such non-adjacent land shall exceed five acres, and payment for the same must be made at the same rate as fixed by this chapter for the superficies of the lode. The owner of a quartz mill or reduction works, not owning a mine in connection therewith, may also receive a patent for his mill site, as provided in this section.

SEC. 2338. As a condition of sale, in the absence of necessary legisla-

tion by Congress, the local Legislature of any State or Territory may provide rules for working mines, involving easements, drainage, and other necessary means to their complete development; and those conditions shall be fully expressed in the patent.

SEC. 2339. Whenever, by priority of possession, rights to the use of water for mining, agricultural, manufacturing, or other purposes, have vested and accrued, and the same are recognized and acknowledged by the local customs, laws, and the decisions of Courts, the possessors and owners of such vested rights shall be maintained and protected in the same; and the right of way for the construction of ditches and canals for the purposes herein specified is acknowledged and confirmed; but whenever any person, in the construction of any ditch or canal, injures or damages the possession of any settler on the public domain, the party committing such injury or damage shall be liable to the party injured for such injury or damage.

SEC. 2340. All patents granted, or preëmption or homesteads allowed, shall be subject to any vested and accrued water-rights, or rights to ditches and reservoirs used in connection with such water-rights, as may have been acquired under or recognized by the preceding section.

SEC. 2341. Wherever, upon the lands heretofore designated as mineral lands, which have been excluded from survey and sale, there have been homesteads made by citizens of the United States, or persons who have declared their intention to become citizens, which homesteads have been made, improved, and used for agricultural purposes, and upon which there have been no valuable mines of gold, silver, cinnabar, or copper discovered, and which are properly agricultural lands, the settlers or owners of such homesteads shall have a right of preëmption thereto, and shall be entitled to purchase the same at the price of one dollar and twenty-five cents per acre, and in quantity not to exceed one hundred and sixty acres; or they may avail themselves of the provisions of chapter five of this title, relating to "homesteads."

SEC. 2342. Upon the survey of the lands described in the preceding section, the Secretary of the Interior may designate and set apart such portions of the same as are clearly agricultural lands, which lands shall thereafter be subject to preëmption and sale as other public lands, and be subject to all the laws and regulations applicable to the same.

SEC. 2343. The President is authorized to establish additional land districts, and to appoint the necessary officers under existing laws, wherever he may deem the same necessary for the public convenience in executing the provisions of this chapter.

SEC. 2344. Nothing contained in this chapter shall be construed to impair, in any way, rights or interests in mining property acquired under existing laws; nor to affect the provisions of the Act entitled "an Act granting to A. Sutro the right of way and other privileges to aid in the construction of a draining and exploring tunnel to the Comstock lode, in the State of Nevada," approved July twenty-fifth, eighteen hundred and sixty-six.

SEC. 2345. The provisions of the preceding sections of this chapter shall not apply to the mineral lands situated in the States of Michigan, Wisconsin, and Minnesota, which are declared free and open to exploration and purchase according to legal subdivisions, in like manner as before the tenth day of May, eighteen hundred and seventy-two. And any bona fide entries of such lands within the States named since the tenth of May, eighteen hundred and seventy-two, may be patented without reference to any of the foregoing provisions of this chapter. Such lands shall be

offered for public sale in the same manner, at the same minimum price, and under the same rights of preëmption, as other public lands.

SEC. 2346. No Act passed at the first session of the thirty-eighth Congress, granting lands to States or corporations to aid in the construction of roads, or for other purposes, or to extend the time of grants made prior to the thirtieth day of January, eighteen hundred and sixty-five, shall be so construed as to embrace mineral lands, which in all cases are reserved exclusively to the United States, unless otherwise specially provided in the Act or Acts making the grant.

REPEAL PROVISIONS.

TITLE LXXIV.

SEC. 5595. The foregoing seventy-three titles embrace the statutes of the United States, general and permanent in their nature, in force on the first day of December, one thousand eight hundred and seventy-three, as revised and consolidated by Commissioners appointed under an Act of Congress, and the same shall be designated and cited as the revised statutes of the United States.

SEC. 5596. All Acts of Congress passed prior to said first day of December, one thousand eight hundred and seventy-three, any portion of which is embraced in any section of said revision, are hereby repealed, and the section applicable thereto shall be in force in lieu thereof; all parts of such Acts not contained in such revision, having been repealed or superseded by subsequent Acts, or not being general and permanent in their nature; *provided*, that the incorporation into such revision of any general and permanent provision, taken from an Act making appropriations, or from an Act containing other provisions of a private, local, or temporary character, shall not repeal, or in any way affect any appropriation, or any provision of a private, local, or temporary character, contained in any of said Acts, but the same shall remain in force; and all Acts of Congress passed prior to said last named day, no part of which are embraced in said revision, shall not be affected or changed by its enactments.

SEC. 5597. The repeal of the several Acts embraced in said revision shall not affect any act done, or any right accruing or accrued, or any suit or proceeding had or commenced in any civil cause before the said repeal, but all rights and liabilities under said Acts shall continue, and may be enforced in the same manner, as if said repeal had not been made; nor shall said repeal in any manner affect the right to any office, or change the term or tenure thereof.

SEC. 5598. All offenses committed and all penalties or forfeitures incurred under any statute embraced in said revision prior to said repeal, may be prosecuted and punished in the same manner and with the same effect, as if said repeal had not been made.

SEC. 5599. All acts of limitation, whether applicable to civil causes and proceedings, or to the prosecution of offenses, or for the recovery of penalties or forfeitures, embraced in said revision and covered by said repeal, shall not be affected thereby, but all suits, proceedings, or prosecutions, whether civil or criminal, for causes arising, or acts done or committed prior to said repeal, may be commenced and prosecuted within the same time as if said repeal had not been made.

SEC. 5600. The arrangement and classification of the several sections of the revision have been made for the purpose of a more convenient and

orderly arrangement of the same, and therefore no inference or presumption of a legislative construction is to be drawn by reason of the title under which any particular section is placed.

SEC. 5601. The enactment of the said revision is not to affect or repeal any Act of Congress passed since the first day of December, one thousand eight hundred and seventy-three, and all Acts passed since that date are to have full effect as if passed after the enactment of this revision, and so far as such Acts vary from, or conflict with any provision contained in said revision, they are to have effect as subsequent statutes, and as repealing any portion of the revision inconsistent therewith.

Approved June 22, 1874.

The following is an Act of Congress approved June 6, 1874:

An Act to amend the Act entitled "An Act to promote the development of the mining resources of the United States," passed May tenth, eighteen hundred and seventy-two.

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, That the provisions of the fifth section of the Act entitled "An Act to promote the development of the mining resources of the United States," passed May tenth, eighteen hundred and seventy-two, which requires expenditures of labor and improvements on claims located prior to the passage of said Act, are hereby so amended that the time for the first annual expenditure on claims located prior to the passage of said Act shall be extended to the first day of January, eighteen hundred and seventy-five.

The following is an Act of Congress approved February 11, 1875:

An Act to amend section two thousand three hundred and twenty-four of the Revised Statutes, relating to the development of the mining resources of the United States.

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, That section two thousand three hundred and twenty-four of the Revised Statutes be and the same is hereby amended so that where a person or company has or may run a tunnel for the purposes of developing a lode or lodes, owned by said person or company, the money so expended in said tunnel shall be taken and considered as expended on said lode or lodes, whether located prior to or since the passage of said Act, and such person or company shall not be required to perform work on the surface of said lode or lodes in order to hold the same as required by said Act.

The following is an Act of Congress approved May 5, 1876:

An Act to exclude the States of Missouri and Kansas from the provisions of the Act of Congress entitled "An Act to promote the development of the mining resources of the United States," approved May tenth, eighteen hundred and seventy-two.

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, That within the States of Missouri and Kansas, deposits of coal, iron, lead, or other mineral be and they are hereby excluded from the operation of the Act entitled "An Act to promote the development of the mining resources of the United States," ap-

proved May tenth, eighteen hundred and seventy-two, and all lands in said States shall be subject to disposal as agricultural lands.

The following is an Act of Congress approved June 3, 1878:

An Act authorizing the citizens of Colorado, Nevada, and the Territories to fell and remove timber on the public domain for mining and domestic purposes.

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, That all citizens of the United States and other persons, bona fide residents of the State of Colorado or Nevada, or either of the Territories of New Mexico, Arizona, Utah, Wyoming, Dakota, Idaho, or Montana, and all other mineral districts of the United States, shall be and are hereby authorized and permitted to fell and remove, for building, agricultural, mining, or other domestic purposes, any timber or other trees growing or being on the public lands, said lands being mineral, and not subject to entry under existing laws of the United States, except for mineral entry, in either of said States, Territories, or districts of which such citizens or persons may be at the time bona fide residents, subject to such rules and regulations as the Secretary of the Interior may prescribe for the protection of the timber and of the undergrowth growing upon such lands, and for other purposes; *provided*, the provisions of this Act shall not extend to railroad corporations.

Sec. 2. That it shall be the duty of the Register and the Receiver of any local Land Office in whose district any mineral land may be situated, to ascertain from time to time whether any timber is being cut or used upon any such lands, except for the purposes authorized by this Act, within their respective land districts; and, if so, they shall immediately notify the Commissioner of the General Land Office of that fact; and all necessary expenses incurred in making such proper examinations shall be paid and allowed such Register and Receiver in making up their next quarterly accounts.

Sec. 3. Any person or persons who shall violate the provisions of this Act, or any rules and regulations in pursuance thereof made by the Secretary of the Interior, shall be deemed guilty of a misdemeanor, and, upon conviction, shall be fined in any sum not exceeding five hundred dollars, and to which may be added imprisonment for any term not exceeding six months.

The following is an Act of Congress approved January 22, 1880:

An Act to amend sections twenty-three hundred and twenty-four and twenty-three hundred and twenty-five of the Revised Statutes of the United States concerning mineral lands.

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, That section twenty-three hundred and twenty-five of the Revised Statutes of the United States be amended by adding thereto the following words: "*Provided*, that where the claimant for a patent is not a resident of or within the land district wherein the vein, lode, ledge, or deposit sought to be patented is located, the application for patent and the affidavits required to be made in this section by the claimant for such patent may be made by his, her, or its authorized agent, where said agent is conversant with the facts sought to be established by said affidavits; *and provided*, that this section shall apply to all applications now pending for patents to mineral lands."

SEC. 2. That section twenty-three hundred and twenty-four of the Revised Statutes of the United States be amended by adding the following words: "*Provided*, that the period within which the work required to be done annually on all unpatented mineral claims shall commence on the first day of January succeeding the date of location of such claim, and this section shall apply to all claims located since the tenth day of May, Anno Domini eighteen hundred and seventy-two."

The following is an Act of Congress approved March 3, 1881:

An Act to amend section twenty-three hundred and twenty-six of the Revised Statutes of the United States, relating to suits at law affecting the title to mining claims.

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, That if, in any action brought pursuant to section twenty-three hundred and twenty-six of the Revised Statutes, title to the ground in controversy shall not be established by either party, the jury shall so find, and judgment shall be entered according to the verdict. In such case costs shall not be allowed to either party, and the claimant shall not proceed in the Land Office or be entitled to a patent for the ground in controversy until he shall have perfected his title.

REGULATIONS.

MINERAL LANDS OPEN TO EXPLORATION, OCCUPATION, AND PURCHASE.

1. It will be perceived that by the foregoing provisions of law the mineral lands in the public domain, surveyed or unsurveyed, are open to exploration, occupation, and purchase by all citizens of the United States, and all those who have declared their intentions to become such.

STATUS OF LODE-CLAIMS LOCATED PRIOR TO MAY TENTH, EIGHTEEN HUNDRED AND SEVENTY-TWO.

2. By an examination of the several sections of the Revised Statutes, it will be seen that the *status* of lode-claims located *previous* to the tenth of May, 1872, is not changed with regard to their *extent along the lode or width of surface.*

3. Mining rights acquired under such previous locations are, however, enlarged by said Revised Statutes in the following respect, viz.: The locators of all such previously taken veins or lodes, their heirs and assigns, so long as they comply with the laws of Congress and with State, Territorial, or local regulations not in conflict therewith, governing mining claims, are invested with the exclusive possessory right of all the surface included within the lines of their locations, and of all veins, lodes, or ledges throughout their entire depth, the top or apex of which lies inside of such surface lines extended downward vertically, although such veins, lodes, or ledges may so far depart from a perpendicular in their course downward as to extend outside the vertical side lines of such locations at the surface, it being expressly provided, however, that the right of possession to such outside parts of said veins or ledges shall be confined to such portions thereof as lie between vertical planes drawn downward as aforesaid, through the end lines of their locations so continued in their own direction that

such planes will intersect such exterior parts of such veins, lodes, or ledges; no right being granted, however, to the claimant of such outside portion of a vein or ledge to enter upon the surface location of another claimant.

4. It is to be distinctly understood, however, that the law limits the possessory right to veins, lodes, or ledges, *other* than the one named in the original location, to such as were not *adversely claimed on May 10, 1872*, and that where such other vein or ledge was so adversely claimed at that date, the right of the party so adversely claiming is in no way impaired by the provisions of the Revised Statutes.

5. In order to hold the possessory title to a mining claim located prior to May 10, 1872, and for which a patent has not been issued, the law requires that *ten dollars* shall be expended annually in labor or improvements on each claim of *one hundred feet* on the course of the vein or lode until a patent shall have been issued therefor; but where a number of such claims are held in common upon the same vein or lode, the aggregate expenditure that would be necessary to hold all the claims, at the rate of ten dollars per hundred feet, may be made upon any one claim; a failure to comply with this requirement in any one year subjecting the claim upon which such failure occurred to relocation by other parties, the same as if no previous location thereof had ever been made, unless the claimants under the original location shall have resumed work thereon, after such failure and before such relocation. The first annual expenditure upon claims of this class should have been performed subsequent to May 10, 1872, and prior to January 1, 1875. From and after January 1, 1875, the required amount must be expended *annually* until patent issues. By decision of the honorable Secretary of the Interior, dated March 4, 1879, such annual expenditures are not required subsequent to entry, the date of issuing the patent certificate being the date contemplated by statute.

6. Upon the failure of any one of several coöwners of a vein, lode, or ledge, which has not been entered, to contribute his proportion of the expenditures necessary to hold the claim or claims so held in ownership in common, the coöwners who have performed the labor, or made the improvements, as required by said Revised Statutes, may, at the expiration of the year, give such delinquent coöwner personal notice in writing, or notice by publication in the newspaper published nearest the claim, for at least once a week for ninety days; and, if upon the expiration of ninety days after such notice in writing, or upon the expiration of one hundred and eighty days after the first newspaper publication of notice, the delinquent coöwner shall have failed to contribute his proportion to meet such expenditures or improvements, his interest in the claim by law passes to his coöwners, who have made the expenditures or improvements as aforesaid. Where a claimant alleges ownership of a forfeited interest under the foregoing provision, the sworn statement of the publisher as to the facts of publication, giving dates and a printed copy of the notice published, should be furnished, and the claimant must swear that the delinquent coöwner failed to contribute his proper proportion within the period fixed by the statute.

PATENTS FOR VEINS OR LODES HERETOFORE ISSUED.

7. Rights under patents for veins or lodes heretofore granted under previous legislation of Congress are enlarged by the Revised Statutes so as to invest the patentee, his heirs or assigns, with title to all veins, lodes, or ledges, throughout their entire depth, the top or apex of which lies within the end and side boundary lines of his claim on the surface, as patented, extending downward vertically, although such veins, lodes, or ledges may

so far depart from a perpendicular in their course downward as to extend outside the vertical side lines of the claim at the surface. The right of possession to such outside parts of such veins or ledges to be confined to such portions thereof as lie between vertical planes drawn downward through the end lines of the claims at the surface, so continued in their own direction that such planes will intersect such exterior parts of such veins or ledges, it being expressly provided, however, that all veins, lodes, or ledges, the top or apex of which lies inside such surface locations, *other* than the one named in the patent, which were *adversely claimed on the tenth May, 1872*, are excluded from such conveyance by patent.

8. Applications for patents for mining claims pending at the date of the Act of May 10, 1872, may be prosecuted to final decision in the General Land Office, and where no adverse rights are affected thereby, patents will be issued in pursuance of the provisions of the Revised Statutes.

MANNER OF LOCATING CLAIMS ON VEINS OR LODES AFTER MAY TENTH, EIGHTEEN HUNDRED AND SEVENTY–TWO.

9. From and after the tenth May, 1872, any person who is a citizen of the United States, or who has declared his intention to become a citizen, may locate, record, and hold a mining claim of *fifteen hundred linear feet* along the course of any mineral vein or lode subject to location; or an association of persons, severally qualified as above, may make joint location of such claim of *fifteen hundred feet*, but in no event can a location of a vein or lode made subsequent to May 10, 1872, exceed fifteen hundred feet along the course thereof, whatever may be the number of persons composing the association.

10. With regard to the extent of surface-ground adjoining a vein or lode, and claimed for the convenient working thereof, the Revised Statutes provide that the lateral extent of locations of veins or lodes made after May 10, 1872, shall in no case *exceed three hundred feet on each side of the middle of the vein at the surface*, and that no such surface rights shall be limited by any mining regulations to less than twenty-five feet on each side of the middle of the vein at the surface, except where adverse rights existing on the tenth May, 1872, may render such limitation necessary; the end-lines of such claims to be in all cases parallel to each other. Said lateral measurements cannot extend beyond three hundred feet on *either* side of the middle of the vein at the surface, or such distance as is allowed by local laws. For example: Four hundred feet cannot be taken on one side and two hundred feet on the other. If, however, three hundred feet on each side are allowed, and by reason of prior claims but one hundred feet can be taken on one side, the locator will not be restricted to less than three hundred feet on the other side; and when the locator does not determine by exploration *where* the middle of the vein at the surface is, his discovery shaft must be assumed to mark such point.

11. By the foregoing it will be perceived that no lode-claim located after the tenth May, 1872, can exceed a parallelogram fifteen hundred feet in length by six hundred feet in width, but whether surface-ground of that width can be taken, depends upon the local regulations or State or Territorial laws in force in the several mining districts; and that no such local regulations or State or Territorial laws shall limit a vein or lode claim to less than fifteen hundred feet along the course thereof, whether the location is made by one or more persons, nor can surface rights be limited to less than fifty feet in width, unless adverse claims existing on the tenth day of May, 1872, render such lateral limitation necessary.

12. It is provided by the Revised Statutes that the miners of each district may make rules and regulations not in conflict with the laws of the United States, or of the State or Territory in which such districts are respectively situated, governing the location, manner of recording, and amount of work necessary to hold possession of a claim. They likewise require that the location shall be so distinctively marked on the ground that its boundaries may be readily traced. This is a very important matter, and locators cannot exercise too much care in defining their locations at the outset, inasmuch as the law requires that all records of mining locations made subsequent to May 10, 1872, shall contain the name or names of the locators, the date of the location, and such a *description of the claim or claims* located, by reference to some natural object or permanent monument, as will identify the claim.

13. The statutes provide that no lode-claim shall be recorded until after the discovery of a vein or lode within the limits of the claim located, the object of which provision is evidently to prevent the appropriation of presumed mineral ground for speculative purposes to the exclusion of *bona fide* prospectors, before sufficient work has been done to determine whether a vein or lode really exists.

14. The claimant should, therefore, prior to locating his claim, unless the vein can be traced upon the surface, sink a shaft, or run a tunnel or drift, to a sufficient depth therein to discover and develop a mineral-bearing vein, lode, or crevice; should determine, if possible, the general course of such vein in either direction from the point of discovery, by which direction he will be governed in marking the boundaries of his claim on the surface. His location notice should give the course and distance as nearly as practicable from the discovery-shaft on the claim, to some permanent, well known points or objects, such, for instance, as stone monuments, blazed trees, the confluence of streams, point of intersection of well known gulches, ravines, or roads, prominent buttes, hills, etc., which may be in the immediate vicinity, and which will serve to perpetuate and fix the *locus* of the claim and render it susceptible of identification from the description thereof given in the record of locations in the district, and should be duly recorded.

15. In addition to the foregoing data, the claimant should state the names of adjoining claims, or if none adjoin, the relative positions of the nearest claims; should drive a post or erect a monument of stones at each corner of his surface ground, and at the point of discovery or discovery shaft should fix a post, stake, or board, upon which should be designated the name of the lode, the name or names of the locators, the number of feet claimed, and in which direction from the point of discovery, it being essential that the location notice filed for record, in addition to the foregoing description, should state whether the entire claim of fifteen hundred feet is taken on one side of the point of discovery, or whether it is partly upon one and partly upon the other side thereof, and in the latter case, how many feet are claimed upon each side of such discovery point.

16. Within a reasonable time, say twenty days after the location shall have been marked on the ground, or such time as is allowed by the local laws, notice thereof, accurately describing the claim in manner aforesaid, should be filed for record with the proper Recorder of the district, who will thereupon issue the usual certificate of location.

17. In order to hold the possessory right to a location made since May 10, 1872, not less than one hundred dollars' worth of labor must be performed, or improvements made thereon annually until entry shall have been made. Under the provisions of the Act of Congress approved Jan-

uary 22, 1880, the first annual expenditure becomes due and must be performed during the calendar year succeeding that in which the location was made. Expenditure made or labor performed prior to the first day of January succeeding the date of location will not be considered as a part of, or applied upon the first annual expenditure required by law. Failure to make the expenditure or perform the labor required will subject the claim to relocation by any other party having the necessary qualifications, unless the original locator, his heirs, assigns, or legal representatives have resumed work thereon after such failure and before such relocation.

18. The expenditures required upon mining claims may be made from the surface or in running a tunnel for the development of such claims, the Act of February 11, 1875, providing that where a person or company has, or may, run a tunnel for the purpose of developing a lode or lodes owned by said person or company, the money so expended in said tunnel shall be taken and considered as expended on said lode or lodes, and such person or company shall not be required to perform work on the surface of said lode or lodes in order to hold the same.

19. The importance of attending to these details in the matter of location, labor, and expenditure will be the more readily perceived when it is understood that a failure to give the subject proper attention may invalidate the claim.

TUNNEL RIGHTS.

20. Section 2323 provides that where a tunnel is run for the development of a vein or lode, or for the discovery of mines, the owners of such tunnel shall have the right of possession of all veins or lodes within three thousand feet from the face of such tunnel on the line thereof, not previously known to exist, discovered in such tunnel, to the same extent as if discovered from the surface; and locations on the line of such tunnel of veins or lodes not appearing on the surface, made by other parties after the commencement of the tunnel, and while the same is being prosecuted with reasonable diligence, shall be invalid; but failure to prosecute the work on the tunnel for six months shall be considered as an abandonment of the right to all undiscovered veins or lodes on the line of said tunnel.

21. The effect of this is simply to give the proprietors of a mining tunnel run in good faith the possessory right to fifteen hundred feet of any blind lodes cut, discovered, or intersected by such tunnel, which were not previously known to exist, within three thousand feet from the face or point of commencement of such tunnel, and to prohibit other parties, after the commencement of the tunnel, from prospecting for and making locations of lodes on the *line thereof* and within said distance of three thousand feet, unless such lodes appear upon the surface or were previously known to exist.

22. The term "face," as used in said section, is construed and held to mean the first working-face formed in the tunnel, and to signify the point at which the tunnel actually enters cover; it being from this point that the three thousand feet are to be counted, upon which prospecting is prohibited as aforesaid.

23. To avail themselves of the benefits of this provision of law, the proprietors of a mining tunnel will be required, at the time they enter cover, as aforesaid, to give proper notice of their tunnel location by erecting a substantial post, board, or monument at the face or point of commencement thereof, upon which should be posted a good and sufficient notice, giving the names of the parties or company claiming the tunnel

right; the actual or proposed course or direction of the tunnel; the height and width thereof, and the course and distance from such face or point of commencement to some permanent well known objects in the vicinity by which to fix and determine the *locus* in manner heretofore set forth applicable to locations of veins or lodes, and at the time of posting such notice they shall, in order that miners or prospectors may be enabled to determine whether or not they are within the lines of the tunnel, establish the boundary lines thereof, by stakes or monuments placed along such lines at proper intervals, to the terminus of the three thousand feet from the face or point of commencement of the tunnel, and the lines so marked will define and govern as to the specific boundaries within which prospecting for lodes not previously known to exist is prohibited while work on the tunnel is being prosecuted with reasonable diligence.

24. At the time of posting notice and marking out the lines of the tunnel as aforesaid, a full and correct copy of such notice of location defining the tunnel claim must be filed for record with the mining Recorder of the district, to which notice must be attached the sworn statement or declaration of the owners, claimants, or projectors of such tunnel, setting forth the facts in the case; stating the amount expended by themselves and their predecessors in interest in prosecuting work thereon; the extent of the work performed, and that it is *bona fide* their intention to prosecute work on the tunnel so located and described with reasonable diligence for the development of a vein or lode, or for the discovery of mines, or both, as the case may be. This notice of location must be duly recorded, and, with the said sworn statement attached, kept on the Recorder's files for future reference.

25. By a compliance with the foregoing much needless difficulty will be avoided, and the way for the adjustment of legal rights acquired in virtue of said Section 2323 will be made much more easy and certain.

26. This office will take particular care that no improper advantage is taken of this provision of law by parties making or professing to make tunnel locations, ostensibly for the purposes named in the statute, but really for the purpose of monopolizing the lands lying in front of their tunnels to the detriment of the mining interests and to the exclusion of *bona fide* prospectors or miners, but will hold such tunnel claimants to a strict compliance with the terms of the statutes; and a *reasonable diligence* on their part in prosecuting the work is one of the essential conditions of their implied contract. Negligence or want of due diligence will be construed as working a forfeiture of their right to all undiscovered veins on the line of such tunnel.

MANNER OF PROCEEDING TO OBTAIN GOVERNMENT TITLE TO VEIN OR LODE CLAIMS.

27. By Section 2325 authority is given for granting titles for mines by patent from the Government to any person, association, or corporation having the necessary qualifications as to citizenship and holding the right of possession to a claim in compliance with law.

28. The claimant is required in the first place to have a correct survey of his claim made under authority of the Surveyor-General of the State or Territory in which the claim lies; such survey to show with accuracy the exterior surface boundaries of the claim, which boundaries are required to be distinctly marked by monuments on the ground. Four plats and one copy of the original field notes, in each case, will be prepared by the

Surveyor-General; one plat and the original field notes to be retained in the office of the Surveyor-General, one copy of the plat to be given to the claimant for posting upon the claim, one plat and a copy of the field notes to be given the claimant for filing with the proper Register, to be finally transmitted by that officer, with other papers in the case, to this office, and one plat to be sent by the Surveyor-General to the Register of the proper land district, to be retained on his files for future reference.

29. The claimant is then required to post a copy of the plat of such survey in a conspicuous place upon the claim, together with notice of his intention to apply for a patent therefor, which notice will give the date of posting, the name of the claimant, the name of the claim, mine, or lode; the mining district and county; whether the location is of record, and, if so, where the record may be found; the number of feet claimed along the vein and the presumed direction thereof; the number of feet claimed on the lode in each direction from the point of discovery, or other well defined place on the claim; the name or names of adjoining claimants on the same or other lodes; or, if none adjoin, the names of the nearest claims, etc.

30. After posting the said plat and notice upon the premises, the claimant will file with the proper Register and Receiver a copy of such plat, and the field notes of survey of the claim, accompanied by the affidavit of at least two credible witnesses, that such plat and notice are posted conspicuously upon the claim, giving the date and place of such posting; a copy of *the notice* so posted to be attached to and form a part of said affidavit.

31. Attached to the field notes so filed must be the sworn statement of the claimant that he has the possessory right to the premises therein described, in virtue of a compliance by himself (and by his grantors, if he claims by purchase) with the mining rules, regulations, and customs of the mining district, State, or Territory in which the claim lies, and with the mining laws of Congress; such sworn statement to narrate briefly, but as clearly as possible, the facts constituting such compliance, the origin of his possession, and the basis of his claim to a patent.

32. This affidavit should be supported by appropriate evidence from the mining Recorder's office as to his possessory right, as follows, viz.: Where he claims to be a locator, a full, true, and correct copy of such location should be furnished, as the same appears upon the mining records; such copy to be attested by the seal of the Recorder, or if he has no seal, then he should make oath to the same being correct, as shown by his records; where the applicant claims as a locator in company with others who have since conveyed their interests in the lode to him, a copy of the original record of location should be filed, together with an abstract of title from the proper Recorder, under seal or oath as aforesaid, tracing the co-locator's possessory rights in the claim to such applicant for patent; where the applicant claims only as a purchaser for valuable consideration, a copy of the location record must be filed, under seal or upon oath as aforesaid, with an abstract of title certified as above by the proper Recorder, tracing the right of possession by a continuous chain of conveyances from the original locators to the applicant, also certifying that no conveyances affecting the title to the claim in question appear of record in his office other than those set forth in the accompanying abstract.

33. In the event of the mining records in any case having been destroyed by fire or otherwise lost, affidavit of the fact should be made, and secondary evidence of possessory title will be received, which may consist of the affidavit of the claimant, supported by those of any other parties cognizant of the facts relative to his location, occupancy, possession, improvements, etc.; and in such case of lost records, any deeds, certificates of location or pur-

chase, or other evidence which may be in the claimant's possession, and tend to establish his claim, should be filed.

34. Upon the receipt of these papers the Register will, at the expense of the claimant (who must furnish the agreement of the publisher to hold applicant for patent alone responsible for charges of publication), publish a notice of such application for the period of sixty days, in a newspaper published nearest to the claim; and will post a copy of such notice in his office for the same period. In all cases sixty days must intervene between the first and the last insertion of the notice in such newspaper. When the notice is published in a weekly newspaper, ten consecutive insertions are necessary; when in a daily newspaper, the notice must appear in each issue for the required period.

35. The notices so published and posted must be as full and complete as possible, and embrace all the *data* given in the notice posted upon the claim.

36. Too much care cannot be exercised in the preparation of these notices, inasmuch as upon their accuracy and completeness will depend, in a great measure, the regularity and validity of the whole proceeding.

37. The claimant, either at the time of filing these papers with the Register, or at any time during the sixty days' publication, is required to file a certificate of the Surveyor-General that not less than five hundred dollars' worth of labor has been expended or improvements made upon the claim by the applicant or his grantors; that the plat filed by the claimant is correct; that the field notes of the survey, as filed, furnish such an accurate description of the claim as will, if incorporated into a patent, serve to fully identify the premises, and that such reference is made therein to natural objects or permanent monuments as will perpetuate and fix the *locus* thereof.

38. It will be the more convenient way to have this certificate indorsed by the Surveyor-General, both upon the plat and field notes of survey filed by the claimant as aforesaid.

39. After the sixty days' period of newspaper publication has expired the claimant will file his affidavit, showing that the plat and notice aforesaid remained conspicuously posted upon the claim sought to be patented during said sixty days' publication, giving the dates.

40. Upon the filing of this affidavit the Register will, if no adverse claim was filed in his office during the period of publication, permit the claimant to pay for the land according to the area given in the plat and field notes of survey aforesaid, at the rate of five dollars for each acre, and five dollars for each fractional part of an acre, the Receiver issuing the usual duplicate receipt therefor. The claimant will also make a sworn statement of all charges and fees paid by him for publication and surveys, together with all fees and money paid the Register and Receiver of the Land Office, after which the whole matter will be forwarded to the Commissioner of the General Land Office, and a patent issued thereon, if found regular.

41. In sending up the papers in the case the Register must not omit certifying to the fact that the notice was posted in his office for the full period of sixty days, such certificate to state distinctly when such posting was done, and how long continued.

42. The consecutive series of numbers of mineral entries must be continued, whether the same are of lode or placer claims.

43. The Surveyor-General must continue to designate all surveyed mineral claims as heretofore, by a progressive series of numbers, beginning with lot No. 37 in each township; the claim to be so designated at date

of filing the plat, field notes, etc., in addition to the local designation of the claim, it being required in all cases that the plat and field notes of the survey of a claim must, in addition to the reference to permanent objects in the neighborhood, describe the *locus* of the claim with reference to the lines of public surveys, by a line connecting a corner of the claim with the nearest public corner of the United States surveys, unless such claim be on unsurveyed lands, at a remote distance from such public corner, in which latter case the reference by course and distance to permanent objects in the neighborhood will be a sufficient designation by which to fix the *locus*, until the public surveys shall have been closed upon its boundaries.

ADVERSE CLAIMS.

44. Section 2326 provides for adverse claims, fixes the time within which they shall be filed to have legal effect, and prescribes the manner of their adjustment.

45. Said section requires that the adverse claim shall be filed during the period of publication of notice; that it must be on the oath of the adverse claimant; and that it must show the "*nature*," the "*boundaries*," and the "*extent*" of the adverse claim.

46. In order that this section of law may be properly carried into effect, the following is communicated for the information of all concerned:

47. An adverse mining claim must be filed with the Register of the same Land Office with whom the application for patent was filed, or in his absence, with the Receiver, and within the sixty days' period of newspaper publication of notice.

48. The adverse notice must be duly sworn to by the person or persons making the same, before an officer authorized to administer oaths within the land district, or before the Register or Receiver; it will fully set forth the nature and extent of the interference or conflict; whether the adverse party claims as a purchaser for valuable consideration, or as a locator; if the former, a certified copy of the original location, the original conveyance, a duly certified copy thereof, or an abstract of title from the office of the proper Recorder, should be furnished, or if the transaction was a mere verbal one, he will narrate the circumstances attending the purchase, the date thereof, and the amount paid, which facts should be supported by the affidavit of one or more witnesses, if any were present at the time, and if he claims as a locator, he must file a duly certified copy of the location from the office of the proper Recorder.

49. In order that the "*boundaries*" and "*extent*" of the claim may be shown, it will be incumbent upon the adverse claimant to file a plat, showing his entire claim, its relative situation or position with the one against which he claims, and the extent of the conflict. This plat must be made from an actual survey by a United States Deputy Surveyor, who will officially certify thereon to its correctness; and in addition there must be attached to such plat of survey a certificate or sworn statement by the Surveyor as to the approximate value of the labor performed or improvements made upon the claim by the adverse party or his predecessors in interest, and the plat must indicate the position of any shafts, tunnels, or other improvements, if any such exist, upon the claim of the party opposing the application, and by which party said improvements were made.

50. Upon the foregoing being filed within the sixty days, as aforesaid, the Register, or in his absence the Receiver, will give notice in writing to *both parties* to the contest, that such adverse claim has been filed, informing them that the party who filed the adverse claim will be required within thirty

days from the date of such filing, to commence proceedings in a Court of competent jurisdiction to determine the question of right of possession, and to prosecute the same with reasonable diligence to final judgment, and that should such adverse claimant fail to do so, his adverse claim will be considered waived, and the application for patent be allowed to proceed upon its merits.

51. When an adverse claim is filed as aforesaid, the Register or Receiver will indorse upon the same the precise date of filing, and preserve a record of the date of notifications issued thereon; and thereafter all proceedings on the application for patent will be suspended, with the exception of the completion of the publication, and posting of notices, and plat, and the filing of the necessary proof thereof, until the controversy shall have been adjudicated in Court, or the adverse claim waived or withdrawn.

52. The proceedings after rendition of judgment by the Court in such case are so clearly defined by the act itself as to render it unnecessary to enlarge thereon in this place.

53. The proceedings to obtain patents for claims usually called placers, including all forms of deposit, are similar to the proceedings prescribed for obtaining patents for vein or lode claims; but where said placer claim shall be upon surveyed lands, and conform to legal subdivisions, no further survey or plat will be required, and all placer mining claims located after May 10, 1872, shall conform as nearly as practicable with the United States system of public land surveys and the rectangular subdivisions of such surveys, and no such location shall include more than twenty acres for each individual claimant; but where placer claims cannot be conformed to legal subdivisions, survey and plat shall be made as on unsurveyed lands. But where such claims are located previous to the public surveys, and do not conform to legal subdivisions, survey, plat, and entry thereof may be made according to the boundaries thereof, provided the location is in all respects legal.

54. The proceedings for obtaining patents for veins or lodes having already been fully given, it will not be necessary to repeat them here; it being thought that careful attention thereto by applicants and the local officers will enable them to act understandingly in the matter and make such slight modifications in the notice, or otherwise, as may be necessary in view of the different nature of the two classes of claims, placer claims being fixed, however, at two dollars and fifty cents per acre, or fractional part of an acre.

55. By Section 2330, authority is given for the subdivision of forty-acre legal subdivisions into *ten-acre* lots, which is intended for the greater convenience of miners in segregating their claims both from one another and from intervening agricultural lands.

56. It is held, therefore, that under a proper construction of the law these ten-acre lots in mining districts should be considered and dealt with, to all intents and purposes, as legal subdivisions, and that an applicant having a legal claim which conforms to one or more of these ten-acre lots, either adjoining or cornering, may make entry thereof, after the usual proceedings, without further survey or plat.

57. In cases of this kind, however, the notice given of the application must be very specific and accurate in description, and as the forty-acre tracts may be subdivided into ten-acre lots, either in the form of squares of ten by ten chains, or of parallelograms five by twenty chains, so long as the lines are parallel and at right angles with the lines of the public surveys, it will be necessary that the notice and application state specifi-

cally what ten-acre lots are sought to be patented, in addition to the other *data* required in the notice.

58. Where the ten-acre subdivision is in the form of a square it may be described, for instance, as the "S. E. $\frac{1}{4}$ of the S. W. $\frac{1}{4}$ of N. W. $\frac{1}{4}$," or, if in the form of a parallelogram as aforesaid, it may be described as the "W. $\frac{1}{2}$ of the W. $\frac{1}{2}$ of the S. W. $\frac{1}{4}$ of the N. W. $\frac{1}{4}$ (or the N. $\frac{1}{2}$ of the S. $\frac{1}{2}$ of the N. E. $\frac{1}{4}$ of the S. E. $\frac{1}{4}$) of section ——, township ——, range ——," as the case may be; but, in addition to this description of the land, the notice must give all the other *data*, that is required in a mineral application, by which parties may be put on inquiry as to the premises sought to be patented. The proof submitted with applications for claims of this kind must show clearly the character and the extent of the improvements upon the premises.

Inasmuch as the Surveyor-General has no duty to perform in connection with the entry of a placer claim of legal subdivisions, the proof of improvements must show their value to be not less than *five hundred dollars* and that they were made by the applicant for patent or his grantors.

59. Applicants for patent to a placer claim, who are also in possession of a known vein or lode included therein, must state in their application that the placer includes such vein or lode. The published and posted notices must also include such statement; and the vein or lode must be surveyed and marked upon the plat; the field notes and plat giving the area of the lode claim or claims and the area of the placer separately. If veins or lodes lying within a placer location are owned by other parties, the fact should be distinctly stated in the application for patent, and in all the notices. It should be remembered that an application which omits to include an application for a known vein or lode therein, must be construed as a conclusive declaration that the applicant has no right of possession to the vein or lode. Where there is no known lode or vein, the fact must appear by the affidavit of claimant and one or more witnesses.

60. When an adverse claim is filed to a placer application, the proceedings are the same as in the case of vein or lode claims, already described.

QUANTITY OF PLACER GROUND SUBJECT TO LOCATION.

61. By Section 2330 it is declared that no location of a placer claim, made after July 9, 1870, shall exceed one hundred and sixty acres for any one person or association of persons, which location shall conform to the United States surveys.

62. Section 2331 provides that all placer mining claims located after May 10, 1872, shall conform as nearly as practicable with the United States system of public surveys and the subdivisions of such surveys, and no such locations shall include more than twenty acres for each individual claimant.

63. The foregoing provisions of law are construed to mean that after the ninth day of July, 1870, no location of a placer claim can be made to exceed one hundred and sixty acres, whatever may be the number of locators associated together, or whatever the local regulations of the district may allow; and that from and after May 10, 1872, no location made by an individual can exceed twenty acres, and no location made by an association of individuals can exceed one hundred and sixty acres; which location of one hundred and sixty acres cannot be made by a less number than eight *bona fide* locators; and no local laws or mining regulations can restrict a placer location to less than twenty acres, although the locator is not compelled to take so much.

64. The regulations hereinbefore given as to the manner of marking loca-

tions on the ground, and placing the same on record, must be observed in the case of placer locations, so far as the same are applicable; the law requiring, however, that where placer claims are upon *surveyed* public lands, the locations must hereafter be made to conform to legal subdivisions thereof as near as practicable.

65. With regard to the proofs necessary to establish the possessory right to a placer claim, Section 2332 provides that "where such person or association, they and their grantors, have held and worked their claims for a period equal to the time prescribed by the statute of limitations for mining claims of the State or Territory where the same may be situated, evidence of such possession and working of the claims for such period shall be sufficient to establish a right to a patent thereto under this chapter, in the absence of any adverse claim."

66. This provision of law will greatly lessen the burden of proof, more especially in the case of old claims located many years since, the records of which, in many cases, have been destroyed by fire, or lost in other ways during the lapse of time, but concerning the possessory right to which all controversy or litigation has long been settled.

67. When an applicant desires to make his proof of possessory right in accordance with this provision of law, you will not require him to produce evidence of location, copies of conveyances, or abstracts of title, as in other cases, but will require him to furnish a duly certified copy of the statute of limitations of mining claims for the State or Territory, together with his sworn statement giving a clear and succinct narration of the facts as to the origin of his title, and likewise as to the continuation of his possession of the mining ground covered by his application; the area thereof, the nature and extent of the mining that has been done thereon; whether there has been any opposition to his possession, or litigation with regard to his claim, and if so, when the same ceased; whether such cessation was caused by compromise or by judicial decree; and any additional facts within the claimant's knowledge having a direct bearing upon his possession and *bona fides* which he may desire to submit in support of his claim.

68. There should likewise be filed a certificate, under seal of the Court having jurisdiction of mining cases within the judicial district embracing the claim, that no suit or action of any character whatever involving the right of possession to any portion of the claim applied for is pending, and that there has been no litigation before said Court affecting the title to said claim, or any part thereof, for a period equal to the time fixed by the statute of limitations for mining claims in the State or Territory as aforesaid, other than that which has been finally decided in favor of the claimant.

69. The claimant should support his narrative of facts relative to his possession, occupancy, and improvements, by corroborative testimony of any disinterested person or persons of credibility who may be cognizant of the facts in the case, and are capable of testifying understandingly in the premises.

70. It will be to the advantage of claimants to make their proofs as full and complete as practicable.

MILL-SITES.

71. Section 2337 provides that "where non-mineral land not contiguous to the vein or lode is used or occupied by the proprietor of such vein or lode for mining or milling purposes, such non-adjacent surface ground may be embraced and included in an application for a patent for such vein or lode, and the same may be patented therewith, subject to the same pre-

liminary requirements as to survey and notice as are applicable to veins or lodes; but no location hereafter made of such non-adjacent land shall exceed five acres, and payment for the same must be made at the same rate as fixed by this chapter for the superficies of the lode. The owner of a quartz mill or reduction works, not owning a mine in connection therewith, may also receive a patent for his mill-site, as provided in this section."

72. To avail themselves of this provision of law, parties holding the possessory right to a vein or lode, and to a piece of non-mineral land not contiguous thereto, for mining or milling purposes, not exceeding the quantity allowed for such purpose by Section 2337, United States Revised Statutes, or prior laws under which the land was appropriated, the proprietors of such vein or lode may file in the proper Land Office their application for a patent, under oath, in manner already set forth herein, which application, together with the plat and field notes, may include, embrace, and describe, in addition to the vein or lode, such non-contiguous mill-site, and after due proceedings as to notice, etc., a patent will be issued conveying the same as one claim.

73. In making the survey in a case of this kind, the lode-claim should be described in the plat and field-notes as "Lot No. 37, A," and the mill-site as "Lot No. 37, B," or whatever may be its appropriate numerical designation; the course and distance from a corner of the mill-site to a corner of the lode-claim to be invariably given in such plat and field notes, and a copy of the plat and notice of application for patent must be conspicuously posted upon the mill-site as well as upon the vein or lode, for the statutory period of sixty days. In making the entry no separate receipt or certificate need be issued for the mill-site, but the whole area of both lode and mill-site will be embraced in one entry, the price being five dollars for each acre and fractional part of an acre embraced by such lode and mill-site claim.

74. In case the owner of a quartz mill or reduction works is not the owner or claimant of a vein or lode, the law permits him to make application therefor in the same manner prescribed herein for mining claims, and after due notice and proceedings, in the absence of a valid adverse filing, to enter and receive a patent for his mill-site at said price per acre.

75. In every case there must be satisfactory proof that the land claimed as a mill-site is not mineral in character, which proof may, where the matter is unquestioned, consist of the sworn statement of the claimant, supported by that of one or more disinterested persons capable from acquaintance with the land to testify understandingly.

76. The law expressly limits mill-site locations made from and after its passage to *five acres.*

77. The Registers and Receivers will preserve an unbroken consecutive series of numbers for all mineral entries.

PROOF OF CITIZENSHIP OF MINING CLAIMANTS.

78. The proof necessary to establish the citizenship of applicants for mining patents must be made in the following manner: In case of an incorporated company, a certified copy of their charter or certificate of incorporation must be filed. In case of an association of persons unincorporated, the affidavit of their duly authorized agent, made upon his own knowledge, or upon information and belief, setting forth the residence of each person forming such association, must be submitted. This affidavit must be accompanied by a power of attorney from the parties forming such associ-

ation, authorizing the person who makes the affidavit of citizenship to act for them in the matter of their application for patent.

79. In case of an individual or an association of individuals who do not appear by their duly authorized agent, you will require the affidavit of each applicant, showing whether he is a native or naturalized citizen, when and where born, and his residence.

80. In case an applicant has declared his intention to become a citizen, or has been naturalized, his affidavit must show the date, place, and the Court before which he declared his intention, or from which his certificate of citizenship issued, and present residence.

81. The affidavit of the claimant as to his citizenship may be taken before the Register or Receiver, or any other officer authorized to administer oaths within the land district. If citizenship is established by the testimony of disinterested persons, such testimony may be taken at any place before any person authorized to administer oaths, and whose official character is duly verified.

APPOINTMENT OF DEPUTY SURVEYORS OF MINING CLAIMS—CHARGES FOR SURVEYS AND PUBLICATIONS—FEES OF REGISTERS AND RECEIVERS, ETC.

82. Section 2334 provides for the appointment of surveyors of mineral claims, authorizes the Commissioner of the General Land Office to establish the rates to be charged for surveys and for newspaper publications, prescribes the fees allowed to the local officers for receiving and acting upon applications for mining patents and for adverse claims thereto, etc.

Under this authority of law the following rates have been established as the maximum charges for newspaper publications in mining cases:

a. Where a daily newspaper is designated the charge shall not exceed seven dollars for each ten lines of space occupied, and where a weekly newspaper is designated as the medium of publication, five dollars for the same space will be allowed. Such charge shall be accepted as full payment for publication in each issue of the newspaper for the entire period required by law.

It is expected that these notices shall not be so abbreviated as to curtail the description essential to a perfect notice, and the said rates established upon the understanding that they are to be in the usual body-type used for advertisements.

b. For the publication of citations in contests or hearings involving the character of lands, the charges shall not exceed eight dollars for five publications in weekly newspapers, or ten dollars for publications in daily newspapers for thirty days.

83. The Surveyors-General of the several districts will, in pursuance of said law, appoint in each land district as many *competent* deputies for the survey of mining claims as may seek such appointment; it being distinctly understood that all expenses of these notices and surveys are to be borne by the mining claimants and not by the United States; the system of making *deposits* for mineral surveys, as required by previous instructions, being hereby revoked as regards *field work;* the claimant having the option of employing *any* deputy surveyor within such district to do his work in the field.

84. With regard to the *platting* of the claim and other *office work* in the Surveyor-General's Office, that officer will make an estimate of the cost thereof, which amount the claimant will deposit with any Assistant United States Treasurer, or designated depository, in favor of the United States Treasurer, to be passed to the credit of the fund created by "individual

depositors for surveys of the public lands," and file with the Surveyor-General duplicate certificate of such deposit in the usual manner.

85. The Surveyors-General will endeavor to appoint mineral deputy surveyors, so that one or more may be located in each mining district for the greater convenience of miners.

86. The usual oaths will be required of these deputies and their assistants as to the correctness of each survey executed by them.

The duty of the deputy mineral surveyor ceases when he has executed the survey and returned the field notes and preliminary plat thereof with his report to the Surveyors-General. He will not be allowed to prepare for the mining claimant the papers in support of an application for patent, or otherwise perform the duties of an attorney before the Land Office in connection with a mining claim.

The Surveyor-General and local land officers are expected to report any infringement of this regulation to this office.

87. The law requires that each applicant shall file with the Register and Receiver a sworn statement of all charges and fees paid by him for publication of notice and for survey; together with all fees and money paid the Register and Receiver, which sworn statement is required to be transmitted to this office, for the information of the Commissioner.

88. Should it appear that excessive or exorbitant charges have been made by any surveyor, or any publisher, prompt action will be taken with the view of correcting the abuse.

89. The fees payable to the Register and Receiver for filing and acting upon applications for mineral land patents are five dollars to each officer, to be paid by the applicant for patent at the time of filing, and the like sum of five dollars is payable to each officer by an adverse claimant at the time of filing his adverse claim.

90. All fees or charges under this law may be paid in United States currency.

91. The Register and Receiver will, at the close of each month, forward to this office an abstract of mining applications filed, and a register of receipts, accompanied with an abstract of mineral lands sold, and an abstract of adverse claims filed.

92. The fees and purchase money received by Registers and Receivers must be placed to the credit of the United States in the Receiver's monthly and quarterly account, charging up in the disbursing account the sums to which the Register and Receiver may be, respectively, entitled as fees and commissions, with limitations in regard to the legal maximum.

HEARINGS TO ESTABLISH THE CHARACTER OF LANDS.

93. In every case where it becomes necessary, under the law and existing instructions of this office, that a hearing be held and testimony taken for the purpose of ascertaining the mineral or agricultural character of land, the local officers are directed to cause the evidence to be taken before a duly qualified officer, whose office is located nearest the land in dispute, the distance to be computed by ordinary routes of travel.

Whenever the local office comes within this rule, the hearing will be held before the Register and Receiver.

It is intended to cause these hearings to be held, as far as practicable, in such manner as to afford the least inconvenience to persons interested. Should it appear, therefore, by written stipulation of all the parties, that this purpose will best be subserved by the designation of any particular officer authorized to administer oaths within the land district in which the

land in controversy is situated, the instructions herein may be departed from in accordance with such stipulation. Such deviation may also be allowed where the officer who would, otherwise, be designated is an interested party, or where, for other good reasons, his selection would be improper.

When the evidence is taken before an officer other than the Register and Receiver, the record should be sealed up, the title of the case indorsed on the envelope, and the whole returned by mail or express to the Register and Receiver.

On the twenty-seventh April, 1880, in accordance with the directions of the Secretary of the Interior, this office revoked the withdrawals theretofore made, upon general information, that vast tracts of public land were mineral in character, and instructed the local officers, in the absence of a specific allegation of the mineral character of land, to allow applications for agricultural entry thereof, upon due proof.

Hereafter the only tracts of public lands that will be withheld from entry as agricultural land on account of its mineral character, will be such as are returned by the Surveyor-General as mineral; and even the presumption which is supported by such return may be overcome by testimony taken at a regular hearing.

94. Hearings to determine the character of land, as practically distinguished, are of two kinds:

First—Where lands which are sought to be entered and patented as agricultural are alleged by affidavit to be mineral, or when sought as mineral their non-mineral character is alleged.

The proceedings relative to this class are in the nature of a contest between two or more known parties, and the testimony may be taken on personal notice of at least ten days, duly served on all parties, or, if they cannot be found, then by publication for thirty days in a newspaper of general circulation, to be designated by the Register of the Land Office as published nearest to the land in controversy. If publication is made in a weekly newspaper, the notice must be inserted in five consecutive weekly issues thereof.

Second—When lands are returned as mineral by the Surveyor-General. When such lands are sought to be entered as agricultural, notice must be given by publication for thirty days, as aforesaid.

95. All notices must describe the land, give the name and address of the claimant, the character of his claim, and the time, place, and purpose of the hearing.

Proof of service of notice, when personal, must consist of either acknowledgment of service indorsed on the citation (which is always desirable), or the affidavit of the party serving the same, giving date, place, and manner of service, indorsed as aforesaid.

Proof of publication must be the affidavit of the publisher of the newspaper, stating the period of publication, giving dates, stating whether in a daily or weekly issue, and a copy of the notice so published must be attached to and form a part of the affidavit.

Proof of posting on the claim must be made by the affidavits of two or more persons who state when and where the notice was posted; that it remained so posted during the prescribed period, giving dates, and a copy of the notice so posted must be attached to and made a part of the affidavits.

Proof of notice is indispensable to the regularity of proceedings and must accompany the record in every case.

The expense of notice must in every case be paid by the parties thereto.

96. At the hearing there must be filed the affidavit of the publisher of

the paper that said notice was published for the required time, stating when and for how long such publication was made, a printed copy thereof to be attached and made a part of the affidavit.

97. At the hearing the claimants and witnesses will be thoroughly examined with regard to the character of the land; whether the same has been thoroughly prospected; whether or not there exists within the tract or tracts claimed any lode or vein of quartz or other rock in place, bearing gold, silver, cinnabar, lead, tin, or copper, or other valuable deposit which has ever been claimed, located, recorded, or worked; whether such work is entirely abandoned, or whether occasionally resumed; if such lode does exist, by whom claimed, under what designation, and in which subdivision of the land it lies; whether any placer mine or mines exist upon the land; if so, what is the character thereof—whether of the shallow surface description, or of the deep cement, blue lead, or gravel deposits; to what extent mining is carried on when water can be obtained, and what the facilities are for obtaining water for mining purposes; upon what particular ten-acre subdivisions mining has been done, and at what time the land was abandoned for mining purposes, if abandoned at all.

98. The testimony should also show the agricultural capacities of the land, what kind of crops are raised thereon, and the value thereof; the number of acres actually cultivated for crops of cereals or vegetables, and within which particular ten-acre subdivision such crops are raised; also which of these subdivisions embrace his improvements, giving in detail the extent and value of his improvements, such as house, barn, vineyard, orchard, fencing, etc.

99. It is thought that bona fide settlers upon lands really agricultural will be able to show, by a clear, logical, and succinct chain of evidence, that their claims are founded upon law and justice; while parties who have made little or no permanent agricultural improvements, and who only seek title for speculative purposes, on account of the mineral deposits known to themselves to be contained in the land, will be defeated in their intentions.

100. The testimony should be as full and complete as possible; and, in addition to the leading points indicated above, everything of importance bearing upon the question of the character of the land should be elicited at the hearing.

101. Where the testimony is taken before an officer who does not use a seal, other than the Register and Receiver, the official character of such officer must be attested by a clerk of a Court of record, and the testimony transmitted to the Register and Receiver, who will thereupon examine and forward the same to this office, with their joint opinion as to the character of the land as shown by the testimony.

102. When the case comes before this office, such an award of the land will be made as the law and the facts may justify; and in cases where a survey is necessary to set apart the mineral from the agricultural land in any forty-acre tract, the necessary instructions will be issued to enable the agricultural claimant, *at his own expense*, to have the work done, at his option, either by United States deputy, county, or other local surveyor; the survey in such case may be executed in such manner as will segregate the portion of land actually containing the mine, and used as surface-ground for the convenient working thereof, from the remainder of the tract, which remainder will be patented to the agriculturist to whom the same may have been awarded, subject, however, to the condition that the land may be entered upon by the proprietor of any vein or lode for which a

patent has been issued by the United States for the purpose of extracting and removing the ore from the same, where found to penetrate or intersect the land so patented as agricultural, as stipulated by the mining Act.

103. Such survey when executed must be properly sworn to by the Surveyor, either before a Notary Public, officer of a Court of record, or before the Register or Receiver, the deponent's character and credibility to be properly certified to by the officer administering the oath.

104. Upon the filing of the plat and field notes of such survey, duly sworn to as aforesaid, you will transmit the same to the Surveyor-General for his verification and approval; who, if he finds the work correctly performed, will properly mark out the same upon the original township plat in his office, and furnish authenticated copies of such plat and description both to the proper local Land Office and to this office, to be affixed to the duplicate and triplicate township plats respectively.

105. In cases where a portion of a forty-acre tract is awarded to an agricultural claimant, and he causes the segregation thereof from the mineral portion, as aforesaid, such agricultural portion will not be given a numerical designation, as in the case of surveyed mineral claims, but will simply be described as the "Fractional —— quarter of the —— quarter of section ——, in township ——, of range ——, —— meridian, containing —— acres, the same being exclusive of the land adjudged to be mineral in said forty-acre tract."

106. The Surveyor must correctly compute the area of such agricultural portion, which computation will be verified by the Surveyor-General.

107. After the authenticated plat and field notes of the survey have been received from the Surveyor-General, this office will issue the necessary order for the entry of the land, and in issuing the Receiver's receipt and Register's patent certificate you will invariably be governed by the description of the land given in the order from this office.

108. The fees for taking testimony and reducing the same to writing in these cases will have to be defrayed by the parties in interest. Where such testimony is taken before any other officer than the Register and Receiver, the Register and Receiver will be entitled to no fees.

109. If, upon a review of the testimony at this office, a ten-acre tract should be found to be properly mineral in character, that fact will be no bar to the execution of the settler's legal right to the remaining *non-mineral* portion of his claim, if contiguous.

110. No fear need be entertained that miners will be permitted to make entries of tracts ostensibly as mining claims, which are not mineral, simply for the purpose of obtaining possession and defrauding settlers out of their valuable agricultural improvements, it being almost an impossibility for such a fraud to be consummated under the laws and regulations applicable to obtaining patents for mining claims.

111. The fact that a certain tract of land is decided upon testimony to be mineral in character is by no means equivalent to an award of the land to a miner. A miner is compelled by law to give sixty days' publication of notice, and posting of diagrams and notices, as a preliminary step; and then, before he can enter the land, he must show that the land yields mineral; that he is entitled to the possessory right thereto in virtue of compliance with local customs or rules of miners, or by virtue of the statute of limitations; that he or his grantors have expended, in actual labor and improvements, an amount of not less than five hundred dollars thereon, and that the claim is one in regard to which there is no controversy or opposing claim. After all these proofs are met he is entitled to

have a survey made, at his own cost, where a survey is required, after which he can enter and pay for the land embraced by his claim.

112. Blank forms for proofs in mineral cases are not furnished by the General Land Office.

Respectfully,

N. C. McFARLAND, Commissioner.

Department of Interior, October 31, 1881.

Approved:

S. J. KIRKWOOD, Secretary.

Department of the Interior, General Land Office,
Washington, D. C., April 27, 1880.

Registers and Receivers, U. S. District Land Offices:

Gentlemen: Your attention is directed to the following copy of a letter from the Hon. Secretary of the Interior:

Department of the Interior, Washington, April 22, 1880.

Sir: I have received your letter of the sixteenth instant, calling my attention to the withdrawals heretofore made of mineral lands under the direction of my predecessor, Hon. C. Delano, and setting forth at length the difficulties which arise in the adjustment of homestead and preëmption claims on account of said withdrawals, and recommending in view of such difficulties that the "present policy and practice of throwing the burden of proof upon agricultural claimants be reversed; that the applicant for such entry be required to make the non-mineral affidavit required as aforesaid, and that this be deemed sufficient in absence of the alleged mineral character of his claim; that if a party does allege in proper form that the land is valuable for minerals, he should be required to affirmatively prove the fact, instead of in every case, with or without such allegation, requiring every settler to prove an expensive negative."

You further recommend "that the withdrawals heretofore made as aforesaid be revoked, in order to remove the restriction upon *bona fide* agricultural settlements, and to place such lands in a condition where they can be occupied, purchased, and developed."

I have carefully considered the recommendations made by you for the reasons stated and have to say that they meet my approval.

You are therefore instructed to so modify the instructions of your office as to conform to said recommendations, and you are also instructed to revoke the orders of withdrawals mentioned by you, in order that the restrictions thereby made upon agricultural settlements of the lands may be removed.

Very respectfully,

C. SCHURZ, Secretary.

The Commissioner of the General Land Office.

The recommendations to the Hon. Secretary, upon which his said approval was based, are, in brief and in substance, that immense tracts of land are now, and, for several years last past, have been, officially designated as mineral lands; that as a matter of fact but an exceedingly small part of this entire area is valuable for minerals, but is good agricultural land; that these withdrawn lands are subject to entry under the homestead, preemption, and other laws providing for the sale of agricultural lands only after a hearing in every case wherein the burden of proof lies upon the agricultural applicant to establish that the tract claimed is non-mineral; that it is thus rendered exceedingly easy to cause such applicant great expense, delay, and vexation; that the expense, embarrassment, and delay actually incident to the course hitherto pursued operate to discourage and prevent settlements on such lands; that the timber on these lands is being largely taken on the claim that they are mineral lands; and that the vast tracts so designated, and which are capable of supporting many thousands of settlers, adding largely to the productions of the country and contributing to its better progress, are not only for the most part practically reserved

from sale under any law, but being so secluded it becomes easy for a party to fraudulently enter as agricultural a tract which he may discover to be valuable for minerals than for a *bona fide* settler to secure patent for agricultural land. All of such withdrawals heretofore made of lands in your district are hereby revoked; and when any party applies to enter any tract under any of the laws relating to agricultural lands, he will be required to make the usual non-mineral affidavit, which, in the absence of any allegation that the land is mineral, will be deemed sufficient. Should affidavits be filed with you properly alleging any tract sought to be entered as aforesaid to be mineral, you will, after due notice, hold a hearing to determine the facts. In such cases the burden of proof will rest upon the party who alleges the land to be valuable for minerals, and he must affirmatively prove his allegations.

It is expected that you will exercise all possible prudence and care in respect to this matter, and endeavor to carefully and conscientiously maintain and advance the purpose of the department and this office, to wit: to enable the public lands which are in fact agricultural to be occupied and purchased without oppressive conditions, and to prevent lands which are in fact valuable for minerals from being taken, except under the special laws applicable thereto.

Very respectfully,

J. A. WILLIAMSON, Commissioner.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFCE,
WASHINGTON, D. C., September 23, 1880.

Registers and Receivers, United States District Land Offices:

GENTLEMEN: Hereafter, in case of application being made in your office to enter or select, as agricultural land under any Act of Congress other than the preëmption or homestead Acts, lands returned as mineral by the Surveyor-General, you will require the applicant, at date of final proof, location, or selection, to publish for thirty days a notice describing the land applied for, and giving time and place when such proof will be submitted or selection tendered. You will also post in your office a copy of the notice for the same period. Proof of publication will consist of the affidavit of the publisher of the newspaper in which the notice was published, and you will furnish your own certificate as to posting in your office.

The revocation of the withdrawals of lands as mineral by circular of April 27, 1880, was made not only because said withdrawals had, in many instances, worked great hardship to settlers, but because it is required by law that homestead and preëmption claimants shall publish notices of their intention to make final proof on their entries, and this was thought to afford sufficient protection to all parties; but in case of entries under other laws there is no such notice required. This procedure will apply to cases of application to enter under the town site, desert land, and timber culture laws; applications to select lands under grants to States, railroad and wagon-road companies; and the location of the various classes of scrip upon lands which have been returned by the Surveyor-General as mineral in character.

Where, after such publication of notice has been regularly made, no affidavits alleging the mineral character of the land have been filed with you, you will allow the entry, selection, or location upon the filing of a

proper non-mineral affidavit. If such mineral affidavits shall have been filed, you will proceed with a hearing, as directed by the circular of April 27, 1880.

Acknowledge receipt hereof.

Very respectfully,

J. A. WILLIAMSON, Commissioner.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFICE,
WASHINGTON, D. C., May 9, 1882.

To Registers and Receivers, United States District Land Offices:

GENTLEMEN: Your attention is directed to the provisions of the following Act of Congress, approved April 26, 1882:

An Act to amend section twenty-three hundred and twenty-six of the Revised Statutes, in regard to mineral lands, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, That the adverse claim required by section twenty-three hundred and twenty-six of the Revised Statutes may be verified by the oath of any duly authorized agent or attorney in fact of the adverse claimant cognizant of the facts stated; and the adverse claimant, if residing or at the time being beyond the limits of the district wherein the claim is situated, may make oath to the adverse claim before the Clerk of any Court of record of the United States or the State or Territory where the adverse claimant may then be, or before any Notary Public of such State or Territory.

SEC. 2. That applicants for mineral patents, if residing beyond the limits of the district wherein the claim is situated, may make any oath or affidavit required for proof of citizenship before the Clerk of any Court of record, or before any Notary Public of any State or Terrritory.

1. It will be observed that the Act is not retroactive, and hence cannot affect proceedings had prior to its approval; where citizenship, however, has not been proven, it may be established as provided by section two of this Act.

2. Where an agent or attorney in fact verifies the adverse claim, he must distinctly swear that he is such agent or attorney, and accompany his affidavit by proof thereof.

3. The agent or attorney in fact must make the affidavit in verification of the adverse claim within the land district where the claim is situated.

Very respectfully,

N. C. McFARLAND, Commissioner.

Department of Interior, May 26, 1882.
Approved:

H. M. TELLER, Secretary.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFICE,
WASHINGTON, D. C., September 22, 1882.

To Registers and Receivers, and Surveyors-General:

GENTLEMEN: The following regulations are promulgated as amendatory of circular of October 31, 1881, entitled "United States Mining Laws and Regulations Thereunder," and have special reference to applications for patents to placer claims. They are to be considered in connection with paragraphs fifty-three to sixty of regulations contained in said circular:

1. The first care in recognizing an application for patent upon a placer

claim must be exercised in determining the exact classification of the lands. To this end the clearest evidence of which the case is capable should be presented. If the claim be all placer ground, that fact must be stated in the application, and corroborated by accompanying proofs. If of mixed placers and lodes it should be so set out, with a description of all known lodes situated within the boundaries of the claim. A specific declaration, such as is required by Section 2333, Revised Statutes, must be furnished as to each lode intended to be claimed. All other known lodes are, by the silence of the applicant, excluded by law from all claim by him, of whatsoever nature, possessory or otherwise.

2. Section 2395, Revised Statutes (subdivision 7), requires the Surveyor to "note in his field books, the true situation of all mines, salt licks, salt springs, and mill seats which come to his knowledge;" also, all watercourses over which the lines he runs may pass." It further requires him to "note the quality of the lands." These descriptive notes are required by subdivision 8 to be incorporated in the plat by the Surveyor-General.

3. If these duties have been performed, the surveys will furnish a reasonable guide to the district officers, and to claimants in prosecuting their applications. But experience has shown that great neglect has resulted from inattention to the law in this respect, and the regular plats are of very little value in the matter. It will, therefore, be required in the future that Deputy Surveyors shall, at the expense of the parties, make full examination of all placer claims, and duly note the facts as specified in the law, stating the quality and composition of the soil, the kind and amount of timber and other vegetation, the locus and size of streams, and such other matters as may appear upon the surface of the claims. This examination should include the character and extent of all surface and underground workings, whether placer or lode, for mining purposes.

4. In addition to these data, which the law requires to be shown in all cases, the deputy should report with reference to the proximity of centers of trade or residence; also of well known systems of lode deposit or of individual lodes. He should also report as to the use or adaptability of the claim for placer mining; whether water has been brought upon it in sufficient quantity to mine the same, or whether it can be procured for that purpose; and finally, what works or expenditures have been made by the claimant or his grantors for the development of the claim, and their situation and location with respect to the same as applied for.

5. This examination should be reported by the deputy under oath to the Surveyor-General, and duly corroborated; and a copy of the same should be furnished with the application for patent to the claim, constituting a part thereof, and included in the oath of the applicant.

6. In case of a proposed claim for lands not yet surveyed, the foregoing regulations will govern the application for survey.

7. In controversies hereafter to be determined respecting the mineral value of lands, their value for all purposes, whether agricultural or municipal, or as seats for towns, will be considered, without reference to the decisions heretofore made in particular cases. No decision finally executed, however, will be reconsidered under this modification.

8. No application by an association of persons for patent to a placer claim will be allowed to embrace more than one hundred and sixty acres, nor will any application be entertained that embraces more than one location.

9. Applications awaiting entry, whether published or not, must be made to conform to these regulations, both with respect to amount of ground and examination as to the character of the land. Entries already made

will be suspended for examination by the Commissioner, and such additional proofs as may be deemed necessary in each case will be demanded.

Very respectfully,

N. C. McFARLAND, Commissioner.

Department of the Interior, September 23, 1882.
Approved:

H. M. TELLER, Secretary.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFCE,
WASHINGTON, D. C., December 9, 1882.

To Registers and Receivers, and Surveyors-General:

GENTLEMEN: By direction, contained in letter dated the seventh instant, from the honorable Secretary of the Interior, paragraph number eight, of the preceding circular of September 22, 1882, relating to placer mining claims, has been amended so as to read as follows:

8. No application by an association of persons for patent to a placer claim will be allowed to embrace more than one hundred and sixty acres; and not less than five hundred dollars' worth of work must be shown to have been expended upon or for the benefit of each separate location embraced in such application. If an individual becomes the purchaser and possessor of several separate claims of twenty acres each or less, he may be permitted to include in his application for patent any number of such claims contiguous to each other, not exceeding in the aggregate one hundred and sixty acres; but upon or for the benefit of each original claim or location so embraced, he or his grantors must have expended the sum of five hundred dollars in improvements.

You are instructed to observe this modification of my said circular of September 22, 1882.

Very respectfully,

N. C. McFARLAND, Commissioner.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFICE,
WASHINGTON, D. C., November 16, 1882.

To United States Surveyors-General:

GENTLEMEN: The regulations of this office require that the plats and field notes of surveys of mining claims shall disclose all conflicts between such surveys and prior surveys, giving the areas of conflicts.

The rule has not been properly observed in all cases. Your attention is invited to the following particulars which should be observed in the survey of every mining claim:

1. The exterior boundaries of the claim should be represented on the plat of survey and in the field notes.

2. The intersection of the lines of the survey with the lines of conflicting prior surveys should be noted in the field notes and represented upon the plat.

3. Conflicts with unsurveyed claims, where the applicant for survey does not claim the area in conflict, should be shown by actual survey.

4. The total area of the claim embraced by the exterior boundaries should be stated, and also the area in conflict with each intersecting survey, substantially as follows:

Total area of claim	10.50 acres.
Area in conflict with Survey No. 302	1.56 acres.
Area in conflict with Survey No. 948	2.33 acres.
Area in conflict with Mountain Maid lode mining claim, unsurveyed	1.48 acres.

In a number of instances that have come to the attention of this office the total area in conflict has been given, but not the area in conflict with *each* intersecting claim. The portion of the plat not in conflict has been colored, and the remainder left uncolored. The language of the field notes has been such as to convey the idea that the conflicting areas were excluded from the claim, whereas such was not the intention. It does not follow that because mining surveys are required to exhibit all conflicts with prior surveys the areas of conflict are to be excluded. The field notes and plat are made a part of the application for patent, and care should be taken that the description does not inadvertently exclude portions intended to be retained. It is better that the application for patent should state the portions to be excluded in express terms. A survey executed as in the example given will enable the applicant for patent to exclude such conflicts as may seem desirable. For instance, the conflict with Survey No. 302, and with the Mountain Maid lode claim, might be excluded, and that with Survey No. 948 included.

Your attention is also invited to another matter. The practice of coloring portions of surveys, leaving other portions uncolored, is open to the same objections that have been stated concerning the field notes. In the future no coloring will be used.

Very respectfully,

N. C. McFARLAND, Commissioner.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFICE,
WASHINGTON, D. C., June 8, 1883.

To Registers and Receivers and Surveyors-General:

GENTLEMEN: The following additional regulations are promulgated as amendatory of circular of October 31, 1881, entitled "United States Mining Laws and Regulations Thereunder," which, except as herein modified, will remain in full force:

1. No application will be received, or entry allowed, which embraces more than one lode location.

2. A party who is not an applicant for patent under Section 2325, Revised Statutes, or the assignee of such applicant, is not entitled to make entry under said section, and in no case will the name of such party be inserted in the certificate of entry. This regulation has no reference to proceedings under Section 2326.

3. Any party applying to make entry as *trustee* must disclose fully the nature of the trust, and the name of the *cestui que trust;* and such trustee, as well as the beneficiaries, must furnish satisfactory proof of citizenship; and the names of beneficiaries, as well as that of the trustee, must be inserted in the final certificate of entry.

4. Where an adverse claim has been filed and suit thereon commenced within the statutory period, and final judgment determining the right of possession rendered in favor of the applicant, it will not be sufficient for him to file with the Register a certificate of the Clerk of the Court setting forth the facts as to such judgment, but he must, before he is allowed to

make entry, file a certified copy of the judgment, together with the other evidence required by Section 2326, Revised Statutes.

5. Where such suit has been dismissed, a certificate of the Clerk of the Court to that effect, or a certified copy of the order of dismissal, will be sufficient.

6. In no case will a relinquishment of the ground in controversy, or other proof, filed with the Register or Receiver, be accepted in lieu of the evidence required in paragraphs 4 and 5.

7. Where an adverse claim has been filed, but no suit commenced against the applicant for patent within the statutory period, a certificate to that effect, by the Clerk of the State Court having jurisdiction in the case, and also by the Clerk of the Circuit Court of the United States for the district in which the claim is situated, will be required.

8. Possessory title to a lode claim held and worked for a period equal to the time prescribed by the statute of limitations for mining claims of the State or Territory where the same may be situated, may, in the absence of any adverse claim, be established in the same manner as now allowed in placer claims, and indicated generally in paragraphs 67, 68, and 69, of the circular hereby amended.

9. No entry will be allowed until the Register has satisfied himself, by a careful examination, that proper proofs have been filed upon all the points indicated in official regulations in force, and that they show a sufficient *bona fide* compliance with the laws and such regulations. A strict observance of this regulation will be required.

L. HARRISON, Acting Commissioner.

JULY 6, 1883.
Approved:

H. M. TELLER, Secretary.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFICE,
WASHINGTON, D. C., December 20, 1883.

Register and Receiver, Leadville, Colorado:

Where consolidated, application filed prior to receipt by you of circular of July 6, entry may be allowed on filing satisfactory proof of five hundred dollars' improvements on each lode claim, the application being otherwise regular.

L. HARRISON, Acting Commissioner.

Approved:

H. M. TELLER, Secretary.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFICE,
WASHINGTON, D. C., December 20, 1883.

To Register and Receiver, ——, ——:

GENTLEMEN: Inclosed find copy of telegraphic order this day approved by the honorable Secretary of the Interior. These instructions are intended to apply to all cases where an application for patent embracing more than one lode location had been filed prior to the receipt of circular "N" of this office, approved July 6, 1883.

In regard to similar cases in your office you will be governed by the rule therein stated.

Very respectfully,

L. HARRISON, Acting Commissioner.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFICE,
WASHINGTON, D. C., January 14, 1884.

Registers and Receivers:

GENTLEMEN: Your attention is called to the following extract from the decision of the honorable Secretary of the Interior, in case of Charles K. Miner, claimant of the Spencer Lode, *vs.* J. G. Marriott *et al.*, claimants of the Tabor Lode, dated January 4, 1884:

Section 2325 of the Revised Statutes requires, among other things, newspaper publication for the period of sixty days, as notice of application for mineral patent. It also provides that "if no adverse claim shall have been filed with the Register and Receiver of the proper Land Office at the expiration of the sixty days of publication, it shall be assumed that the applicant is entitled to a patent, upon the payment to the proper officer of five dollars per acre, and that no adverse claim exists."

Section 2326 prescribes the method of procedure "where an adverse claim is filed during the period of publication."

For the purpose of deciding the question raised by the appeal, it is only necessary to apply the provisions of law above cited to the facts relative to publication, as disclosed by the record.

These are found to be as follows: The first publication for the Tabor Lode was, as already stated, on the first of June, 1882. The adverse claim of Miner was filed on the third of August, 1882.

Excluding, in accordance with a long established rule of the Department, the first day, we find the third of August to be the sixty-third day of publication.

An apparently plain and simple proposition is thus presented for consideration.

The law requires that an adverse, to be effective, must be filed within the sixty days of publication. Miner's adverse claim was not filed until the sixty-third day. Was it filed within the period prescribed by the law, and has the adverse claimant a legal status as such?

This would admit of no discussion except for the following facts: This Department has held for a number of years (certainly since 1874) that where publication is made in a weekly newspaper, ten insertions are essential in order to show compliance with the law requiring sixty days' publication. In such cases the tenth issue falls on the sixty-third day after the first. In view of this ruling of the Department, your office, in October, 1879, promulgated a decision or order containing the following: "The last, or tenth, insertion being essential, it follows that adverse claims may be filed until the expiration of the day upon which the last issue of such weekly publication is made."

This rule has since been followed by your office, and you therefore recognize as legal and valid the adverse claim of Miner filed on the day of tenth issue of paper containing publication, *i. e.*, on the sixty-third day. In my opinion, the practice of your office referred to is not necessary as a logical result of the rule requiring ten insertions in a weekly paper, nor is it consistent with the law which prescribes the time within which an adverse claim may be filed.

Section 2325 of the Revised Statutes specifically fixes sixty days as the period of publication, and says "if no adverse claim shall have been filed * * * at the expiration of the *sixty days* of publication it shall be assumed that the applicant is entitled to a patent," etc. The regulation requiring ten publications (in a weekly paper), thus in fact making the period sixty-three days instead of sixty, does not alter the law as to sixty days for the filing of an adverse.

The regulation has its reason in the fact that in no other way can the law requiring sixty days' publication be complied with. Nine issues of a weekly paper would not cover the required period. It is true that the tenth insertion carries the publication three days beyond the legally required sixty days, yet, for the purpose of meeting the requirement of law, ten insertions are in fact necessary, since the continuity for sixty days can be preserved only by the tenth publication which falls on the sixty-third day after the first. It is also true that the applicant cannot proceed to complete his entry until after the tenth publication, but this is because it is essential as proof of sixty days' publication. These reasons do not apply to an adverse claimant, and his acts are not controlled thereby. He has the plain letter of the law for his guide. His course is clear and his duty plain. He has sixty days, on any one of which he may file his adverse claim.

If he fails to file within the sixty days of publication prescribed by the law he is barred. So far as he is concerned, the question is one of very simple computation.

It would be equally plain as to the applicant, except for the reasons herein given, and which do not control in considering the rights, either legal or equitable, of an adverse claimant.

* * * * * * * * * * * *

So far as the case under consideration is concerned, however, your decision that the adverse claim was properly received, and therefore dismissing the appeal, is affirmed. The rule of this decision should not operate to interfere with or take away any rights acquired under the law, as it has heretofore been construed by your office. Though that construction is, in my opinion, clearly erroneous, such fact does not render illegal any acts which have been performed in accordance with and pursuant to that construction or interpretation. Until a rule is changed it has all the force of law, and acts done under it while it is in force must be regarded as legal. This view will govern you in the consideration of any similar cases which may arise.

After the receipt of this circular at your office, you will be required to observe strictly the above ruling of the Department.

Very respectfully,

N. C. McFARLAND, Commissioner.

N. CIRCULAR.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFICE,
WASHINGTON, D. C., May 11, 1885.

To U. S. Surveyors-General and Registers and Receivers:

GENTLEMEN: Circular "N" of December 4, 1884, is hereby amended as follows:

1. In entries made prior to the receipt by the Register and Receiver of said circular the survey, if free from objection under the former practice, need not be amended to conform to the provisions of paragraph 2 of said circular.

2. All decisions under said circular in conflict with the foregoing amendment may, to that extent, be recalled.

Very respectfully,

WM. A. J. SPARKS, Commissioner.

Approved:

L. Q. C. LAMAR, Secretary.

N. CIRCULAR.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFICE,
WASHINGTON, D. C., December 4, 1884.

To United States Surveyors-General and Registers and Receivers:

GENTLEMEN: 1. The rights granted to locators under Section 2322, Revised Statutes, are restricted to such locations on veins, lodes, or ledges as may be "situated on the *public domain*." In applications for lode claims where the survey conflicts with a prior valid lode claim or entry, and the ground in conflict is excluded, the applicant not only has no right to the excluded ground, but he has no right to that portion of any vein or lode the top or apex of which lies within such excluded ground, unless his location was prior to May 10, 1872. His right to the lode claimed terminates where the lode, in its onward course or strike, intersects the exterior boundary of such excluded ground and passes within it.

2. The end-line of his survey should not, therefore, be established beyond such intersection, unless it should be necessary so to do for the purpose of including ground held and claimed under a location which was made upon public land and valid at the time it was made. To include such ground

(which may possibly embrace other lodes) the end-line of the survey may be established within the conflicting survey, but the line must be so run as not to extend any further into the conflicting survey than may be necessary to make such end-line parallel to the other end-line, and at the same time embrace the ground so held and claimed. The useless practice in such cases of extending *both* the side lines of a survey into the conflicting survey and establishing an end-line wholly within it, beyond a point necessary under the rule just stated, will be discontinued.

3. These instructions will be observed by Surveyors-General in all cases where surveys have not been approved by them prior to receipt hereof.

4. If, however, a survey under the old practice has been approved by the Surveyor-General prior to the receipt by him of these instructions application for patent thereon, if otherwise regular, will not be rejected.

5. In applications filed prior to receipt hereof at the local Land Office, and applications allowed under the preceding paragraph, entry will be allowed as heretofore, when the necessary proofs under former regulations are complete.

6. In case of applications and entries allowed under paragraphs four and five, amendment of the survey will be directed by this office, if found necessary.

7. After the receipt of this circular at the local Land Office all applications for mineral patents, applications to purchase, Register's final certificates of entry, and Receiver's receipts, must not only describe the ground claimed, but must state specifically what conflict or conflicts with other surveys, lots, or claims are excluded, giving the number of each conflicting survey or lot. The published and posted notices must contain the same information.

8. As this circular does not affect any rights which an applicant has under the law, its enforcement in pending cases cannot operate injuriously, and it will therefore be carried into effect at once in the adjudication of cases by this office. In the form of patents to be issued the same rule will go into operation as soon as the necessary blanks and records can be prepared.

9. A strict observance of these regulations will be required.

Very respectfully,

N. C. McFARLAND, Commissioner.

Approved:

H. M. TELLER, Secretary.

N.

CIRCULAR.

DEPARTMENT OF THE INTERIOR, GENERAL LAND OFFICE,
WASHINGTON, D. C., December 14, 1885.

To Registers and Receivers and Surveyors-General:

GENTLEMEN: 1. For reasons stated in decision dated October 31, 1885, in the case of the Good Return Placer Mine (4 L. D. 221), the Hon. Secretary of the Interior holds that the "circular instructions of ninth December, 1882, and the first requirement of the circular of eighth June, 1883, are erroneous, and the same are accordingly overruled."

2. Said decision also holds: That the annual expenditure to the amount of $100, required by Section 2324, Revised Statutes, must be made upon placer claims as well as lode claims.

3. That "compliance 'with the terms of this chapter,' as a condition

for the making of application for patent according to Section 2325, requires the preliminary showing of work or expenditure upon each location, sufficient to the maintenance of possession under Section 2324, either by showing the full amount for the pending year, or if there has been failure it should be shown that work has been resumed so as to prevent relocation by adverse parties after abandonment."

4. "That as Section 2325 only directs proof of expenditure to the amount of five hundred dollars by certificate of the Surveyor-General on the claim embraced in the application for patent, it must be error to hold that it further requires that amount on each individual original location, in lieu of the amount already provided for by Section 2324."

5. Registers will, therefore, before receiving any applications or permitting entry upon applications already made, require a satisfactory preliminary showing of work or expenditure, under paragraph 3 hereof, upon or for the benefit of each location embraced in the claim, which may, where the matter is unquestioned, consist of the affidavit of the applicant, clearly and specifically setting out all the *facts* constituting the compliance with the law by himself or grantors. Where application is made by an incorporated company, or where an applicant satisfactorily shows by affidavit that he is not personally acquainted with the facts, the applicant's affidavit may be made by the duly authorized agent who has such knowledge, but whether made by principal or agent it must be specifically and fully corroborated by the affidavits of at least two disinterested and credible witnesses familiar with the facts. This showing must include the year in which the application for patent is filed. The evidence specified in paragraph 32 of Circular N of October 31, 1881, will still be required. Where the abstract of title is dated prior to the date of filing the application for patent, a continuation of the abstract to and including such date must be filed before the applicant is allowed to make entry.

6. Where an application for patent embraces several locations or claims *held in common*, constituting one entire claim, whether lode or placer, an expenditure of five hundred dollars, under Section 2325, R. S., upon such entire claim embraced in the application, will be sufficient and need not be shown upon each of the locations included therein.

You will observe carefully the modification of the practice and regulations as above indicated.

WM. A. J. SPARKS, Commissioner.

Approved December 15, 1885:

L. Q. C. LAMAR, Secretary.

TIMBER AND STONE LANDS.

An Act for the Sale of Timber Lands in the States of California, Oregon, Nevada, and in Washington Territory. (Approved June 3, 1878. U. S. Stats., v. 20, p. 89.)

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, That surveyed public lands of the United States, within the States of California, Oregon, and Nevada, and in Washington Territory, not included within military, Indian, or other reservations of the United States, valuable chiefly for timber, but unfit for cultivation, and which have not been offered at public sale, according to law, may be sold to citizens of the United States, or persons

who have declared their intention to become such, in quantities not exceeding one hundred and sixty acres to any one person, or association of persons, at the minimum price of two dollars and fifty cents per acre; and lands valuable chiefly for stone may be sold on the same terms as timber lands; *provided*, that nothing herein contained shall defeat or impair any bona fide claim under any law of the United States, or authorize the sale of any mining claim, or the improvements of any *bona fide* settler, or lands containing gold, silver, cinnabar, copper, or coal, or lands selected by the said States under any law of the United States donating lands for internal improvements, education, or other purposes; *and provided further*, that none of the rights conferred by the Act approved July twenty-sixth, eighteen hundred and sixty-six, entitled "An Act granting the right of way to ditch and canal owners over the public lands, and for other purposes," shall be abrogated by this Act; and all patents granted shall be subject to any vested and accrued water rights, or rights to ditches and reservoirs used in connection with such water rights as may have been acquired under and by the provisions of said Act; and such rights shall be expressly reserved in any patent issued under this Act.

SEC. 2. That any person desiring to avail himself of the provisions of this Act, shall file with the Register of the proper district a written statement in duplicate, one of which is to be transmitted to the General Land Office, designating, by legal subdivisions, the particular tract of land he desires to purchase, setting forth that the same is unfit for cultivation, and valuable chiefly for its timber or stone, that it is uninhabited, contains no mining or other improvements, except for ditch or canal purposes, where any such do exist, save such as were made by or belong to the applicant, nor, as deponent verily believes, any valuable deposit of gold, silver, cinnabar, copper, or coal; that deponent has made no other application under this Act; that he does not apply to purchase the same on speculation, but in good faith to appropriate it to his own exclusive use and benefit; and that he has not, directly or indirectly, made any agreement or contract, in any way or manner, with any person or persons whatsoever, by which the title which he might acquire from the Government of the United States should inure, in whole or in part, to the benefit of any person except himself; which statement must be verified by the oath of the applicant before the Register or the Receiver of the Land Office within the district where the land is situated; and if any person taking such oath shall swear falsely in the premises he shall be subject to all the pains and penalties of perjury, and shall forfeit the money which he may have paid for said lands, and all right and title to the same; and any grant or conveyance which he may have made, except in the hands of *bona fide* purchasers, shall be null and void.

SEC. 3. That upon the filing of said statement, as provided in the second section of this Act, the Register of the Land Office shall post a notice of such application, embracing a description of the land by legal subdivisions, in his office, for a period of sixty days, and shall furnish the applicant a copy of the same for publication, at the expense of such applicant, in a newspaper published nearest the location of the premises, for a like period of time; and after the expiration of said sixty days, if no adverse claim shall have been filed, the person desiring to purchase shall furnish to the Register of the Land Office satisfactory evidence: first, that said notice of the application prepared by the Register as aforesaid, was duly published in a newspaper as herein required; secondly, that the land is of the character contemplated in this Act, unoccupied and without improvements, other than those excepted, either mining or agricultural,

and that it apparently contains no valuable deposits of gold, silver, cinnabar, copper, or coal; and upon payment to the proper officer of the purchase money of said land, together with the fees of the Register and the Receiver, as provided for in case of mining claims in the twelfth section of the Act, approved May tenth, eighteen hundred and seventy-two, the applicant may be permitted to enter said tract, and, on the transmission of the General Land Office of the papers and testimony in the case, a patent shall issue thereon; *provided*, that any person having a valid claim to any portion of the land may object, in writing, to the issuance of a patent to lands so held by him, stating the nature of his claim thereto; and evidence shall be taken, and the merits of said objection shall be determined by the officers of the Land Office, subject to appeal, as in other land cases. Effect shall be given to the foregoing provisions of this Act by regulations to be prescribed by the Commissioner of the General Land Office.

Sec. 4. That after the passage of this Act it shall be unlawful to cut, or cause or procure to be cut, or wantonly destroy any timber growing on any lands of the United States, in said States and Territory, or remove, or cause to be removed, any timber from said public lands, with intent to export or dispose of the same; and no owner, master, or consignee of any vessel, or owner, director, or agent of any railroad, shall knowingly transport the same, or any lumber manufactured therefrom; and any person violating the provisions of this section shall be guilty of a misdemeanor, and, on conviction, shall be fined for every such offense a sum not less than one hundred nor more than one thousand dollars; *provided*, that nothing herein contained shall prevent any miner or agriculturist from clearing his land in the ordinary working of his mining claim, or preparing his farm for tillage, or from taking the timber necessary to support his improvements, or the taking of timber for the use of the United States; and the penalties herein provided shall not take effect until ninety days after the passage of this Act.

Sec. 5. That any person prosecuted in said States and Territory for violating section two thousand four hundred and sixty-one of the Revised Statutes of the United States, who is not prosecuted for cutting timber for export from the United States, may be relieved from further prosecution and liability therefor upon payment, into the Court wherein such action is pending, of the sum of two dollars and fifty cents per acre for all lands on which he shall have cut, or caused to be cut, timber, or removed, or caused to be removed, the same; *provided*, that nothing contained in this section shall be construed as granting to the person hereby relieved, the title to said lands for said payment; but he shall have the right to purchase the same upon the same terms and conditions as other persons, as provided hereinbefore in this Act; *and further provided*, that all moneys collected under this Act shall be covered into the Treasury of the United States, and section four thousand seven hundred and fifty-one of the Revised Statutes is hereby repealed, so far as it relates to the States and Territory herein named.

Sec. 6. That all Acts and parts of Acts inconsistent with the provisions of this Act are hereby repealed.

TO FIND THE VALUE OF GOLD OR SILVER OF A SPECIMEN.

(By C. H. Aaron.)

There are many rules for ascertaining the proportion of gold in specimens, all based on the different densities of the specimens as a whole, of the gold, and of the quartz. The specific gravity of the gold and of the quartz is generally assumed, the former at 17 to 19, the latter at 2.6. That of the specimen is found by weighing it in air and in water, and dividing its weight in air by the difference. In this case, the easiest rule to remember is this: Divide the specific gravity of the gold by that of the quartz and by that of the specimen. From the greater quotient subtract the lesser; the remainder is the proportion of gold. From the lesser quotient subtract 1; the remainder is the proportion of quartz. Then as the sum of these proportional quantities is to the proportion of gold, so is the weight of the specimen to the actual quantity of gold in it. Suppose a specimen weighs 32 ounces in air and 28 ounces in water; the difference is 4, and 32 divided by 4 gives 8, which is the specific gravity of the specimen. If the specific gravity of the gold is assumed to be 17, and that of the quartz 2.6, we have 17 divided by 2.6, gives 6.539 nearly, and 17 divided by 8 gives 2.125. Subtracting the lesser quotient from the greater leaves 4.414, and subtracting 1 from the lesser leaves 1.125, and the proportion is 4.414 ounces of gold to 1.125 of quartz. Adding these together we have 5.539. Now it is a mere question in the rule of three. If 5.539 ounces of the specimen contain 4.414 ounces of gold, how much does the whole specimen weighing 32 ounces contain? Answer, 25.5 ounces. This is correct provided the assumed specific gravities of the gold and gangue are correct; but if greater accuracy be desired, proceed thus: Weigh the specimen, a piece of the metal, and a piece of the gangue, each in air and water. Divide the difference between the respective weights in air and in water by the weights in air. From the greater quotient subtract the next less, and from that the least. The first remainder is the proportional weight of the metal, the second is that of the gangue; the sum of these is that of the specimen. Having the actual weight of the specimen, that of the metal is easily found, as before, by the rule of three.

Suppose a specimen of native silver in spar weighs 84 pounds in air and 73.5 in water; a piece of the silver weighs 27 grains in air and 24 in water; a piece of the spar 20 in air and 12 in water. Then—

Spar in air	20
Spar in water	12
Difference	8÷20=0.400.
Specimen in air	84
Specimen in water	73.5
Difference	10.5÷84=0.125.

Silver in air	27
Silver in water	24
Difference	3+27=0.111.

And 400 –125= 275=proportion of silver.
And 125—111= 14=proportion of spar.

289=proportion of specimen.

Then 289:275::84:79,93 pounds of silver in specimen.

The weight of the object in air divided by its difference in water is the specific gravity. The difference divided by the weight in air is the specific displacement. From either of these, the proportional quantities of two different substances composing a mixture can be determined by the rules given for the valuation of specimens.

TABLES.

The following tables and figures are taken from "Practical Hydraulics," by P. M. Randall:

QUANTITY OF WATER REQUIRED FOR QUARTZ MINING.

The contents of one ton of quartz, in its normal condition in the lode, is estimated at 13 cubic feet, and at 20 cubic feet when the quartz is broken, as it usually comes from the mine. Adopting the lode measurement, it is seen that a cubic yard of quartz is $27 \div 13 = 2.08$ tons, nearly. Experience shows that the duty of a miner's inch is as follows: Duty of a miner's inch (under 4-inch pressure) in the reduction and amalgamation of silver ores in a "stamp silver mill," Nevada, 3.25 cubic yards, or 6.76 tons; in the reduction and amalgamation by riffles, or copper plate, in "stamp gold mill," California, 5.78 cubic yards, or 12 tons. Duty of miner's inch under 7-inch pressure, in the former case (silver), 4.3 cubic yards, or 8.93 tons; in the latter case (gold), 6.65 cubic yards, or 15.88 tons. The volume of water to that of ore is, in working silver ores, Nevada, 19.5 to 1; in working gold ores, California, 11.1 to 1; in working copper ores, Lake Superior, 20 to 1.

MEASUREMENT OF THE POWER OF WATER AS A MOTOR.

The unit in the measurement of power is a foot-pound—that is, the amount of energy necessary to raise one pound weight vertically through a distance of one foot. On the other hand, one pound falling by the force of gravity through a distance of one foot, generates a foot-pound. The amount of energy required to raise one pound vertically 550 feet, is equal to the amount of energy necessary to raise 550 pounds vertically one foot in height. This amount of energy rendered in one second is termed a horse-power—that is, 550 foot-pounds rendered in one second, is the value of a horse-power in mechanics.

The weight of a cubic foot of fresh water is estimated in practice at 62.5 pounds. Ex.—How many horse-power will 10 cubic feet of water, applied to an overshot water wheel, 40 feet diameter, render, the efficiency of the wheel being 75 per cent, and one foot being allowed for clearance? Cal.—$40-1=39$ feet, effective head; $62.5 \times 10 \times 39 \times .75 \div 550 = 33.24$ horse-power. Ans.

MISCELLANIES.

One cubic foot of distilled water (U. S. standard), barometer 30 inches, 39.83° Fahr., equals 62.3793 pounds.

One cubic foot of distilled water (British standard), barometer 30 inches, 62° Fahr., equals 62.321 pounds.

One cubic foot of distilled water (U. S. standard), equals 7.48052 gallons.

One cubic inch of distilled water (U. S. standard), equals 0.0361 pounds.

One gallon (U. S. standard), equals 231 cubic inches, equals 0.133681 cubic feet, equals 8.3389 pounds water.

One gallon, imperial (British standard), equals 277.123 cubic inches, equals 0.160372 cubic feet, equal 10 pounds water.

One gallon (N. Y. statute measure), barometer 30 inches, 39.83° Fahr., equals 221.184 cubic inches, equals 8 pounds water.

One pound avoirdupois equals 16 ounces, equals 7,000 grains (U. S. standard), equals 27.7015 cubic inches.

One pound troy equals 1 pound apothecary, equals 12 ounces, equals 5,760 grains.

One ounce avoirdupois equals 437.5 grains.

One ounce troy equals one ounce apothecary, equals 480 grains.

One chain equals 100 links, equals 4 rods, equals 66 feet, equals 792 inches.

Eighty chains equal 1 statute mile, equals 320 rods, equals 1,760 yards, equals 5,280 feet, equals 63,260 inches.

One geographical, nautical, or sea mile equals 6,086.5 feet in longitude, and 6,076.5 feet in latitude.

One league (English), equals 3 nautical miles.

One metre equals 3.2808992 feet, equals 3.281 feet in practice.

One square metre equals 1 centiare, equals 10.7643 square feet.

One are equals 100 square meters, equals 1076.43 square feet.

One cubic meter equals 1 stare, equals 35.3166 cubic feet.

One vara equals 2.75 feet.

One legua (Mexican) equals 5,000 varas linear, equals 13,750 feet, equals 2.60417 miles.

One hundred vara lot equals 100 varas square, equals 75,625 square feet, equals 1.73611 acres.

One legua (Mexican, of land) equals 6.7817 square miles, equals 4340.-27778 acres.

One acre equals 4 roods, equals 10 square chains, equals 160 square rods, equals 43,560 square feet.

One section equals 1 square mile, equals 640 acres.

One township equals 36 sections, equals 6 miles square, equals 36 square miles.

One cubic yard equals 27 cubic feet, equals 16,656 cubic inches.

One hundred weight (British) equals 8 stone, equals 112 pounds.

One ton (long ton) commercial, equals 20-hundred weight, equals 2240 pounds.

One ton (short ton) U. S., equals 2000 pounds.

One quintal equals 100 pounds.

One fathom equals 6 feet; 1 cable length equals 120 fathoms.

One point equals $\frac{1}{72}$ of an inch.

One line equals 6 points, equals $\frac{1}{12}$ of an inch.

Twelve inches equals 1 foot; 3 feet equals 1 yard.

Five and one half yards equals 1 rod.

One foot board measure equals 1 foot square and 1 inch thick.

Twelve feet board measure equals 1 cubic foot.

One foot-pound equals work required to raise one pound vertically one foot.

One second foot-pound equals work required to raise one pound vertically one foot in one second of time.

One minute foot-pound equals work required to raise one pound vertically one foot in one minute.

One degree (1°), centigrade, equals 1.8° (degrees), Fahrenheit.

One barometric inch equals column of mercury, with one square inch base and one inch high.

Atmospheric pressure per square inch equals 14.7 pounds equals 30 barometric inches nearly, at 39.83° Fahr.

One ounce Troy, gold, 1,000 fine, equals $20.6718.

One ounce Troy, gold coin, U. S., 900 fine, equals $18.6046.

One pound avoirdupois, gold coin, U. S., 900 fine, equals $271.375.

One ounce Troy, silver, 1,000 fine, equals $1.29293.*

One ounce Troy, silver, U. S., 900 fine, equals $1.163636.*

One pound avoirdupois, silver coin, U. S., 900 fine, equals $16.96969.

One dollar, U. S. gold coin, equals 23.22 grains gold × 2.58 grains copper, equals 25.8 grains.

One dollar, U. S. silver coin, equals 371.25 grains silver × 41.25 grains copper, equals 412.5 grains.

One pound sterling equals 1 sovereign, equals 113.001 grains gold × 10.273 grains copper, equals 123.274 grains weight, fineness 22 carats, equals 916.6667.

One grain gold, 1,000 fine, equals $.0430663, mint value.

One grain silver, 1,000 fine, equals $.0026936, mint value.

One gramme gold, 1,000 fine, equals $.6646142, mint value.

One gramme silver, 1,000 fine, equals $.0415686, mint value.

One cubic foot air equals .0806726 pounds, equals 564.7082 grains.

One pound of air at 39.83° equals 12.387 cubic feet by volume.

One cubic foot hydrogen equals .005042 pounds, equals 35.2743 grains.

Twenty-five cubic feet of sand equals 1 ton.

Eighteen cubic feet of earth equals 1 ton.

Seventeen cubic feet of clay equals 1 ton.

Thirteen cubic feet of quartz, unbroken in lode, equals 1 ton.

Eighteen cubic feet of gravel or earth, before digging, equals 27 cubic feet when dug.

Twenty cubic feet of quartz, broken (of ordinary fineness, coming from the lode), equals 1 ton, contract measurement.

One horse-power (H. P.) equals 550 second foot-pounds, equal 33,000 minute foot-pounds.

One hundred libras (Mexico)=1 quintal = 46,025.00 grammes = 101.5 pounds avoirdupois.

Avoirdupois Ounces to Troy Ounces.

Avoirdupois Ounces.	Troy Ounces.	Avoirdupois Ounces.	Troy Ounces.	Avoirdupois Ounces.	Troy Ounces.
1	0.911	7	6.380	13	11.849
2	1.823	8	7.292	14	12.760
3	2.734	9	8.203	15	13.672
4	3.646	10	9.115	16	14.583
5	4.557	11	10 026		
6	5.469	12	10.397		

437.5 grains equals 1 avoirdupois ounce.
480 grains equals 1 troy ounce.

*Subject to discount.

Avoirdupois Pounds to Troy Ounces.

Pounds.	Ounces.	Pounds.	Ounces.	Pounds.	Ounces.
1	14.583	10	145.833	100	1458.333
2	29.167	20	291.667	200	2916.667
3	43.750	30	437.500	300	4375.000
4	58.333	40	583.333	400	5833.333
5	72.917	50	729.167	500	7291.667
6	87.500	60	875.000	600	8750.000
7	102.083	70	1020.833	700	10208.333
8	116.667	80	1166.667	800	11666.667
9	131.250	90	1312.500	900	13125.000

Table Showing the Melting Points of Metals.

Metal.	Centigrade.	Fahrenheit.	Metal.	Centigrade.	Fahrenheit.
Aluminium	700°	1292°	Iron, steel	1400°	2552°
Antimony	425°	797°	Lead	334°	617°
Arsenic	185°	365°	Magnesium	235°	455°
Bismuth	264°	507.°2	Mercury	— 40°	*654.°8
Cadmium	320°	608°	Nickel	1600°	2912°
Cobalt	1200°	2192°	Potassium	62°	143.°6
Copper	1091°	1995.°8	Platinum	2600°	4712°
Gold	1381°	2485.°8	Silver	1040°	1904°
Indium	176°	348.°8	Sodium	96°	172.°8
Iron, wrought	1530°	2786°	Tin	235°	455°
Iron, cast	1200°	2192°	Zinc	412°	773.°6

Amalgams.

Gold—One weight of mercury amalgamates with two weights of gold.
Silver—10 silver to 19 mercury.
Tin—1 tin to 3 mercury, for looking-glasses.
1 tin, 1 lead, 2 bismuth, 10 mercury, for glass globes.
1 tin, 1 zinc, 3 mercury, for rubbers in electric machines.

Metrical System. Measures of Length.

	In Inches.	In Feet.	In Yards.	In Fathoms.	In Miles.
Millimetre	.03937	.003281	.0010936	.0005468	.0000006
Centimetre	.39371	.032809	.0109363	.0056482	.0000062
Decimetre	3.93708	.328090	.1093633	.0546816	.0000621
Metre	39.37079	3.280899	1.0936331	.5468165	.0006214
Decametre	393.70790	32.808992	10.9363306	5.4681653	.0062138
Hectometre	3937.07900	328.089917	109.3633056	54.6816528	.0621382
Kilometre	39370.7900	3280.899167	1093.6330556	546.8165278	.6213824
Myriametre	393707.9000	32808.991667	10936.3305556	5468.1652778	6.2138242

1 inch equals 2.539954 centimetres.
1 foot equals 3.0479449 decimetres.
1 yard equals 0.9143835 metre.
1 mile equals 1.06093149 kilometre.

* Boils.

MEASURES OF SURFACE.

	In Square Feet.	In Square Yards.	In Poles.	In Roods.	In Acres.
Centiare, square metre	10.764299	1.196033	.0395383	.0009885	.0002471
Are, 100 square metres	1076.429934	119.603326	3.9538290	.0988457	.0247114
Hectare, 10,000 square metres	107642.993419	11960.332602	395.3828959	9.8845724	2.4711431

1 square inch equals 6.4514669 square centimetres.
1 square foot equals 9.2899683 square decimetres.
1 square yard equals .83609715 square metre.
1 acre equals .40467102 hectare.
1 square mile equals 2.58989451 hectares.

MEASURES OF CAPACITY.

	In Cubic Inches.	In Cubic Feet.	In Pints.	In Gallons.	In Bushels.
Millilitre cubic centimetres	.06103	.000035	.00176	.0002201	.0000275
Litre or cubic decimetre	61.02705	.035317	1.76077	.2200967	.0275121

1 cubic inch equals 16.386176 cubic centimetres.
1 cubic foot equals 28.315312 cubic decimetres.
1 gallon equals 4.543458 litres.

MEASURES OF WEIGHTS.

	In Grains.	In Troy Ounces.	In Avoirdupois Pounds.	In Cwts.	In Tons.
Milligram	.01543	.000032	.0000022	.0000000	.0000000
Centigram	.15432	.000322	.0000220	.0000002	.0000000
Decigram	1.54323	.003215	.0002205	.0000020	.0000001
Gram	15.43235	.032151	.0022046	.0000197	.0000010

1 grain equals .064799 gram.
1 pound avoirdupois equals .453593 kilogram.
1 troy ounce equals 31.103496 grams.
1 cwt. equals 50.802377 kilograms.

CHAPTER IV, PART II, TITLE III, POLITICAL CODE OF THE STATE OF CALIFORNIA.

LEGAL DISTANCES IN THE STATE.

150. *Legal Distances.*

SEC. 150. The legal distances in this State are fixed as follows:

151. *Alameda.*

SEC. 151. From the county seat of Alameda County to Sacramento, ninety-one (91) miles; to Napa, forty-six (46) miles; to Stockton, eighty-five (85) miles; to San Quentin, nineteen (19) miles.

152. *Alpine.*

SEC. 152. From the county seat of Alpine County to Sacramento, two hundred and twenty-five (225) miles; to Napa, two hundred and eighty-six (286) miles; to Stockton, two hundred and seventy-three (273) miles; to San Quentin, three hundred and twenty-one (321) miles.

153. *Amador.*

SEC. 153. From the county seat of Amador County to Sacramento, fifty-nine (59) miles; to Napa, one hundred and ten (110) miles; to Stockton, fifty-seven (57) miles; to San Quentin, one hundred and forty-five (145) miles.

154. *Butte.*

SEC. 154. From the county seat of Butte County to Sacramento, seventy-eight (78) miles; to Napa, one hundred and thirty-nine (139) miles; to Stockton, one hundred and twenty-six (126) miles; to San Quentin, one hundred and seventy-four (174) miles.

155. *Calaveras.*

SEC. 155. From the county seat of Calaveras County to Sacramento, seventy-three (73) miles; to Napa, one hundred and thirty-four (134) miles; to Stockton, sixty (60) miles; to San Quentin, one hundred and sixty-four (164) miles.

156. *Colusa.*

SEC. 156. From the county seat of Colusa County to Sacramento, eighty (80) miles; to Napa, one hundred and forty-one (141) miles; to Stockton, one hundred and twenty-eight (128) miles; to San Quentin, one hundred and seventy-six (176) miles.

157. *Contra Costa.*

SEC. 157. From the county seat of Contra Costa County to Sacramento,

eighty-nine (89) miles; to Napa, twenty-seven (27) miles; to Stockton, one hundred and twenty-one (121) miles; to San Quentin, forty-one (41) miles.

[Amendment approved March 14, 1878; amendments 1877–1878; in force from passage.]

158. *Del Norte.*

SEC. 158. From the county seat of Del Norte County to Sacramento, three hundred and sixty-four (364) miles; to Napa, three hundred and nineteen (319) miles; to Stockton, three hundred and seventy-two (372) miles; to San Quentin, two hundred and ninety-two (292) miles.

159. *El Dorado.*

SEC. 159. From the county seat of El Dorado County to Sacramento, sixty-one (61) miles; to Napa, one hundred and twenty-two (122) miles; to Stockton, one hundred and nine (109) miles; to San Quentin, one hundred and fifty-seven (157) miles.

160. *Fresno.*

SEC. 160. From the county seat of Fresno County to Sacramento, one hundred and sixty-nine (169) miles; to Napa, two hundred and thirty (230) miles; to Stockton, one hundred and thirteen (113) miles; to San Quentin, two hundred and seven (207) miles.

161. *Humboldt.*

SEC. 161. From the county seat of Humboldt County to Sacramento, three hundred and twelve (312) miles; to Napa, two hundred and sixty-seven (267) miles; to Stockton, three hundred and twenty (320) miles; to San Quentin, two hundred and forty (240) miles.

162. *Inyo.*

SEC. 162. From the county seat of Inyo County to Sacramento, four hundred and seventy-one (471) miles; to Napa, five hundred and thirty-two (532) miles; to Stockton, four hundred and twenty-three (423) miles; to San Quentin, five hundred and eight (508) miles.

163. *Kern.*

SEC. 163. From the county seat of Kern County to Sacramento, two hundred and seventy-eight (278) miles; to Napa, three hundred and thirty-nine (339) miles; to Stockton, two hundred and thirty (230) miles; to San Quentin, three hundred and fifteen (315) miles.

164. *Lake.*

SEC. 164. From the county seat of Lake County to Sacramento, two hundred and four (204) miles; to Napa, one hundred and fifty-nine (159) miles; to Stockton, two hundred and twelve (212) miles; to San Quentin, one hundred and thirty-two (132) miles.

165. *Lassen.*

SEC. 165. From the county seat of Lassen County to Sacramento, one hundred and eighty-three (183) miles; to Napa, two hundred and forty-

four (244) miles; to Stockton, two hundred and thirty-one (231) miles; to San Quentin, two hundred and seventy-nine (279) miles.

166. *Los Angeles.*

Sec. 166. From the county seat of Los Angeles County to Sacramento, four hundred and seventy-eight (478) miles; to Napa, four hundred and thirty-three (433) miles; to Stockton, four hundred and eighty-six (486) miles; to San Quentin, four hundred and six (406) miles.

167. *Marin.*

Sec. 167. From the county seat of Marin County to Sacramento, ninety-six (96) miles; to Napa, fifty-one (51) miles; to Stockton, one hundred and four (104) miles; to San Quentin, three (3) miles.

168. *Mariposa.*

Sec. 168. From the county seat of Mariposa County to Sacramento, one hundred and fifty-six (156) miles; to Napa, two hundred and seventeen (217) miles; to Stockton, one hundred and nine (109) miles; to San Quentin, one hundred and ninety-three (193) miles.

169. *Mendocino.*

Sec. 169. From the county seat of Mendocino County to Sacramento, two hundred and five (205) miles; to Napa, one hundred (100) miles; to Stockton, two hundred and thirteen (213) miles; to San Quentin, one hundred and thirty-three (133) miles.

170. *Merced.*

Sec. 170. From the county seat of Merced County to Sacramento, one hundred and fourteen (114) miles; to Napa, one hundred and seventy-five (175) miles; to Stockton, sixty-six (66) miles; to San Quentin, one hundred and fifty-two (152) miles.

171. *Modoc.*

Sec. 171. From the county seat of Modoc County to Sacramento, three hundred and seventy-nine (379) miles; to Napa, four hundred and forty (440) miles; to Stockton, four hundred and twenty-seven (427) miles; to San Quentin, four hundred and seventy-five (475) miles.

172. *Mono.*

Sec. 172. From the county seat of Mono County to Sacramento, two hundred and ninety-six (296) miles; to Napa, three hundred and fifty-seven (357) miles; to Stockton, three hundred and forty-four (344) miles; to San Quentin, three hundred and ninety-two (392) miles.

173. *Monterey.*

Sec. 173. From the county seat of Monterey County to Sacramento, one hundred and ninety-six (196) miles; to Napa, one hundred and fifty-seven (157) miles; to Stockton, one hundred and forty-eight (148) miles; to San Quentin, one hundred and thirty (130) miles.

174. *Napa.*

SEC. 174. From the county seat of Napa County to Sacramento, sixty-one (61) miles; to Stockton, eighty-seven (87) miles; to San Quentin, fifty-one (51) miles.

175. *Nevada.*

SEC. 175. From the county seat of Nevada County to Sacramento, seventy-one (71) miles; to Napa, one hundred and thirty-two (132) miles; to Stockton, one hundred and nineteen (119) miles; to San Quentin, one hundred and sixty-seven (167) miles.

176. *Placer.*

SEC. 176. From the county seat of Placer County to Sacramento, thirty-seven (37) miles; to Napa, ninety-eight (98) miles; to Stockton, eighty-five (85) miles; to San Quentin, one hundred and thirty-three (133) miles.

177. *Plumas.*

SEC. 177. From the county seat of Plumas County to Sacramento, one hundred and thirty-six (136) miles; to Napa, one hundred and ninety-seven (197) miles; to Stockton, one hundred and eighty-four (184) miles; to San Quentin, two hundred and thirty-two (232) miles.

178. *Sacramento.*

SEC. 178. From the county seat of Sacramento County to Napa, sixty-one (61) miles; to Stockton, forty-eight (48) miles; to San Quentin, ninety-six (96) miles.

179. *San Benito.*

SEC. 179. From the county seat of San Benito County to Sacramento, one hundred and seventy-three (173) miles; to Napa, one hundred and thirty-four (134) miles; to Stockton, one hundred and twenty-five (125) miles; to San Quentin, one hundred and seven (107) miles.

180. *San Bernardino.*

SEC. 180. From the county seat of San Bernardino County to Sacramento, five hundred and eighty-eight (588) miles; to Napa, five hundred and forty-three (543) miles; to Stockton, five hundred and thirty (530) miles; to San Quentin, five hundred and sixteen (516) miles.

181. *San Diego.*

SEC. 181. From the county seat of San Diego County to Sacramento, five hundred and sixty-six (566) miles; to Napa, five hundred and twenty-one (521) miles; to Stockton, five hundred and seventy-four (574) miles; to San Quentin, four hundred and ninety-four (494) miles. [Amendment, approved March 27, 1878. Amendments, 1877–8; in full force from passage.]

182. *San Francisco.*

SEC. 182. From the county seat of San Francisco County to Sacramento, eighty-four (84) miles; to Napa, thirty-nine (39) miles; to Stockton, ninety-two (92) miles; to San Quentin, twelve (12) miles.

183. *San Joaquin.*

SEC. 183. From the county seat of San Joaquin County to Sacramento, forty-eight (48) miles; to Napa, eighty-seven (87) miles; to San Quentin, one hundred and four (104) miles.

184. *San Luis Obispo.*

SEC. 184. From the county seat of San Luis Obispo County to Sacramento, two hundred and ninety-three (293) miles; to Napa, two hundred and forty-eight (248) miles; to Stockton, two hundred and eighty-seven (287) miles; to San Quentin, two hundred and twenty-one (221) miles.

185. *San Mateo.*

SEC. 185. From the county seat of San Mateo County to Sacramento, one hundred and five (105) miles; to Napa, sixty (60) miles; to Stockton, one hundred and thirteen (113) miles; to San Quentin, thirty-three (33) miles.

186. *Santa Barbara.*

SEC. 186. From the county seat of Santa Barbara County to Sacramento, three hundred and sixty-nine (369) miles; to Napa, three hundred and twenty-four (324) miles; to Stockton, three hundred and seventy-seven (377) miles; to San Quentin, two hundred and ninety-seven (297) miles.

187. *Santa Clara.*

SEC. 187. From the county seat of Santa Clara County to Sacramento, one hundred and twenty-eight (128) miles; to Napa, eighty-nine (89) miles; to Stockton, eighty (80) miles; to San Quentin, sixty-two (62) miles.

188. *Santa Cruz.*

SEC. 188. From the county seat of Santa Cruz County to Sacramento, two hundred and five (205) miles; to Napa, one hundred and sixty (160) miles; to Stockton, one hundred and fifty-one (151) miles; to San Quentin, one hundred and thirty-three (133) miles.

189. *Shasta.*

SEC. 189. From the county seat of Shasta County to Sacramento, one hundred and seventy-seven (177) miles; to Napa, two hundred and thirty-eight (238) miles; to Stockton, two hundred and twenty-five (225) miles; to San Quentin, two hundred and seventy-three (273) miles.

190. *Sierra.*

SEC. 190. From the county seat of Sierra County to Sacramento, one hundred and nineteen (119) miles; to Napa, one hundred and seventy (170) miles; to Stockton, one hundred and sixty-seven (167) miles; to San Quentin, two hundred and fifteen (215) miles.

191. *Siskiyou.*

SEC. 191. From the county seat of Siskiyou County to Sacramento, two hundred and eighty-five (285) miles; to Napa, three hundred and forty-six

(346) miles; to Stockton, three hundred and thirty-three (333) miles; to San Quentin, three hundred and seventy-one (371) miles.

192. *Solano.*

SEC. 192. From the county seat of Solano County to Sacramento, forty (40) miles; to Napa, twenty-one (21) miles; to Stockton, eighty-eight (88) miles; to San Quentin, fifty-six (56) miles.

193. *Sonoma.*

SEC. 193. From the county seat of Sonoma County to Sacramento, one hundred and forty-one (141) miles; to Napa, thirty-five (35) miles; to Stockton, one hundred and forty-nine (149) miles; to San Quentin, sixty-nine (69) miles.

194. *Stanislaus.*

SEC. 194. From the county seat of Stanislaus County to Sacramento, seventy-seven (77) miles; to Napa, one hundred and thirty-eight (138) miles; to Stockton, thirty (30) miles; to San Quentin, one hundred and fourteen (114) miles.

195. *Sutter.*

SEC. 195. From the county seat of Sutter County to Sacramento, fifty (50) miles; to Napa, one hundred and eleven (111) miles; to Stockton, ninety-eight (98) miles; to San Quentin, one hundred and forty-six (146) miles.

196. *Tehama.*

SEC. 196. From the county seat of Tehama County to Sacramento, one hundred and thirty-five (135) miles; to Napa, one hundred and ninety-six (196) miles; to Stockton, one hundred and eighty-three (183) miles; to San Quentin, two hundred and thirty-one (231) miles.

197. *Trinity.*

SEC. 197. From the county seat of Trinity County to Sacramento, two hundred and seventeen (217) miles; to Napa, two hundred and seventy-eight (278) miles; to Stockton, two hundred and sixty-five (265) miles; to San Quentin, three hundred and thirteen (313) miles.

198. *Tulare.*

SEC. 198. From the county seat of Tulare County to Sacramento, two hundred and eleven (211) miles; to Napa, two hundred and seventy-two (272) miles; to Stockton, one hundred and sixty-three (163) miles; to San Quentin, two hundred and forty-nine (249) miles.

199. *Tuolumne.*

SEC. 199. From the county seat of Tuolumne County to Sacramento, one hundred (100) miles; to Napa, one hundred and sixty-one (161) miles; to Stockton, sixty-six (66) miles; to San Quentin, one hundred and sixty-six (166) miles. [Amendment, approved February 15, 1878. Amendments 1877–78, took effect sixtieth day after passage.]

200. *Ventura.*

SEC. 200. From the county seat of Ventura County to Sacramento,

three hundred and ninety-two (392) miles; to Napa, three hundred and forty-seven (347) miles; to Stockton, four hundred (400) miles; to San Quentin, three hundred and twenty (320) miles.

201. *Yolo.*

Sec. 201. From the county seat of Yolo County to Sacramento, twenty (20) miles; to Napa, forty-one (41) miles; to Stockton, sixty-eight (68) miles; to San Quentin, ninety-two (92) miles.

202. *Yuba.*

Sec. 202. From the county seat of Yuba County to Sacramento, fifty-two (52) miles; to Napa, one hundred and thirteen (113) miles; to Stockton, one hundred (100) miles; to San Quentin, one hundred and forty-six (146) miles.

ROUTES OF TRAVEL, MODES OF CONVEYANCE, DISTANCES, ETC., FROM SAN FRANCISCO.

[Compiled from the Railroad Gazetteer.]

ABBREVIATIONS.

a Southern Pacific Company, station foot of Market Street.
b Southern Pacific Company, station Fourth and Townsend Streets.
C. & C.—Carson & Colorado Railroad.
C. N.—California Northern Railroad.
C. S.—California Southern Railroad.
N. C.—Nevada County Narrow Gauge Railroad.
N. & C.—Nevada and California Railroad.
N. P.—Northern Pacific Railroad.
N. P. C.—North Pacific Coast Railroad.
O. & C.—Oregon and California Railroad.
P. C. Ry.—Pacific Coast Railway.
P. M.—Pacific Mail Steamship Company.
P. C.—Pacific Coast Steamship Company.
S. J. & S. N.—San Joaquin and Sierra Nevada Railroad.
S. & P.—Sacramento and Placerville Railroad.
S. F. & N. P.—San Francisco and North Pacific Railroad.
S. P. C.—South Pacific Coast Railroad.
Stmr.—River Steamer.
S. V.—Sonoma Valley Railroad.
U. P.—Union Pacific Railroad.
V. V. & C. L.—Vaca Valley and Clear Lake Railroad.

CALIFORNIA.

Acampo, San Joaquin County.—*a* 107 miles.

Acton, Los Angeles County.—*a* 427 miles.

Adin, Modoc County.—*a* to Redding, 234 miles; stage, 124 miles.

Ætna Hot Springs, Napa County.—*a* to St. Helena, 64 miles; stage, 15 miles.

Agnews, Santa Clara County.—S. P. C., 40 miles.

Alameda, Alameda County.—*a* 11 miles; or S. P. C., 10 miles.

Albion, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 65 miles; or N. P. C. to Duncan Mills, 79 miles; stage, 89 miles; or P. C.

Alder Point, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 127 miles.

Alderneys, Marin County.—N. P. C., 24 miles.

Alder Creek, Sacramento County.—*a* to Sacramento, 90 miles; S. & P., 19 miles.

Alila, Tulare County.—*a* 274 miles.

Alleghany, Sierra County.—*a* to Marysville, 142 miles; stage, 60 miles; or *a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 40 miles.

Allens, Shasta County.—*a* to Redding, 234 miles; stage, 22 miles.

Allens Springs, Lake County.—*a* to Williams, 125 miles; stage, 42 miles.

Alma, Santa Clara County.—S. P. C., 58 miles; or *b* to Santa Clara, 47 miles; S. P. C., 15 miles.

Alpine, Los Angeles County.—*a* 417 miles.

Altamont, Alameda County.—*a* 56 miles.

Alta, Placer County.—*a* 158 miles.

Altaville, Calaveras County.—*a* to Milton, 122 miles; stage, 22 miles.

Alturas (Dorris Bridge), Modoc County.—*a* to Redding, 234 miles; stage, 165 miles.

Alvarado, Alameda County.—S. P. C., 24 miles.

Alviso, Santa Clara County.—S. P. C., 38 miles.

Alvord, Inyo County.—*a* to Reno, 244 miles; V. & T. to Mound House, 41 miles; C. & C., 239 miles.

Amador City, Amador County.—*a* to Ione, 140 miles; stage, 14 miles.

Amboy, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 156 miles.

Anaheim, Los Angeles County.—*a* 509 miles, or P. C. to Anaheim Landing, 396 miles; stage, 13 miles.

Anderson, Shasta County.—*a* 223 miles.

Anderson Springs, Lake County.—*a* to Calistoga, 73 miles; stage, 18 miles, to Middleton; private conveyance, 3 miles.

Angels, Calaveras County.—*a* to Milton, 122 miles; stage, 24 miles.

Anita, Butte County.—*a* 195 miles.

Antelope, Sacramento County.—*a* 104 miles.

Antioch, Contra Costa County.—*a* 54 miles.

Applegate, Placer County.—*a* 136 miles.

Aptos, Santa Cruz County.—*b* 112 miles, or P. C.

Arbuckle, Colusa County.—*a* 114 miles.

Arcade, Sacramento County.—*a* 98 miles.

Arcata, Humboldt County.—P. C. to Eureka, 216 miles; stage, 12 miles.

Arena, Merced County.—*a* 140 miles.

Arroyo Grande, San Luis Obispo County.—*b* to Soledad, 143 miles; stage to San Luis Obispo, 114 miles, P. C. Ry., 15 miles; or P. C. to Port Harford, 201 miles, and P. C. Ry., 25 miles.

Ash Hill, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 131 miles.

Asti, Sonoma County.—S. F. & N. P., 80 miles.

Athlone, Merced County.—*a* 162 miles.

Atwater, Merced County.—*a* 144 miles.

Auburn, Placer County.—*a* 126 miles.

Avon, Contra Costa County.—*a* 39 miles.

Bakersfield, Kern County.—*a* to Sumner, 314 miles; stage, 1 mile.

Ballards, Santa Barbara County.—P. C. to Santa Barbara, 288 miles; stage, 43 miles; or P. C. to Port Harford, 201 miles; P. C. Ry. to Los Alamos, 64 miles; stage, 12 miles.

Baden, San Mateo County.—*b* 12 miles.

Bagdad, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 149 miles.

Bale, Napa County.—*a* 68 miles.

Balena, San Diego County.—*a* to Colton, 540 miles; C. S. to San Diego, 121 miles; stage, 43 miles; or P. C. to San Diego, 482 miles; stage, 43 miles.

Ballona, Los Angeles County.—*a* 493 miles.

Bangor, Butte County.—*a* to Marysville, 142 miles; stage, 20 miles.

Banner, San Diego County.—*a* to Colton, 540 miles; C. S. to San Diego, 121 miles; stage, 50 miles; P. C. to San Diego, 482 miles; stage, 50 miles.

Banning, San Bernardino County.—*a* 569 miles.

Banta, San Joaquin County.—*a* 75 miles.

Bartlett Springs, Lake County.—*a* to Calistoga, 73 miles; stage via Lakeport, 70 miles; or *a* to Williams, 125 miles; stage, 45 miles; or S. F. & N. P. to Cloverdale, 84 miles; stage, 66 miles.

Barretts, Contra Costa County.—*a* 16 miles.

Barro, Napa County.—*a* 66 miles.

Batavia, Solano County.—*a* 65 miles.

Bay Point, Contra Costa County.—*a* 42 miles.

Bealville, Kern County.—*a* 342 miles.

Belmont, San Mateo County.—*b* 25 miles.

Bello, Napa County.—*a* 62 miles.

Bells Springs, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 102 miles.

Benicia, Solano County.—*a* 33 miles.

Benton, Mono County.—*a* to Reno, 244 miles; V. & T. to Mound House, 41 miles; C. & C. 193 miles.

Berenda, Fresno County.—*a* 178 miles.

Berkeley, Alameda County.—*a* 12 miles.

Berlin, Colusa County.—*a* 119 miles.

Berry Creek, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 16 miles.

Bethany, San Joaquin County.—*a* 77 miles.

Bidwells Bar, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 9 miles.

Bieber, Lassen County.—*a* to Delta, 272 miles; stage, 70 miles.

Big Meadows, Plumas County.—*a* to Chico, 186 miles; stage, 65 miles.

Big Oak Flat, Tuolumne County.—*a* to Milton, 122 miles; stage, 44 miles.

Big Trees, Calaveras County.—*a* to Milton, 122 miles; stage, 47 miles.

Big Trees, Santa Cruz County.—S. P. C., 74 miles.

Big Trees, Mariposa County.—*a* to Raymond, 200 miles; stage, 40 miles.

Biggs Station, Butte County.—*a* 163 miles.

Big Valley, Lassen County.—*a* to Chico, 186 miles; stage, 80 miles.

Binghampton, Solano County.—*a* to Dixon, 68 miles; stage, 7 miles.

Birchville, Nevada County.—*a* to Marysville, 142 miles; stage, 36 miles.

Bishop Creek, Inyo County.—*a* to Reno, 244 miles; V. & T. to Mound House, 41 miles; C. & C., 224 miles.

Blacks, Yolo County.—*a* 97 miles.

Black Diamond, Contra Costa County.—*a* to Cornwall, 50 miles; Black Diamond R. R., 1 mile.

Black Point, Sonoma County.—N. P. C. to Duncan Mills, 79 miles; stage, 36 miles.

Blithedale, Marin County.—N. P. C., 10 miles.

Blocksburg, Humboldt County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 138 miles.

Bloomfield, Sonoma County.—N. P. C. to Valley Ford, 61 miles; stage, 4 miles.

Blue Cañon, Placer County.—*a* 168 miles.

Blue Tent, Nevada County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 6 miles.

Boca, Nevada County.—*a* 218 miles.

Bodega Roads, Sonoma County.—N. P. C. 64 miles.

Bodie, Mono County.—*a* to Reno, 245 miles; V. & T. to Mound House, 41 miles; C. and C. to Hawthorne, 100 miles; stage, 40 miles.

Bolinas, Marin County.—N. P. C. to San Rafael, 18 miles; stage, 18 miles.

Bolsa, San Benito County.—*a* 89 miles.

Boonville, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 30 miles.

Borden, Fresno County.—*a* 188 miles.

Boulder Creek, Santa Cruz County.—S. P. C. 81 miles.

Bowen's Landing, Mendocino County.—N. P. C. to Duncan Mills, 79 miles; stage, 47 miles.

Brentwood, Contra Costa County.—*a* 63 miles.

Bridgeport, Mendocino County.—N. P. C. to Duncan Mills, 79 miles; stage, 72 miles.

Bridgeport, Mono County.—*a* to Reno, 244 miles; V. & T. to Mound House, 41 miles; C. & C. to Hawthorne, 100 miles; stage, 62 miles.

Brighton, Sacramento County.—*a* 134 miles.

Bristol, San Bernardino County.—*a* to Mojave, 382 miles; A. & P. 163 miles.

Bronco, Nevada County.—*a* 223 miles.

Brown's Valley, Yuba County.—*a* to Marysville, 142 miles; stage, 12 miles.

Brownsville, Yuba County.—*a* to Marysville, 142 miles; stage, 33 miles.

Brooklyn, Alameda County.—*a* 9 miles.

Brookside, San Bernardino County.—*a* 547 miles.

Brush Creek, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 25 miles.

Buckeye, Tehama County.—*a* 214 miles.

Buck's Ranch, Plumas County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 44 miles.

Buena Vista, Nevada County.—*a* to Colfax, 144 miles; N. C. 10 miles.

Burson, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N. 24 miles.

Burgettsville, Shasta County.—*a* to Redding, 234 miles; stage, 80 miles.

Burdells, Sonoma County.—S. F. & N. P. 29 miles.

Burnetts, Stanislaus County.—*a* 124 miles.

Burney Valley, Shasta County.—*a* to Redding, 234 miles; stage, 64 miles.

Byron, Contra Costa County.—*a* 68 miles.

Byron Hot Springs, Contra Costa County.—*a* to Byron, 68 miles; stage, 2 miles.

Cabazon, San Bernardino County.—*a* 575 miles.

Cactus, San Diego County.—*a* 708 miles.

Cadiz, San Bernardino County.—*a* to Mojave, 382 miles; A. & P. 171 miles.

Cahto, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 74 miles.

Caliente, Kern County.—*a* 336 miles.

Calistoga, Napa County.—*a* 73 miles.

Callahans, Siskiyou County.—*a* to Delta, 272 miles; stage, 45 miles.

Calpella, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 34 miles.

Cambria, San Luis Obispo County.—P. C. to San Simeon, 160 miles; stage, 8 miles.

Cameron, Kern County.—*a* 371 miles.

Camp Bidwell, Modoc County.—*a* to Reno, 244 miles; N. & C. to Moran, 39 miles; stage, 245 miles.

Campbells, Santa Clara County.—S. P. C. 51 miles.

Camp Capitola, Santa Cruz County.—*b* to Soquel (Camp Capitola), 116 miles, or S. P. C. to Santa Cruz, 80 miles; stage, 5 miles.

Camp Taylor, Marin County.—N. P. C., 30 miles.

Campo, San Diego County.—*a* to Colton, 540 miles; C. S. to San Diego, 121 miles; stage, 60 miles; or P. C. to San Diego, 480 miles; stage, 60 miles.

Campo Seco, Calaveras County.—*a* to Lodi, 104 miles; S. J. and S. N. to Valley Spring, 28 miles; stage, 2 miles.

Camptonville, Nevada County.—*a* to Marysville, 142 miles; stage, 43 miles; or *a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 22 miles.

Cana, Butte County.—*a* 198 miles.

Carbondale, Amador County.—*a* 133 miles.
Cannon, Solano County.—*a* 56 miles.
Carnadero, San Benito County.—*b* 82 miles.
Carpenteria, Santa Barbara County.—*a* to Newhall, 452 miles, and stage; or P. C. to Santa Barbara, 288 miles; stage, 8 miles.
Cascade, Nevada County.—*a* 189 miles.
Cape Horn, Placer County.—*a* 148 miles.
Caspar, Mendocino County.—N. P. C. to Duncan Mills, 79 miles; stage, 101 miles, or P. C.
Castle Rock, Shasta County.—*a* to Delta, 272 miles; stage, 27 miles.
Castroville, Monterey County.—*b* 110 miles.
Castle, San Joaquin County.—*a* 98 miles.
Cave City, Calaveras County.—*a* to Milton, 122 miles; stage, 32 miles; or *a* to Lodi, 104 miles; S. J. & S. N. to Valley Spring, 28 miles; stage, 22 miles.
Ceres, Stanislaus County.—*a* 119 miles.
Cerro Gordo, Inyo County.—*a* to Reno, 244 miles; V. & T. to Mound House, 41 miles; C. & C. to Hawley, 293 miles; stage, 6 miles.
Cerritos, Los Angeles County.—*a* 498 miles.
Charleston, San Joaquin County.—*a* 98 miles.
Cherokee Flat, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 12 miles.
Cherokee (Patterson), Nevada County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 12 miles.
Chico, Butte County.—*a* 186 miles.
Chili Bar, El Dorado County.—*a* 90 miles to Sacramento; S. & P. to Shingle Springs, 48 miles; stage, 14 miles.
China Ranch, Placer County.—*a* 166 miles.
Chinese Camp, Tuolumne County.—*a* to Milton, 122 miles; stage, 26 miles.
Chinns, Placer County.—*a* 173 miles.
Christine, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 30 miles.
Chualar, Monterey County.—*b* 128 miles; or P. C. S.
Cicero, Sacramento County.—*a* 121 miles.
Cienega, Los Angeles County.—*a* 490 miles.
Cisco, Placer County.—*a* 182 miles.
Clairville, Sonoma County.—S. F. & N. P., 74 miles.
Clarks Summit, Marin County.—N. P. C., 59 miles.
Clay, Sacramento County.—*a* 124 miles.
Clear Creek, Shasta County.—*a* 229 miles.
Clements, San Joaquin County.—*a* to Lodi, 104 miles; S. J. & S. N., 12 miles.
Clinton, Nevada County.—*a* 220 miles.
Clipper Mills, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 30 miles.
Clipper Gap, Placer County.—*a* 133 miles.
Clyde, San Joaquin County.—*a* 119 miles.
Cloverdale, Sonoma County.—S. F. & N. P., 84 miles.
Coles, Siskiyou County.—*a* to Delta, 272 miles; stage, 100 miles.
Colfax, Placer County.—*a* 144 miles.
Collinsville, Solano County.—Stmr., 40 miles.
Coloma, El Dorado County.—*a* to Auburn, 126 miles; stage, 20 miles.
Colma, San Mateo County.—*b* 9 miles.
Colton, San Bernardino County.—*a* 540 miles.

Columbia, Tuolumne County.—*a* to Milton, 122 miles; stage, 49 miles.

Columbia Hill, Nevada County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 12 miles; or *a* to Marysville, 142 miles; stage, 47 miles.

Colusa, Colusa County.—*a* to Colusa Junction, 129 miles; Colusa R. R., 10 miles.

Comanche, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N. to Wallace, 18 miles; stage, 3 miles.

Cometa, San Joaquin County.—*a* 117 miles.

Compton, Los Angeles County.—*a* 494 miles.

Copper City, Shasta County.—*a* to Redding, 234 miles; stage, 25 miles.

Copperopolis, Calaveras County.—*a* to Milton, 122 miles; stage, 13 miles.

Cordelia, Solano County.—*a* 46 miles.

Cordero, San Diego County.—*a* to Colton, 540 miles; C. S., 101 miles.

Corning, Tehama County.—*a* 179 miles.

Cornwall, Contra Costa County.—*a* 50 miles.

Corralitos, Santa Cruz County.—*b* to Watsonville, 101 miles; stage, 7 miles.

Corte Madera, Marin County.—N. P. C., 12 miles.

Costa, Los Angeles County.—*a* 505 miles.

Cotate Ranch, Sonoma County.—S. F. & N. P., 46 miles.

Cothrins, El Dorado County.—*a* to Sacramento, 90 miles; S. & P., 34 miles.

Cottonwood, Shasta County.—*a* 216 miles.

Cuba, Nevada County.—*a* 222 miles.

Coulterville, Mariposa County.—*a* to Merced, 152 miles; stage, 46 miles.

Courtland, Sacramento County.—Stmr., 95 miles.

Covello, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage to Ukiah, 30 miles; stage, 65 miles.

Coyote, Santa Clara County.—*b* 63 miles.

Crescent City, Del Norte County.—Steamer Crescent City, every ten days; 274 miles.

Cayucos, San Luis Obispo County.—P. C. 180 miles.

Cedarville, Modoc County.—*a* to Reno, 244 miles; N. & C. to Moran, 30 miles; stage, 186 miles.

Centerville, Alameda County.—S. P. C. to Newark, 29 miles; horse-car, 3 miles; or *a* to Niles, 30 miles; stage, 3 miles.

Crescent Mills, Plumas County.—*a* to Chico, 186 miles; stage, 64 miles; or *b* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 81 miles.

Cross Creek, Tulare County.—*a* 235 miles.

Crystal Springs, San Mateo County.—*b* to San Mateo, 21 miles; stage, 4 miles.

Cucamonga, San Bernardino County.— *a* 524 miles.

Cuffey's Cove, Mendocino County.—N. P. C. to Duncan Mills, 79 miles; stage, 80 miles. or P. C., 112 miles.

Cummings, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 90 miles.

Daggett, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 80 miles.

Danby, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 183 miles.

Darwin, Inyo County.—*a* to Reno, 244 miles; V. & T. to Mound House, 41 miles; C. & C. to Hawley, 293 miles; stage, 22 miles.

Davenport's Landing, Santa Cruz County.—*b* to San Mateo, 21 miles; stage, 57 miles; or S. P. C. to Santa Cruz, 81 miles; stage, 14 miles.

Davis, Yolo County.—*a* 77 miles.
Dayton, Butte County.—*a* to Chico, 186 miles; stage, 6 miles.
Deadwood, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 21 miles.
Decoto, Alameda County.—*a* 27 miles.
De Luz, San Diego County.—*a* to Colton, 540 miles; C. S., 66 miles.
Delano, Kern County.—*a* 282 miles.
Delavan, Colusa County.—*a*, 139 miles.
Delhi, Merced County.—*a*, 133 miles.
Delta, Shasta County.—*a*, 272 miles.
Denverton, Solano County.—Steamer to Rio Vista, 89 miles; stage, 14 miles; or *a* to Suisun, 49 miles; stage, 9 miles.
Diamond Springs, El Dorado County.—*a* 90 miles to Sacramento; S. & P. to Shingle Springs, 48 miles; stage, 7 miles.
Dixon, Solano County.—*a* 68 miles.
Dogtown, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 32 miles.
Dominguez, Los Angeles County.—*a* 496 miles.
Donahue, Sonoma County.—S. F. & N. P., 36 miles.
Donner Lake, Nevada County.—*a* to Summit, 195 miles; stage, 2 miles.
Dougherty's, Santa Cruz County.—S. P. C., 70 miles.
Downey, Los Angeles County.—*a* 495 miles.
Downieville, Sierra County.—*a* to Marysville, 142 miles; stage, 67 miles; or *a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 42 miles.
Drytown, Amador County.—*a* to Ione, 140 miles; stage, 16 miles.
Dugan's, El Dorado County.—*a* to Sacramento, 90 miles; S. & P., 42 miles.
Dry Camp, San Diego County.—*a* 602 miles.
Duncan Mills, Sonoma County.—N. P. C., 79 miles.
Dunnigan, Yolo County.—*a* 104 miles.
Durham, Butte County.—*a* 180 miles.
Dutch Flat, Placer County.—*a* 157 miles.

East Oakland, Alameda County.—*a* 9 miles.
Eden Vale, Santa Clara County.—*b* 57 miles.
Eden Valley, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage to Ukiah, 30 miles; stage, 45 miles.
Edson, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 192 miles.
El Dorado, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N. to Valley Spring, 28 miles; stage; 20 miles.
El Casco, San Bernardino County.—*a* 554 miles.
El Rio, San Diego County.—*a* 725 miles.
Elk Grove, Sacramento County.—*a* 124 miles.
Ellis, San Joaquin County.—*a* 70 miles.
Elmira, Solano County.—*a* 60 miles.
Elsinore, San Diego County.—*a* to Colton, 540 miles; C. S. 34 miles.
Ely's, Sonoma County.—S. F. & N. P., 30 miles.
Emigrant Gap, Placer County.—*a* 173 miles.
Emmaton, Sacramento County.—Steamer, 56 miles.
Encinitas, San Diego County.—*a* to Colton, 540 miles; C. S. 92 miles.
Eperson, Colusa County.—*a* to Williams, 125 miles; stage, 26 miles.
Eureka, Humboldt County.—S. F. & N. P. to Cloverdale, 84 miles; stage to Hydesville, 182 miles; E. R. & E. R. R. to Eureka, 24 miles; or P. C., 216 miles.

Ewing, Placer County.—*a* 123 miles.

Fairfax, Marin County.—N. P. C., 17 miles.
Fair Oaks, San Mateo County.—*b* 31 miles.
Fall City, Shasta County.—*a* to Redding, 234 miles; stage, 80 miles.
Fallbrook, San Diego County.—*a* to Colton, 540 miles; C. S., 60 miles.
Farmington, San Joaquin County.—*a* 111 miles.
Felton, Santa Cruz County.—S. P. C., 73 miles; or *b* to Santa Cruz, 121 miles; S. P. C., 7 miles.
Fenner, San Bernardino County.—*a* to Mojave, 382 miles; A. & P. 199 miles.
Ferndale, Humboldt County.—S. F. & N. P. to Cloverdale, 84 miles; stage to Eureka, 210 miles; stage, 17 miles; or P. C. S.
Ferndale, Alameda County.—*a* 12 miles.
Fiddletown, Amador County.—*a* to Ione, 140 miles; stage, 22 miles.
Field's Landing, Humboldt County.—S. F. & N. P. to Cloverdale, 84 miles; stage to Hydesville, 182 miles; E. R. & E. R. R. to Field's Landing, — miles.
Finnell, Tehama County.—*a* 185 miles.
Firebaugh's, Fresno County.—*a* to Madera, 185 miles; stage, 20 miles.
Fish Rock, Mendocino County.—N. P. C. to Duncan Mills, 79 miles; stage, 50 miles.
Fisherman's, Marin County.—N. P. C., 45 miles.
Fisherman's Bay, Sonoma County.—N. P. C. to Duncan Mills, 79 miles; stage, 33 miles.
Fisk's Mills, Sonoma County.—N. P. C. to Duncan Mills, 79 miles; stage, 30 miles.
Florin, Sacramento County.—*a* 130 miles.
Florence, Los Angeles County.—*a* 488 miles.
Folsom, Sacramento County.—*a* to Sacramento, 90 miles; S. & P., 22 miles.
Flowing Well, San Diego County.—*a* 671 miles.
Forbestown, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 22 miles.
Forest City, Sierra County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 40 miles; or *a* to Marysville, 142 miles; stage, 60 miles.
Forest Hill, Placer County.—*a* to Auburn, 126 miles; stage, 22 miles.
Forest Home, Amador County.—*a* to Ione, 140 miles; stage, 4 miles.
Forestville, Sonoma County.—S. F. & N. P., 64 miles.
Fort Jones, Siskiyou County.—*a* to Delta, 272 miles; stage, 107 miles.
Fort Ross, Sonoma County.—N. P. C. to Duncan Mills, 79 miles; stage, 17 miles.
Fort Yuma, San Diego County.—*a* 729 miles.
Fowler, Fresno County.—*a* 216 miles.
Fraziers, San Diego County.—*a* to Colton, 540 miles; C. S., 83 miles.
Freeport, Sacramento County.—*a* to Sacramento, 90 miles; S. & P., 7 miles.
Freestone, Sonoma County.—N. P. C., 65 miles.
French Camp, San Joaquin County.—*a* 87 miles.
French Corral, Nevada County.—*a* to Marysville, 142 miles; stage, 33 miles.
Fresno, Fresno County.—*a* 207 miles.
Frinks, San Diego County.—*a* 653 miles.
Fruitvale, Alameda County.—*a* 10 miles.
Fulton, Sonoma County.—S. F. & N. P., 56 miles.

Gabilan, Monterey County.—*b* to Salinas, 118 miles; stage, 10 miles.
Galt, Sacramento County.—*a* 113 miles.
Garcia, Marin County.—N. P. C., 34 miles.
Garden Valley, El Dorado County.—*a* to Auburn, 126 miles; stage, 25 miles.
Garrotte, Tuolumne County.—*a* to Milton, 122 miles; stage, 37 miles.
Gaviota, Santa Barbara County.—P. C., 260 miles.
Germantown, Colusa County.—*a* 158 miles.
Georgetown, El Dorado County.—*a* to Auburn, 126 miles; stage, 22 miles.
Geyser Springs, Sonoma County.—*a* to Calistoga, 73 miles; stage, 27 miles; or S. F. & N. P. to Cloverdale, 84 miles; stage, 15 miles.
Gibsonville, Sierra County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 28 miles.
Gilroy, Santa Clara County.—*b* 80 miles.
Gilroy Hot Springs, Santa Clara County.—*b* to Gilroy, 80 miles; stage, 10 miles.
Girard, Kern County.—*a* 355 miles.
Glenbrook, Lake County.—*a* to Calistoga, 73 miles; stage, 29 miles.
Glencoe, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N. to Valley Springs, 28 miles; stage, 20 miles.
Glendale, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 12 miles.
Glen Ellen, Sonoma County.—S. V., 44 miles.
Glenwood, Santa Cruz County.—S. P. C., 66 miles.
Gloster, Kern County.—*a* 388 miles.
Goffs, San Bernardino County.—*a* to Mojave, 382 miles; A. & P. 209 miles.
Gold Run, Placer County.—*a* 154 miles.
Gonzales, Monterey County.—*b* 134 miles.
Goodwins, Sonoma County.—S. F. & N. P., 41 miles.
Goodyears, Solano County.—*a* 39 miles.
Goshen, Tulare County.—*a* 241 miles.
Graciosa, Santa Barbara County.—P. C. to Port Harford, 201 miles; P. C. R., 49 miles.
Grand Island, Colusa County.—*a* to Knight's Landing, 95 miles; stmr., 36 miles.
Granite Hill, El Dorado County.—*a* to Auburn, 126 miles; stage, — miles.
Graniteville (Eureka South), Nevada County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 27 miles.
Grant's Station, Sonoma County.—S. F. & N. P., 64 miles.
Green Brae, Marin County.—S. F. & N. P., 13 miles.
Grass Valley, Nevada County.—*a* to Colfax, 144 miles; N. C., 17 miles.
Green Valley, Sonoma County.—S. F. & N. P., 66 miles.
Greenville, Plumas County.—*a* to Chico, 186 miles; stage, 60 miles; or *a* to Reno, 244 miles; N. & C. to Moran, 39 miles; stage, 24 miles.
Greenwood, Colusa County.—*a* 163 miles.
Greenwood, El Dorado County.—*a* to Auburn, 126 miles; stage, 4 miles.
Gridley, Butte County.—*a* 160 miles.
Griffins, Marin County.—N. P. C., 57 miles.
Guadalupe, Santa Barbara County.—P. C. to Port Harford, 201 miles; P. C. Ry. and stage, 24 miles.

Gualala, Mendocino County.—N. P. C. to Duncan Mills, 79 miles; stage, 45 miles.
Guerneville, Sonoma County.—S. F. & N. P., 72 miles.

Halls, Alameda County.—S. P. C., 25 miles.
Hamlet, Marin County.—N. P. C., 51 miles.
Hanford, Tulare County.—*a* 254 miles.
Hangtown Crossing, Sacramento County.—*a* to Sacramento, 90 miles; S. & P., 12 miles.
Harper, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 51 miles.
Harrington, Colusa County.—*a* 109 miles.
Harbin Springs, Lake County.—*a* to Calistoga, 73 miles; stage, 21 miles.
Havilah, Kern County.—*a* to Caliente, 336 miles; stage, 28 miles.
Hawley, Inyo County.—*a* to Reno, 244 miles; V. & T. to Mound House, 41 miles; C. & C., 293 miles.
Haslett, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 105 miles.
Haywards, Alameda County.—*a* 21 miles.
Healdsburg, Sonoma County.—S. F. & N. P., 66 miles.
Heinlen, Tulare County.—*a* 263 miles.
Henly, Siskiyou County.—*a* to Delta, 272 miles; stage, 94 miles.
Highland, Santa Cruz County.—S. P. C., 64 miles.
Highland Springs, Lake County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 28 miles.
Highland, Alameda County.—*a* 12 miles.
Hilarita, Marin County.—S. F. & N. P., 7 miles.
Hinckley, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 61 miles.
Holden, San Joaquin County.—*a* 103 miles.
Hollister, San Benito County.—*b* 94 miles.
Honcut, Butte County.—*a* to Marysville, 142 miles; C. N., 12 miles.
Homer, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 217 miles.
Homestead, Sacramento County.—*a* to Sacramento, 90 miles; S. & P., 3 miles.
Hooker, Tehama County.—*a* 209 miles.
Hookton, Humboldt County.—P. C., 222 miles.
Hopland, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 16 miles.
Hornitos, Mariposa County.—*a* to Merced, 152 miles; stage, 22 miles.
Hotel de Redwood, Santa Cruz County.—S. P. C. to Wrights, 62 miles; stage, 4 miles.
Hotel del Monte, Monterey County.—(See Monterey.)
Houghs Mineral Springs, Lake County.—*a* to Williams, 125 miles; stage, 38 miles.
Howards, Sonoma County.—N. P. C., 69 miles.
Howland Flat, Sierra County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 55 miles.
Hueneme, Ventura County.—P. C., 321 miles.
Humboldt Bay, Humboldt County.—P. C., 216 miles.
Huron, Tulare County.—*a* 281 miles.
Hydesville, Humboldt County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 182 miles; or P. C. to Eureka, 216 miles; stage, 25 miles.

Ibex, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 226 miles.
Igo, Shasta County.—*a* to Anderson, 223 miles; stage, 14 miles.
Independence, Inyo County.—*a* to Reno, 244 miles; V. & T. to Mound House, 41 miles; C. & C., 276 miles.
Indio, San Diego County.—*a* 612 miles.
Ingrams, Sonoma County.—N. P. C., 87 miles.
Ione, Amador County.—*a* to Galt, 140 miles.
Iowa Hill, Placer County.—*a* to Colfax, 144 miles; stage, 8 miles.

Jacinto, Colusa County.—*a* to Chico, 186 miles; stage, 15 miles.
Jackson, Amador County.—*a* to Ione, 140 miles; stage, 12 miles.
Jacksonville, Tuolumne County.—*a* to Milton, 122 miles; stage, 29 miles.
Java, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 233 miles.
Jamestown, Tuolumne County.—*a* to Milton, 122 miles; stage, 31 miles.
Janesville, Lassen County.—*a* to Reno, 244 miles; N. & C. to Moran, 39 miles; stage, 41 miles.
Jenny Lind, Calaveras County.—*a* to Milton, 122 miles; stage, 4 miles.
Jewells, Marin County.—N. P. C., 3 1miles.
Jolon, Monterey County.—*b* to Soledad, 143 miles; stage, 42 miles.
Julian, San Diego County.—*a* to Colton, 540 miles; C. S. to San Diego, 121 miles; stage, 65 miles; or P. C. to San Diego, 482 miles; stage, 65 miles.
Junction, Marin County.—S. F. & N. P., 35 miles.
Junction (Roseville), Placer County.—*a* 108 miles.

Keene, Kern County.—*a* 350 miles.
Kent, Los Angeles County.—*a* 444 miles.
Kelsey, El Dorado County.—*a* to Auburn, 126 miles; stage, 28 miles.
Kelseyville, Lake County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 33 miles; or *a* to Calistoga, 73 miles; stage, 40 miles.
Kernville, Kern County.—*a* to Caliente, 336 miles; stage, 40 miles.
Keyes, Stanislaus County.—*a* 122 miles.
Kingsburg, Tulare County.—*a* 227 miles.
Kibbesilla, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 90 miles; or N. P. C. to Duncan Mills, 79 miles; stage, 120 miles.
Kirkwood, Tehama County.—*a* 174 miles.
Klamath Ferry, Siskiyou County.—*a* to Delta, 272 miles; stage, 90 miles.
Knights Ferry, Stanislaus County.—*a* to Oakdale, 126 miles; stage, 12 miles.
Knights Landing, Yolo County.—*a* 95 miles.
Knoxville, Napa County.—*a* to Calistoga, 73 miles; stage, 28 miles.
Korbells, Sonoma County.—S. F. & N. P., 69 miles.
Kramer, Kern County.—*a* to Mojave, 382 miles; A. & P., 38 miles.
Kress Summit, Nevada County.—*a* to Colfax, 144 miles; N. C., 13 miles.

La Graciosa, Santa Barbara County.—P. C.
La Grange, Stanislaus County.—*a* to Modesto, 114 miles; stage, 32 miles.
La Honda, San Mateo County.—*b* to Redwood, 29 miles; stage, 18 miles.
La Porte, Plumas County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 45 miles.
Laguna, Sonoma County.—S. F. & N. P., 62 miles.
Lagunitas, Marin County.—N. P. C., 27 miles.

Lake City (Surprise Valley), Modoc County.—*a* to Reno, 244 miles; stage, 220 miles; or *a* to Redding, 234 miles; stage, 220 miles.

Lake City, Nevada County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 12 miles.

Lake Tahoe—(see Tahoe City).

Lakeport, Lake County.—*a* to Calistoga, 73 miles; stage, 46 miles; or S. F. & N. P. to Cloverdale, 84 miles; stage, 40 miles.

Lakeville, Sonoma County.—S. F. & N. P., 36 miles.

Lakeview, Modoc County.—*a* to Marysville, 142 miles; stage, 225 miles.

Lancaster, Los Angeles County.—*a* 406 miles.

Lancha Plana, Amador County.—*a* to Lodi, 104 miles; S. J. & S. N. to Wallace, 18 miles; stage, 7 miles.

Lander, Placer County.—*a* 141 miles.

Langville, Yolo County.—*a* to Woodland, 86 miles; stage, 16 miles.

Lang, Los Angeles County.—*a* 439 miles.

Lathrop, San Joaquin County.—*a* 83 miles.

Latrobe, El Dorado County.—*a* to Sacramento, 90 miles; S. & P., 37 miles.

Lawrence, Santa Clara County.—*b* 44 miles.

Laytonville, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 78 miles.

Leesville, Colusa County.—*a* to Williams, 125 miles; stage, 21 miles.

Lemoore, Tulare County.—*a* 262 miles.

Lerdo, Kern County.—*a* 302 miles.

Lexington, Santa Clara County.—S. P. C. to Alma, 58 miles; stage, 7 miles; or *b* to Santa Clara, 47 miles; stage, 15 miles.

Liebigs, Sonoma County.—N. P. C. to Duncan Mills, 79 miles; stage, 22 miles.

Lincoln, Placer County.—*a* 119 miles.

Linden, San Joaquin County.—*a* to Stockton, 92 miles; stage, 14 miles.

Little River, Mendocino County.—N. P. C. to Duncan Mills, 79 miles; stage, 93 miles; or S. F. & N. P. to Cloverdale, 84 miles; stage, 73 miles, or P. C.

Little York, Nevada County.—*a* to Colfax, 144 miles; N. C., 22 miles; stage, 13 miles.

Litton Springs, Sonoma County.—S. F. & N. P., 70 miles.

Live Oak, Sutter County.—*a* 153 miles.

Livermore, Alameda County.—*a* 48 miles.

Livingston, Merced County.—*a* 137 miles.

Lockeford, San Joaquin County.—*a* to Lodi, 104 miles; S. J. & S. N., 8 miles.

Lodi, San Joaquin County.—*a* 104 miles.

Logandale, Colusa County.—*a* 145 miles.

Lomo, Sutter County.—*a* 149 miles.

Lompoc, Santa Barbara County.—P. C. to Gaviota, 260 miles; stage, 14 miles.

Lompoc, San Luis Obispo County.—P. C. to Port Harford, 201 miles; P. C. Ry. to Los Alamos, 64 miles; stage, 12 miles.

Lone Pine, Inyo County.—*a* to Reno, 244 miles; V. T. to Mound House, 41 miles; C. & C., 281 miles.

Lorenzo, Alameda County.—*a* 18 miles.

Lorenzo, Santa Cruz County.—S. P. C., 80 miles.

Los Alamos, Santa Barbara County.—P. C. to Port Harford, 201 miles; P. C. Ry., 64 miles.

Los Angeles, Los Angeles County.—*a* 482 miles; or P. C. to San Pedro, 389 miles; *a* 25 miles.

Los Banos, Merced County.—*b* to Gilroy, 80 miles; stage, 52 miles.

Los Berros, San Luis Obispo County.—P. C. to Port Harford, 201 miles; P. C. Ry., 30 miles.

Los Flores, San Diego County.—*a* Colton, 540 miles; C. S. to San Diego, 121 miles; stage, 28 miles; or P. C. to San Diego, 482 miles; stage, 28 miles.

Los Gatos, Santa Clara County.—S. P. C., 55 miles.

Los Medanos, Contra Costa County.—*a* 51 miles.

Louisville, El Dorado County.—*a* to Auburn, 126 miles; stage, 29 miles.

Lovejoys, El Dorado County.—*a* to Auburn, 126 miles; stage, 7 miles.

Lovelady, Santa Clara County.—S. P. C., 51 miles.

Lower Lake, Lake County.—*a* to Calistoga, 73 miles; stage, 35 miles.

Lowes, Monterey County.—*b* to Soledad, 143 miles; stage, 28 miles.

Ludlow, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 125 miles.

Lyfords, Marin County.—N. P. C., 10 miles.

Lyman, Colusa County.—*a* 154 miles.

Macy, Colusa County.—*a* 119 miles.

Madison, Yolo County.—*a* to Elmira, 60 miles; V. V. & C. L., 29 miles.

Madera, Fresno County.—*a* 185 miles.

Madrone, Santa Clara County.—*b* 69 miles.

Magnetic Springs.—S. P. C., to Glenwood, 66 miles; stage, 4 miles.

Malaga, Fresno County.—*a* 211 miles.

Malton, Colusa County.—*a* 170 miles.

Mammoth Tank, San Diego County.—*a* 683 miles.

Manchester, Mendocino County.—N. P. C. to Duncan Mills, 79 miles; stage, 65 miles, or P. C.

Mariposa, Mariposa County.—*a* to Merced, 152 miles; stage, 41 miles.

Markleeville, Alpine County.—*a* to Reno, 244 miles; V. & T. to Carson, 31 miles; stage, 39 miles.

Mark West, Sonoma County.—S. F. & N. P., 57 miles.

Markhams, Sonoma County.—N. P. C. to Duncan Mills, 79 miles; stage, 3 miles.

Marshalls, Marin County.—N. P. C., 47 miles.

Martinez, Contra Costa County.—*a* 36 miles.

Marysville, Yuba County.—*a* 142 miles.

Maxwell, Colusa County.—*a* 134 miles.

Mayfield, Santa Clara County.—*b* 35 miles.

Mayhews, Sacramento County.—*a* to Sacramento, 90 miles; S. & P., 10 miles.

McAvoy, Contra Costa County.—*a* 45 miles.

McConnells, Sacramento County.—*a* 120 miles.

Meacham's, Sonoma County.—S. F. & N. P., 58 miles.

Meadow Valley, Plumas County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 53 miles.

Melrose, Alameda County.—*a* 11 miles.

Mendocino, Mendocino County.—N. P. C. to Duncan Mills, 79 miles; stage, 8 miles; or S. F. & N. P. to Cloverdale, 84 miles; stage, 75 miles; or P. C., 122 miles.

Menlo Park, San Mateo County.—*b* 32 miles.

Merced, Merced County.—*a* 152 miles.

Merced Falls, Merced County.—*a* to Merced, 152 miles; stage, 22 miles.

Meridian, Sutter County.—*a* to Marysville, 142 miles; stage, 17 miles.

Michigan Bar, Sacramento County.—*a* to Sacramento, 90 miles; S. & P. to Latrobe, 37 miles; stage, 6 miles.
Michigan Bluffs, Placer County.—*a* to Auburn, 126 miles; stage, 30 miles.
Middletown, Lake County.—*a* to Calistoga, 73 miles; stage, 18 miles.
Midway, Alameda County.—*a* 64 miles.
Milford, Lassen County.—*a* to Reno, 244 miles; N. & C. to Moran, 39 miles; stage, 28 miles.
Millbrae, San Mateo County.—*b* 17 miles.
Millerton, Fresno County.—*a* to Borden, 188 miles; stage, 20 miles.
Millerton, Marin County.—N. P. C., 42 miles.
Millers, Marin County.—S. F. & N. P., 20 miles.
Millville, Shasta County.—*a* to Redding, 234 miles; stage, 15 miles.
Milpitas, Santa Clara County.—*a* 42 miles.
Milton, Calaveras County.—*a* 122 miles.
Minturn, Fresno County.—*a* 168 miles.
Mitchel, Alameda County.—*a* 13 miles.
Modesto, Stanislaus County —*a* 114 miles.
Mojave, Kern County.—*a* 382 miles.
Mokelumne Hill, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N. to Valley Spring, 28 miles; stage, 12 miles.
Monitor, Alpine County.—*a* to Reno, 244 miles; V. & T. to Carson, 31 miles; stage, 36 miles.
Monte, Los Angeles County.—*a* 495 miles.
Monticello, Napa County.—*a* to Napa, 46 miles; stage, 27 miles.
Monterey, Monterey County.—*b* 125 miles; or P. C., 85 miles.
Montezuma, Tuolumne County.—To Milton, 122 miles; stage, 28 miles.
Moore's Flat, Nevada County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 20 miles.
Morrano, San Joaquin County.—*a* 100 miles.
Morro, San Luis Obispo County.—P. C., 166 miles.
Moscow Mills, Sonoma County.—N. P. C., 78 miles.
Mosquito Gulch, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N. to Valley Spring, 28 miles; stage, 17 miles.
Mound City, San Bernardino County.—*a* 543 miles.
Mount Eden, Alameda County.—S. P. C., 20 miles; or *a* to Haywards, 21 miles; stage, 8 miles.
Mountain House, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 24 miles.
Mountain Ranch, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N. to Valley Spring, 28 miles; stage, 20 miles.
Mountain View, Santa Clara County.—*b* 39 miles.
Mowrys, Alameda County.—S. P. C., 32 miles.
Mud Springs (El Dorado), El Dorado County.—*a* to Sacramento, 90 miles; S. & P. to Shingle Springs, 48 miles; stage, 5 miles.
Murrieta, San Diego County.—*a* to Colton, 540 miles; C. S., 43 miles.
Murphys, Calaveras County.—*a* to Milton, 122 miles; stage, 33 miles.
Mystic, Nevada County.—*a* 227 miles.

Nacimento, Monterey County.—*b* to Soledad, 143 miles; stage to San Miguel, 73 miles.
Nadeau, Kern County.—*a* 376 miles.
Napa, Napa County.—*a* 46 miles.
Napa Junction, Napa County.—*a* 38 miles.

Nashville, El Dorado County.—*a* to Sacramento, 90 miles; S. & P. to Shingle Springs, 48 miles; stage, 4 miles.

National City, San Diego County.—*a* to Colton, 540 miles; C. S., 127 miles, or P. C. S.

Natividad, Monterey County.—*b* to Salinas, 118 miles; stage, 8 miles.

Navarro Ridge, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 63 miles; or N. P. C. to Duncan Mills, 79 miles; stage, 85 miles; or P. C. to Whitesboro.

Nelson, Butte County.—*a* 173 miles.

Nevada, Nevada County.—*a* to Colfax, 144 miles; N. C., 22 miles.

New Hope, San Joaquin County.—*a* to Lodi, 104 miles; stage, 14 miles.

New Idria, Fresno County.—*b* to Tres Pinos, 100 miles; stage, 63 miles.

New York Landing, Contra Costa County.—Stmr., 39 miles.

New Almaden, Santa Clara County.—*b* to San José, 50 miles; stage, 15 miles.

Newark, Alameda County.—S. P. C., 29 miles.

Newcastle, Placer County.—*a* 121 miles.

Newhall, Los Angeles County.—*a* 452 miles.

Newville, Colusa County.—*a* to Williams, 125 miles; stage, 65 miles.

Neylans Mills, Mendocino County.—N. P. C. to Duncan Mills, 79 miles; stage, 57 miles.

N. E. Mills, Placer County.—*a* 139 miles.

Nicasio, Marin County.—N. P. C. 25 miles; stage, 3 miles.

Nicolaus, Sutter County.—*a* to Wheatland, 130 miles; stage, 4 miles.

Niles, Alameda County.—*a* 30 miles.

Nipomo, San Luis Obispo County.—*a* P. C. to Port Harford, 201 miles; P. C. Ry., 35 miles.

Nord, Butte County.—*a* 193 miles.

Nordhoff, Ventura County.—P. C. to San Buenaventura, 311 miles; stage, 12 miles; or *a* Newhall, 452 miles; stage, 60 miles.

Norman, Colusa County.—*a* 143 miles.

North Bloomfield, Nevada County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 15 miles.

North San Juan, Nevada County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 12 miles; or *a* to Marysville, 142 miles; stage, 45 miles.

Nortonville, Contra Costa County.—*a* to Cornwall, 50 miles; Black Diamond R. R., 6 miles.

Norwalk, Los Angeles County.—*a* 499 miles; or by P. C. to Los Angeles.

Novato, Marin County.—S. F. & N. P., 26 miles.

Noyo, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 83 miles; or N. P. C. to Duncan Mills, 79 miles; stage, 106 miles; or P. C.

Oak Grove, San Mateo County.—*b* 19 miles.

Oak Grove, Sonoma County.—S. F. & N. P., 48½ miles.

Oak Knoll, Napa County.—*a* 51 miles.

Oakdale, Stanislaus County.—*a* 126 miles.

Oakland, Alameda County.—*a* 6 miles; or S. P. C., 8 miles.

Oakville, Napa County.—*a* 58 miles.

Oat Creek, Tehama County.—*a* 192 miles.

Ocean Side, San Diego County.—*a* to Colton, 540 miles; C. S., 80 miles.

Ocean View, San Francisco County.—*b* 7 miles.

Ocean View, Sonoma County.—N. P. C. to Duncan Mills, 79 miles; stage, 14 miles.

Ogilby, San Diego County.—*a* 715 miles.

Olema, Marin County.—N. P. C., 38 miles.
Omega, Nevada County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 20 miles.
Ontario, San Bernardino County.—*a* 521 miles.
Ophir, Placer County.—*a* to Newcastle, 121 miles; stage, 2 miles.
Orange, Los Angeles County.—*a* 514 miles.
Oregon House, Yuba County.—*a* to Marysville, 142 miles; stage, 23 miles.
Orland, Colusa County.—*a* 166 miles.
Oro Fino, Siskiyou County.—*a* to Delta, 272 miles; stage, 65 miles.
Oroville, Butte County.—*a* to Marysville, 142 miles; C. N., 28 miles.
Otay, San Diego County.—*a* via San Diego or P. C.

Pacheco, Contra Costa County.—*a* to Martinez, 36 miles; stage, 5 miles.
Pacific Congress Springs, Santa Clara County.—*b* to Santa Clara, 47 miles; stage, 11 miles; or S. P. C. to Los Gatos, 55 miles; stage, 5 miles.
Pacheco, Marin County.—S. F. & N. P., 23 miles; or N. P. C., 18 miles.
Pages, Sonoma County.—S. F. & N. P., 43 miles.
Pajaro, Santa Clara County.—*b* 99 miles.
Pampa, Kern County.—*a* 329 miles.
Paraiso Springs, Monterey County.—*b* to Soledad, 143 miles; stage, 7 miles.
Paso Robles Hot Springs, San Luis Obispo County.—*b* to Soledad, 143 miles; stage, 78 miles; or P. C. to Port Harford, 201 miles; P. C. Ry. to San Luis Obispo, 11 miles; stage, 30 miles.
Patchin, Santa Clara County.—*b* to Santa Clara, 47 miles; stage; S. P. C. to Alma, 45 miles; stage.
Pasadena, Los Angeles County.—*a* to Los Angeles, 482 miles; Los Angeles and San Gabriel Valley R. R., 10 miles.
Pearsons Springs, Lake County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 46 miles.
Penns Grove, Sonoma County.—S. F. & N. P., 40 miles.
Penyrn, Placer County.—*a* 118 miles.
Pentz, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 12 miles.
Perkins, Sacramento County.—*a* to Sacramento, 90 miles; S. & P., 7 miles.
Perrys, Santa Cruz County.—*b* 66 miles.
Pescadero, San Mateo County.—*b* to San Mateo, 21 miles; stage, 32 miles; or *b* to Redwood, 29 miles; stage, 35 miles.
Petaluma, Sonoma County.—S. F. & N. P., 36 miles.
Peters, San Joaquin County.—*a* 107 miles.
Petrolia, Humboldt County.—S. F. & N. P. to Cloverdale, 84 miles; stage to Eureka, 210 miles; stage, 50 miles; or P. C. to Eureka.
Pino, Placer County.—*a* 115 miles.
Pigeon Point, San Mateo County.—*b* to San Mateo, 21 miles; stage, 39 miles.
Pike City, Sierra County.—*a* to Marysville, 142 miles; stage, 50 miles; or *a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 27 miles.
Pilot Hill, El Dorado County.—*a* to Auburn, 126 miles; stage, 8 miles.
Pilot Knob, San Diego County.—*a* 721 miles.
Pinacate, San Diego County.—*a* to Colton, 540 miles; C. S., 22 miles.
Pine Flat, Sonoma County.—*a* to Calistoga, 73 miles; stage, 18 miles.
Pinole, Contra Costa County.—*a* 24 miles.
Platts Mill, Sonoma County.—N. P. C. to Duncan Mills, 79 miles; stage, 30 miles.
Placerville, El Dorado County.—*a* to Sacramento, 90 miles; S. & P. to Shingle Springs, 48 miles; stage, 10 miles.

Pleasanton, Alameda County.—*a* 42 miles.
Pleasant Valley, El Dorado County.—*a* to Sacramento, 90 miles; S. & P. to Shingle Springs, 48 miles; stage, 21 miles.
Pleito, Monterey County.—*b* to Soledad, 143 miles; stage, 54 miles.
Plymouth, Amador County.—*a* to Ione, 140 miles; stage, 18 miles.
Point Arena, Mendocino County.—N. P. C. to Duncan Mills, 79 miles; stage, 60 miles; or P. C., 100 miles.
Point Reyes (Olema), Marin County.—N. P. C., 38 miles.
Point Tiburon, Marin County.—S. F. &. N. P., 6 miles.
Pomona, Los Angeles County.—*a* 515 miles.
Port Costa, Contra Costa County.—*a* 32 miles.
Port Harford, San Luis Obispo County.—P. C. S., 201 miles.
Poso, Kern County.—*a* 294 miles.
Potter Valley, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 48 miles.
Poway, San Diego County.—P. C. to San Diego, 482 miles; stage, 22 miles; or *a* to Colton, 540 miles; C. S. to San Diego, 121 miles; stage, 22 miles.
Prairie, Yolo County.—*a* to Blacks, 97 miles; stage, 2 miles.
Prattville, Plumas County.—*a* to Chico, 186 miles; stage, 40 miles.
Princeton, Colusa County.—*a* to Norman, 143 miles; stage, 10 miles.
Proctors, Nevada County.—*a* 212 miles.
Prosser, Nevada County.—*a* 216 miles.
Puente, Los Angeles County.—*a* 501 miles.
Purissima, San Mateo County.—*b* to San Mateo, 21 miles; stage, 18 miles.

Quaker Hill, Nevada County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 7 miles.
Quincy, Plumas County.—*a* to Reno, 244 miles; N. & C. to Moran, 3 miles; stage, 60 miles.

Railroad Flat, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N. to Valley Spring, 28 miles; stage, 25 miles.
Ravena, Los Angeles County.—*a* 431 miles.
Rawson, Tehama County.—*a* 194 miles.
Raymond, Fresno County.—*a* 200 miles.
Redding, Shasta County.—*a* 234 miles.
Red Bluff, Tehama County.—*a* 199 miles.
Reeds, Yuba County.—*a* 136 miles.
Reeds, Marin County.—S. F. & N. P., 10 miles.
Redwood City, San Mateo County.—*b* 29 miles.
Reynolds Ferry, Calaveras County.—*a* to Milton, 122 miles; stage, 20 miles.
Rich Bar, Plumas County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage to Spanish Ranch, 57 miles; saddle train, 12 miles.
Richfield, Tehama County.—*a* 183 miles.
Ridgeville, Humboldt County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 160 miles.
Rincon, Santa Cruz County.—S. P. C., 77 miles.
Rio Vista, Solano County.—Stmr., 89 miles.
Ripon, San Joaquin County.—*a* 105 miles.
Riverside, San Bernardino County.—*a* to Colton, 540 miles; C. S., 5 miles.
Rocklin, Placer County.—*a* 112 miles.

Rhonerville, Humboldt County.—P. C. to Eureka, 216 miles; stage, 20 miles; or S. F. & N. P. to Cloverdale, 84 miles; stage to Hydesville, 182 miles; E. R. & E. R. R. to Rhonerville.

Roseville (Junction), Placer County.—*a* 108 miles.

Ross Station, Marin County.—N. P. C., 15 miles.

Rules Landing, Sonoma County.—N. P. C. to Duncan Mills, 79 miles; stage, 8 miles.

Rough and Ready, Nevada County.—*a* to Colfax, 144 miles; N. C. to Grass Valley, 17 miles; stage, 4 miles.

Routiers, Sacramento County.—*a* to Sacramento, 90 miles; S. & P., 12 miles.

Russells, Alameda County.—S. P. C., 19 miles.

Russian River, Sonoma County.—N. P. C., 75 miles.

Rutherford, Napa County.—*a* 60 miles.

Sacramento, Sacramento County.—*a* via Benicia, 90 miles; or Stmr., 120 miles.

Sacramento Ferry, Shasta County.—*a* to Redding, 234 miles; stage, 32 miles.

Salida, Stanislaus County.—*a* 108 miles.

Salinas, Monterey County.—*b* 118 miles; or P. C. S.

Salmon Falls, El Dorado County.—*a* to Sacramento, 90 miles; S. & P. to Folsom, 22 miles; stage, 9 miles.

Salsbury, Sacramento County.—*a* to Sacramento, 90 miles; S. & P., 16 miles.

Salmon Creek, Humboldt County.—S. F. & N. P. to Cloverdale, 84 miles; stage to Hydesville, 182 miles; E. R. & E. R. R. to Salmon Creek.

Sand Cut, Monterey County.—*b* 94 miles.

Salt Point, Sonoma County.—N. P. C. to Duncan Mills, 79 miles; stage, 25 miles.

San Andreas, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N. to Valley Springs, 28 miles; stage, 10 miles.

San Anselmo, Marin County.—N. P. C., 16 miles.

San Antonio, Monterey County.—*b* to Soledad, 143 miles; stage, 30 miles.

San Benito, San Benito County.—*b* to Tres Pinos, 101 miles; stage, 28 miles.

San Bernardino, San Bernardino County.—*a* to Colton, 540 miles; C. S., 3 miles.

San Bruno, San Mateo County.—*b* 14 miles.

San Buenaventura, Ventura County.—P. C., 311 miles; or *a* to Newhall, 452 miles; stage, 50 miles.

San Clemente, Marin County.—S. F. & N. P., 10 miles.

San Diego, San Diego County.—*a* to Colton, 540 miles; C. S., 121 miles; or P. C., 482 miles.

San Fernando, Los Angeles County.—*a* 461 miles.

San Dieguito, San Diego County.—*a* to Colton, 450 miles; C. S. to San Diego, 121 miles; stage, 23 miles; or P. C.

San Felipe, Santa Clara County.—*b* to Gilroy, 80 miles; stage, 10 miles.

San Gabriel, Los Angeles County.—*a* 491 miles.

San Geronimo, Marin County.—N. P. C., 24 miles.

San Gorgonio, San Bernardino County.—*a* 563 miles.

San Gregorio, San Mateo County.—*b* to San Mateo, 21 miles; stage, 26 miles; or *b* to Redwood, 29 miles; stage, 26 miles.

San José, Santa Clara County.—S. P. C., 46 miles; or *b* 50 miles; or *a* 47 miles.

San Juan, San Benito County.—*b* to Sargent's, 86 miles; stage, 6 miles.

San Juan Capistrano, Los Angeles County.—*a* to Santa Ana, 516 miles; stage, 28 miles; or P. C.

San Leandro, Alameda County.—*a* 16 miles; or S. P. C., 14 miles.

San Lorenzo, Alameda County.—S. P. C., 17 miles.

San Luis Obispo, San Luis Obispo County.—*b* to Soledad, 143 miles; stage, 114 miles; or P. C. to Port Harford, 201 miles; P. C. Ry., 11 miles.

San Luis Ranch, Merced County.—*b* to Gilroy, 80 miles; stage, 42 miles.

San Luis Rey, San Diego County.—*a* to Santa Ana, 516 miles; stage, 59 miles; or by P. C. to San Diego, 482 miles; stage, 45 miles.

San Marcos, Santa Barbara County.—*b* to Soledad, 143 miles; stage, 190 miles; or P. C. to Port Harford, 201 miles; stage, 24 miles.

San Mateo, San Mateo County.—*b* 21 miles.

San Miguel, San Luis Obispo County.—*b* to Soledad, 143 miles; stage, 78 miles; or P. C.

San Pablo, Contra Costa County.—*a* 18 miles.

San Pasqual, San Diego County.—*a* to Santa Ana, 516 miles; stage, 59 miles; or P. C. to San Diego, 482 miles; stage, 45 miles.

San Pedro, Los Angeles County.—P. C., 387 miles; or *a* 507 miles.

San Quentin, Marin County.—N. P. C., 21 miles.

San Rafael, Marin County.—N. P. C., 18 miles; or S. F. & N. P., 15 miles.

San Ramon, Contra Costa County.—*a* to Oakland, 7 miles; stage, 14 miles.

San Simeon, San Luis Obispo County.—P. C., 160 miles.

San Ysidro, Santa Clara County.—*b* to Gilroy, 80 miles; stage, 3 miles.

Sanel, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 17 miles.

Santa Ana, Los Angeles County.—*a* 516 miles.

Santa Anita, Los Angeles County, 16 miles from Los Angeles via L. A. & S. G. V. R. R.

Santa Barbara, Santa Barbara County.—P. C., 288 miles; or *a* to Newhall, 452 miles; stage, 80 miles; or *b* to Soledad, 143 miles; stage, 260 miles.

Santa Clara, Santa Clara County.—*b* 47 miles; or S. P. C., 44 miles.

Santa Cruz, Santa Cruz County.—S. P. C., 81 miles; or *b* 121 miles; or P. C., 70 miles.

Santa Paula, Ventura County.—P. C. to San Buenaventura, 311 miles; stage, 10 miles; or *a* to Newhall, 452 miles; stage, 40 miles.

Santa Inez, Santa Barbara County.—P. C. to Santa Barbara, 228 miles; stage, 40 miles.

San Margarita, San Luis Obispo County.—*b* to Soledad, 143 miles; stage 104 miles; or P. C.

Santa Maria, Santa Barbara County.—P. C. to Port Harford, 201 miles; P. C. Ry., 42 miles.

Santa Maria, San Diego County.—*a* to Colton, 540 miles; C. S. to San Diego, 121 miles; stage, 38 miles; or P. C.

Santa Monica, Los Angeles County.—*a* 500 miles; or P. C., 361 miles.

Santa Rita, Monterey County.—*b* to Salinas, 118 miles; stage, 3 miles.

Santa Rosa, Sonoma County.—S. F. & N. P., 51 miles.

Santa Ynez, Santa Barbara County.—P. C. to Port Harford, 201 miles; P. C. Ry., 64 miles; stage, 15 miles.

Saratoga, Santa Clara County.—S. P. C. to Los Gatos, 55 miles; stage, 4 miles; or *b* to Santa Clara, 47 miles; stage, 8 miles.

Sargents, Santa Clara County.—*b* 86 miles.
Saucelito, Marin County.—N. P. C., 6 miles.
Savanna, Los Angeles County.—*a* 494 miles.
Sawyers Bar, Siskiyou County.—*a* to Delta, 272 miles; stage, 110 miles.
Scott Bar, Siskiyou County.—*a* to Delta, 272 miles; stage to Fort Jones, 65 miles; saddle train, 20 miles.
Searsville, San Mateo County.—*b* to Redwood, 29 miles; stage, 9 miles.
Sebastopol, Sonoma County.—S. F. & N. P. to Santa Rosa, 51 miles; stage, 6 miles.
Selma, Fresno County.—*a* 222 miles.
Sepulveda, Los Angeles County.—*a* 474 miles.
Selwyns, San Diego County.—*a* to Colton, 540 miles; C. S., 108 miles.
Sesma, Tehama County.—*a* 212 miles.
Seven Palms, San Diego County.—*a* 591 miles.
Seventy Mile Siding, San Diego County.—*a* to Colton, 540 miles; C. S., 56 miles.
Shady Run, Placer County.—*a* 163 miles.
Shasta, Shasta County.—*a* to Redding, 234 miles; stage, 6 miles.
Shaws Flat, Tuolumne County.—*a* to Milton, 122 miles; stage, 30 miles.
Shaws, Butte County.—*a* 191 miles.
Sheep Ranch, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N. to Valley Spring, 28 miles; stage, 27 miles.
Shelter Cove, Mendocino County.—P. C., 167 miles.
Sheridan, Placer County.—*a* 126 miles.
Sherwood Valley, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 66 miles.
Shingle Springs, El Dorado County.—*a* to Sacramento, 90 miles; S. & P., 48 miles.
Shorb, Los Angeles County.—*a* 489 miles.
Siberia, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 141 miles.
Sierra City, Sierra County.—*a* to Marysville, 142 miles; stage, 79 miles; or *a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 57 miles.
Sierra Madre Villa, 1 mile from Lamanda Park and 13 miles from Los Angeles via Los Angeles and San Gabriel Valley R. R.
Sierraville, Sierra County.—*a* to Truckee, 209 miles; stage, 30 miles.
Signal Port, Mendocino County.—N. P. C. to Duncan Mills, 79 miles; stage, 8 miles.
Silver Mountain, Alpine County.—*a* to Reno, 244 miles; V. & T. to Carson, 31 miles; stage, 54 miles.
Simi, Ventura County.—*a* to Newhall, 452 miles; stage, 35 miles; or P. C. to San Buenaventura, 311 miles; stage, 15 miles.
Silsby, Butte County.—*a* 169 miles.
Skaggs Springs, Sonoma County.—S. F. & N. P. to Clairville, 75 miles; stage, 8 miles.
Slate Creek, Shasta County.—*a* to Delta, 272 miles; stage, 44 miles.
Smartsville, Yuba County.—*a* to Marysville, 142 miles; stage, 18 miles.
Smiths River, Del Norte County.—Stmr, 298 miles.
Snelling, Merced County.—*a* to Merced, 152 miles; stage, 16 miles.
Sobrante, Contra Costa County.—*a* 21 miles.
Soda Bay, Lake County.—S. F. & N. P. to Cloverdale, 84 miles; stage to Lakeport, 40 miles; stmr., 10 miles; or *a* to Calistoga, 73 miles; stage to Lakeport, 46 miles; stmr., 10 miles.
Soda Springs, Nevada County.—*a* 192 miles.

Soda Springs, Siskiyou County.—*a* to Delta, 272 miles; stage, 41 miles.
Soda Springs, Napa County.—*a* to Napa, 46 miles; stage, 7 miles.
Soledad, Monterey County.—*b* 143 miles.
Somersville, Contra Costa County.—*a* to Los Medanos, 51 miles; Pittsburg R. R., 6 miles.
Sonoma, Sonoma County.—*a* to Napa, 46 miles; stage, 15 miles; or S. V., 38 miles.
Sonoma Mills, Sonoma County.—N. P. C., 72½ miles.
Sonora, Tuolumne County.—*a* to Milton, 122 miles; stage, 35 miles.
Soquel, Santa Cruz County.—*b* 116 miles; or P. C.
Soto, Tehama County.—*a* 200 miles.
South Eel River, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 65 miles.
Southerns, Shasta County.—*a* to Delta, 272 miles; stage, 54 miles.
Spadra, Los Angeles County.—*a* 511 miles.
Spanish Dry Diggings, El Dorado County.—*a* to Auburn, 126 miles; stage, 14 miles.
Spanish Ranch, Plumas County.—*a* to Marysville, 142 miles; N. C. to Oroville, 28 miles; stage, 57 miles.
Spanishtown (Half Moon Bay), San Mateo County.—*b* to San Mateo, 21 miles; stage, 13 miles.
Spring Valley, Colusa County.—*a* to Williams, 125 miles; stage, 12 miles.
Springfield, Tuolumne County.—*a* to Milton, 122 miles; stage, 30 miles.
Springville, Humboldt County.—S. F. & N. P. to Cloverdale, 84 miles; stage to Hydesville, 182 miles; E. R. & E. R. R. to Springville.
Spruce Grove, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 116 miles.
Stanfords, Nevada County.—*a* 204 miles.
Starveout, Siskiyou County.—*a* to Delta, 272 miles; stage, 165 miles.
Stege, Alameda County.—*a* 14 miles.
Steeles, San Luis Obisbo County.—P. C. to Port Harford, 201 miles; P. C. Ry., 16 miles.
Stewarts, San Diego County.—*a* to Colton, 540 miles; C. S., 85 miles.
St. Helena, Napa County.—*a* 64 miles.
St. John, Colusa County.—*a* to Williams, 125 miles; stage, 50 miles.
St. Louis, Sierra County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 51 miles.
Stockton, San Joaquin County.—*a* 92 miles.
Stock Yards, Alameda County.—*a* 9 miles.
Strawberry Valley, Siskiyou County.—*a* to Delta, 272 miles; stage, 40 miles.
Strongs, Nevada County.—*a* 203 miles.
Strongs, Humboldt County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 172 miles.
Sugar Pine, Tuolumne County.—*a* to Milton, 122 miles; stage, 49 miles.
Suisun, Solano County.—*a* 49 miles.
Sulphur Creek, Colusa County.—*a* to Williams, 125 miles; stage, 40 miles.
Summer Home Farm, Santa Cruz County.—S. P. C. to Glenwood, 66 miles; stage, 3 miles.
Summit, Nevada County.—*a* 195 miles.
Summit, Marin County.—N. P. O., 11 miles.
Sumner, Kern County.—*a* 314 miles.
Sunol, Alameda County.—*a* 37 miles.

Susanville, Lassen County.—*a* to Reno, 244 miles; N. & C. to Moran, 39 miles; stage, 57 miles; or *a* to Chico, 186 miles; stage, 85 miles.
Sutter Creek, Amador County.—*a* to Ione, 140 miles; stage, 12 miles.
Swansea, Inyo County.—*a* to Reno, 244 miles; V. & T. to Mound House, 41 miles; C. & C., 290 miles.
Sweetland, Nevada County.—*a* to Marysville, 142 miles; stage, 37 miles.
Sycamore, Fresno County.—*a* 197 miles.

Table Bluff, Humboldt County.—P. C. to Eureka, 219 miles; stage, 15 miles.
Tagus, Tulare County.—*a* 247 miles.
Tahoe City (Lake Tahoe), Placer County.—*a* to Truckee, 210 miles; stage, 14 miles.
Tamalpais, Marin County.—N. P. C., 14 miles.
Tamarack, Placer County.—*a* 185 miles.
Tamarack Flat, Mariposa County.—*a* to Milton, 122 miles; stage, 70 miles.
Taylorville, Plumas County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 105 miles; or *a* to Chico, 186 miles; stage, 85 miles; or *a* to Reno, 244 miles; N. & C. to Moran, 39 miles; stage, 55 miles.
Taylorville, Marin County.—N. P. C., 30 miles.
Teal, Solano County.—*a* 44 miles.
Tehachapi, Kern County.—*a* 362 miles.
Tehama. Tehama County.—*a* 187 miles,
Telegraph City, Calaveras County.—*a* to Milton, 122 miles; stage, 5 miles.
Temecula, San Diego County.—*a* to Colton, 540 miles; C. S., 49 miles.
Temescal, Alameda County.—*a* to Oakland, 8 miles; street railroad, 2 miles.
Tennants, Santa Clara County.—*b* 71 miles.
The Needles, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 240 miles.
Thompsons Flat, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 2½ miles.
Timber Cove, Sonoma County.—N. P. C. to Duncan Mills, 79 miles; stage, 19 miles.
Timbuctoo, Yuba County.—*a* to Marysville, 142 miles; stage, 18 miles.
Tipton, Tulare County.—*a* 262 miles.
Tocaloma, Marin County.—N. P. C., 32 miles.
Todds Valley, Placer County.—*a* to Auburn, 126 miles; stage, 20 miles.
Tomales, Marin County.—N. P. C., 55 miles.
Tortuga, San Diego County.—*a* 677 miles.
Tormey, Contra Costa County.—*a* 27 miles.
Tower House, Shasta County.—*a* to Delta, 272 miles; stage, 18 miles.
Towles, Placer County—*a* 159 miles.
Town Talk, Nevada County.—*a* to Colfax, 144 miles; N. C., 20 miles.
Tracy, San Joaquin County.—*a* 72 miles.
Tres Pinos, San Benito County—*b* 100 miles.
Tremont, Solano County.—*a* 73 miles.
Trigo, San Joaquin County.—*a* 115 miles.
Trinidad, Humboldt County.—P. C., 233 miles.
Trinity Centre, Trinity County.—*a* to Delta, 272 miles; stage, 51 miles.
Trubody, Napa County.—*a* 54 miles.
Truckee, Nevada County.—*a* 209 miles.
Truitts, Sonoma County.—S. F. & N. P., 86 miles.

Tulare, Tulare County.—*a* 251 miles.
Tunnel, Los Angeles County.—*a* 456 miles.
Turlock, Stanislaus County.—*a* 127 miles.
Tuscan Springs, Tehama County.—*a* to Red Bluff, 199 miles; stage, 7 miles.
Tustin City, Los Angeles County.—*a* to Anaheim, 516 miles; stage, 7 miles.
Tuttletown, Tuolumne County.—*a* to Milton, 122 miles; stage, 26 miles.
Two Rocks, Sonoma County.—S. F. & N. P. to Petaluma, 36 miles; stage, 8 miles.
Tyler, Tehama County.—*a* 188 miles.
Tylers, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 18 miles.
Tyrone Mills, Sonoma County.—N. P. C., 74 miles.

Ukiah, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 30 miles.
Uniontown, El Dorado County.—*a* to Auburn, 126 miles; stage, 9 miles.
Upper Lake, Lake County.—*a* to Calistoga, 73 miles; stage to Lower Lake, 35 miles; stmr., 20 miles; or S. F. & N. P. to Cloverdale, 84 miles; stage, 50 miles.

Vacaville, Solano County.—*a* to Elmira, 60 miles; V. V. & C. L., 4 miles.
Vallecito, Calaveras County.—*a* to Milton, 122 miles; stage, 29 miles.
Vallejo, Solano County.—*a*, 32 miles; or stmr., 27 miles.
Vallejo Junction, Solano County.—*a* 29 miles.
Valley Ford, Sonoma County.—N. P. C., 61 miles.
Valley Spring, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N., 28 miles.
Valona, Contra Costa County.—*a* 30 miles.
Vega, Monterey County.—*b* 96 miles.
Venada, Colusa County.—*a* to Williams, 125 miles; stage, 13 miles.
Ventura, Ventura County.—P. C., 311 miles.
Vina, Tehama County.—*a* 205 miles.
Vincent, Los Angeles County.—*a* 421 miles.
Vineland, Napa County.—*a* 63 miles.
Virginia, Placer County.—*a* to Lincoln, 119 miles; stage, 6 miles.
Visalia, Tulare County.—*a* to Goshen, 241 miles; Visalia R. R., 9 miles.
Volcano, Amador County.—*a* to Ione, 140 miles; stage, 25 miles.
Volcano Springs, San Diego County.—*a* 661 miles.

Wade, Kern County.—*a* 321 miles.
Walkers Landing, Sacramento County.—Stmr., 92 miles.
Wallace, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N., 18 miles.
Walnut Creek, Contra Costa County.—*a* or S. P. C. to Oakland, 8 miles; stage, 17 miles.
Walnut Grove, Napa County.—*a* 70 miles.
Walters, San Diego County.—*a* 625 miles.
Walthall, San Joaquin County.—*a* 101 miles.
Warm Springs, Alameda County.—*a* 37 miles.
Warners Ranch, San Diego County.—*a* to Colton, 540 miles; and C. S. to San Diego, 121 miles; stage, 60 miles; or P. C.
Washington, Nevada County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 21 miles.

Washington, Yolo County.—*a* 90 miles.
Washington Corners, Alameda County.—*a* 34 miles.
Waterloo, San Joaquin County.—*a* to Stockton, 92 miles; stage, 10 miles.
Waterman, San Bernardino County.—*a* to Mojave, 382 miles; A. & P., 70 miles.
Watsonville, Santa Cruz County.—*b* 101 miles.
Waverly, San Joaquin County.—*a* 114 miles.
Webster, Yolo County.—*a* 81 miles.
Weaverville, Trinity County.—*a* to Delta, 272 miles; stage, 46 miles.
Webbs Landing, Contra Costa County.—Stmr., 53 miles.
Webber Lake, Sierra County.—*a* to Truckee, 209 miles; stage, 24 miles.
Westport, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 95 miles.; or N. P. C. to Duncan Mills, 79 miles; stage, 125 miles.
West Berkeley, Alameda County.—*a* 10 miles.
West Oakland, Alameda County.—*a* 6 miles.
West Point, Calaveras County.—*a* to Lodi, 104 miles; S. J. & S. N. to Valley Spring, 28 miles; stage, 29 miles.
Wheatland, Yuba County.—*a* 130 miles.
Westminster, Los Angeles County.—*a* to Anaheim, 509 miles; stage, 4 miles; or P. C.
Whisky Hill, Santa Cruz County.—*b* to Watsonville, 101 miles; stage, 2 miles.
Whitelys Ford, Modoc County.—*a* to Delta, 272 miles; stage, 135 miles.
Whitehall, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 15 miles.
Whitneys, Sutter County.—*a* 114 miles.
White Rock, Sacramento County.—*a* to Sacramento, 90 miles; S. & P., 29 miles.
White Sulphur Springs, Napa County.—*a* to St. Helena, 64 miles; stage, 3 miles.
Whitewater, San Diego County.—*a* 583 miles.
Whitesboro, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; N. P. C. to Duncan Mills, 79 miles; stage, 87 miles; or P. C.
Wilburs Hot Springs, Colusa County.—See Sulphur Creek.
Williams, Colusa County.—*a* 125 miles.
Williamsons, Sacramento County.—*a* to Sacramento, 90 miles; S. & P., 14 miles.
Willits, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 54 miles.
Willmore, Los Angeles County.—*a* 500 miles.
Willows, Colusa County.—*a* 151 miles.
Wilmington, Los Angeles County.—P. C., 392 miles; or *a* 504 miles.
Windsor, Sonoma County.—S. F. & N. P., 60 miles.
Winters, Yolo County.—*a* to Elmira, 60 miles; V. V. & C. L., 17 miles.
Woodbridge, San Joaquin County.—*a* to Lodi, 104 miles; S. J. & S. N., 3 miles.
Woodfords, Alpine County.—*a* to Reno, 244 miles; V. & T. to Carson, 31 miles; stage, 30 miles.
Woodland, Yolo County.—*a* 86 miles.
Woodside, San Mateo County.—*b* to Redwood, 29 miles; stage, 6 miles.
Woodville, Tulare County.—*a* to Goshen, 241 miles; V. to Visalia, 7 miles.
Woolseys Flat, Nevada County.—*a* to Colfax, 144 miles; N. C. to Nevada, 22 miles; stage, 16 miles.
Wrights, Santa Clara County.—S. P. C., 62 miles.

Wrights Hotel, Santa Clara County.—S. P. C., to Wrights, 63 miles; stage, 2 miles.

Wyandotte, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 6 miles.

Yankee Hill, Butte County.—*a* to Marysville, 142 miles; C. N. to Oroville, 28 miles; stage, 18 miles.

Yankee Jims, Placer County.—*a* to Auburn, 126 miles; stage, 18 miles.

Yorkville, Mendocino County.—S. F. & N. P. to Cloverdale, 84 miles; stage, 20 miles.

Yosemite Valley, Mariposa County.—*a* to Raymond (end of new Yosemite extension), 200 miles; stage via Mariposa Big Trees, 60 miles; or *a* to Milton via Stockton, 143 miles; stage, 85 miles.

Yolo, Yolo County.—*a* 91 miles.

You Bet, Nevada County.—*a* to Dutch Flat, 157 miles; stage, 7 miles.

Yountville, Napa County.—*a* 55 miles.

Yreka, Siskiyou County.—*a* to Delta, 272 miles; stage, 115 miles.

Ysidora, San Diego County.—*a* to Colton, 540 miles; C. S., 75 miles.

Yuba City, Sutter County.—*a* 141 miles.

Yucca, Kern County.—*a* to Mojave, 382 miles; A. & P., 20 miles.

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