THE BIG BEND TUNNEL IN BUTTE COUNTY, CALIFORNIA.

Since that famous year of 1848, when Marshall found his gold nuggets in the race-course of Sutter's sawmill on American River, California has been noted in the history of the precious metals as one of the most bountiful and at the same time one of the most constant producers. The legitimate industrial pursuit of gold has become so characteristic of her people that the bare mention of her name is sufficient to call up a picture of quartz ledge and placers. Thirty odd years spent in persistent attention to one calling has given her a pre-eminence in the industry as gratifying as it is remarkable.

The machinery which has been devised to work her auriferous quartz and gravels is unsurpassed in the entire world. A distinct type has been evolved. The machinery of the Pacific is to-day the model for the machine builders of all gold-producing countries. Her enterprise in the search and working of the sources of the precious metals has been marked by an unprecedented magnitude and boldness. Her hydraulic mining has been on a scale sufficient to permanently change the topography of the country. Whole mountains have been washed away. The beds of ancient rivers have been followed, and deprived of their precious burden. The course of living streams has been checked and altered. One hundred million dollars' worth of gold, that was at one time mingled with the sands of these river bottoms, has been recovered in three years, and is now added to the commerce of the world.

All of these changes have been accomplished, all this wealth has been gathered, in but a comparatively short period of time. With the appropriation of the more eligible sites and the exhaustion of the more available treasure, however, it has been necessary for the gold miner to turn his attention to works of even greater difficulty. This more closely guarded gold has only been brought within reach by the wonderful advance in engineering science and by the perfection of the tools and mechanisms of the engineer.

The early discovery of gold having been made on Feather River led to a most careful prospecting of the length of its entire bank. Considerable value has been taken from its bed. Portions of the river have, however, on account of their impetuous currents and steep banks, remained inaccessible to the miner even after their value became known. The almost semicircular curve in Butte County denominated the Big Bend is a case in point. Occasional washing of its bars and hurried incisions into the gravel of its bed proper have disclosed a promising richness, and made further working very desirable. The rocky canon through which the river flows for fourteen miles before disengaging its waters from the Big Bend is wild, and accessible only with difficulty. The river itself has a sufficient fall to create a strong current, and a volume seldom less than 80,000 miners' inches. These circumstances have never permitted more than casual operations.

Both above and below the Bend, very profitable enterprises are said to have been carried out. A company of Buffalo capitalists, induced by these considerations, determined to investigate the possibility of driving a tunnel across the base of the semicircle, and by thus draining the fourteen miles of river bed included in the Bend, make it feasible to thoroughly work the promising gravels. During the summer of 1882, careful surveys of the region were made by Mr. N. A. Harris, the superintendent chosen by the company, and Mr. James McGann, at that time official surveyor for Butte County. At the completion of the surveys, it was found that a tunnel about 12,000 feet long, with an average grade of 32·1 feet to the mile, would carry the waters from above the Bend to Dark Canon, from which they would pass to the West Branch, and eventually reach the main river at a point some distance below the Bend. By diverting the waters in this manner, the entire bed of the river for a distance of about fourteen miles would be exposed to mining operations.

As the scheme was regarded as entirely practical by several experienced engineers, the company determined to carry it into effect. In the following November, work was begun by blasting off the surface of the rock in Dark Canon, and getting a solid working face for the air drills. It was decided to run the tunnel at an upward grade of 29·7 feet to the mile until within 300 feet of its upper end. From this point, all of the unused grade will be utilized in giving a high velocity to the inflowing waters. The drilling proper began on the 18th of November, 1882. Two days later a night shift was put to work, and on the first of the following month three shifts of eight hours each were established. When the operations first began, the plant consisted of a No. 4 Burleigh air compressor, so arranged that it could be driven by steam or water power; an air tank, 4 by 16 feet, a No. 3 Knowles pump; a 2 by 8 ft. Lewellyn heater; an 8 ft. Knight water wheel and fittings; a Buffalo drill carriage mounting four drills; and a complete tubular boiler, 5 by 16 feet. Since then, there have been added 4 Burleigh tunnel drills, a No. 4 Clayton duplex air compressor, a No. 5 Baker blower, and an engine to run the blower.

The water wheel is supplied from a ditch carrying 100 miners' inches of water taken from Dark Canon. An 11 inch iron pipe, having a vertical fall of 275 feet, conveys the water to the wheel.

The progress of the work since the beginning is shown in the following table:

Distance by hand prior to Nov. 18, 1882	26 ft.
" " drills to Dec. 31, 1882	373 "
" " " Jan. 1, 1884	3,503 "
" " " Jan. 1, 1885	3,090 "
" " " Jan. 1, 1886	3,855 "
Total to Jan. 1, 1886	10,847 "
" length of tunnel	12,007 "
Remaining distance	1,160 "

No full record of work was kept prior to Jan. 1, 1883, but since then it is complete. In 1883, six days' time, or 18 shifts, were lost; in 1884, four and two-thirds days, or 14 shifts, were lost; and in 1885, only three and two-thirds days, or 11 shifts. This represents all time lost by reason of breakage of machinery, cleaning boiler, and all other causes.

The least distance made in any month was in August, 1883, when only 175 feet were accomplished. The greatest distance made in the same time was in September, 1885, when the heading was advanced 405 feet. The monthly average for 1883 was 291·9 feet, and for 1885 was 327·2. The character of the rock has changed during the progress of the tunnel, and therefore the results of the different months are not strictly comparable with each other. During the first nine months, an easily penetrated slate formation, with occasional stringers of quartz and granite, prevailed, with the exception of about 200 feet of very hard diorite. The rock was sufficiently firm to dispense with all timbering. In several cases, bodies of rock were passed through, yielding from eight to fourteen dollars per ton in gold and silver. For several months after this, the rock continued hard and difficult to work; but when the tunnel had been driven about six thousand feet, or just half the distance, a black slate was encountered, which, though close and hard, and requiring a large amount of explosives to blast it, permitted excellent speed with the drills.

The tunnel is being constructed with a width of 16 ft. and height of 10 ft., giving a cross sectional area of 160 square feet, or 23,040 square inches. From an elaborate series of measurements made at the site of the upper end of the tunnel, it is calculated that an outlet of this area will suffice to carry off the waters of the river for a period of from seven to nine months out of each year. Just at this point the river is narrow and inclosed between steep banks, so that it offers a favorable site for a dam.

In driving the heading, each of the three shifts is made up of a boss, 4 drill men, 4 helpers on drills, 1 powder man, 1 car man, and 2 laborers. The outside force consists of 2 blacksmiths, 2 helpers, 1 machinist, 2 engineers, and a number of other laborers varying with the requirements of the work. The ventilation of the tunnel is kept up by means of the air drills and the Baker blower. When the drills are in operation, the exhaust furnishes all the fresh air needed.

The blower is located at the mouth of the tunnel, and is driven by means of a separate engine. It connects with an eleven inch iron pipe, which extends up the tunnel to within two hundred feet of the working face. The blower is used exclusively as an exhaust for extracting the smoke and bad air from the heading. It is only put in operation ten or fifteen minutes before a blast, and at the same time the air compressor delivers a volume of fresh air directly into the face of the working. This arrangement permits the men to resume work within about fifteen minutes after blasting. Both blower and compressor are kept at work until the debris has been removed and the drilling recommenced, when the blower is shut down until just before another blast. A track of two foot gauge, laid with sixteen pound T rail, extends from the heading. The grade being uniformly down, the removal of the rock is not difficult. The movement of the cars is effected entirely by means of mules, six animals being kept at the tunnel for this purpose. The trains are composed of from ten to twelve cars, and the number of daily trips is regulated entirely by circumstances.

In addition to the main part of the enterprise, that of driving the tunnel, an immense amount of work has been necessary on the surface. Roads have been built in order to facilitate the transportation of supplies from Oroville, some sixteen miles distant, and have been extended over different parts of Big Bend Mt., so that timber can be conveniently brought to the sawmill and furnace. Fourteen miles of pack-animal trail have been built around the Big Bend, in order to make all portions of the claim accessible. A private telephone wire has been built to Oroville, and in time will be extended to all parts of the trail. The company has bought several thousand acres of land, in order to cover its tunnel site, provide ample timber reserves, and protect it against actions for damages arising out of the backing up of the water above the proposed dam or out of the increased volume which, as soon as the tunnel is completed, will find an outlet through Dark Canon and the West Branch. The president of the company, R. V. Pierce, Esq., of Buffalo, N. Y., informs us that the tunnel itself will probably be completed about April 1, and that they hope to do a good season's work in treating the gravel during the coming summer.

When the river is turned into the tunnel and its bed drained, several mining camps will be established at favorable points on the Bend, so that the gravel can be worked in a number of localities at the same time. The treatment will consist in loosening up the gravel, raising it, and running it through sluices. The gold, from its greater specific gravity, collects on the bottom of these sluiceways, while the earth and debris are carried along by the stream of water, and will be deposited at convenient points on the bank. The water for the supply of these sluices and "long toms" will be taken from the river above the dam, by means of ditches, and from the smaller tributaries that enter the Bend itself. The illustrations on the front page show the tunnel site and workings.

No materials exist for the formation of even an approximate estimate of the amount of gold which may be expected to be recovered from these gravels. Practical miners of the neighborhood state that it will be from fifty to one hundred and fifty million dollars. This estimate, however, is only valuable as an experienced guess, for there are no data at hand which would warrant one in venturing upon figures.

English Patents in 1885.

The Board of Trade has appointed Sir Farrer Herschell, the Earl of Crawford and Balcarres, and Baron Henry de Worms, M. P., to be a committee to inquire into the working of the patent office under the act of 1883. The *Ironmonger* thinks the step is a very proper one and very well timed, for, as the act has now had two years' trial (it came into force on January 1, 1884), it is possible to ascertain how far it has really proved an improvement on the previous law, and what are the defects which practical trial may have brought to light. Certain defects have already been discovered, and have been remedied by the short amending act passed last session,* and there will probably not be much question among those familiar with patents that, whether or not any further alteration in the law is required, there are many points in which the practice of the office leaves considerable room for improvement.

On the whole, it need not be doubted that the act has given satisfaction to inventors. Reduction in fees was what they mainly clamored for, and this they got, at all events, in the initial stages. If the number of patents applied for be taken as a criterion of the value of the act, there can be no further question about it, for in this respect its success exceeded the most sanguine expectations of its promoters. In the first year of the new act there were 17,110 applications, not far from three times the number in any previous year, and in the year just past there were 16,101. This falling off of 1,000 may easily be accounted for by the fact that there was a sort of accumulation of inventions at the beginning of 1884 waiting for cheap patents, as is shown by the rush to the patent office in the earlier months of that year.

About 20 per cent of the applications are from persons not resident in the United Kingdom, and the suspicion cannot but arise that a certain proportion of this large percentage are applications for patents made with the idea of preventing the working of an invention in England, and therefore enabling its owners to supply English markets with goods manufactured abroad. Under the act, the Board of Trade has power to compel an inventor to grant licenses. But the *mandamus* by which this provision is to be enforced cannot reach the foreigner, and the Board has no power to cancel the patent. It may be thought that, in any case in which there had been failure on these grounds to obtain a license, the fact of having applied for one would be sufficient defense to an action for infringement; but this is one of those questions which remain matter for speculation until the courts have had their say upon them.

The Tehuantepec Ship Railway.

Captain James B. Eads and Hon. William Windom, president of the Tehuantepec Ship Railway, recently appeared before a joint meeting of the Congressional Committee on Commerce to advocate the passage of the ship railway measure introduced by Senator Vest in December last. A model showing the workings of the railway was exhibited and explained. All of the members present manifested the greatest interest in the subject. The case was thoroughly presented to them in all its details. A most favorable impression was evidently made upon the gentlemen of the committee, and while the fate of the measure has not yet been assured, the chances are thought to be in its favor.

* This act, passed August 14, 1885, comprises several sections, but most of them pertain to rules of practice in the patent office. But that affecting inventors most generally is the one declaring that neither the drawings nor specifications in abandoned applications shall be open to public inspection or be published. Another section determines the right of several persons to apply jointly for a patent, whereas doubts on this point had arisen.—ED.

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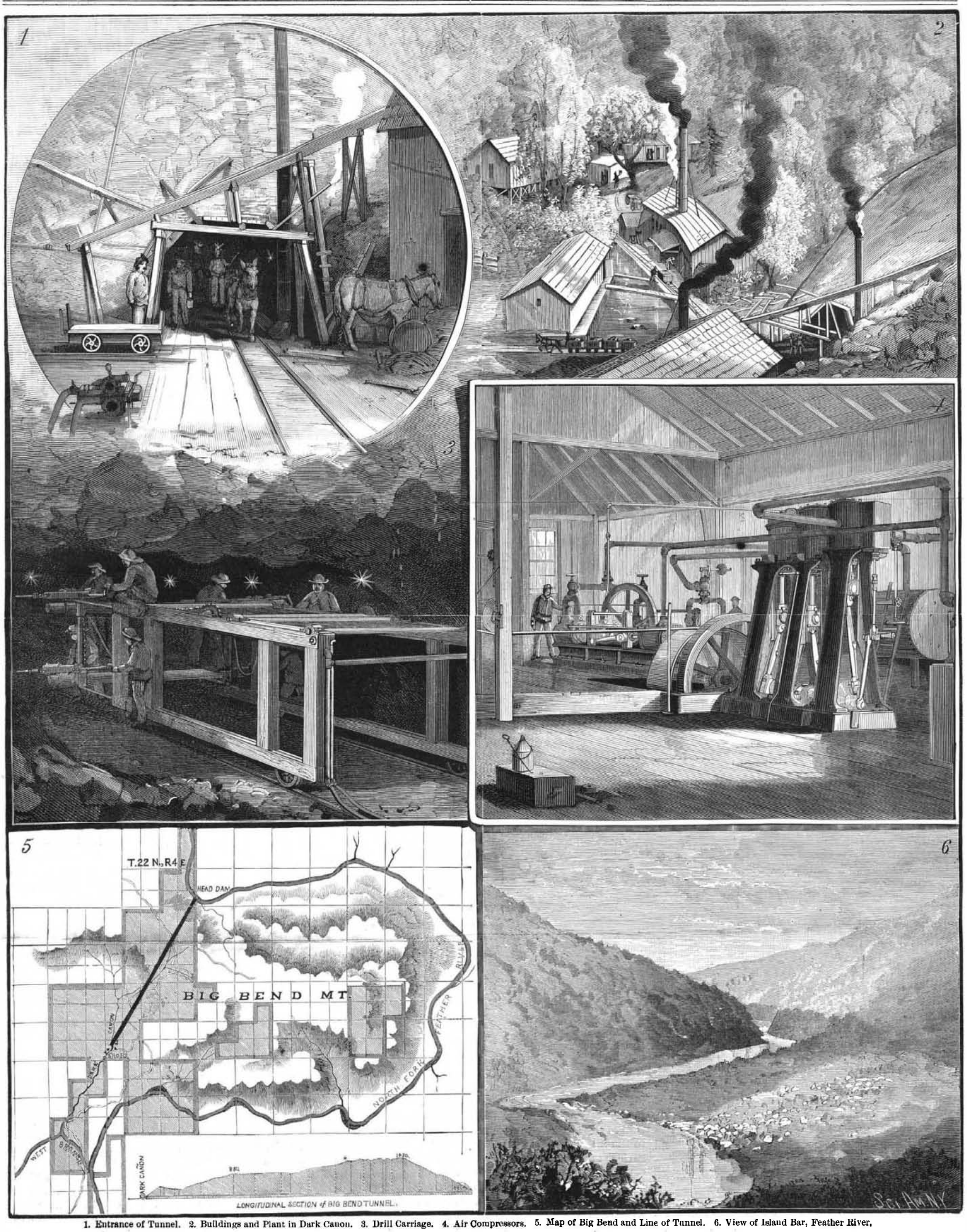

1. Entrance of Tunnel. 2. Buildings and Plant in Dark Canon. 3. Drill Carriage. 4. Air Compressors. 5. Map of Big Bend and Line of Tunnel. 6. View of Island Bar, Feather River.

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