

which is connected by a rod to a lever mounted above the cam-shaft. The lower end of this lever is provided with a roller, which engages a face-cam on the shaft. This cam is so shaped as to swing back the lower end of the lever when the drum-cams have drawn their respective cutters to the outer positions. This serves to push forward the link and pawl, turning the ratchet wheel on the conveyor-shaft; the conveyor-chains are all suitably connected with this shaft, so that the work on the beds will move forward in position for the next cut, while the cutters round the inner faces of the tenon that are being formed. After the projection on the cam has been cleared, the lever, together with its connections, is drawn back by the tension of a spring, and the pawl snaps behind the next tooth of the ratchet wheel, ready to move it forward another notch, when the cam projection again engages the lever. In the meantime the cutters are moved inward, each forming another tenon in its respective vertical piece and cutting grooves in the horizontal piece. Thus the work continues without requiring any attention on the part of the operator. When it is desired to dovetail an irregular piece of work, such as the swelled or curved front of a bureau drawer, it is necessary to support this front while the ends are being acted upon by the cutters. A central support and a supplemental conveyor-chain are therefore provided for the purpose. These are of course adjustable to different heights according to the shape of the work, and provision is made for moving them sidewise, also, in order that they may be properly positioned for work of different lengths. The machine embodies many improved details of construction which we cannot here describe, owing to the limits of space. One important construction will be observed in the mounting of the cutter spindles. It will be seen that they have tapered portions which fit in tapered bearings. The bearings may be screwed down to take up any play due to wear of the spindle. It is obvious that any size or shape of cutter may be secured in the spindle to meet the requirements of the work.

LONG-DISTANCE HIGH-TENSION TRANSMISSION OF POWER IN CALIFORNIA.

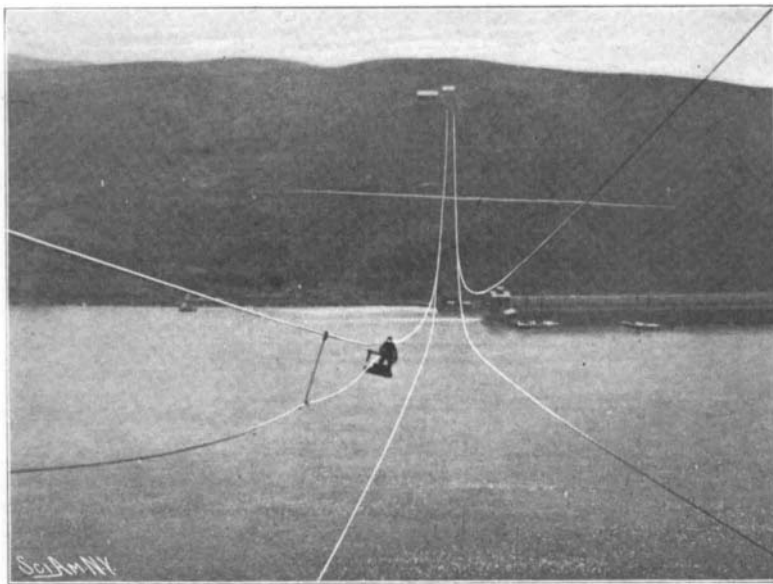
BY HAMILTON WRIGHT.

In the vast developments of electric power and its transmission California is fast solving the problem of cheaper fuel and power. The remarkable development that has occurred in the long-distance high-tension transmission of power as well as the approximate magnitude of the transmission industry is directly traceable to the absence of coal in material quantities in this State and the corresponding high price of mechanical power. The great cost of steam power at the time of earliest efforts toward electric transmission was responsible for the turn of the California tide of engineering effort from the coal pile to the waterfall as the most promising source of energy whence to operate the rapidly-growing electrical industries of the Golden State.

Perhaps the most consequential and interesting phase of electric transmission engineering in California lies in the unification of remotely separated electric systems into a single unit of vast proportions. In other words, all the elec-

tric lighting, power and railway interests of all the cities of the central and northern portion of the State have been concentrated and centralized into a single system which receives power from sources enabling the cheapest generation. The development and perfection of extremely long-distance transmission lines has made such unification of interests possible, and the honors should perhaps be divided equally between the Standard Electric Company of California, with its

145-mile electric San Francisco transmission, and the Bay Counties Power Company, with its main-line transmission of 142 miles from the Colgate power house to Oakland. The Standard Electric Company was the first in the world to come out with a definite and matured project for the transmission of power of great quantity over a distance materially in excess of 100 miles. It built its electric power plant and sub-stations and finished its pole lines practically ready



Greasing the Cables of the Colgate Power House.

for operation, but unforeseen difficulties prevented the completion of its water system, so that the Bay Counties Power Company, although beginning operations at a considerably later time, finished its plant before the Standard plant and in so doing secured the honor of being the first enterprise to successfully undertake such a long transmission. More than this, the Bay Counties Company secured a temporary contract with the Standard Company by which the Bay Counties Company delivered current to the Standard lines at Oakland for transmission to Stockton, a distance of 211 miles from the power house at Colgate, and as far north on the peninsula of San Francisco as Burlingame, a distance of 218½ miles from Colgate. These are the longest systems of electric transmission in the world. Now both the Standard and the Bay Counties plants are in operation, and each over its own line.

The plan of centralization was the direct outgrowth of the success of extremely long-distance transmission. The Bay Counties Power Company's pole lines traverse

from the power houses under the control of the Bay Counties Power Company. In fact, this company operates in all more than 3,000 miles of transmission lines.

By means of its transmission lines the Standard Electric Company is tying together the electrical interests of the cities and towns extending around the Bay of San Francisco from Oakland to San Francisco. The Standard plant at Electra, in Amador County, has a capacity of 15,000 horse power, while that of the four generating stations of the Bay Counties Power Company, located in Yuba, Nevada, and Butte counties, is close to 23,000 horse power. In addition to these outputs the Standard Company is now building a new 21,000 horse power station in Stanislaus County and the Bay Counties Company is building an 8,000 horse power station in Butte.

However, these two great systems, which fairly cobweb the central portion of the State from east to west, by no means comprise a major portion of the electric long-distance transmission plants in California.

In the northern California system are the Butte County Electric Power Company, supplying Chico and the gold dredgers of that region and traveling with 23,000 volts thirty miles, and the Keswick Electric Power Company, which supplies power from Shasta to Redding and the Mountain Copper Company.

Electricity in mining is proving of immense value, especially for gold and silver mining in the desert regions where water is precious and fuel is costlier than almost anywhere else in the United States. With

electricity, shafts, tunnels, leads, and slopes may be illuminated, drills may be run, elevator hoists lifted, fans will keep out impure air and pumps will keep the mine dry, while dynamite blasting may be conducted with less than half the present dangers.

The famous Yellow Aster Mining Company, at Randburg, has gone to great expenditure in demonstrating the uses of electricity in working mines and has recently contracted to buy 3,500 horse power from a power company which is developing 8,000 horse power for mining purposes. Very recently a company with \$1,500,000 paid-up capital has been organized for utilizing the power in five great streams along the Sierras. A corps of engineers who have been making plans for the development of electric power from the Kaweah River in Tulare County put the total expense of the work at \$9,000,000. About 9,000 horse power will be obtained and this may be utilized in Tulare, Porterville, and other San Joaquin Valley towns. The San Joaquin Valley Company has recently finished harness-

ing a stream in the Sierras and is now transmitting several thousand horse power to Fresno and Hanford, over foothills and across rivers, ranches, orchards, and vineyards, for a distance of thirty-two miles. This is the cheapest power in the world and is furnished at as low a rate as two cents per horse power per hour.

Probably the most remarkable use to which electric power has been put is to move the implements of agriculture. At this writing a number of big grain raisers in San Joaquin Valley, California, are closing a successful series of experiments by which a combined harvester is impelled by electric power. Thus the stream which has furnished the wheat fields with water for irrigation purposes, also

gives the power by which the crop may be later harvested.

The world's first successful experiment in electrical transmission was made in Germany in 1891. From Lauffen a line of 108 miles was run into Frankfurt to light an exposition held there in that year. It worked successfully. Within a year the first electrical power plant in which the specific gravity of water was used in the United States was begun at Pomona,



The Latest View of the Interior of the Colgate Power House.

LONG-DISTANCE HIGH-TENSION TRANSMISSION OF POWER IN CALIFORNIA.

that entire portion of California from Nevada County on the east to Butte County on the north, to Sonoma and Modoc counties on the west, and to Alameda County on the south, taking in each and every city, mining or other community consuming power *en route*. The electric lighting, electric power, electric railway and gas interests of this entire section are, almost without exception, under one transmission service for the operation of their electrical business, for all take power

Cal. This was followed by the opening of the big plant at Folsom, Cal., which at that time was the largest in the world. The first current that flashed along its wires carried 400 horse power 21 miles at a voltage of 11,000. Years were spent in the work at Folsom. An immense masonry dam 650 feet long, 24 feet wide at the crest, 87 feet wide at the bottom, and 89 feet high at the highest point had been thrown across the American River. The dam contains 50,000 cubic yards of granite and creates a reservoir three miles long. At either end are massive head gates to contract the passage of the water into canals, which give a flow of 85,000 cubic feet a minute. The water supply is sufficient for the irrigation of 300,000 acres of land, including large areas on both sides of the American River. The work on the Folsom plant five years ago was only second to that at Niagara Falls, and the great plant already furnished 45,000 horse power, transmitted a distance of 24 miles to Sacramento for use by street car lines, electric lighting companies, and in factories and machine shops. The success of this great plant was only made possible by the fact that the year after it started a dynamo was invented which made electric power available for manufacturing purposes. The first plants could employ their currents for lighting and for the propulsion of street cars alone, but here was a new application which made the patronage and the profits of the concerns doubly sure. The demand for electric power and the field for its operations in California are proved by the alacrity with which it has been caught up by consumers all along the power lines. All plants are running full power, with the whole current in use and more in demand. Very lately the large Folsom plant was found inadequate to supply Sacramento with a sufficient current and additional power was obtained from Colgate. All electric power companies strive for a business so regular that it will take a full supply all the time, for a full line will furnish just so many horse power a day and it costs as much to maintain a line whether it is supplying a full current or half its possible current. In industries which call for a regular supply of power, electricity has largely supplanted steam in San Francisco.

At the present time the power of the mountain cascades is being rapidly harnessed and a new industrial era has sprung up upon the Pacific coast. There are now twenty electric power plants upon the Pacific coast, and of those yet unmentioned is that now in process of construction at Redding in northern California, at the base of Mount Shasta. New York, San Francisco, and Buffalo capital is back of this enterprise to the extent of \$6,000,000, and when completed it will be the greatest electrical power plant in America outside of Niagara. Another large plant which when completed will hold the world's record for long-distance transmission is being constructed upon the Kern River, 27 miles from Bakersfield, Cal. A corps of engineers and a gang of laborers are hard at work. Then, too, there are the big Yuba County power plants and that of the Mount Whitney Power Company. There is a big plant at Truckee, Cal., which sends 1,500 horse power to the Comstock mines, the great mines which made millions for the Stewarts, Mackays, Flood, and Fair families and which are still paying dividends. The Blue Lake Water Company is another important plant. The South Yuba Water Company, in which Senator C. N. Felton and Dr. Charles Van Norden, of New York, are largely interested, will develop a 30,000 horse power plant. The company controls a number of large storage reservoirs and twenty large lakes in Placer and Nevada counties, California. They now have 400 miles of flumes and a storage capacity of five billions of cubic feet. They now furnish 5,000 horse power to the small cities and mines in that district.

In utilizing the power of mountain streams to run street cars, ship yards, mines, canning factories, gold dredgers, to illuminate, to propel machinery, and even to heat buildings in far-away cities, the value of the streams is not diminished, for most of the water upon issuing from the turbine is re-diverted for the purpose of irrigation. In fact the use of water for power does not consume one drop of the fluid, but employs only the energy furnished by its fall. Thus the two go hand-in-hand, and wherever the resources for irrigation are tapped, a double return for the capital employed may be obtained through the installation of electric power plants.

Altogether, 140,000 horse power has been converted into electrical energy in California. It is conservatively estimated that the waterfalls alone have close to 300,000 horse power, exclusive of that which will arise in the building of dams in torrential streams. There are now in the neighborhood of \$10,000,000 invested in these plants, and several thousand men are at present engaged in as many as a dozen different projects to convert the vast, almost inexhaustible power of the flowing streams into a force that shall be commercially valuable.

Correspondence.

A Jointed Snake.

To the Editor of the SCIENTIFIC AMERICAN:

Being a reader of your paper, of course I notice the snake stories; and having been raised on a farm in Missouri, while a boy killed many rattlesnakes, also other kinds, among them what was known to me as the joint-snake, that by striking would fall into sections about one and one-half inches in length; and the head end, about four inches long, would run away and hide until it thought the enemy had gone, then return and gather itself up, and be as good as new. In discussing snakes with a friend, born and raised in New York, now living in Ohio, I was unable to convince him that there was such a thing as a joint-snake. Since the statement that I have made is strongly disputed, it is but natural that I should be anxious to find an authority for my statement regarding the present or past existence of the joint-snake in the United States. Will you look the matter up, and give it a little space in your next issue?

NORMAN S. DONNELLY.

[Our correspondent refers to a creature which has puzzled many an observer and given rise to as many stories as the "milk-snake" and the "toad in the solid rock." It is fair to say that a large percentage of the farmers of the country believe that there is a "jointed" or "glass snake," which can disjoint itself and break up, to come together later; and it is difficult to find a boy brought up in the country who will not testify that he has seen the miracle time and again; and the most interesting feature is that they all firmly believe it. To give the deluded ones credit, the actions of the "jointed snake" are so remarkable, so extremely unconventional, that there is little wonder that the sharpest observer is deceived; but there is a vast difference between what one really sees and what one thinks he sees, and herein lies the mystery of the "jointed snake."

To start fairly, there is no animal known to science as a jointed snake. What the credulous observer believes to be such is a lizard known scientifically as *Ophiosaurus ventralis*; a well-known low form common east of the Mississippi River and south of the Ohio River. That it is considered a snake is hardly to be wondered at, as it has no feet; and when alarmed, darts away with the peculiar gliding or wriggling motion of a snake, and to any one but a naturalist it would, doubtless, be considered a snake. But the animal is a lizard, and the long cylindrical tail, twice as long as the body, to the untrained observer appears to be the body. This slender tail is the cause of the many fables prevalent regarding the marvelous powers of the "glass-snake," which is so brittle that it cannot be touched without breaking; but the fact is that the vertebrae, or bones of this long tail, are so delicately adjusted or connected that it is almost impossible to lift the animal by it without breaking it. Any violent jerk or strain will throw the tail into one or more pieces, which lie on the ground wriggling with a convulsive movement, while the head and body crawl away. In a word, it is not the body of the lizard, but its long tail which breaks up—a very common trick among lizards. The tail thus thrown off is deserted, the lizard having no more power to reattach it than has a man to assume his amputated leg. But the lizard has this advantage: a new tail begins to grow at once, and the glass-snake is in a short time itself again, and may break up and be renewed an indefinite number of times, so far as known. In a collection of lizards caught at random in the San Gabriel Valley, Southern California, fifty per cent had new tails in all stages of growth from one to four inches in length, being darker and readily recognized as new and growing tails. This faculty of reproducing lost parts or limbs is common among crustaceans, and the casting of tails is so deftly carried out among lizards that the conclusion is irresistible that it is intended to deceive the pursuer or enemy. Another "glass-snake" is the lizard of the genus *Anguis*. The "blind worm" often throws off its tail at the slightest danger, and it is almost impossible to catch and retain one without the loss of this member.—E.]

The New English Torpedo Boats.

The first of the new type of torpedo boat destroyers, for the British navy, the "Erne," has been launched from the yards of the Palmer Shipbuilding Company, of Jarrow-on-Tyne. This improved class has been rendered necessary by the loss of the "Cobra," and the buckling in heavy seas of other vessels, consequent on too light construction of the hull. In the "Erne" class, a fore-castle is provided in lieu of the turtleback deck, thereby providing a much higher bow for driving against a rough sea. The structural length of the hull has also been increased, whereby a considerable addition to the displacement is made above that of the 30-knot type boat. As a matter of fact, speed has not been sought after so much as

strength in the "Erne," for the maximum speed is only 25½ knots under the usual loading conditions. In this vessel somewhat of a reversion is made as regards speed to the first type of torpedo-boat destroyers, the speed of which was 27 knots. In subsequent vessels a speed of 30 knots was attained, but only by the sacrifice of structural strength. The dimensions of the "Erne" are: length, 222 feet; beam, 23 feet 6 inches; and 7,000 I. H. P. The armament, however, is the same as that of the 30-knot boats, comprising one 12-pounder, mounted on the conning tower forward, and five 6-pounders, four of these being on the broadside and one on the raised central platform aft, and two 18-inch torpedo tubes. With regard to the armament of future destroyers, the Admiralty has made an important alteration. Boats of 27-knots speed are to carry only one instead of two torpedo tubes, while the first-class torpedo boats will be fitted only with a view to enable this type of vessel to move with greater celerity in night attacks. The "Erne" is to carry a crew of 70 officers and men. The machinery consists of twin-screw triple-expansion engines, steam being supplied by four of Reed's water-tube boilers.

The Historical Novel and Its Value in Trees.

The flood of novels which has incessantly poured in upon us of late years, more than ever emphasizes the truism that of the making of books there is no end. A decade ago it was the so-called "psychological novel" that enthralled us; now it is the judiciously advertised historical novel that holds our rapt attention. Through the ingenious refinements of modern advertising the sales of fiction have been increased so prodigiously that a novel can hardly be called a "success" unless it has been sold to the extent of a hundred thousand copies.

The newspaper tales of the enormous editions of historical novels are by no means as fantastic as they may read. A list, carefully compiled from publishers' returns which are absolutely without reproach, shows that the sales of nine recently published novels have reached astounding proportions. Of one book, over 400,000 copies have been sold. Another is in its 325 thousand. Less successful books have attained only a paltry sale of 100,000, while a few minor ones hardly exceed a disappointing 80,000.

It is not our purpose to dilate upon the relative merits of these volumes of fiction, but simply to show what it costs to satisfy the public appetite for tales of wild adventure.

Books are made of paper. Paper in turn is made of cellulose, of which the chief source of supply is timber. In order to describe the romantic career of a seventeenth century gentleman of the rapier, it is necessary to fell a few hundred trees; the publication of many narratives in which the exploits of other cavaliers are dwelt on, may therefore entail the destruction of a forest.

The nine novels to which we have referred had a total sale of over 1,600,000 copies. Since the average weight of each book sold was probably twenty ounces, a little calculation will prove that these 1,600,000 books contained approximately 2,000,000 pounds of paper. We are assured by a manufacturer of paper that the average spruce tree yields a little less than half a cord of wood, which is equivalent to about 500 pounds of paper. In other words, these nine novels swept away 4,000 trees, and they form but a small part of the fiction so eagerly read by the American public. Some books are worth more than 4,000 trees. What may be the tree-value of the modern historical novel it is not within our province to decide.

A National Club House for Engineers.

Through the munificence of Andrew Carnegie, who has agreed to give financial aid to the extent of one million dollars or more, a national club house for engineers may be erected in the city of New York. The building proposed will occupy a plot extending from 39th to 40th Streets, between Fifth and Sixth avenues, upon a small portion of which the Engineers' Club of New York now stands. According to the present plans, the Engineers' Club will occupy one portion, and the remainder will be used by the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Society of Electrical Engineers, and the American Society of Mining Engineers provided the separate organizations decide to take advantage of Mr. Carnegie's offer.

More News About Nova Geminorum.

The light of Nova Geminorum appears to be fluctuating like that of Nova Persei No. 2. On the evening of May 1 it appeared that its light had increased about half a magnitude during the preceding twenty-four hours. Since the measures described in the Bulletin of April 22, similar measures were obtained on April 24, 25, 27, 28, 29, 30 and May 1, and gave the magnitudes 9.37, 9.67, 9.71, 9.81, 9.61, 9.76, and 9.26 respectively.

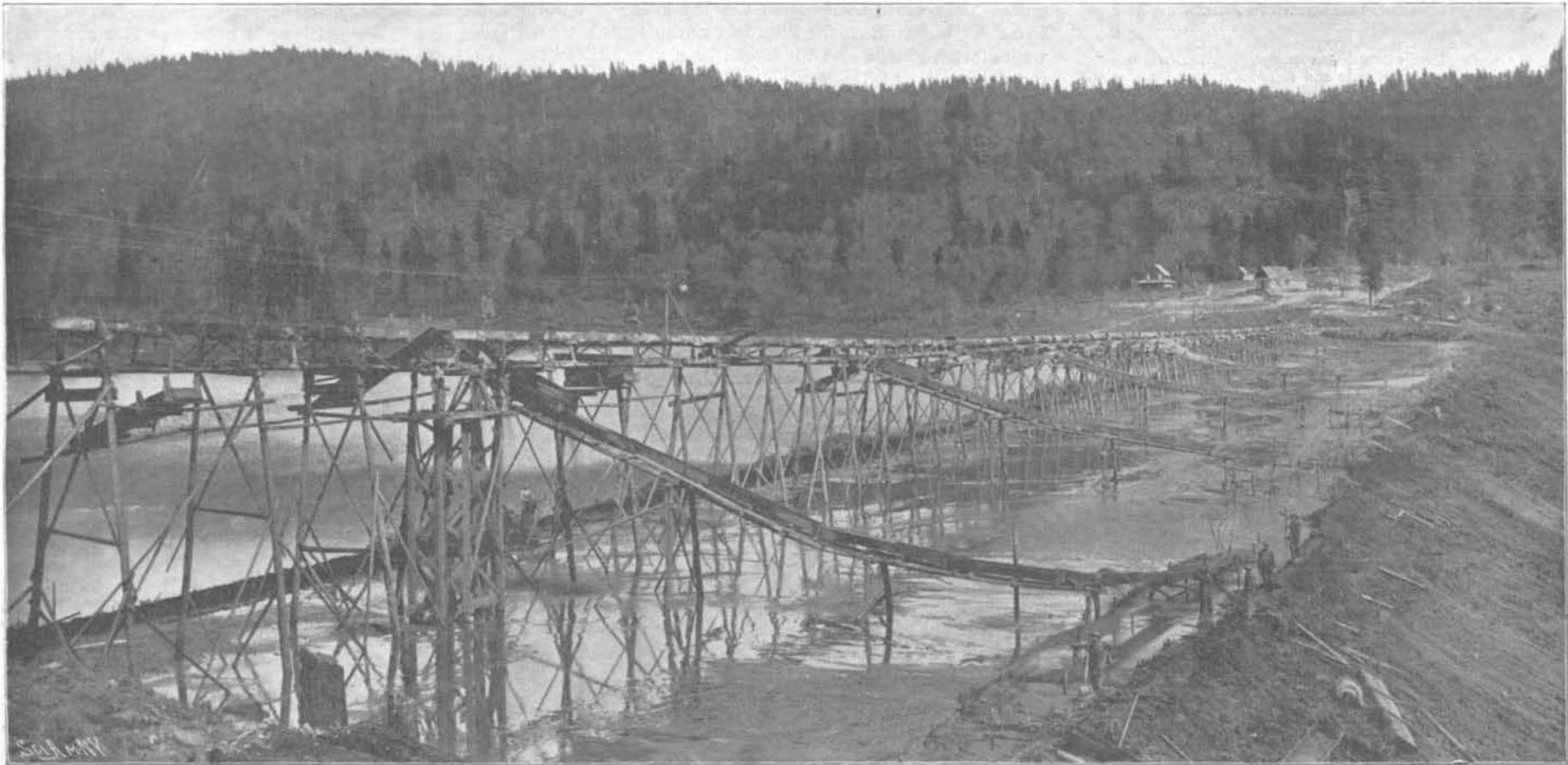
EDWARD C. PICKERING.

Harvard College Observatory.

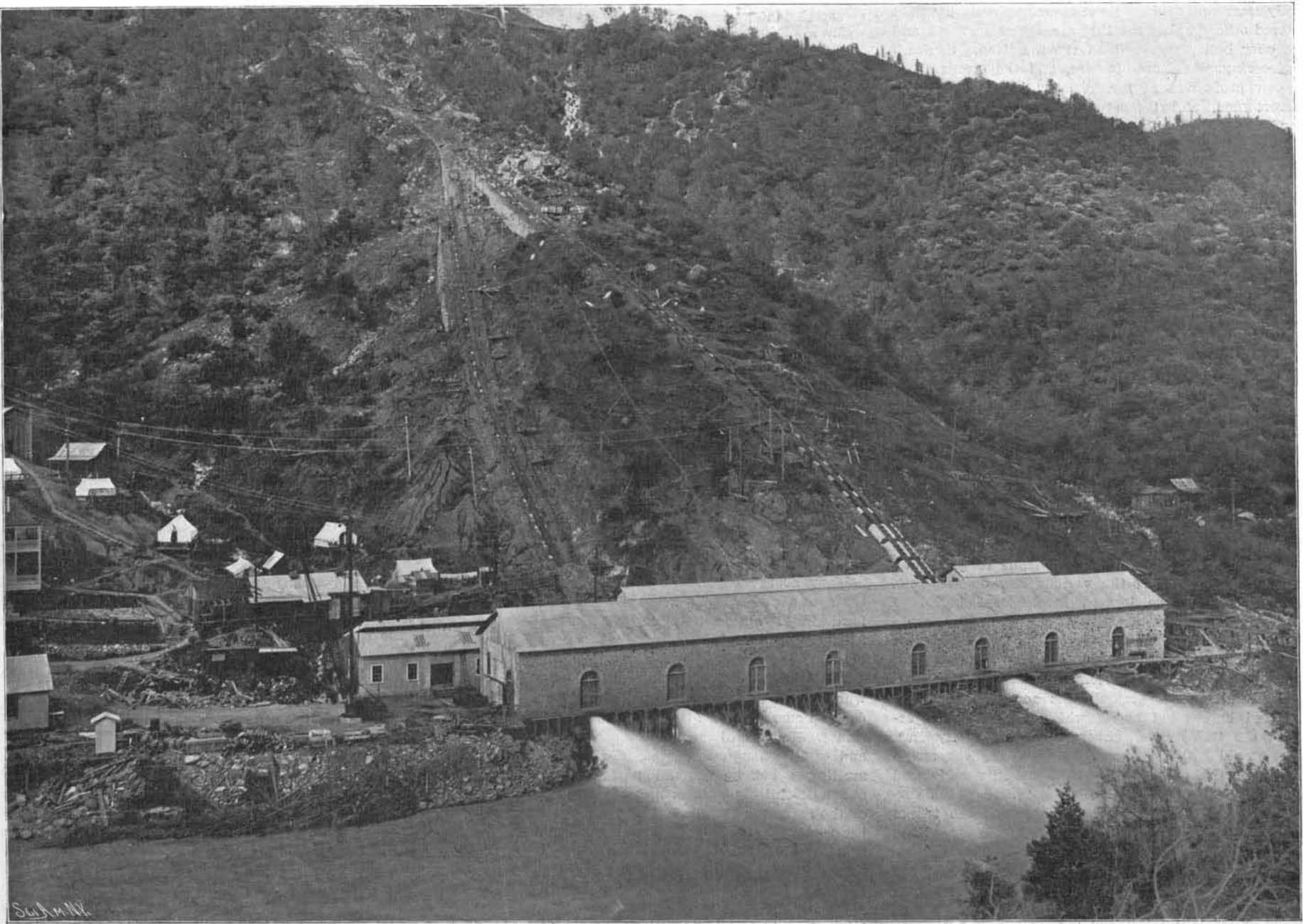
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Where the Filling of the Dam Confining the Reservoir is Being Sluiced in.



The Power House at Colgate.

LONG-DISTANCE HIGH-TENSION TRANSMISSION OF POWER IN CALIFORNIA.—[See page 373.]