THE TRANSPORTATION OF PETROLEUM.

Petroleum was discovered at a very early date in the United States. In western Pennsylvania oil had long been observed floating as a film upon the surface of some of the streams. The Indians and the early settlers used to collect it by placing blankets in the streams, which absorbed the oil, which subsequently was wrung out of them by hand. Even remains of excavations made by the aborigines have been taken to indicate crude "oil wells" made to collect the surface oil. The oil thus collected was used by the settlers to mix with paint, as an illuminant and medicinally. As a medicament it was sold as Seneca oil, and can still be procured in the drug stores.

Prof. Benjamin Silliman, the elder, described in 1833 what he termed a "fountain of petroleum" in western New York. It was a muddy, dirty pool of 18 ft. diameter, without outlet. On the surface of the stagnant water the oil collected, and was removed by skimming somewhat as cream is removed from milk. A board was used as skimmer, and when coated with the thick adhesive oil was freed from it by scraping. It was collected for use as a liniment or ointment. In the beginning of the present century oil had been collected from the West Virginia salt wells, and in 1849, or thereabout, an enterprising person named Kier bottled petroleum and sold it as a "natural remedy," sometimes selling as much as three barrels a day. In 1852 he distilled the oil and made a lamp oil, but one of very bad odor, and his efforts were entirely experimental.

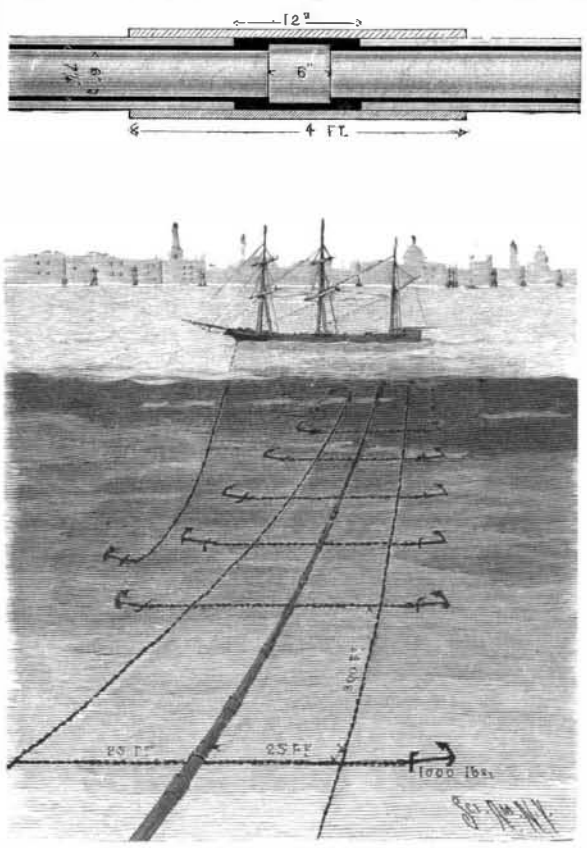
Meanwhile coal oil was being introduced into commerce. This was prepared by the distillation of cannel coal and bituminous shales. From 1840 to 1850 the industry was developed until it had attained considerable dimensions, there being fifty or sixty refineries at work. The name of kerosene was given to their product by the Downer Company, at Boston, Mass. In 1853 Mr. George H. Bissel saw a bottle of petroleum in the office of Prof. Crosby, of Dartmouth College. The oil had been sent to Prof. Crosby as a curiosity by Dr. Brewer, of Titusville, Pa. Mr. Bissel induced his partner, Mr. J. E. Eveleth, to prospect the ground whence the oil came, and they purchased one hundred acres and rented for ninety-nine years another tract of about the same size, all for the consideration of five thousand dollars. They organized the "Pennsylvania Rock Oil Co.," with $500,000 capital, notable as the first petroleum oil company, and the actual predecessor of the great Standard Oil Co. of to-day. They dug shallow wells and trenches for collecting the oil, and had it analyzed by Prof. Silliman. By accident Mr. Bissel came across one of Kier's showbills. Kier advertised his specific as coming from a well 400 ft. deep, and gave a picture of the derrick. At once Mr. Bissel conceived the idea of drilling artesian wells. After much trouble and a delay of two years the arrangements for drilling were completed, and the work was put in charge of Mr. E. L. Drake, known now to fame as Col. Drake. The well was drilled, and on Saturday, August 28, 1859, the workmen quit for the day, the drill having penetrated a cavity. The total depth was 69 ft. 6 in.

On Sunday one of their number, looking into the well, found it filled with fluid within 8 or 10 ft. of the surface. With an improvised tin dipper he drew up a sample and found it was petroleum. On Monday a pump was adjusted and some twenty-five barrels a day of oil was obtained.

The news spread far and wide, and occasioned intense excitement. Mr. Bissel, who was notified by telegraph, bought up all the stock he could get at in his own company, and the petroleum epoch was inaugurated. To-day the petroleum industry represents one of the greatest industries of the world. With gas and the electric light to compete against as illuminants, it is every year acquiring more importance, and holds a position as one of the three great sources of artificial light.

The present article is principally concerned with the transportation of the crude oil to the seaboard. The process of carrying petroleum from the wells to the distant refineries has been greatly modified within recent years, and new engineering methods have been devised to effect the transportation in question.

LEAD JACKETED PIPE CROSSING THE EAST RIVER.



METHOD OF LAYING PIPE LINE UNDER THE HUDSON RIVER AT NEW YORK.

The transferal of petroleum from the wells to the local refineries and depots was, originally, very laborious, and had to be carried on by teams and wagons, over the very bad roads and wagon tracks of the sparsely settled region. From the oil regions to the seaboard or to the large cities of the interior, the oil was originally shipped by rail, in barrels or on tank cars, or on boats, by a species of slack water navigation, down Oil Creek to the Alleghany River. In 1862 it cost about eight dollars to send one barrel of oil to New York, while oil, at the same time, was selling at the wells for fifty cents a barrel. The original tank cars carried two circular wooden vats. These were replaced by horizontal cylindrical iron tanks, 26 ft. long and 5 ft. 6 in. in diameter, holding about 2,000 gallons each. A number of these cars are still in use. In 1862 and 1864 the first suggestions toward transporting oil by lines of pipe were made, and in 1865 a pipe, 3,200 ft. long, was laid from Pithole toward Oil Creek, at Miller Farm. It could pass 81 barrels a day. It was often cut and damaged by the teamsters, who regarded it as a deadly rival, and had eventually to be guarded by a patrol of armed watchmen. At this period it cost between five and six dollars to send a barrel of oil to New York.

GO-DEVIL FOR CLEANING PIPES AUTOMATICALLY.

At the present day the entire oil region is covered by pipe lines. Small pipes, often of two inches diameter, do local service for wells, and collect the oil for shipment to the distant cities. To effect the latter, transportation trunk lines have been laid to New York, Philadelphia, Baltimore, Cleveland, and other points. These lines are for the most part owned by the National Transit Co., which is, really, a branch of the Standard Oil Company, which controls practically all of the refineries, as well as the oil business of the United States. The map which we publish shows the trunk lines and their size as operated by the company in question.

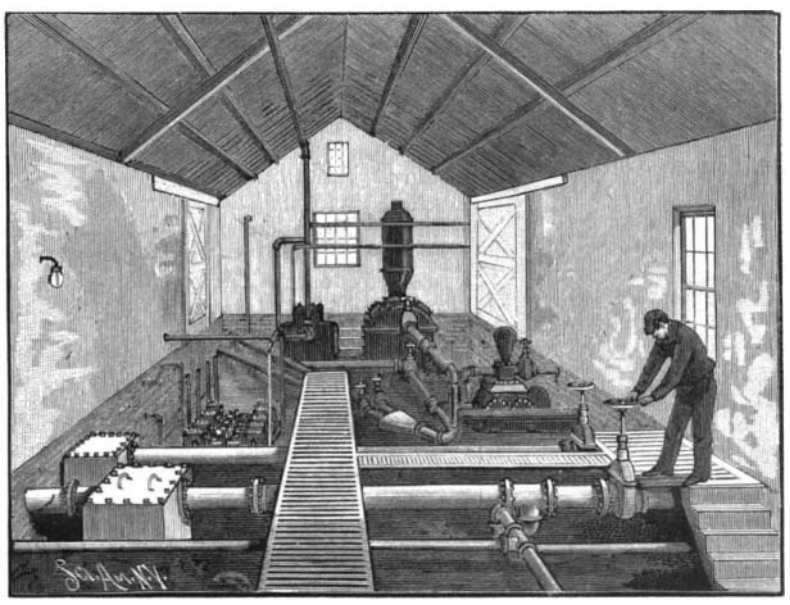
The New York City line may be taken as typical. It is about 300 miles long, and consists for most of its length of two parallel lines of six inch lap-welded, taper screw jointed pipe. This pipe is made for the purpose and is sold as pipe line tubing. To force the oil through the pipe powerful pumps are used, and pumping stations are established all along the line, at about 28 miles apart. The plant at each of these stations comprises one or more receiving tanks, 90 ft. diameter and 30 ft. height being standard dimensions for them. Boilers and Worthington pumps sufficient for the work complete the equipment. The work of a pumping station consists in forcing the oil through the pipe to the next station. Although this is the usual practice, loops have been laid around stations and the oil has been pumped through 110 miles of consecutive pipe line.

At the station hourly readings, day and night, are taken of the levels of oil in the tanks. To enable this to be done at night a reflector and distant lamp are employed, so that no light need be carried over the tank's roof.

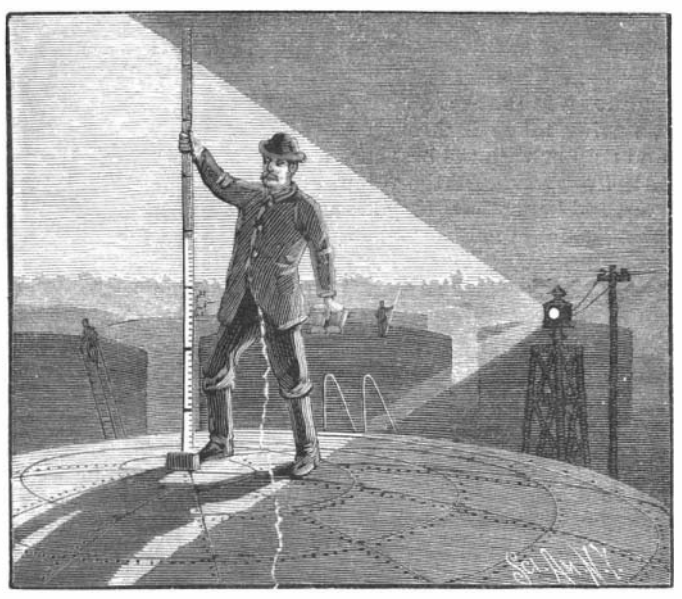
The Worthington high service pump, which we illustrate, was designed especially for this work. It has four steam cylinders, two high and two low pressure, steam jacketed, each set working tandem, and is direct acting. Each pair of cylinders actuates two single stroke rams of the exterior packed type. This brings the only possible source of plunger leakage under the eyes of the engineer. Between the high and low pressure cylinders the steam passes through a receiver, where the steam from the high pressure cylinder is heated before admission to the low pressure cylinder. The general dimensions of one of these pumps are as follows: Diameter of low pressure steam cylinder, 66 in.; of high pressure ditto, 33 in.; of plungers, 9¼ in.; stroke, 37¾ in. Horse power, 440; average duty 105,000,000 foot pounds per 100 lb. of coal. The rated capacity is one and one-half millions of gallons, against a pressure equivalent to 2,000 feet head of water.

The extraordinarily high duty record is the most striking feature of these engines. The great disproportion of diameter between the steam pistons and pump plungers indicates the nature of the service they are called on to perform. The delivery of oil at pressures of 900 lb. to the square inch was one of the early difficulties in the way of pipe transit, and the problem has been completely solved by the Worthington pumping engine.

For such high pressures it was found disadvantageous to use an air vessel, and to take its place and maintain an even pressure a pair of compensating cylinders and plungers are connected at the outer end of the rams. As shown in the drawing, these appear as two vertical cylinders, their position being the one occupied at half stroke. Each cylinder is mounted on trunnions near its center. A heavy pressure is maintained by an accumulator, and fluid on the rear of the plungers tending to thrust them out. As the rams of the main pump move outward from the center position, the compensating cylinders swing on their trunnions and take increasingly oblique positions.



VALVE PIT OF PUMPING STATION.



SOUNDING OIL TANKS AT NIGHT.

the pump gets nearer the end of its stroke. The compensating rams are forced out during this period, and re-enforce the action of the steam, whose pressure is getting lower, owing to expansion. On the return stroke the compensating rams are pushed back against the accumulator pressure, their cylinders swinging back to the vertical position. In this period, therefore, the action of the steam at a high pressure in the steam cylinder is resisted by the rams. As the stroke returns from center in the other direction, the compensating rams act as in the other half stroke. By thus opposing the action of the unexpanded and re-enforcing the action of the expanded steam, an almost even action is preserved at all periods of the stroke, and a nearly constant pressure is exerted on the liquid pumped. Thus there is no need for a fly wheel or air vessel. The spring accumulator and compensating cylinders effect all the regulating.

Eight horizontal return tubular boilers, 5×14 ft., with one high power and another often low power pump for use in emergencies, or when the main pump is being repaired or adjusted, represent the main plant of a station. Six boilers are fired at once, and a single pump is kept at work. A usual practice is to have one low and one high service pump, and to use the latter for most of the work, the low service pump serving as an alternative in case of repairs or accidents.

The distribution of the oil is effected by valve connections contained in a cellar called the valve pit.

Where the pipe crosses the Hudson River, a system of chain protection is employed to prevent damage from anchors. Two lines of chain are laid across the river parallel with the pipe and about twenty-five feet distant from it. Lateral chains and anchors hold these in place Any vessel which anchors near enough the pipe to be in danger of fouling with it, were it unprotected, can only catch the chain with her anchor. A diver is kept on the New York shore by the Transport Co., who, when a vessel catches her anchor, goes out and arranges with the captain to cut his vessel loose and provide a new anchor. This done and the old anchor being buoyed, it is dived for if necessary, and is raised and kept in exchange for the other one. The pipe runs across the city and passes under the East River to Long Island City, where the refineries are situated. This portion of the pipe has a second pipe outside it with tight-fitting sleeve joints. The jacket pipe has its ends separated by a space of twelve inches, to permit the inner pipe to be screwed home. The sleeve is pushed over the twelve inch gap and the whole space between the pipes is filled with lead, run in while melted. The object of this lead jacket is to protect the pipe from corrosion.

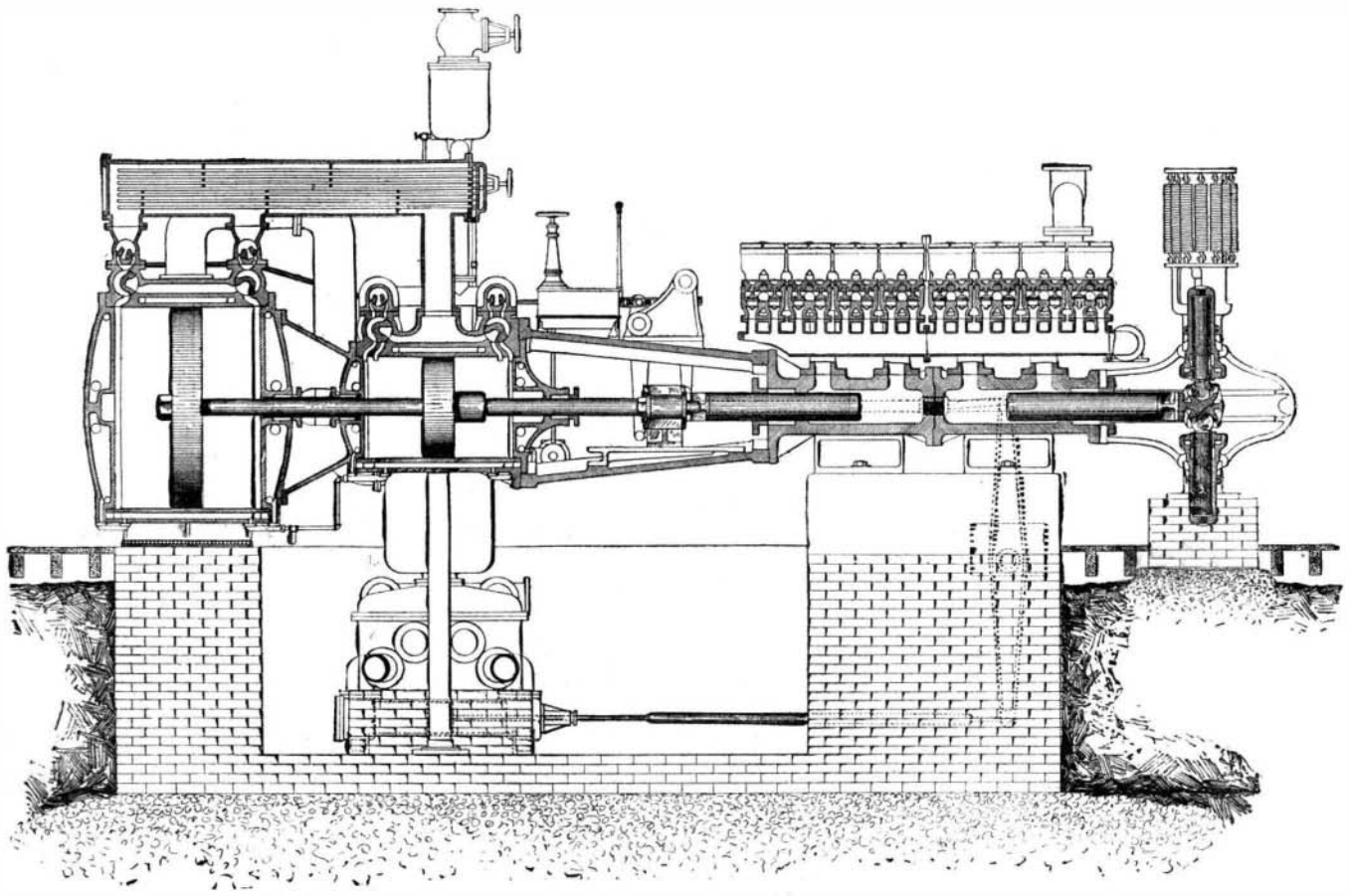
Recently it was found that a portion of the eastern end of the line which crosses the salt marshes back of Jersey City was being corroded by the action of the salt water. This portion is being gradually replaced by a single eight inch pipe laid in a rectangular wooden box, which is filled with hydraulic cement.

To clean the interior of the pipes an instrument which we illustrate and which is called the scraper or "go-devil" is employed. A spindle with ball and socket joint near its center carries steel blades set radially. In front and rear are three arms with guide wheels to keep keep the spindle co-axial with the pipe into which it is inserted. A set of oblique vanes serves to rotate the blades and a piston in the rear approximately fits the pipe in which it is used. To clean the pipe it is inserted at a pumping station into the line. As the oil is pumped in it forces it forward at about three miles an hour, the blades turning as it goes and scraping the interior of the pipe. A catch box is provided at the other end of the line, at the next pumping station, to catch it in as it reaches that point. Formerly when a "scraper" was started its course was followed by the pipe patrol, the sound it produced being audible above ground. It was reported that it went faster up hill than down, but this was probably a subjective phenomenon of the patrollers. The present practice is to let it go unaccompanied, and to time its arrival by the hours it normally consumes in its journey.

The entire pipe line is patrolled to watch for leaks, which show very soon at the surface. A footpath worn by the feet of the patrollers extends over hundreds of miles of the lines that stretch across the eastern territory.

It sometimes happens that the oil tanks are struck by lightning, and the oil catches fire. In such cases the oil may be pumped out from the bottom of the tank, so as to be saved as far as possible. Sometimes water is pumped in to keep the level of combustion at the top, so that only the upper segment of the iron of the tank is injured by the heat.

The statistics of the production of oil indicate an increasing production. For 1891 an average monthly production of over 93,000 barrels was recorded. The nearest approach to this was in 1882, when the monthly average was 82,303 barrels. Over 3,300 new wells were completed in the past year—a rather low showing, as in 1890 6,358 wells and in 1889 5,489 wells were completed. The prices of crude oil have now attained a comparatively steady basis, compared to the old times of fierce speculation. For the past year a difference of twenty cents a barrel would cover the general range, the price fluctuating from fifty-eight to seventy-four cents a barrel. With these figures the average of former years may be contrasted. In 1865 the range was from $4.62½ to $8.25 per barrel, monthly average, while on the same basis the even dollar per barrel was reached for the first time in 1873, and in November, 1874, the monthly average price fell to fifty-five cents. These prices are stated in value of pipe line certificates or crude oil at the wells.



HIGH POWER WORTHINGTON OIL PUMP.

California Gold and Early River Mining.

It was January 7, 1853, that I landed in San Francisco, and thousands of gold seekers then thronged that wooden village. I arrived in the rainy season, with the valleys flooded, so that it was quite difficult and very expensive to reach the mines. I spent seven years, lacking one day, in these wonderful regions, and witnessed the most heroic enterprises ever engaged in by mortal man.

Hydraulic mining was infantile, as compared with fluming the rivers. I soon engaged in the saw mill business, in Grass Valley, Nevada County, and being near the Eaubar River, a stream of considerable size, winding its crooked way down among the golden hills. During the dry season, this and Feather River became very low, so that prospectors and miners could pan out considerable of the yellow metal along the edges of the rivers by digging out the ore from the crevices in the slate rock, and would follow it into the water sometimes two or three feet in depth. This soon led to the idea of constructing a wooden flume, made of lumber of sufficient size to carry all of the running water of the river, sometimes for miles along the bank and sometimes for many miles in length. Companies were formed for this purpose, and they would order often millions of feet of lumber sawed to special dimensions, and delivered along the banks, and the lower portions of the flumes would be built during high water, or, as we used to say, during the rainy season. This would leave a short piece to be put in at or near the bed of some waterfall, when the rivers fell to a size that the flume could convey. As a rule, they would buy their lumber and provisions, to be paid for out of the first gold taken out, so that we, who trusted them, took part of their risk. But with all of their peculiarities, a more honest set of men never lived on earth than the California gold miners, nor a set of harder workers. At one time—I forget the year now, but I had furnished a large amount of lumber for a flume above Oroville, and was quite well acquainted with one of the managers—I took my wife and clambered down over rocks and ledges, among rockers and sluices, to one of the richest spots, of about four miles of river bed. The gentleman took his pan, and after a short search, said: "Here, I think, is a rich crevice." So, with his narrow-pointed pick, he dug out a panful of dirt from a seam in the ledge; the naked eye could see the gold all through the gravel. He then washed it out, and there was a full half pint of the yellow metal; from this he selected a beautiful specimen, which I had soldered to the head of a gold pin that my wife wore. The gentleman then scraped up a pan of dirt, and gave it to my wife, which she panned out, and the contents we kept; and one of my daughters still has it. Before the rainy season came that year, more than $300,000 in gold had been taken from opposite this one flume. It was contrary to all mining laws then to wear a "biled shirt," as they called it, but physicians, lawyers, preachers, doctors of divinity, who lived in the mining regions, wore gray shirts, and worked with pick and shovel, played cards, and some of them gambled; and if a miner had bad luck and got dead broke, go to a lucky miner, or even a gambler, and he would give him a lift, as they then called it.

DANGERS OF LOSS IN GOLD MELTING.

Gold melts at from 2016° to 2590° Fahrenheit, so it is stated by good authority. But it evaporates and passes off at much less than a melting heat, and also if held in a molten state for any considerable time before it is cast into an ingot.

Soon after the San Francisco mint went into operation, the United States inspector visited it to take stock, and there was about $160,000 of a shortage. This amazed every one, and arrests were threatened for theft. Finally, some one suggested that evaporation had caused it, and that it had gone up chimney. So some one climbed up, and, upon examination, it could be seen in scrolls of gold lining on the slate, where it had evaporated as it came in contact with the air. The slate was all taken off, also from a church roof and other buildings near; these were ground to powder, and the gold saved; so was also the furnace and chimney brick, and, after all that could be profitably saved in San Francisco, the dust was sent to the Philadelphia mint, and worked over more closely, and then the dust was all sold to French chemists and shipped to Paris and worked over again. I think, now, that more than one-half the deficiency was saved. I was in San Francisco when the loss was discovered, and the excitement was next to that of the Vigilance Committee when Casey and Corey were hung.

J. E. EMERSON.

Railroad in the Holy Land.

The first railway to Jerusalem will, it is reported, be opened in the spring of the coming year. It is a short line, running only from Joppa, the nearest port on the Mediterranean, and intended to accommodate the growing passenger and other traffic between that place and the Holy City. The work of construction is being carried out by a French company, who began laying down the line in April, 1890. It is stated that over eight hundred vessels of various kinds annually land 40,000 persons at Joppa whose destination is Jerusalem. On the completion of the railroad, tourists will be able to buy a return ticket from the port to Jerusalem for twenty francs.