

ble equalizer fulcrum. This consists of a pair of levers operated by air cylinders, which are so arranged that when air is admitted to the cylinders and the levers are depressed, the fulcrum is shifted and a part of the engine load which ordinarily rests upon the engine truck and trailing wheels is thrown on to the drivers, thereby increasing their adhesion. The normal distribution of the weight of the engine, which in working order is 176,000 pounds, is 95,000 pounds on the drivers, 42,600 pounds on the truck, and 38,400 pounds on the trailers. On approaching a grade, or in starting, or when any supreme effort is to be made, the adjustable fulcrum is shifted and the weight distribution becomes 104,800 pounds on the drivers, 37,000 pounds on the truck, and 34,200 pounds on the trailing wheels. The normal traction, reckoned at 85 per cent of the full steam pressure is 23,725 pounds; but when the device just described is thrown into action the tractive effort is raised to 25,350 pounds. The valves are of the piston type, 12 inches in diameter with inside admission; the engines are of the simple type and the drivers are 79 inches in diameter. The tender has a tank capacity of 50,000 gallons of water and a coal capacity of 10 tons.

Altogether we must confess to a great liking for this beginning-of-the-century locomotive. It is strictly in line with the trend of developments in American locomotive designing, and as far as its contour and general appearance is concerned it is exceedingly handsome and impressive. The only criticism which we could make on this score is that the smokestack, though probably quite sufficient for its legitimate purpose, looks dwarfed and insignificant in comparison with the vast bulk of the engine. Our thanks are due to the Schenectady Locomotive Works for the photograph from which our engraving is made.

THE PITCH LAKE AND THE ASPHALT INDUSTRY OF TRINIDAD.

The island of Trinidad, which is the largest of the British West Indies, is 30 by 50 miles and lies in 10 degrees north latitude, 62 degrees 0 minute west longitude, and is separated from Venezuela by the Gulf of Paria and the narrow channels connecting it with the Caribbean Sea to the north and the broad Atlantic to the east, the island being apparently broken off from the mainland.

This island contains numerous asphaltic deposits. The largest and most interesting of this section, as well as of the world, is the one known as the "Pitch Lake." This is situated on the gulf coast or northern side of the western portion of the island, and lies inland about one mile. The topography of this portion of the island is irregular and rolling, and in the immediate vicinity of the Pitch Lake it is extremely simple, with the ground sloping gradually up from the sea to the Pitch Lake, which lies on the brow of a hill forming the end of a low ridge extending into the interior.

The lake lies at an elevation of 136 feet above the sea and covers an area of 114 acres, nearly circular in form, and lies on top of this hill in a basin-like depression that presents most convincing evidence of being the broad-mouthed crater of a volcano. The existence of mud volcanoes in this portion of the island and one small one about a mile to the south-east of the lake lends to the theory that this is the crater of an extinct mud volcano into which the asphalt has broken and filled it to the brim, and possibly at some prehistoric time has broken over the combing of the crater and flowed down toward the sea, filling on its way the hollows and pockets in the irregular surface and mixing with the dirt and other impurities on its way, forming what is known as land asphalt deposits. The rim of this crater is from 3 to 6 feet higher than the general level of the lake, the highest of the inner slopes of which are covered with a thin layer of sun-dried or dead pitch that seems to indicate that the entire mass has at some prehistoric time subsided. Borings show that the bottom of the lake is funnel shaped, as it is possible to bore through the mass and into the clay at a considerable distance in from the rim, but as the center is approached it has been so far impossible to get through it; a depth of 140 feet has been reached with no perceptible change in the nature of the material, and the deposit tapers from a thin sheet at the rim to the bottomless center.

To the west of the lake, on the gulf coast, bold cliffs of bright red and yellow porcelaine with veins of porcelain jasper, strata of loose sandstone saturated with asphaltic oil are to be found for a distance of 4 or 5 miles along the coast. Two oil springs occur in this vicinity, one about 200 feet from the beach and about 40 feet above the sea; the other bubbles up from beneath the gulf at a similar distance out from the shore and spreads out over the surface of the water. Attempts were made at one time to separate the petroleum from the product of the former deposit, a company being formed for this purpose, but they were unsuccessful and soon gave it up.

The surface of the lake is not a continuous sheet, but is traversed by a series of crevasses or channels,

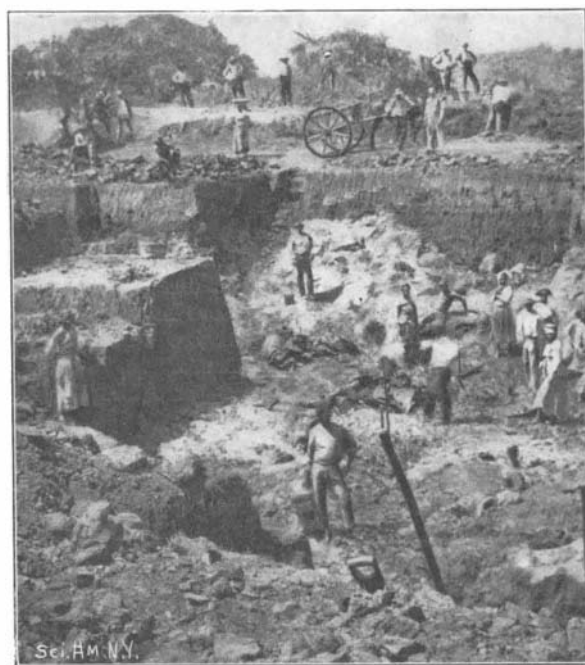
which are connected into one system, that are always filled with water, and at times during the rainy season become 12 or 15 feet deep. These channels divide the entire surface into a great number of flat topped, slightly convex areas, many of which are nearly circular, and which resemble flattened cones. These areas each present a surface of concentric wrinkles, caused by the gradual sliding of the surface from the higher center toward the channels of water. The movement of these areas from the center outward is probably caused by a blow-hole or fissure in the underlying sandstone being directly under the center through which the pitch and gases are slowly issuing. Blow-holes that are much more defined occur in many places in the surrounding vicinity at distances varying from a few hundred feet to a mile from the lake. They



DIGGING AND LOADING ASPHALT ON THE LAKE.

are at times active, and small quantities of semi-liquid sticky pitch are forced up and build up small cones of 6 or 8 feet in diameter that spread out on the surface and form miniature pitch lakes, the pitch soon becoming hard by the evaporation of the volatile oils, leaving a small mass of pitch that is very largely mixed with the earth that it has gathered in its passage in what appears to be a small tube leading down to a larger deposit below, the surface of the ground being in most instances higher than the level of the surface of the lake.

The largest and most active of these cones is at the center of the crater, where semi-liquid pitch and gases are constantly bubbling up. This appears to be the main source of inflow and builds up a convex area of considerably larger proportions than its neighbors and is the highest portion of the entire surface, and is soft enough at the center so that a man will slowly sink



DIGGING LAND ASPHALT.

into it and would probably, in time, be engulfed. The gases that are emitted are sulphureted hydrogen, and give off a vile sulphurous odor and are inflammable, the bubbles burning with a slight explosion as a lighted match is held to them.

The water filling the channels is clear rain water, and nearly always holds in solution considerable sulphur absorbed from the pitch; in places this becomes of a decided acid reaction and will turn litmus paper. These mineral properties lead the native negroes to believe that it possesses medical virtues, and they come from some distance to bathe themselves in this veritable "Siloam."

Notwithstanding the mineral nature and the exceedingly high temperature of this water, which at times during the middle of the day is 140 degrees F., a peculiar kind of fish thrives here and grows to 8

and 10 inches in length. This water is also used for laundry purposes, and during the dry season the natives come from long distances, bringing their soiled clothing in bundles on their heads to wash in these pools of clear warm water.

The pitch is excavated for shipment by digging it up with a pick-ax, into pieces weighing 20 or 30 pounds, in patches of about 30 or 40 feet square, to a depth of 3 or 4 feet. As soon as work ceases on one of these excavations it begins to obliterate itself and come back to the original level. There is a slight closing in of the sides and a general rising up of the bottom, caused by the surrounding pressure and a slightly softer mass underneath the crust-like surface, and four or five hours of midday sun will bring it back to practically the same level, and as many days will obliterate all trace of it. There is no evidence of a higher temperature or of internal heat, and the plasticity is probably due to the oily matter it contains. The excavations and the movement caused by the inflow of pitch and gases cause the entire mass to be constantly moving in an irregular manner, and a line of stakes set across the lake with a surveyor's transit will in a few days be 8 or 10 feet out of line.

Numerous patches of vegetation, consisting in some cases of trees 5 or 6 inches in diameter at the butt, subsist on soil which has been accumulated in the crevasses. These islands, too, share in this general movement.

Statistics show that a lowering of 6 inches over the entire surface of the lake corresponds to the removal of about 100,000 tons, which is the approximate annual shipment.

An American company has a lease of this lake from the British government and is engaged in shipping the pitch to all parts of the world, to be used principally for paving purposes. Previous to 1894 it was dug out and loaded into carts and hauled to the beach, and from there lightered out to the ships lying at anchor in an open roadstead, but during that year a pier 1,700 feet long was built out into the gulf and an extensive loading plant was installed. The accompanying illustrations will help to give the reader some idea of this plant, which consists of a surface tramway running from a terminal power station, on the hard ground bordering the lake, run by an endless wire rope forming a loop around the center of the lake 4,000 feet long. Trains of three flat cars, carrying two iron tubs holding 1,000 pounds of pitch each and controlled by a gripman on each train, traverse this loop, stopping at the excavations to be loaded. At the terminal station these loaded tubs are exchanged for empty ones on a hydraulic lift that transfers them to an aerial tramway, which is also driven by an endless wire rope, and carried on steel towers down over the hill and out to the extreme end of the pier, where it is dumped direct into the hold of the ships laying alongside, the empty tubs returning on the other side of the loop. The surface tramway to the lake and the aerial tramway to the pier are coupled up to the same engine and the loaded tubs going down the aerial tramway by gravity help to run the entire system and a small engine developing about 20 horse power runs the entire plant. Each tub is weighed (and checked by a customs officer for the purpose of fixing the export duty collected by the government) on a scale block in the overhead track in the terminal station before being gripped to the hauling wire. About 175 tubs pass over this scale per hour, making about 80 tons per hour, or 800 tons per day, and employing a working force of 150 men. This plant was a revelation to the people of the island, and was a source of great surprise to them that it was a success, as they looked upon it as a wild scheme and predicted dire failure.

The labor employed is entirely of native negroes, who are not all that could be wished for. These people are ordinarily very contented and happy, with no thought of the morrow, and unless they are hungry they will laugh at a threat to discharge them. They require very little clothing, any temporary shelter will answer for a sleeping place, and they can subsist on sugar cane and fruit that grows in abundance about the island. They are very independent and extremely lazy, and clever only in dishonesty.

The management consists of five Americans. The dwellings of the manager and his staff and the office are built on the pier at a distance of 1,000 feet from the shore. The prevalence of malarial fevers in this portion of the island makes it impossible for a person accustomed to the northern latitudes to live on shore at night time without becoming impregnated with this dread disease that is omnipresent in tropical countries.

A coasting steamer that runs about the island calls at the pier three times a week, bringing local mails and supplies from Port of Spain, the principal city of the island, and at intervals of two weeks the steamers from New York and London visit the island, bringing mails from the outside world.

The site of the ancient Cyrene is being excavated by a Danish archaeological expedition.

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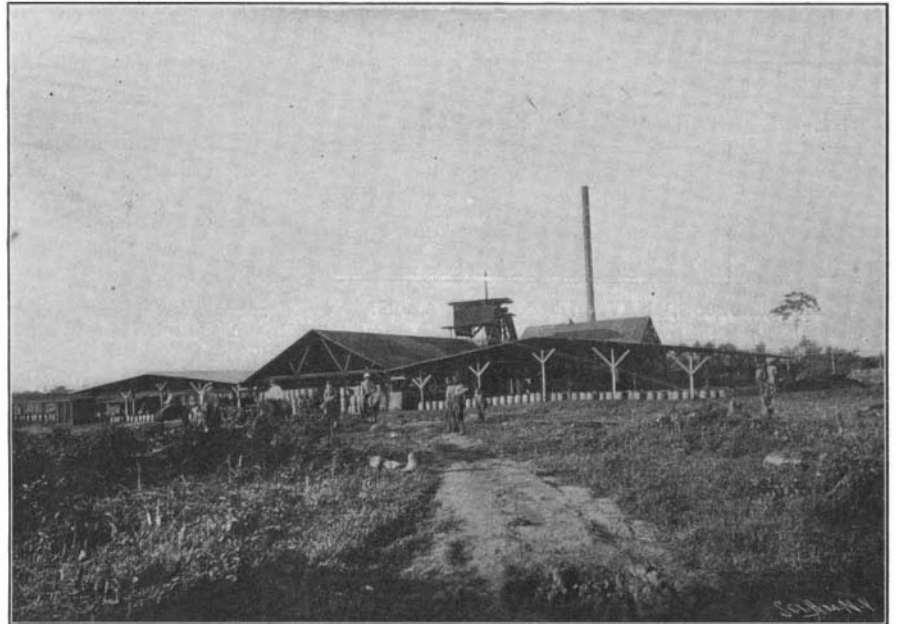
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PITCH LAKE, LOOKING TOWARD TERMINAL STATION



TERMINAL STATION AND DRYING PLANT.



VIEW FROM OFFICE, LOOKING TOWARD PITCH LAKE.



JETTY WHERE ASPHALT IS LOADED.



THE PITCH LAKE, SHOWING THE ASPHALT AND THE POOLS OF WATER.
THE PITCH LAKE AND THE ASPHALT INDUSTRY OF TRINIDAD. [See page 166.]

Science Notes.

When once a milk bottle has been injured, be it in ever so slight a degree, says The New York Medical Journal, its future injury is likely to be speedy. Purveyors of bottled milk should be warned that every bottle with a chipped mouth should be discarded.

The Department of State has received a note from the legation of Sweden and Norway, dated Washington, February 2, 1901, stating that the managers of the Nobel Fund, of Stockholm, have been authorized to correspond directly with interested parties abroad without using the channel of the Ministry of Foreign Affairs at Stockholm.

At a recent meeting of the Academy of Medicine, Dr. Jarre announced the discovery of a remedy for the foot and mouth disease, which is so fatal to sheep. He says he has successfully used the remedy in 1,500 cases in two years. It consists of a concentrated solution of chromic acid at 33 per cent chemically pure. This is employed as a caustic to the sore. The cure is rapid and certain. Dr. Jarre says that M. Dupuy, Minister of Agriculture, has promised to give the remedy official tests.

Armour & Co. closed, on March 4, the largest contract for supplies for a polar expedition ever taken by an Arctic explorer. The contract was awarded by Evelyn B. Baldwin, who will head the expedition to the North Pole which will start about June 1, and will consist of 200 tons—ten carloads—of specially prepared food-stuffs, which it is expected will last Baldwin and his party twenty-seven months. The value of the supplies is between \$50,000 and \$60,000. The supplies are to be delivered in New York by April 1, and will be shipped thence to Dundee, Scotland; Tromsø, Norway, and Sandfjord, Norway.

Consul Hughes, of Coburg, says that Prof. Pictet, of Geneva, is reported to have devised a plan by which oxygen can be produced on a commercial scale and at a cost that will greatly increase its use. By this method air is admitted into a condenser, the condenser being cooled by liquid air. The low temperature causes the oxygen to separate by gravity from the nitrogen of the air. It is then drawn off from the bottom of the condenser, and the nitrogen from the top, while any carbonic acid present, made liquid by the low temperature, is drawn into tubes. As a 500 horse power engine will make 500,000 feet of oxygen a day, it seems that the process is not expensive.

Prof. J. B. Steere, who is well known to readers of the SCIENTIFIC AMERICAN by reason of his valuable papers on the Philippines published in this paper during the late war, has been sent to the Amazon to make a collection of the fauna of that region. Each specimen will be prepared on the spot instead of preserved in alcohol as heretofore, and will be shipped in time to be exhibited at the Pan-American Exposition. Prof. Steere, who, by the bye, is a celebrated ichthyologist, experienced great difficulty in securing passage. He engaged transportation in one vessel, but on arrival in New York he found that the vessel had no license to carry passengers. He signed articles at once and shipped as purser. The energy of American scientific men is to be commended.

The London Standard has been advocating the manufacture of beer from beet roots. A large farmer in the southwest of England has been carrying out experiments for several years for the distilling of brandy from this product, but the results were not encouraging. Other experimenters, however, have been more successful in their efforts, and it appears extensive preparations are being made to give the suggestion a thorough practicable trial. The beet abounds in the sugar juice, but it is stated that the cost of separating it from the gums, acids, and salts is somewhat expensive and would result in a higher price being charged for the beer. On the other hand, the principal recommendation in its favor is that its utilization would dispense with the employment of those dangerous substances conducive to arsenical poisoning.

A project is on foot for the retention for a number of years of twelve out of the sixteen buildings on the Street of Nations, of the Paris Exposition. With the exception of those representing Italy, Spain, Turkey and Servia, the buildings were found to be sound. It is proposed to establish a Museum of Comparative Education in the United States Building, and in the Austrian Building an exhibition of the international exhibitions between 1798 and 1900; the Hungarian Building will be assigned to the history of civilization; the Belgian Building will probably be used as a Museum of National Art; the Norwegian pavilion will contain objects relating to navigation and marine exploration; the German Building will be devoted to learned societies; the Swedish Building will be converted into a Museum of Manual Instruction, and the building of Greece, if it can be retained, will be used to show the recent discoveries in classical architecture. The building of Finland will be devoted to geography, and of Monaco to oceanography. The building occupied by Great Britain will be reserved for sanitary science and bacteriology.

Engineering Notes.

A speed test was recently made with a wood pulley 46½ inches in diameter, 16 inches face and bored for a 4 inch shaft. A total rim speed of 28,889 feet was attained, the pulley showing no signs of giving out at this high speed.

Men who are enlisted for service in the navy are not to be assigned to service in submarine boats without their consent, and the Bureau of Navigation will recommend that special service enlistments for these vessels be authorized.

In the Washington navy yard there are scales with a capacity of 150 tons, but it has been found that they will weigh much more than this, and two 13-inch guns have been weighed with accuracy. The platform of the machine is 48 feet long and 12 feet wide.

The Pennsylvania Railroad will spend about \$2,500,000 for new locomotives during the current year, and the Baltimore & Ohio will spend \$1,300,000 for the same purpose. The Pennsylvania has authorized the construction of 204 new engines, and all but about 50 will be built in the railroad's own shops.

French engineers are again considering the advisability of bringing an adequate water supply from Lake Geneva. The supply is practically inexhaustible and the water is extremely pure. It is thought that the total cost of the undertaking would be \$200,000,000, including \$25,000,000 which the Swiss government would require.

Manufacturers of projectiles and armor plate are experiencing exceptionally busy times in England. The war in South Africa has had the effect of depleting the military department of their heavy stocks of war stores, and consequently it will take a long time to fully replenish them. It has also been decided to reorganize the artillery section of the British army, and to equip it with the latest and most powerful type of guns. Several orders for this new armament have been already placed and the manufacturers are working at full pressure in order to deliver the contracts within the specified time.

An interesting sight at the yards of Denny Bros., shipbuilders, is a flying machine, which the Dennys are confident will be very successful, says the New York Sun. It looks much like Zeppelin's airship, and was designed by a Spanish youth mainly as an engine of war. It is intended to rise to a great height and drop explosives. The Dennys are also building the first turbine passenger ship, which was designed by Parsons, of Glasgow, for a syndicate of shipowners. The boat will ply between Greenock and local pleasure resorts. She will have a speed of 27 knots an hour.

Some two years ago a Mr. Henry W. Wing, of Boston, Mass., devised a new spinning machine, which he took with him to Bradford, the center of the spinning industry of Great Britain. There, aided by local engineers and experts, he improved his appliance which is now in active operation. It is capable of spinning a variety of materials, such as asbestos and peat moss, as easily and as readily as wool, and when completed it is difficult to determine the original nature of the fabric. The apparatus will be specially useful for the spinning of flax waste, which hitherto has been considered almost a waste product, and as such has been sold for paper-making. By this means, however, it will be spun into a more profitable commercial article.

An interesting statistical return has recently been compiled showing the remarkable growth of railways in Great Britain from 1872 to 1899. In the former year 15,814 miles of railways were in operation, while in 1899 the mileage had increased to 21,700. The gross receipts derived from all the railways in 1899 exceed those of 1872 by over \$242,157,675. On the other hand, working expenses have increased to the extent of \$169,065,235. The third-class passenger traffic is the principal source of revenue, the number of first and second-class passengers for the year 1899 showing a decrease of 3,469,856 and 3,972,491, respectively, in comparison with the returns for 1872. The average dividend earned by the railways in 1872 was 4.74 per cent, and it has now decreased to 3.61 per cent for 1899.

The British Naval Department have just placed orders for the construction of two first-class battleships of the "Majestic" class to be named respectively "Queen" and "Prince of Wales;" six armored cruisers, two second-class cruisers of the "Minerva" type, and two sloops. The two first-class battleships are to be built in the government dockyards at Devonport and Chatham. They will each be of 15,000 tons, and a speed of about nineteen knots per hour. The cruisers, two of which will be undertaken by the government, three in private firms on the Clyde, and the sixth at Newcastle on Tyne, will measure 440 feet in length, beam 66 feet, draught 24 feet 6 inches, displacement 9,800 tons, engines 22,000 indicated horse power, and speed 23 knots. The second-class cruisers will have a speed of 20 knots (which, by the way, has been considered insufficient for this type of craft by naval experts), and will, together with the sloops, be built in the royal yards.

Automobile News.

The attention of all United States Inspectors of steam vessels has been called by the Treasury Department to the recent act of Congress, by which automobiles using gasoline may be transported on ferryboats or other steam vessels. The amendment to the Revised Statutes, passed by Congress shortly before the adjournment, provided that nothing in the statutes should forbid the transportation of these vehicles, provided the flame used in connection with the motive power be extinguished while the vehicles are on the vessel. It was provided, however, that the owner or master of a vessel may legally refuse to transport vehicles containing tanks of gasoline or other explosive liquid, if he is disposed to do so.

The question of automobiles for army use has not received the same attention in England as it has among other nations of Europe, especially France, Germany, and Italy; it is, however, being considered favorably by the authorities. It appears that a member of the Automobile Club of England proposed to the War Office to organize a volunteer corps of automobiles for the present campaign. He received the following reply: "The Secretary considers that the time has not yet come for organizing a special corps, although it is disposed, in case of urgency, to call upon the good-will of the authors of the proposition. He would be glad to have them furnish all the information relative to the number of machines to be disposed of and the services which they can render, indicating the speed, the maximum load, the weight, and the consumption of each machine."

The Geographical Congress of Italy, which will be held at Milan, from the 11th to the 14th of April, has authorized the Touring Club of Italy to organize a special exposition of the methods of locomotion used for long voyages during the nineteenth century. The Touring Club has received the idea with enthusiasm, and it will endeavor to make this exposition as complete and as interesting as possible. In the collection will be found a series of maps of different periods, guides, notices relating to the various means of transport, railroads, tramways, boats, cycling and automobile, as well as the subject of aerial navigation. The exposition is in charge of M. Bertarelli, one of the most efficient members of the club. At Milan a series of electric automobiles have been recently put in service as cabs, and it is thought that the system, after it is well started, will prove quite successful.

The programme for the Tour of Italy, which will take place next May, has been definitely fixed by the organization committee. The Tour is divided into two categories; the first includes the whole of the route laid out, or about 1,000 miles, and the second includes Florence-Rome-Milan, 660 miles, or Naples Rome-Milan, 640 miles. The engagements close on the 15th of April; for the first category the sum fixed is \$15, and for the second \$10. Each of the competitors entered for the Tour is to receive a handsome badge, and a special art prize will be offered for each vehicle. An employé specially charged with the baggage is to follow the tour by railroad, and the conductors are to be furnished with coupons for lodging and nourishment at reduced rates. The itinerary is given as follows: 1st day. Turin, Asti, Novi, Genoa, 106 miles. 2d day. Genoa, Chiavari, Spezia, 65 miles. 3d day. Spezia, Pisa, Florence, 99 miles. 4th day. Florence, Sienna, 100 miles. 5th day. Sienna, Grosseto, Civita Vecchia, 125 miles. 6th day. Civita Vecchia, Rome, 42 miles. The seventh day will be spent at Rome. 8th day. Rome, Civita Castellana, Terni, 60 miles. 9th day. Terni, Perugia, 54 miles. 10th day. Perugia, Scheggia, Pesaro, Rimini, 112 miles. 11th day. Rimini, Imola, Bologna, 67 miles. 12th day. Bologna, Ferrara, Padua, 74 miles, with promenade to Venice. 13th day. Padua, Verona, Brescia, 89 miles. 14th day. Brescia, Lodi, Milan, 60 miles.

The New Star in Perseus.

A circular has just been issued by Prof. E. C. Pickering, director of the Harvard Observatory, which supplies further information concerning the first observations of Nova Persei at that institution, and incidentally corrects certain false interpretations that have been put on the bulletin of February 22. The latter, after announcing that the new star was then of the first magnitude, added: "A photograph of this region taken on February 19 showed that it was fainter than the magnitude 10.5. This result was confirmed by photographs taken on February 2, 6, 8, and 18."

The inference has been drawn from this phraseology that, although not so bright as a star of magnitude 10.5, the Nova was, nevertheless, visible on all of the dates specified, but that it increased suddenly in brilliancy between February 19 and 22. But the circular just published makes it clear that the star was not found on any of the plates prior to Dr. Anderson's discovery, although other stars as faint as the eleventh magnitude were there. Its history begins with February 21, therefore.