to bring pipes to be laid in the trench. In Fig. 2 of the engraving the relations of trench, pipe-laying plant, and portable railroad are clearly shown. Below the pipe-laying apparatus the new line of water main is indicated lying at the bottom of the excavation.

The pipes, as fast as required, are run up to the scene of operations upon the portable railroad. The hoisting apparatus consists in general terms of a rectangular platform carried on four wheels and extending over and across the trench. Through its floor a longitudinal opening is arranged, directly over the center of the excavation, large enough for a pipe to pass through in a horizontal position. The superstructure serves as support for the jib tackle of the crane and to carry pulleys, etc., for handling the pipe. As the length of pipe is run alongside, skids or short timbers of wood are laid from the car to the platform, and a pair of skids are also laid across the opening over the axis of the trench. Two or more ropes are brought from the platform to the car, passing under the pipe and then partially around and over it, returning to the upper framework. At this point they pass through pulleys and are brought to the floor, where there is a steam windlass, which is seen mounted on the platform. On drawing in the ropes, the pipe, it is obvious, will be rolled up the inclined plane formed by the skids, and can be brought directly over the trench. The arrangement is what seamen call a common "parbuckle." It is often used in the city in lowering heavy barrels into cellars.

Slings are then placed around the pipe now lying on the skids over the aperture. Tackle is hooked on, and it is lifted a little by the steam windlass, and the skids are withdrawn. It is then lowered into the trench. This stage of operation is shown in the cut. As it descends, the pipe layers guide it into position. Its small or spigot end is entered into the hub or socket of the preceding length, and it is blocked up in a horizontal position in line with the work. This ends this stage of operations.

The joint has next to be calked with oakum. This is driven by hand with a calking iron. It extends all around the pipe within the hub, and is of as even thickness as possible. It forms a base for the lead, which latter is the actual joint-making material. It should be noted that there is a slight space left between the abutting ends of the pipe to allow for changes of temperature.

To complete the joint melted lead has to be introduced into the space in front of the oakum and the lead in turn has to be calked. As the apparatus just described is moved forward, the lead-melting plant seen in its rear is moved into its place. This consists of a house with furnace and lead pot, ladle, and crane. Its interior is shown in Fig. 3, the men being engaged in lowering a ladle full of melted lead. Next to the large furnace is a smaller circular furnace. This is used to keep the ladle hot when it is not in use.

The lead is lowered, as shown, into the trench, where it is received by the pipemen and poured into the joint, as shown in Fig. 4. Before doing this a band of iron hinged at the bottom is placed around the pipe and bolted at the top, so as to inclose the annular space in front of the oakum. A clay mouth or funnel, Fig. 5, is arranged for the lead to be poured into. The connection of two pipe ends, hub and socket, with their oakum and lead filling, and with the band in place, is shown in the small sectional view at the foot of the cut.

The lead at once solidifies. The band is removed, and the calkers attack the lead with large-faced calking irons and hammers and drive it home. This operation expands the lead and makes it fill the joint perfectly.

The metal being somewhat yielding does not form too rigid a connection, and allows for changes of temperature. In spite of numerous attempts, lead-calked joints have never been displaced. The trench in rear of the apparatus is filled in as fast as it progresses, and the work is complete up to that point.

The object of the line is to carry water from the new reservoir between Rockville Center and Baldwins, on the south side of Long Island, to the Ridgewood reservoir and new pumping station at East New York. It will be a pressure line, and will have a capacity of twenty-five millions of gallons per day. It follows the line of the old aqueduct for part of the way. The sectional view, Fig. 2, shows the aqueduct full of water on one side of it. The aqueduct embankment is thus, in part, utilized in its construction.

The work is being executed by Mapes, Crawford & Valentine, of Brooklyn, N. Y. They are the designers of the ingenious and efficient apparatus whose results have taken the direction of greatly accelerating the work we have described.

PROFESSOR ORTON, State Geologist of Ohio, says that the natural gas supply is rapidly and surely being exhausted. The way in which the gas is wasted makes the average stranger sick at heart. Great roaring wells, huge batteries of the cheapest and most wasteful types of boilers blowing off steam night and day, empty furnaces kept hot for weeks at a time, strike him as crimes against the economy of nature.

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Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF

SCIENTIFIC AMERICAN SUPPLEMENT

No. 783.

For the Week Ending January 3, 1891.

Price 10 cents. For sale by all newsdealers.

THE NEW CRUISER NEWARK.

On the 22d of December the new U. S. steel cruiser Newark had her official trial trip, and proved a great success, the contract requirements being exceeded by about five hundred horse power. This was developed in a continuous run of four and a half hours, at the end of which time the machinery was running more smoothly and the engines developing more power than at the commencement of the trial, a result which is seldom obtained on first pushing a new boat to its best performance. The steam pressure was kept at 161 and 162 pounds, the maximum revolutions of screw made were 129·2 per minute for fifteen minutes, the engines vibrating very little, and the firerooms were cool, rendering the firemen's work comparatively easy. The builders are to receive $100 bonus for each horse power developed over 8,500, and it is confidently expected that the final figures will show that 9,000 horse power was developed on the trial. The builders, the Messrs. Cramp, of Philadelphia, and the officials of the Navy Department, were greatly gratified at the good showing made by the vessel, and in this feeling, it is hardly necessary to say, the people generally share, as there are few subjects which attract a more widespread or a keener interest than is manifested concerning each forward step taken in the development of our new navy.

The Newark's hull is the same as that of the San Francisco, whose fine lines have commanded much admiration, and which was illustrated and described in the SCIENTIFIC AMERICAN of October 18, 1890. The engines of the Newark are smaller, however, and are horizontal. The machinery is protected by a steel sloping deck, two inches thick on the top and three inches thick on the sides. The length of the vessel between perpendiculars is 300 ft. 10 in., length on water line 310 ft., and length over all 327 ft. 7 in.; extreme beam, 49 ft.; depth of hold, 28 ft. 8 in.; mean draught 18 ft. 9 in.; displacement 4,090 tons. There are four main cylindrical, double ended, return tube boilers, with four firerooms, and two smoke pipes, each 6 ft. 6 in. in diameter. The boilers are each 19 ft. 5 in. long, and 13 ft. 6 in. in diameter, with three corrugated furnaces at each end, and a total grate surface of 540 square feet. There are two horizontal, direct acting, twin screw triple expansion engines, each in a separate compartment. The cylinders are 34, 52, and 76 inches in diameter, respectively, with a 40 inch stroke. The shafts are hollow steel, the crank shaft being fourteen inches in diameter with a four inch hole, while the after section of the propeller shaft has an eight inch hole. The coal capacity of the vessel is 830 tons, which is disposed of in fifty-three different coal bunkers. She will burn four to five tons of coal per hour when pushed to her utmost limit.

The armament of the Newark will be twelve six inch breech loading rifles; four rapid fire guns, two three-pounders and two one-pounders; four revolving cannon and four Gatling guns. There are also six torpedo launching tubes. Three steel masts are adapted to carry fore and aft sails, and the fore and main mast have military tops.

OFFICIAL PROCLAMATION OF THE GREAT FAIR.

The last act necessary to start into booming activity the gigantic works pertaining to the great fair has been performed. The presidential proclamation has been issued, and soon we shall see holes in the ground and structures in the air. The following is the text of the proclamation:

"By the President of the United States of America:

"A proclamation: Whereas, satisfactory proof has been presented to me that provision has been made for adequate grounds and buildings for the uses of the World's Columbian Exposition, and that a sum not less than $10,000,000 to be used and expended for the purposes of said exposition has been provided in accordance with the conditions and requirements of section 10 of an act entitled 'An act to provide for celebrating the 400th anniversary of the discovery of America by Christopher Columbus by holding an international exhibition of arts, industries, manufactures and the products of the soil, mine and sea, in the city of Chicago, in the State of Illinois,' approved April 25, 1890.

"Now therefore I, Benjamin Harrison, President of the United States, by virtue of the authority vested in me by said act, do hereby declare and proclaim that such international exhibition will be opened on the first day of May, in the year 1893, in the city of Chicago, in the State of Illinois, and will not be closed before the last Thursday in October of the same year. And in the name of the government and of the people of the United States, I do hereby invite all the nations of the earth to take part in the commemoration of an event that is pre-eminent in human history, and of lasting interest to mankind, by appointing representatives thereto, and sending such exhibits to the World's Columbian Exposition as will most fitly and fully illustrate their resources, their industries, and their progress in civilization.

"In testimony whereof I have hereunto set my hand and caused the seal of the United States to be affixed.

"Done at the City of Washington, this twenty-fourth

day of December, 1890, and of the Independence of the United States the one hundred and fifteenth.

"BENJAMIN HARRISON.

"By the President. JAMES G. BLAINE, Secretary of State."

The proclamation marks an epoch in the Exposition. The work heretofore done has represented the civic organization of the enterprise. Actual erection of buildings could not be commenced in the absence of the governmental sanction, now granted, and which comes just at the time when it is likely to be the most beneficial. The legislatures of many of the States are about to meet and will be asked to take part in the grand display. That all the States will liberally respond there is no question. The commission may now solicit foreign exhibitors to come to Chicago, and the contributions from abroad will doubtless be great and wonderful.

In this connection we would call attention to the very interesting and able lecture upon the Chicago Exhibition recently delivered before the Society of Arts, in London, by Mr. James Dredge, editor of *Engineering*, upon the nature and scope of the great enterprise. We give the paper in full in our SUPPLEMENT of the present week, Number 783. The lecturer presents a brief history of the project of the fair. Its financial basis he considers to be equal to that of the recent Paris exhibition. He then describes the history, situation, resources, population, area, importance, trade, and industries of Chicago, giving a most glowing picture thereof, of which Chicagoans may well be proud. The author next proceeds to describe the grounds selected for the exhibition purposes, namely, Jackson Park, Washington Park, and the broad connecting strip known as the Midway Plaisaunce, the whole comprising an area of 1,200 acres, more than ample for actual requirements.

The selection of Jackson Park with its lake front for the location of the great buildings is highly commended. He declares that no such favorable site has been ever placed at the disposal of an exhibition executive. The desirability of European participation is next discussed, and the important benefits likely to be realized by English exhibitors are forcibly stated. But whether a British section is created or not, the author urges every Englishman who can spare the money and time to visit Chicago in 1893, for in no other way can he become so readily informed respecting the vast capabilities and resources of America and her wonderful advances in industry and invention. It is evident the undertaking will be full of the greatest interest to the thoughtful foreign visitor.

In the discussion which followed the reading of the lecture, some most excellent and some quite funny English ideas were expressed, all of which are given in our SUPPLEMENT report.

PROGRESS OF THE GREAT RAILWAY TUNNEL UNDER THE HUDSON RIVER.

Since our last account, published in the SCIENTIFIC AMERICAN of November 1, about 470 feet have been added to the Hudson River tunnel, which brings the total completed length up to 2,720 feet. This indicates a progress at the rate of about 7 feet per day. The work is progressing without interruption. By removing the intermediate accumulating pump, and bringing the power of the pump direct to the hydraulic jacks, the Beach pneumatic shield is advanced the width of one of the rings in eight minutes, a progress formerly requiring from 2 to 4 hours. Formerly, the great trouble was in getting the shield ahead, at present the great obstacle is in getting away the excavated silt rapidly enough. A system of chutes is soon to be tried, one under each opening in the shield front, down which the silt will slide direct into the waiting cars, instead of shoveling it by hand as heretofore. The company hope to record ten feet per day when these changes are completed.

NEW TERMINUS OF PENNSYLVANIA RAILROAD IN JERSEY CITY.

The work of elevating the tracks and terminal structures of the Pennsylvania Railroad Company, at their terminus in Jersey City, has so far advanced as to clearly outline its completion, advantages and defects. Entrance to Jersey City has been effected upon a two-track roadbed. By the present change to the elevated plan, four tracks will be obtained. Beginning at a point back of the city near what is known as Bergen Hill, a slope ultimately merging into an iron superstructure, similar in design to the Sixth Avenue elevated road, has been constructed, to the station at the water front, about one and a half miles. The part so nearly completed is but one-half, or two tracks, of the system, the present road tracks being moved a little one side, that the business of the road might continue until the two elevated tracks are ready for use, after which the other half will be erected and wedded to it.

The structure is a continuous plate II girder in its continuity, including street bridging, with scarcely an exception.

The broad girders and substantial upright columns give an impression of strength and durability, but like its kindred structure in New York, promise is given of a metallic resonance under moving trains that will be burdensome to nerves near its path.

High in the air, at the river front, timbers of massive strength are being put up, as a superstructure for the erection thereon of the iron train shed.

The work so far as accomplished has all the characteristics of strength, but few of beauty, as compared with the terminal approaches at Philadelphia.

On the New York side, work has been commenced in raising the height of the ferry houses to accommodate the two-story boats that are to be used in connection with the elevated structures on each side of the river. This part of the system we described and illustrated in our issue of February 8 last.

Magnetic Rocks and Ships' Compasses.

The following extract from a letter of Profs. Rucker and Thorpe, which recently appeared in the London *Times*, may be of interest:

As it has been suggested that the loss of her Majesty's ship Serpent, lately wrecked at night on the north coast of Spain, may have been due to a deviation of the compass caused by magnetic rocks, we think your readers should be warned that such an explanation should only be accepted after rigorous proof. In the first place, it must be borne in mind that ordinary ironstone is not magnetic. Metallic iron and the magnetic oxide are practically the only substances which could affect the compass to an appreciable extent. Large disturbances generally occur in the neighborhood of basalts, gabros, and the like, throughout which magnetite is scattered in a more or less finely divided state. Such rocks are plentiful on the west coast of Scotland, and on the island of Canna there is a cliff named Compass Hill, from the great effect which it produces on the magnet. . . . We have made a special study of the magnetic properties of this island, and can confirm the statement that its basaltic cliffs are powerfully magnetic. The needle of a compass placed near them may be deviated by two points. The effect, however, diminishes very rapidly with the distance, and is inappreciable on a ship's compass 200 yards from the base of the hill to which tradition ascribes, and in which we have ourselves detected, the most powerful magnetic properties. We have tested this on more than one occasion. In particular, in 1888, we approached the island from the north. The course was magnetic S. ¼ E., a direction most favorable for the detection of the effect of Compass Hill. We passed it within 200 yards of the shore, but observed no effect on the compass. . . . Nowhere in the United Kingdom have we discovered a disturbance which extends for a mile and also produces throughout that distance a constant deviation of the compass of as much as a couple of degrees. While, therefore, it is difficult to assign any limit to what might occur in an extraordinary and special case, and while we believe that there are some well-authenticated instances of magnetic rocks affecting seriously the compasses of ships in their immediate neighborhood, the greatest caution ought to be exercised in accepting any such instance as proved. It is contrary to general experience that intense local magnetic disturbances should also be far reaching.

White Ants in India.

That species of Termes known as the white ant is very abundant in India, and is dreaded by all European residents, on account of its extraordinary ravages, especially in the larva state, in which it is truthfully called a worker.

The workers unite in colonies of countless numbers and take up their abode in the ground, in wood, on the ceiling or roof of a house, making tunnels and forming routes which lead to the center of their nests.

Their deeds are deeds of darkness, for so ingenious are they that they form the tunnels inside and leave the surface of the door or beam intact.

I was standing by the door of our parlor, says C. M. Wherry, in the *Graphic* (Chicago), talking to a friend, and on putting my hand upon the door frame, found that it was hollow. On further examination it was found to be filled with earth along one side, which the Termes had deposited as they worked their way through.

One morning our sweeper removed a pile about two feet in height from our dining room floor, but the energetic creatures, nothing daunted, began their work over again, and by the next morning the pile was a yard in height from the floor and up the side of the wall.

Day after day the sweeper wielded his broom over the spot until he was forced to the conclusion that they meant to conquer him.

As a last remedy, after a great many experiments, he poured a gallon of kerosene over the spot and was exceedingly rejoiced to find that at last they had been driven away after two weeks of hard fighting. But alas! his spirits sank within him when one morning a few days later he found the pile higher than ever.

It became necessary to dig for the queen, as after her expulsion no more are hatched, and they gradually disappear. A hole in the cement floor was dug in which a horse could have been buried, before the queen was found in the center of her colony.

The abdomen of the queen becomes very much distended with the innumerable eggs which it contains. It is said that one such insect has been known to deposit 80,000 eggs in one day. The larvæ are a creamy white and transparent enough to show the substance in the body with which the tunnels are moistened when in construction.

After a time they acquire wings, and flying about during the night, lose them. Being particularly attracted by lamp light, many swarm around the drawing-room lights until the floor is quite littered with the wingless creatures, which soon become the prey of lizards and toads, and by daylight, of birds. The natives do not eat them as the Africans do.

On account of their secret ravages, the houses of Europeans and of most natives are usually only one story high, with plastered floors and roofs of earth or grass, which can be renewed every few years.

I have known of people being severely injured by the falling of a heavy mud roof, caused by the white ants having eaten out portions of a heavy beam. So common are they, that railroad ties and telegraph poles are often made of iron, as nothing but metal seems to be impervious to their waste.

Trunks and boxes must be kept off the floor, on bricks at each corner, or on stands made for the purpose. It is a common occurrence to walk into a room some morning and find a carpet eaten in several places, or a box of clothing tunneled through and through, from which you could not get a square large enough for a table napkin. Thus a housekeeper's life becomes one of everlasting vigilance.

American Cars and Locomotives for Foreign Railways.

Two complete trains of drawing room cars have just been completed for the Buenos Ayres and Ensenada Port Railway Company by the Gilbert Car Manufacturing Company, of Troy, N. Y., U. S. A., and St. Ermin's Mansions, Westminster, England. Each train consists of four saloon cars, two ladies' cars, one buffet and smoking car, and one baggage car. The extreme length of cars is 65 feet, with the exception of baggage car, which is 53 feet by 9 feet 10 inches wide. The gauge of rails is 5 feet 6 inches. The whole of the material is of the highest class, and the cars are of handsome design and finish.

The government of New South Wales has placed with the Baldwin Locomotive Works an order for twelve ten-wheel passenger locomotives, somewhat similar to the engines of the same type built for the Baltimore and Ohio, and now running very successfully on that road. The *Railroad Gazette* says limited weight—on account of the bridges—makes it necessary to reduce the dimensions somewhat, while the specification of materials is altered to conform to the practice of the New South Wales government. Thus, the fire boxes will be of copper, tubes of brass, staybolts of copper, and possibly the wheel centers will be of wrought iron. The specifications are not yet fully determined. The engines will have screw reversing gear. The service for which they are intended is to haul passenger trains weighing 144 gross tons—2,240 pounds—at a speed of 22 miles per hour up a grade of 176 feet per mile, or trains weighing 176 gross tons at the same speed up grades of 130 feet per mile, there being curves of 528 feet radius on the 130 foot grades. In all important respects the engines will conform to American practice. These engines are to be built with the utmost dispatch and shipped direct to Sydney by steamer.

Colorado Electrical Street Railways.

Electricity as a street car motor is rapidly superseding other mediums in Western cities.

Denver has already thirty miles of electrical street road in operation, employing an aggregate of 1,150 horse power of generators, 58 motor cars, each fitted with two 15 horse power motors, and 60 trailers, traversing the city and reaching out in every direction to suburban points.

The old cable and horse car companies are rapidly adopting what is apparently to be the motive power of the future for all city and suburban traffic. Several additional electric lines are in contemplation. Some are already in process of construction, notably the so-called Suburban line of 15 miles and the Golden line of 21 miles mentioned in a previous issue.

The West End line uses double-truck cars 40 feet long and of 2,000 pounds weight, fitted with two 15 horse power Sprague motors, this motor and overhead wires being in general use on all the lines.

The Colorado Springs electrical main line, with branches, is 22 miles long, and runs to Colorado City, the former capital of the State; to Manitou, connecting with the new steam railway to the summit of Pike's Peak, altitude 14,150 feet, and to numerous other points of interest. The aggregate power of the generators of this line is 280 horse, employing 18 motor cars and a like number of trailers.

The various lines are all doing a large and an apparently increasing and profitable business.