is made 50 feet wide. The slope on the reservoir side of the embankment is formed of a thick bed of impervious gravel, covered with broken stone, and paving or rip-rap. There will be another dike on the southerly side of the reservoir one-half a mile in length, and rising 10 feet above the level of the water, consisting of an earth embankment with a concrete core wall built upon the solid rock.

The main dam is located across a narrow gorge about 3,000 feet above the dam of the Lancaster mills, at Clinton. The general form of the cross section is the same as that adopted for the new Croton dam, in New York. It is similar in many respects to the Furens dam upon the Furens River, in France, built in 1866, and to the Tansa dam of the Bombay waterworks, constructed in 1891.

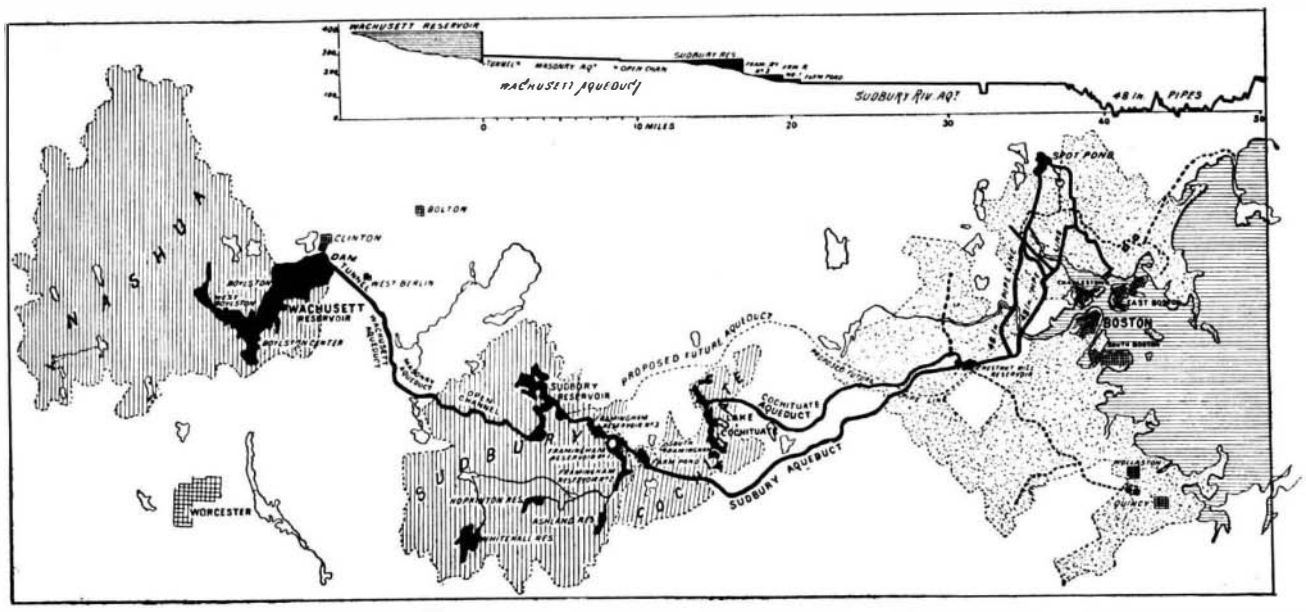
The dam will rise 10 feet above the level of the full reservoir. At the water level it has a thickness of 19 feet, and 145 feet below the water line the thickness increases to 119½ feet. It is composed entirely of masonry. Its total length is 1,250 feet; but only 750 feet has a depth from high water to the rock exceeding 40 feet, and but one-fifth exceeds 120 feet in depth. The maximum depth from high water to the rock at the down-stream edge of the dam is 158 feet.

Advantage has been taken of the favorable topography at the northerly end of the dam to provide a very long overfall and a waste channel for wasting the water during floods without permitting it to flow over or near the high part of the dam. The overfall has a length of 450 feet, and will discharge a quantity of water equal to 8 inches in depth over the whole watershed in twenty-four hours. The greater part of the overfall is to have a masonry crest at the level of the full reservoir; but for a length of 120 feet it is proposed to keep the masonry crest 3 feet longer, and to retain the water at the full height by means of stop planks or movable gates.

Gatehouses are provided on the up-stream and down-stream sides of the dam, with four 48-inch pipes connecting them, which are to serve the joint purpose of supplying water to the aqueduct leading to the Sudbury watershed and of conveying the waste water to the river below. These pipes, with the large head upon them when the reservoir is nearly full, have sufficient capacity to take the waters of a large freshet.

A part of the trench which is to be cut along the line of the north dike and filled with impervious material has been dug. It has a bottom width of 30 feet. The railway for removal of the soil scrapings has been constructed and a substantial and successful beginning has thus been made in the construction of the great reservoir.

As may be inferred, the water that will be stored in the Wachusett reservoir is the best that has ever been distributed in Boston. The Water Board at its well-appointed laboratory, through its biological department and in connection with the State Board of Health, makes scientific inspection each week of water drawn from various points of the works. The building of a reservoir of extra large size permits the water to be stored long enough to bleach and improve by the decomposition and disappearance of the organic matter. The diversion and purification of sewage and manufacturing wastes and the drainage of swamps further aid in furnishing a good quality of water.



MAP SHOWING LOCATION AND SCOPE OF THE NEW BOSTON WATERWORKS.

Antiquities at Ephesus.

There are many antiquities now on view at Ephesus having been unearthed by the excavation of the Austrians. A great theater has been dug out, the whole of the columns of the proscenium and the passage and anteroom, with mosaic pavements, have been opened up and work is going on still in the upper portions of the theater. In the street in front are the marks of chariot wheels along the pavement. There are also the whole series of buildings behind and underneath the gymnasium, including marble water troughs, sculptured with oxen and oak wreaths and fine marble doorways in situ. A semi-circular marble portico with its steps, which occupy the whole east side of the harbor, is now being excavated. It is believed St. Paul landed at these steps.

PROF. NUSSBAUM, of Hanover, has discovered that the plastering on the walls seriously affects the acoustic properties of a room. He finds that the best results are obtained by using pure gypsum that has been heated to a white heat.

Correspondence.

Raising a Russian Battleship.

To the Editor of the SCIENTIFIC AMERICAN:

I beg to bring to your notice the following matter:

Some two years ago a battleship of the imperial Russian navy of about 6000 tons having struck on an isolated rock, sank in 96 feet depth of water at a distance less than three nautical miles from the coast.

A salvage company offered to raise the ship and tow her up to the docks at the nearest port, working on the principle of "no cure no pay." The government was to pay to the company on their delivery of the ship as aforesaid the sum of 950,000 rubles, say £101,500 sterling English worth. The contractors succeeded in straightening the ship on her keel, but failed to raise her, and retired. Later on some private effort was made to rescue the ship, but with no result, owing to the insufficiency of technical means used for the purpose and a complete inexperience in such work.

Perhaps American engineers will be tempted to test their world-renowned genius on this job. The government is always willing to pay the above sum for the ship if raised (in whatever condition she may prove to be) and brought to the nearest port into dry dock.

The work of raising the ship, if commenced in spring (April), can be carried on until the close of navigation at end of November. All engines, contrivances, etc., which will be brought over from America or elsewhere for the salvage purpose will be admitted here free of custom dues.

Workmen and divers, likewise timber of every kind and description, can be procured here at a very low price unknown in America. In case a stratagem would be contrived to work the raising of the sunken ship when the sea over her is frozen, good, solid ice of unlimited strength is to be met during four winter months —December to March—and the assistance of the powerful ice breaker "Ermack" could be easily procured on very moderate terms.

In case you would bring this matter to the attention of your countrymen, and any of them are willing to undertake it, I shall be glad to give all necessary particulars in regard to the matter. I am in a position, owing to my connections with the Navy Department, to assist in furthering the enterprise.

M. POGGENPOHL.

St. Petersburg, 57 Liteinaia, Russia, October 13, 1899.

Recent Earthquakes in Asia Minor.

To the Editor of the SCIENTIFIC AMERICAN:

Commencing just above Hierapolis, the sacred city of the Phrygians, and ending in an abrupt promontory at Priene, once famous for its Panionian games, the range of Mt. Mastaurus traverses one of the most fertile regions of Lesser Asia.

To the north extend the rich plains of Ionia and Lydia; to the south the Meander "winds its slow length" through loam tracts studded with towns and villages.

A long chain of hot springs, some of them chalybeate, one or two small lakes of hot mud, as well as the formation of the rocks, clearly demonstrate the volcanic nature of this region.

On Wednesday morning, September 20, at 4:5, a strong earthquake shock, lasting thirty-five seconds, followed by a number of lesser concussions, sadly reminded the inhabitants of this province that the "latent forces" were by no means extinct. The seismic waves were, in the first commotion, long, and took a southeast to northwest direction, as is shown by the lines made by the seismograph and the zones in which the buildings fell—this, of course, in those centers where it was not felt in all its might, for there everything is in ruins.

In subsequent shocks the waves were short, being, more properly speaking, upheavals of the soil. The nature of these perturbations is evident at Nazli, where the ground rose five or six feet in some places, and subsided as many in others. The effects produced are most extraordinary.

The village of Haskieu looks as if it had been snatched up by some mighty hand, crushed in an all-powerful grasp, and then violently hurled back to Mother Earth. At Aidin a plane tree, which can with difficulty be encircled by two men, has sunk to the bole, the surrounding houses being little damaged.

Between Aidin and Nazli the railway line for 800 yards was shifted seven feet and raised five.

Near Kocharli an enormous crevasse half drained the Meander, while at Yeni Bazaar so large a body of water was ejected from fissures in the soil that a thousand sheep were carried away and the shepherd drowned. In Karaja Su all the water has withdrawn and the wells have dried up, whereas at the Djinli Kaya antimony mines, near Odemish, the volume has increased four-fold.

The pillars of the bridge at Seraikieu have turned round on themselves, but the embankments have suffered little. All the towns and villages in an area of 2,500 square miles have either been totally or partly destroyed, and at Seraikieu, once a busy center, now a heap of ruins, a fire broke out and completed the destruction.

Denizli has 2,700 houses and shops on a level with the ground; Bouladan, 1,500; Nazli, 1,200; Aidin, 500 to 600; Ortakché, 300 to 400. Karaja Su, Bosdoghan and Turkass may be said to be totally destroyed, for the few houses still standing are so shaken as to constitute in themselves a source of danger. Honas, New Shamli, Yeni Bazaar, and Morali require rebuilding.

The loss of life is, comparatively speaking, small, being variously estimated from 1,200 to 2,000. It is, however, impossible to give exact figures.

As is generally the case in earthquakes, the wounds are bad, but the number of the wounded is, luckily, small, not exceeding 1,000 to 1,500. Fully 100,000 persons are deprived of shelter, and disease will, ere long, count more victims than the earthquake, especially at Denizli, which, as its name implies, is a place of many waters.

WALLACE H. TURRELL.

Smyrna.

Armored Glass.

Glass plates cast with wire gauze, or rather mesh, inclosed in its substance, submitted to tests at the Chemnitz Technical Institute and the Vienna Technological Museum, were found to possess great consistency as well as resistance to pressure, shock, and the effects of heat, the resistance being 25·5 kilogrammes per square centimeter (361 pounds per square inch), and the consistency 255·12 kilogrammes per square centimeter (3,610 pounds per square inch) of the transverse sectional area. While plates of ordinary glass frequently broke under the sudden application of pressure, the strengthened glass was only cracked; and the cracks caused by rapid changes of temperature permitted neither damp nor flame to pass. It has already been proposed, says The Journal of the Society of Arts, to use the strengthened glass for protecting water-gage tubes; and the above named qualities would seem to indicate its use for the glasses of safety lamps.

Tobacco Plant Experiments.

Dr. Albert S. Woods, of the Division of Vegetable Pathology, in the Department of Agriculture, is carrying on some interesting tobacco plant experiments. He is growing a lot of tobacco plants, and they receive their nourishment from a bottled mixture which he deals out to them at stated periods. The idea is to try various substances and find out whether they will thrive on a certain diet, or whether they are injured by the treatment which is given them. The tobacco plants are grown in pots filled with sterilized sand. Only boiled and filtered water is given them, so that the plants cannot receive any nourishment, either solid or liquid, which is not intended. At present a mixture of potash, iron, nitrogen, phosphoric acid, lime, etc., is being used. This liquid is diluted with 500 parts of water, and a certain definite amount is poured out on the plants. The condition of the plants is carefully examined under variations of the mixture.

A MONEY order department has been opened in Dawson City.

Science Notes.

The Johns Hopkins University will have an important exhibit at the Paris Exposition. It will include the celebrated concave gratings of Professor Rowland, instruments from their laboratory and examples of the work done with them.

The cultivation of fruit trees along the highways of France is being extended each year, the government having adopted this practice as a source of revenue, so that now roadside fruit cultivation has become an important branch of national industry. Statistics of it will be found in the current number of the SUPPLEMENT.

Grant Allen, the voluminous and versatile Anglo-Canadian author, is dead. He wrote many popular books upon scientific subjects, specially the Darwinian theory of evolution. His writings were not confined to scientific subjects, however, but included works of fiction, theology, guide books, and he also wrote some curious articles upon Italian art.

The United States Publishers' Building at the Paris Exposition is now being constructed. It is for the exclusive exhibition of American printing machinery and allied interests and will be the headquarters for the publishers of the United States. A large number of the latter will exhibit bound volumes of their periodicals and current numbers will be kept on file for the use of visitors.

A hard rubber steam acid pump is made by a New York firm. It is designed specially for conveying acids, chemicals or any volatile liquid. All parts which come in contact with such substance are of hard rubber. These parts are held by and mounted on iron, which takes up all the strain incident to the work performed. These pumps are operated by steam like the ordinary steam pump or by electric motor.

Several months ago a bather was diving in shallow water and fractured several of the spinal vertebræ. He was taken to Roosevelt Hospital, New York city, and an operation was performed upon him for the removal of the fractured pieces of bone. The result of the operation has been very satisfactory and the improvement from day to day is marked. He is now regaining the sense of touch and has some slight control of the muscles.

There is every indication that the Dewey arch will be perpetuated in stone. There is a considerable discussion as to the proper location of the arch. It is the opinion of many of the sculptor-members of the National Sculpture Society that the present location is the best which could be adopted. The arch is considered by some people to have the effect of dividing traffic instead of confusing it, and the efficacy of "refuges" in London and Paris streets is conceded.

The Board of Health of New York city has received a communication from the Board of Health in Michigan stating that twenty clerks of that State who were working over old volumes of records were taken ill with consumption and died. The books were examined by a bacteriologist and were found to be full of tubercules and bacilli, and it is thought they became infected from a clerk who had consumption and who had the habit of moistening his thumb with saliva when turning the pages.

A perpetual calendar has been constructed by a Frenchman named Jagot. It consists of five wheels having a total of ninety-six teeth and of nine levers or catches. It indicates automatically, without any attention save winding, the day of the week, the date and the month, and shows the 29th of February every four years, besides suppressing it in the centenary years that are not leap years and showing it in those that are. A further description of this device will be found in the current number of the SUPPLEMENT.

New York undoubtedly possesses the finest morgue in the world. It was built two years ago, and has a capacity of 125 bodies, which are kept in cold storage. The bodies are not made a grewsome exhibition as in Paris, and the room in which they are kept is not more repulsive in appearance than a safe deposit vault. There are from twenty to fifty arrivals a day, and in 1898, 8,122 bodies passed through the morgue. The bodies of unclaimed persons are photographed and their clothing is preserved for a period of six months.

Amateur photographers will receive excellent treatment at Paris. The French Commissioners have made a ruling concerning the taking of pictures at the Exposition. Cameras will be allowed on the Exposition grounds after a permit has been secured from the Exposition authorities. A charge of ten cents will be made for this, and the applicant will be required to furnish his name, age, and other personal data together with his residence in Paris. Only the buildings and general groups can be taken. Photographs of individual exhibits will not be allowed, as the patent laws of France guarantee the patentee against photographs of articles exhibited. A charge of $2 was made for similar privileges at the World's Fair, in Chicago, and photographs were even then taken with difficulty. It is gratifying to know that the French Commissioners have made such a wise decision so early.

Engineering Notes.

There are 1,135 miles of railway in Cuba, 551 miles of which are controlled by British companies.

The Pennsylvania Railroad Company has contracted for 100,000 tons of steel, and it is said the price to be paid is $33 per ton.

An acetylene gas lamp exploded on the train which runs from Aix-la-Chapelle to Berlin. The compartment happened to be empty at the time so that no one was injured.

A record in shipbuilding has been established at Devonport, England. The first-class battleship "Bulwark" of the "Formidable" class is ready for launching after being in hand for only seven months.

"La Lorraine" of the Compagnie Generale Transatlantique will be ready in the spring. She is 580 feet long and her displacement is 15,000 tons. Her engines are of 22,000 I. H. P., and she will make 22 knots.

A glass factory has been started at St. Helens, England, in which the whole system of blowing is replaced by an automatic arrangement of molds and blowpipes worked by compressed air. The output has been much increased.

One hundred and twenty-seven establishments in Tokyo use gas engines and there appears to be a great field for American gas engines in Japan, as light power is needed for many industries. Gas is also used to a considerable extent for cooking and lighting. The gas plant at Tokyo has been increased 50 per cent during the past few months.

Admiral Crowninshield recommends the substitution of shore barracks for receiving ships in the navy, and estimates have been prepared for submission to Congress; these are for fireproof barracks for 1,000 sailors of the Brooklyn navy yard, to cost $800,000. For barracks for 500 sailors each at League Island, Norfolk, Mare Island and Boston, the cost will be $400,000 in each case.

A 25-mile railway for the Philippines was recently packed in the hold of a steamship at San Francisco. Everything needed for the railroad was sent except the ties, which will be obtained in the islands. It is said that the railway will be used to extend the 30 miles of railroad now controlled by the American troops. The engineering corps will build the bridges, etc.

First-class passengers in England have increased only 10 per cent in ten years, while the number of the third-class passengers has increased 41 per cent. Out of 1,063,000,000, passengers traveling with regular tickets excluding commutation tickets, 963,673,996 went in third class compartments; 66,199,930 in second-class and 33,037,190 in first-class compartments, so that out of 100 travelers, only three went first-class, six second-class and ninety-one third-class.

Proposals are being entertained by the French military authorities for a new weapon called the pistol-saber. It is an ordinary saber provided with a small firearm lodged in the hilt. On encountering a resistance surface the blade recedes and discharges the pistol, a recoil of about $\frac{1}{16}$ of an inch being all that is necessary. The shot will penetrate a steel breastplate. The new weapon will weigh only a third more than the ordinary saber, which of course, when the pistol is not loaded, can be employed in the usual way.

News dispatches from the Transvaal state that armored trains are being used to transport troops and passengers through the districts which are menaced. Such trains are nearly always improvised and are nothing more than a train of ordinary freight cars whose resistance to attack has been increased by plating the inside with sheets of metal. Holes are pierced in the cars through which rifles and small cannon could be used on the attacking party. Sometimes a freight car mounting a piece of artillery forms a part of a train. These trains are improvised as needed and are fitted up with the nearest materials available, such as sheets of steel, sandbags or lumber. Such trains were used with great satisfaction in the Egyptian war.

A new German canal is now proposed between Riesa and Leipsic, and the plans have now been completed. The canal will be 42 miles in length, and being built entirely in Saxon territory will in no way conflict with foreign state interests. It is estimated that the cost of building this canal will be higher than usual with canals of the same length. This is partly on account of the difficulty which will be encountered in getting over the watershed. The total cost of the crown and slope work, road and railway crossings, lift work, water-feeding, etc., will amount to $9,044,000. The cost of the harbor in Leipsic will amount to $2,142,000, and to connect the canal with the Pleisse will require $831,000. The project indicates Saxony's interest in helping its commercial and industrial people. Riesa is the grain center of this kingdom and Leipsic is its largest city. The latter, for a long time, has been the center of an enormous trade, largely due to its fairs, which occur twice a year, one in April and the other in September.

Electrical Notes.

It is proposed to build 70 miles of trolley road between Buffalo and Erie, and a company has been incorporated with this end in view.

Strange to say, in England a church has not the legal power to substitute one method of illumination for another without obtaining an ecclesiastical license called a "faculty" for the alteration.

A series of experiments has been recently carried out under Prof. Carus-Wilson's direction on the three-phase railway connecting Thun with Burgdorf, with the view of ascertaining the ability of polyphase motors to accelerate heavy trains on ordinary lines.

Telephonic communication between St. Petersburg and Moscow is obtained by a line 412 miles long. It is said to be the longest single line in Europe. Nearly all of the towns in Finland are connected by telephone; the rates are very low.

The best way of testing the balancing of armatures is to mount them in bearings which are free to move, then while the armature is running the heavy side can be found with a piece of chalk and counterweights adjusted on the opposite side until the cessation of movement of the bearings shows that the center of gravity coincides with the axis of the shaft.

An interesting bulletin board was mounted on the Thames Embankment of London to report the yacht races. A huge screen was fitted up in front of a newspaper office, and it was properly painted to represent the course. Small electric green and red glow lamps were used to represent the yachts, and they were pushed along thin copper rails once every ten minutes.

Prof. Bergmann, the great surgeon of the Berlin University, states that the healing power of the Roentgen rays are imaginary. The determination of the presence and position of foreign bodies has been extremely successful with the Roentgen rays, as is well known. Their use in connection with broken bones has also been very satisfactory. The hope of discovering, by the aid of the Roentgen rays, the position of bladder and gall stones has not been fulfilled.

A water-driven electric plant is proposed in Brazil to obtain 16,000 horse power from the Tiete River and transmit it electrically to the city of San Paulo, 24 miles distant. A masonry dam 1,000 feet long and 35 feet high will be built, and the water will be conducted by a steel conduit 12 feet in diameter and a half mile long to the turbines. The electric transmission is to be at 20,000 volts, three-phase, and the current will be used by a company which owns 104 miles of street railway in San Paulo.

The Dubois system of telegraph pole protection is described in the Moniteur Industriel. It consists of surrounding the portion of the pole in the ground with an earthenware pipe very similar to a small drain pipe. The end of this pipe comes just above the surrounding soil. Into the space between the pole and the pipe the inventor introduces a mixture of sand and resin. The resin is poured in first, and when it solidifies the sand and resin form a watertight preventive against the rotting of the butt of the pole.

Soundings have been taken for rock bottom foundations for the new dam to be built across the Housatonic River, five miles above Derby, Conn. The Housatonic Lighting and Power Company purposes to generate electricity enough to be conveyed in any desired volume to all the cities of western Connecticut, for the operation of factories and trolley cars and for the lighting of streets. The dam is to be so high that droughts are expected to cause no interruption in the transmission of power. The electrical equipment will be placed close at hand.

The London Lancet gives an account of an instrument called the neurotone for applying a gentle electric current to the skin. The apparatus is contained on a base plate, at the bottom of which are mounted the two electrodes which are applied to the skin. They consist of polished metal plates 3½ inches long by 1 inch wide with a suitable gap between. The batteries are connected to the apparatus with a flexible cord. It is held in the hand and moved over the affected places about the same way as a flat iron is used in ironing clothes. The current can be varied to suit the different requirements of the patient by a regulator on the base.

The Orleans Railway Company is prolonging its main line into the heart of Paris as far as the Quai d'Orsay, as we have already shown in an illustrated article. The distance is 2·3 miles, and 1·9 miles of this road will be underground. At the Austerlitz station, steam locomotives will be taken off the trains and electric locomotives substituted. The current will be generated as three-phase at 5,500 volts, 25 alternations per second. The generating station is over three miles from the terminal at the Quai d'Orsay. The sub-stations at the two termini will contain rotary converters and a large battery, which will deliver current at 550 volts to the line. Continuous currents will also be furnished from other rotary converters for the lighting of the stations.