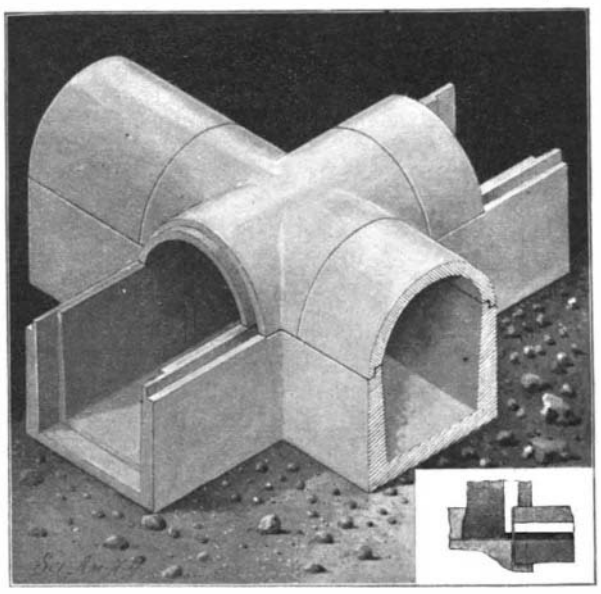
AN UNDERGROUND CONDUIT-CROSSING FOR ELECTRICAL CONDUCTORS.

Our illustrations represent a new crossing for underground conduits for electrical conductors, which has been invented by Victor Koch, of Scranton, Penn., and which is arranged thoroughly to protect the conductors from moisture and to permit the making of repairs.

The crossing is provided with a base having its top rabbeted along the sides. Oppositely-arranged longitudinal trough-sections have projecting tongues continuous along the bottom and sides, the bottom portions engaging the corresponding rabbets in the base. The transverse trough-sections which complete the crossing are provided at one end with projecting tongues to engage the corresponding rabbets on the base. The sides of the transverse sections fit in the rabbets on the



PERSPECTIVE AND PARTIAL PLAN VIEWS OF THE CONDUIT-CROSSING.

sides of the longitudinal sections. Our small plan view of one corner of the crossing, with the cover removed, shows the arrangement of rabbets and tongues. Upon the longitudinal and transverse sections an arched, cross-shaped cover is fitted, and connected with the sections by tongues and grooves so that moisture cannot pass into the conduit in a longitudinal or a transverse section or at the crossing. In making the various parts of the conduit the inventor employs glass or other material impervious to water so that the wires placed in a conduit are protected from the influence of moisture. Interruptions in telegraphic, telephonic, or other electric lines are therefore not likely to occur.

From Cable to Trolley on the Third Avenue Railroad, New York.

The work of changing the Third Avenue Railroad system in New York from cable to trolley has been actively prosecuted during the past year, and last week the first section of the road from Sixty-fifth Street to One Hundred and Twenty-ninth Street was put into electrical operation. The difficult work of making the necessary changes has been carried out without interrupting the heavy traffic which passes over this road. The improvement of the road has consisted in a general reconstruction, in the way of laying down heavier rails, in addition to the insertion of the appliances necessary for its operation on the underground trolley system. The old rails, which weighed 80 pounds to the yard, and were in 30-foot lengths, have been replaced by 100-pound, 60-foot rails. A further improvement, having for its object a smoother, running track, was the uniting of the rails by means of cast-welded joints. The improvement resulting from this change alone has been very marked; the running of the cars being exceptionally smooth and noiseless.

The change to electric power necessitated the laying of the ducts for the electric cables, the construction of handholes, 15 feet apart, at the side of the slot rails, and the putting in position of the insulators which carry the T-rail conductors. As this work had to be done without interfering with the cables of the cable system, the T-rails were not at first placed in the position they will finally occupy, but had to be placed fully 9 inches apart in order to make room for the passage of the plow on the present cable cars. This arrangement was made possible by providing oblong bolt holes in the insulator frames, with sufficient clearance to allow each rail to be moved back 1½ inches from its final permanent position.

The change from one system to the other on the stretch of track above mentioned was made immediately after midnight on Saturday, at which time a large force of men was stationed at the hand-holes and simultaneously moved the feeder rails to within half an inch of their proper position, leaving room for the cable plows to pass. At half-past two in the morning the cars were stopped, both feeder rails were moved to place, and all connections made. In removing the cables, they were cut and the sections were hauled into the power house by means of the main engines.

AN IMPROVEMENT IN ROTARY DRUM-DRIERS.

A patent has been issued to John Bishop, of Bartow, and Andrew P. Jerguson, of Hull, Fla., for an improved drier designed primarily for the handling of phosphate rock and such material as may be allowed to come into direct contact with the products of combustion. The drier is of the rotary-drum type, and is provided with longitudinal partitions forming as many contracted longitudinal channels through which the material to be treated is passed, thus providing a large amount of radiating surface and consequently increasing the efficiency of the drier. The feed end of the drier is furnished with a number of diagonal angle-iron flanges, which, as the drum revolves, feed the material toward the partitions. The stock is further advanced by angle-iron flanges on the partitions, which, however, are used only when the drum is horizontally mounted.

The inventors state that by the use of the continuous partitions a large increase of effective heating surface is obtained and that the material is more equally distributed, since it is divided into a series of sections sliding over the heating-surfaces. The continuous partitions applied to an ordinary, direct-fired rotary drier differentiate this apparatus from others of the same class.

WATERWORKS EXPANSION IN BOSTON.

BY J. A. STEWART.

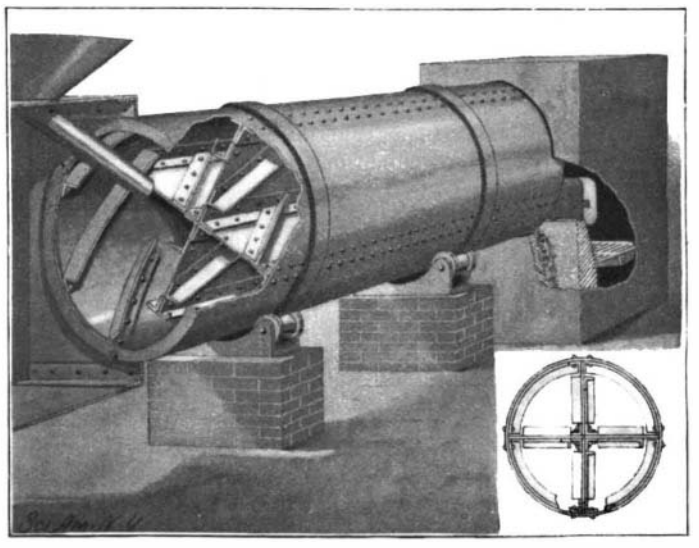
Few people realize, even in Boston, the importance and magnitude of the plans, which are at present under way, to give that city a pure and adequate supply of water for all purposes. Not only Boston is to be benefited, but also the various municipalities which lie within a ten-mile radius.

It was in 1893 that public attention was called to the inadequacy of the water provision and the imminent danger of deficiency in time of drought, by a legislative act authorizing the State Board of Health to present a plan for a suitable water supply for the city of Boston and its suburbs.

At that time Boston was receiving some 57,000,000 gallons of fresh water daily from a watershed of about 120 square miles. About five-eighths of the supply came from Sudbury River and its tributaries (constituting the Sudbury system) and the remainder was drawn from Mystic Lake and Lake Cochituate. Though three distinct systems thus contributed to supply it, there was barely sufficient water to meet the needs of the people, which on a conservative estimate would in 1895 amount to 84,000,000 gallons daily.

It was consequently deemed of the utmost importance that there should be no delay in augmenting the sources of water supply. By the legislative act of 1895, the Metropolitan Water Board was created to act for the State.

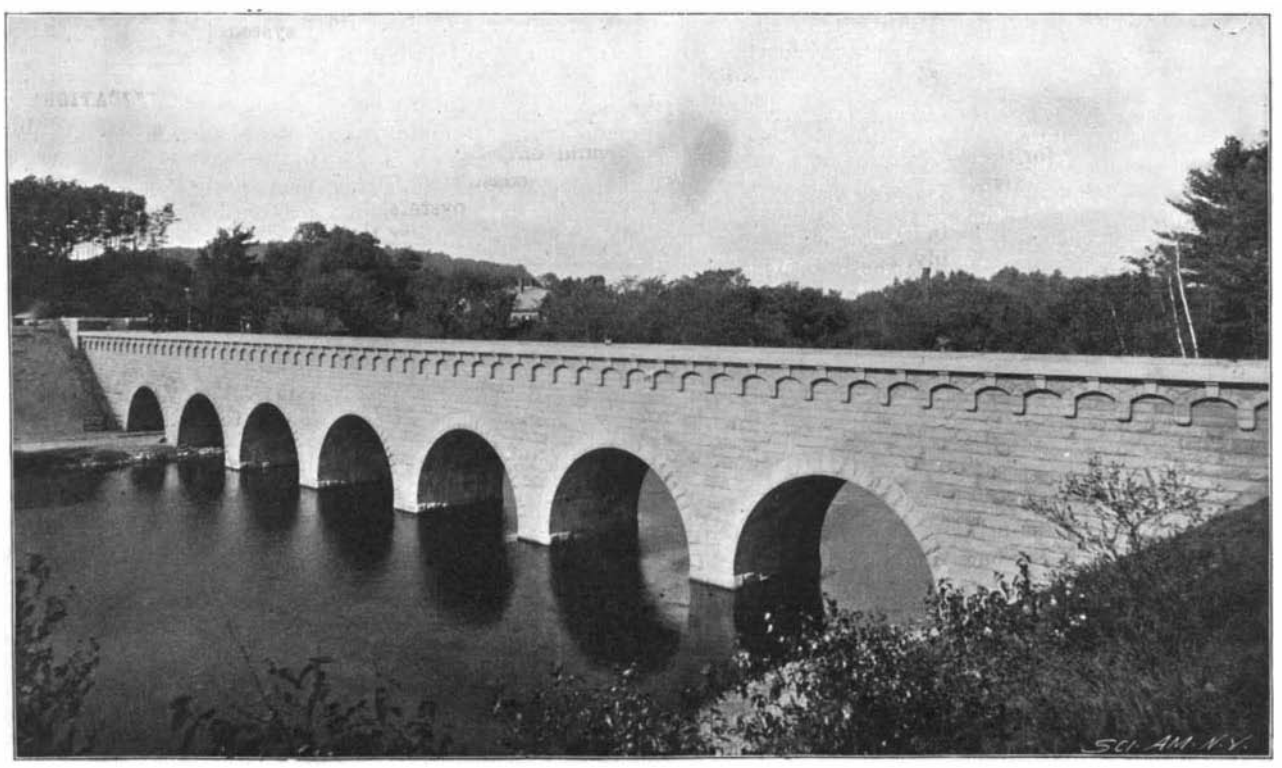
The act constituted a metropolitan district to include the cities of Boston, Chelsea, Everett, Malden, Medford, Newton, and Somerville, and the towns of Belmont, Hyde Park, Melrose, Revere, Watertown, and Winthrop. By a special provision other cities and towns may be supplied by the Board, of which provision Nahant, Swampscott, and Quincy have taken advantage. The issue of bonds to the amount of $27,000,000



AN IMPROVED ROTARY DRUM DRIER.

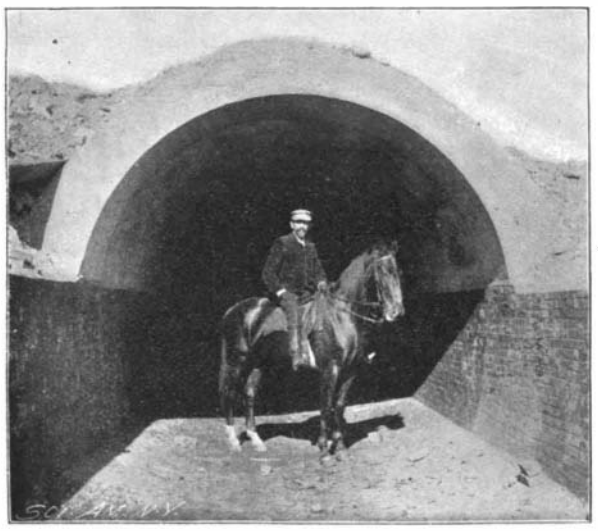
was authorized, the total cost of the extension being estimated at $20,000,000. By the construction of the proposed works, the water of the Nashua watershed, an area of about 118 square miles, capable of yielding, even in a series of very dry years, 105,000,000 gallons of water daily, will be stored in a great reservoir, 6½ square miles in area, on the south branch of the Nashua River. This water is conveyed by the new Wachusett aqueduct to the new Sudbury reservoir in Southborough and Marlborough; thence with the mingled waters of the present Sudbury and Cochituate systems of the city of Boston to the Chestnut Hill reservoir and to Spot Pond, whence it is distributed to the various cities and towns of the metropolitan district, insuring a daily supply of at least 173,000,000 gallons, double that of all other sources combined for the use of the district.

The carrying out of the plans requires the erection of a large dam and dikes at Clinton, Mass., and the construction of a vast storage basin. The building of new pumping stations and the laying of great main distributing pipes are among the minor operations involved. As the first duty of the Board, however, was to furnish increased water supply at the earliest period, its efforts were at once directed to the completion of the Sudbury reservoir (a work half finished by the city of Boston) and the building of the Wachusett aqueduct. The latter important work, begun early in 1896 and completed in 1898, embraces (1) a tunnel two miles long through rock so compact as not to require a lining for half its length, (2) a masonry aqueduct, seven miles long, with a bridge of seven spans and 360 feet in length across the Assabet River, and (3) an open channel, three miles long, following the course of a brook into Sudbury reservoir. The masonry aqueduct, which is 11 feet 4 inches wide and 10 feet 5 inches high, has a maximum capacity of 300,000,000 gallons daily. It terminates at a point on the Sudbury watershed in the town of Northborough. Its waters then run for three miles through the open channel, which is 20 feet wide at the bottom, to Sudbury reservoir, from which a second aqueduct issues, branching at Weston into two great pipe lines, one taking a northeasterly



ASSABET BRIDGE, ON LINE OF AQUEDUCT.

course to Arlington, the other running southeast to Chestnut Hill reservoir. The waters of the Nashua River were diverted into the Wachusett aqueduct by means of a temporary dam, which will also serve as an aid in prosecution of work upon the main dam. The completion of the Sudbury reservoir in 1898 and its connection with the Nashua River by means of the Wachu



WACHUSETT AQUEDUCT—BRICK AND CONCRETE CONSTRUCTION.

sett aqueduct gave the metropolitan district an additional storage basin of nearly two square miles, averaging 19 feet in depth, and having a capacity of 7,500,000 gallons, thus increasing the daily supply from 69,000,000 to 100,000,000 gallons, and enabling the people to receive and enjoy to a large extent the better water which comes from the Nashua River.

COMPARATIVE TABLE OF AREAS, DEPTHS, AND CAPACITIES OF STORAGE RESERVOIRS, WITH HEIGHTS AND LENGTHS OF DAMS.

Name and Location of Reservoir.	Area (Square Miles).	Average Depth (Feet).	Maximum Height of Dam.		Length of Dam (Feet).	Capacity (Million Gallons).
			Above Ground.	Above Rock.		
Wachusett reservoir, Mass.	6·56	46	129	158	1,250	63,068
Nira, near Poona, India.	7·25	27	100	....	3,000	41,143
Tansa, Bombay, India.	5·50	33	127	131	8,770	37,500
Khadakvasla, Poona, India	5·50	32	100	107	5,080	36,737
San Mateo, Cal.	....	....	170	....		32,000
New Croton, N. Y.	....	....	157	290	1,270	32,000
Elan and Claerwen, Birmingham, Eng, waterworks (total for six reservoirs)	2·34	43	98 to 128	...	4,460	20,838
All Boston waterworks reservoirs combined	5·82	14	14 to 65	....	....	15,867
Vyrnwy, Liverpool, Eng.	1·75	....	84	129	1,350	14,560
Ware River, Mass. (contemplated)	1·62	33	71	....	785	11,190
Sodom, N. Y.	....	....	72	89	500	9,500
Hemet, San Jacinto, Cal.	...	....	150	....	200	8,500
Sudbury reservoir, Boston waterworks	1·91	19	65	70	1,865	7,438
Titicus, N. Y.	....	....	105	115	....	7,000
Hobbs Brook, Cambridge waterworks	1·00	12	23	....	....	2,500
Cochituate, Boston waterworks.	1·35	8	....	...	....	2.160
Hopkinton reservoir, Boston waterworks.	0·29	25	52		1,500	1,500
Furens, France.	....	....	146	184	....	422

NOTE.—The heights of dams are given from the ground and rock up to the level of full reservoir. The lengths of dams are the distances across the valleys at the level of full reservoir on the line of the main dam. The capacities are given in United States gallons.

Although the Water Board could rest upon its oars at the termination of its primary task, the progress of extension has been persistently pushed. Preparations have been quietly and steadily going on during the past four years for the most important work and the climax of the scheme—the construction of the Wachusett dam and reservoir in Worcester County. This projected reservoir will supplement and cast into the shade all previous parts of the system. It is evident that it exceeds in vastness and engineering greatness anything before attempted. When completed it will hold about 63,800,000,000 gallons of pure water, or about four times as much as all the present reservoirs, ponds, and basins in the Sudbury, Cochituate, and Mystic systems taken together. The accompanying table shows that the Wachusett reservoir exceeds in capacity the Nira basin, near Poona, Hindostan, by more than a third. The mammoth reservoir Tansa, in Bombay, and the Khadakvasla, at Poona, are left still further behind. The next largest reservoirs yet completed, the San Mateo, California, and the Croton, New York, could both be almost contained in the Wachusett. With but one exception, the Periyar, now building in India, the Wachusett is the largest retaining reservoir in the world.

The site of this great storage basin is in one of the sightliest sections of Central Massachusetts, about 35 miles northwest of Boston, and about seven miles northeast of Worcester. On account of the rocky nature of the soil, very little opportunity is given for agricultural pursuits, and the population is but 69 to the square mile. The region was settled early in the present century. The scenery is diversified by hills, valleys and woods. Nearby toward the north stands Mt. Wachusett like a guardian sentinel. The land is elevated, broken, and of good quality. Merrimac schist, calcareous gneiss and the St. John's group, constitute the geological formation. West Boylston, a busy manufacturing village of 3,000 inhabitants, will pass out of existence.

The entire area of the watershed is 118·23 square miles, and at its highest point its elevation above sea-level is 2,002 feet. There are 2,000 acres of cleared land to be flooded; 1,801 acres of wooded land; 81 acres of stump land; and 313 acres of water surfaces. The elevation of the reservoir is 385 feet above Boston waterworks base, thus affording an adequate head to reach the highest buildings in Boston.

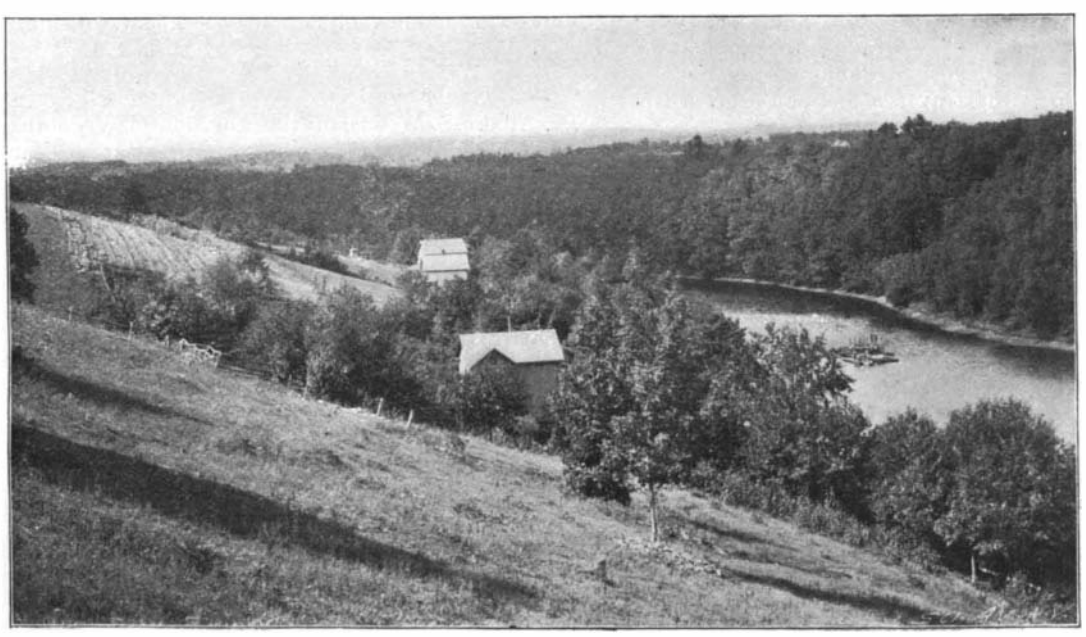
The great retaining chamber is created by building a masonry dam across the Nashua River just above the town of Clinton, and by constructing dikes to the north and south of the main dam to prevent overflowing in certain other directions. The area to be submerged is 4,195 acres or 6·56 square miles exclusive of margins. The length of the basin is 8½ miles, and the total length of shore line, exclusive of islands, 35 miles. As the shores are exceedingly steep by reason of surrounding hills, the average depth of the reservoir is 46 feet, which is an unusual depth, and in places it reaches 129 feet.

The new basin will submerge a small part of Clinton and of Sterling. A great deal of Boylston and almost all of West Boylston will be wiped out. The buildings now being removed include 6 mills, 4 churches, 6 schoolhouses, and 224 dwellings. One thousand seven hundred and eleven people found homes on the land required for the reservoir. In addition it has been found necessary to take the whole area of St. John's Catholic cemetery, in Clinton, the removal of which will be required.

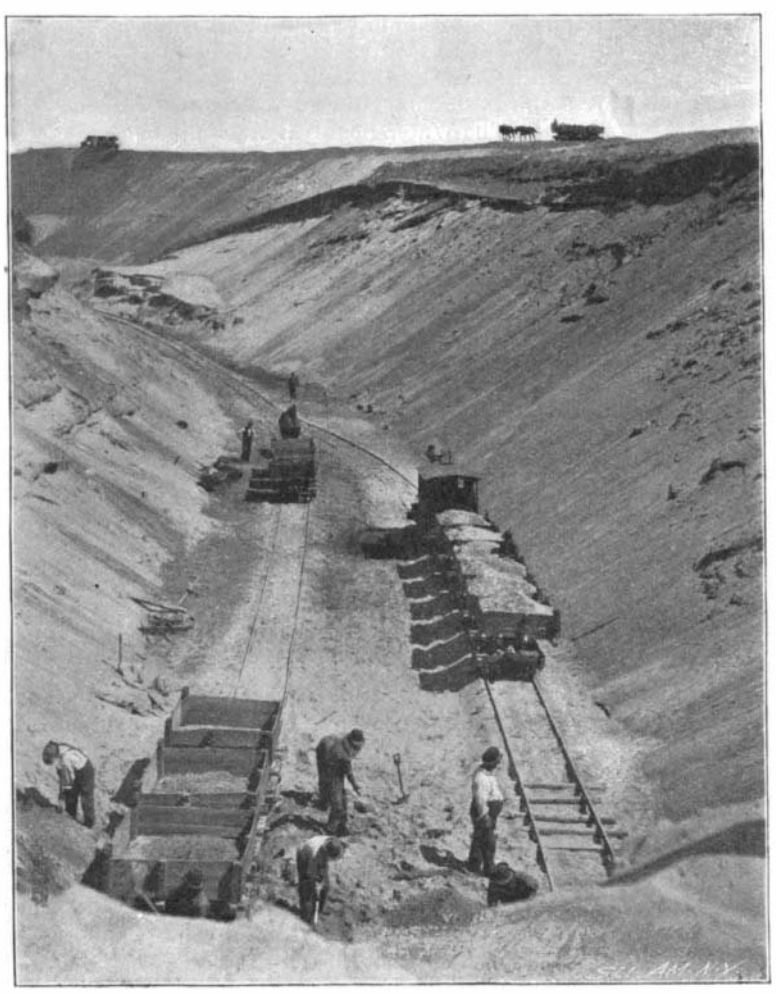
Negotiations in settlement of claims have consequently formed a large part of the preliminary planning. The outlay for this has reached a total of $1,905,734.22, and a few claims are still pending. In some cases, it is easy to see that no amount of money (though the State has made adequate financial compensation) could offset the heartbreak at leaving the spot where a family had been rooted for a century.

The removal of the soil is one of the larger operations connected with the construction, involving as it does an expenditure of $3,000,000. The Board has reached the conclusion that brush, peat, mud, and minor organic matter when accumulated at the bottom or along the sides of reservoirs and basins soil the water at times and infect it with living creatures; consequently, like the recently built basins, the big reservoir will be scraped free of such organic matter down to bed rock, sand or mineral earth. An average of 9 inches of black loam is being taken from the wooded land and 11½ inches from the cleared land. Near the edges of the reservoir the soil is being removed by teams, scrapers, etc., but by far the greater quantity is being carried by the soil-scraping railroad and deposited in the north dike where it cannot unfavorably affect the water in the reservoir. This dike, which will cost half a million dollars, runs along the northerly side of the reservoir from Clinton to West Boylston and Sterling, a total length of 8,550 feet. The top of the dike is raised 15 feet above the high water level in the reservoir and

TERMINAL CHAMBER, WACHUSETT AQUEDUCT.



SITE OF DAM, WACHUSETT RESERVOIR.



NORTH DIKE, EASTERLY PORTION MAIN CUT-OFF TRENCH.

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.

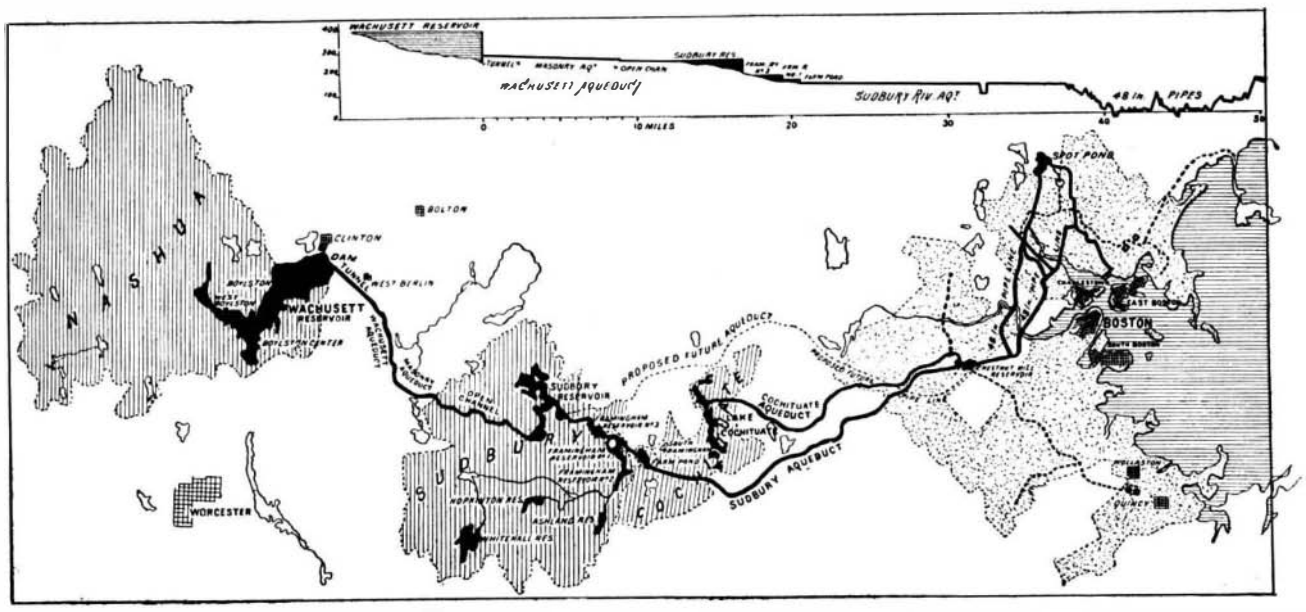
The dam will rise 10 feet above the level of the full reservoir. At the water level it has a thickness of 19 feet, and 145 feet below the water line the thickness increases to 119½ feet. It is composed entirely of masonry. Its total length is 1,250 feet; but only 750 feet has a depth from high water 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.