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TABLE OF CONTENTS.

ENGINEERING NEWS OF THE WEEK........353, 367
Progress on the New Water-Works for Cincinnati, O. (with two-page plate and other illustrations).. 354
A Cooling Tower and Condenser Installation...... 355
Switches and Frogs for Track of 100-lb. Rails, Duluth & Iron Range R. R. (illustrated)............ 356
Is it Safer to Run Fast or Slow Over a Weak Bridge? 356
The New Covered Filter Bed for the Water-Works of Somersworth, N. H. (illustrated)................. 358
A Universal Circular Saw (illustrated)............. 359
Tests of Formaldehyde as a Disinfectant at Newton, Mass. 359
The Hughes Air Lock, Valparaiso Harbor (illustrated)..... 362
New Air Lock and Cylindrical Wooden Pneumatic Caissons for Foundations (illustrated).......... 363
Between the Mine and the Smelter................ 365
The Exposure Fire in the Home Life Insurance Co.'s Office Building, New York city (illustrated)...... 366
Book Reviews 367
The New York Meeting of the American Society of Mechanical Engineers 368
EDITORIAL NOTES 360
The Financial Status of Canadian Bridge Schemes—Experience with Electric Conduit Railways in a Heavy Snowstorm.
EDITORIAL:
Commercial Education in the United States........ 361
LETTERS TO THE EDITOR....................... 362
Canadian Bridge Schemes and Ethics for Engineers—A Battle of Quotations—The Board of Awards of Baltimore and Other Features of the New City Charter—The New Printing Plant of the W. B. Conkey Co.

THE CHESAPEAKE & OHIO CANAL sale is to take place on Feb. 7, 1899, when sealed bids will be opened by the Board of Public Works of Maryland for the entire interest of the state in the canal. This interest consists of a $2,000,000 mortgage made in 1834, and the accrued interest thereon for 64 years, common stock to the amount of $788,724, and preferred stock amounting to $4,375,000. There are some prior liens on the property, amounting to about $2,000,000, which are held by interests friendly to the Baltimore & Ohio R. R. It is generally conceded that the only bidders for the property will be some railway company desiring to use the canal towpath as a roadbed, or the Baltimore & Ohio, which may purchase it to prevent the establishment of a competing line. It is stated that except during the years from 1867 to 1878 the canal has never been a financial success.

THE NEW YORK CANAL INVESTIGATION is again brought to public attention by the report of Hon. Edwin Countryman, who was assigned by Gov. Black last August to make a special study of the testimony taken by the Canal Investigation Commission and to report whether civil or criminal proceedings should be instituted against any persons or public officers by reasons of acts in connection with the canal works. Judge Countryman's report is a voluminous one. He finds in the first place that there is no evidence that any of the contractors were guilty of collusion or fraud in obtaining or carrying out their contracts, and concludes that with two or three possible exceptions there is no chance for a successful suit by the state against the contractors. As regards the State Engineer and the Superintendent of Public Works, however, Judge Countryman holds that, although corrupt collusion with the contractors is not shown on their part, they were guilty of various infractions of law; and he advises that the evidence against both these officials be submitted to the Grand Jury. He holds the State Engineer culpable for not making use of the quantities and information contained in the preliminary surveys in preparing his estimates, and he thinks the reason was that it was desired to conceal from the public the fact that the $9,000,000 appropriation was inadequate to complete the work. The reclassification of earth as rock on various contracts is severely commented upon, together with the means which were adopted to induce subordinate engineers to fix quantities and classify materials in accordance with the instructions of those over them and against their own opinions and measurements.

Concerning the Superintendent of Public Works, Judge Countryman holds that his power and authority were sufficient to have enabled him to have detected and prevented the various illegal acts charged to the State Engineer's department, that he exceeded his powers in the making of special contracts for extra work, and that the application of part of the $9,000,000 appropriation to other work on the canals than the deepening ordered by the legislature was a violation of law.

Concerning the subordinate employees of the departments, Judge Countryman says that while many of them have been shown to be willing assistants in the various illegal practices complained of, he has deemed it best that the public prosecutor should be left at liberty to exercise his discretion in using any of them as witnesses in the prosecution of the principal offenders.

As soon as Judge Countryman's report was made public, Gov. Black instructed the Attorney-General to institute criminal proceedings against the two officials. Superintendent of Public Works Aldridge presented his resignation on Dec. 1.

THE PROBABLE EFFECT OF THE CHICAGO DRAINAGE Canal upon the water flowing by the communities below its outlet, and especially upon the city of St. Louis, is still causing much discussion in Chicago and St. Louis. A committee of prominent public men has been appointed at St. Louis to investigate the subject, while at Chicago Arthur R. Reynolds, M. D., Commissioner of Health, has addressed a communication to the Trustees of the Sanitary District of Chicago urging that a series of bacterial and chemical examinations be instituted of samples of water collected at various points between Chicago and St. Louis. These examinations would be continued for some years, in order to show the changes wrought by putting the canal in operation.

RIVER POLLUTION BY THE SEWAGE OF MIDDLEBOROUGH, Mass., has been pronounced by the State Board of Health of Massachusetts as possibly one of the "causes of the large amount of sickness in the portion of the town which is nearest the river." The board recommends that plans be prepared and carried out for the establishment of a sewage purification plant.

RIVER POLLUTION AT WATERBURY, CONN., has been before the courts more or less of the time since April, 1891, and a new suit, entered upon some two years ago, has just come up for trial after a number of delays. The suit is brought by Platt Bros. & Co. and the Platt Mills Co. against the city of Waterbury. An injunction is sought against the discharge of sewage into the Naugatuck River, and damages are claimed on the ground that the river has been rendered unfit for all uses except power, to which it was formerly put by the plaintiffs.

THE MOST SERIOUS RAILWAY ACCIDENT of the week occurred Dec. 2 on the Fitchburg R. R., near Athol, Mass., in which two freight trains collided. The wreck caught fire and a brakeman, who was pinned in the wreck, was burned to death before he could be released.

THE BURSTING OF THE MAIN STEAM PIPE of the Mallory Line steamship "Alamo," on Dec. 3, caused the death of six men and the injury of one other, all belonging to the engineering force. The "Alamo" had been used as a United States troop transport during the recent war and was just starting on her first regular trip South after being thoroughly overhauled and equipped with new boilers and steam pipes. Both had been tested by U. S. government inspectors, and at the time of the accident the boiler pressure was about 80 lbs., while 100 lbs. was the safe allowable pressure. The accident is attributed to the straining of the copper steam pipe at the time it was tested by the government inspectors.

THE EXPLOSION of a part of the refrigerating machinery of the government hospital ship "Bay State," at a dock in Brooklyn, N. Y., on Dec. 6, resulted in the death of the engineer in charge and the injury of a number of hospital attendants. According to reports one of the pipes leading from the ice machine burst, blowing away the bulkhead separating the ice room from the engine room and otherwise damaging the interior of the vessel.

THE EXPLOSION OF ABOUT 10,000 lbs. of powder at Lamotte, Mo., on Nov. 23, killed 6 men and injured several others. According to accounts the explosion occurred in the packing house of the powder mill at that place, and was so severe that its effect was felt fully 25 miles away.

A HARBOR MINE EXPLODED at Fort Independence, Boston, Mass., on Dec. 6, while being hauled from the water's edge to the magazine. Four men were killed, three of them being blown to fragments.

AN ELEVATOR ACCIDENT occurred in a 11-story building at 55 William St., New York city, on Dec. 6, in which one man was killed and three others were seriously injured. It appears that when the car reached the bottom of the shaft the counterweights became displaced and fell from the shaft upon the car.

TWO BASCULE BRIDGES over the Chicago River will be built by the Drainage Board, as they will be cheaper than the construction of by-passes around the old bridges, in order to increase the capacity of flow. One of these will be at Taylor St., and the other will be for the Chicago & Northern Pacific R. R., between Taylor and 12th Sts. The present structures are swing bridges, and both of the new structures will be of the Scherzer rolling-lift type, already in use at three points on the Chicago River. The cost is estimated at $314,000, or $95,000 less than that of the by-pass, while the new bridges will give better facilities for navigation than those at present existing.

TRACKWAYS OR WAGON TRACKS are proposed for use on State St. and Clark St., Chicago, between 16th and 22d Sts., in order to relieve the street railway tracks from the wear and delay to traffic, due to the very heavy wagon traffic at these points. The Chicago City Ry. Co. has to repair the pavements between the streets named, and Mr. M. K. Bowen, President of the company, proposes to use flat rails, 6 ins. wide, slightly concave on top, forming wagon tracks, between the street railway tracks and the sidewalks.

A COMMISSION TO PREPARE A BUILDING CODE for the city of New York has been authorized by the Municipal Council, and the matter is now in Mayor Van Wyck's hands. The ordinance provides for a representative of the Corporation Counsel, the three Commissioners of Buildings, and five experts who shall have had at least five years' actual experience. It is understood that the five experts will be appointed by President Guggenheimer of the Council, and President Woods of the Board of Aldermen.

THE HOLLAND SUBMARINE TORPEDO BOAT has been favorably reported upon by the Board of Inspection and Survey of the Navy Department. The report says that the board found all the claims of the builders verified, but it recommends a further test under "war conditions." This test is to be conducted in about one month over a mile course. In the center of this course an old vessel will be anchored; and the "Holland" must rise to the surface, discharge a torpedo effectively at the hull and then disappear. On the successful accomplishment of this work will depend the acceptance of the boat by the government.

PROPOSALS FOR MACHINERY for rolling armor plate, to be delivered at St. Petersburg, will be received until Dec. 12 at the office of the Naval Attaché of the Russian Embassy, D. T. Mertvago, 818 18th St. N. W., Washington, D. C. A reversing engine is wanted, capable of rolling the ingots to plates at one heat. The rolls are to be 4,000-mm. in length, the maximum weight of ingot 60 tons, and the maximum thickness of the plate is 900 mm. Roller tables lifting appliances, two sets of regenerative furnaces, with movable bottoms, and other appurtenances, are also called for.

A NEW FACTORY FOR MAKING LARGE GUNS is likely to be built at Newport News, in the vicinity of the shipyard at that place. Negotiations are in progress between Mr. C. P. Huntington and Vickers' Sons & Maxim, the English shipbuilding and gun-making firm, for the taking by the firm of a large part of Mr. Huntington's interest in the Newport News company, and for the addition of gun-making to its business. The work on the great dry-dock at the shipyard is advancing rapidly. About 10,000 piles have been driven, and a large part of the excavation has been made.

THE NEW U. S. COALING STATION at Pago Pago, Island of Lutuilla, Samoa, the contract for which was let some time ago to Healy, Tibbitts & Co., of San Francisco, Cal., is being rapidly rushed. The contract for the steel work, amounting to 2,800,000 lbs., has been awarded to the Carnegie Steel Co., and the mills are now at work getting out the material. Contracts are yet to be let for 350,000 lbs. of iron castings, 200 tons of cement and 200,000 ft., B. M., of timber. The coal shed will be 150 × 100 ft., with a framework of steel covered with corrugated galvanized iron. The contractors will take about 40 skilled workmen from America, but will depend upon native laborers for the other help.

THE TROPENAS STEEL PROCESS is about to be adopted by the Union Iron Works of San Francisco. A large foundry is being built, in which will be placed two 2-ton Tropenas converters. Mr. Irving M. Scott, vice-president and general manager of the company, recently made a thorough investigation of the process in operation in Europe. Messrs. Powell & Colné, 11 Broadway, New York city, are the agents for the process in the United States.

A WOODEN SUBMARINE CABLE CONDUIT to carry electric light cables across Fort Point channel, Boston, Mass., was described in "The Electrical Engineer" for Nov. 24. This was constructed by the Boston Electric Light Co. of 6 × 14-in. pine timber grooved on a planer so that when bolted together there were formed 24 circular ducts. The ends are made of oak and are curved up on a 20-ft. radius. The curves were built up of 4-ft. lengths while 20-ft. lengths were used in the straight section. In placing, a trench was dredged across the channel bottom, the conduit was built in two sections and launched; afterwards being joined and weighted until it sank into the trench, and duplicate cables were then drawn in and terminated in separate manholes.

C. E., of and for the sub-contractors, John Monks & Son.

There will be one central shaft, 10 ft. in diameter, which will be the suction shaft, and twelve smaller ones, each 3 ft. in diameter, as shown in some of the views. The latter are the standard shafts for Moran air locks.

All shafts are lined with steel, the plates of the large shaft being ¾-in., and of the small shafts about ¼-in. thick. The caisson is to be sunk to a depth of about 87 ft. below the surface of the ground. The working cells will be refilled with the best sand found in making the excavation, and the air lock shafts will be filled with concrete. The central shaft will then be carried on down to rock, about 18 ft., and continued in the rock to the level of the intake tunnel, the height from the bottom of the shoe to the center line of the tunnel being about 46 ft. The central shaft and the pump house walls will also be extended upwards from the top of the caisson, as shown in Fig. 4. A special feature of the outer masonry wall will be a ¼-in. steel cylinder built into it to make it water-tight. Mr. Alfred Petry, M. Am. Soc. C. E., is resident engineer on the work now in progress at California.

The intake tunnel is designed for a self-cleansing velocity of 3 ft. per sec. It is to be lined with two rings of brick, backed with concrete.

The subsiding reservoirs will be operated on the fill and draw plan. Each basin will be alternately pumped into and drawn from for from 72 to 48 hours at a time, giving an average subsidence of 72 hours for a daily output of 57,500,000 gallons; 60 hours for 69,000,000 gallons; and 48 hours for 86,250,000 gallons. Grounds have been provided for the construction, when needed, of a third settling basin, at the same elevation as the others, with a capacity of about 120,000,000 gallons.

The reservoirs will be formed by damming ravines, thus giving them the irregular shapes shown on the plan, Fig. 2. This irregularity makes the continuous settling plan impracticable, owing to uncertainties regarding the circulation of the water. The embankments will be built by what Mr. Bouscaren terms the dry process, that is, in 4-in. layers rolled dry with heavy steam rollers. In wet weather work on the embankments will stop. Four years is allowed for building these reservoirs. A similar plan of construction was employed by Mr. Bouscaren on the subsiding reservoirs for Covington, Ky., which are right across the river from the new works for Cincinnati. The Covington intake is close by the location chosen for Cincinnati, so the water for the two cities, as drawn from the river, will be identical in character. This fact has interest because some thirty days of sedimentation in the Covington reservoirs effects a large removal of bacteria and sediment, but even this long period of quiescence does not produce an ideal water. Thirty days sedimentation for Cincinnati, with the proposed ultimate capacity of 90,000,000 gallons, would mean duplicate settling basins of 2,700,000,000 gallons each.

The clear water basin will be 20 ft. deep, 400 ft. sq., and have a capacity of 20,000,000 gallons. As it will contain only about an eight hours' supply it is not thought necessary to cover it.

The final location and character of the conduit to the city pumping station had not been decided up to Nov. 20. Its length will be about 23,000 ft.

A toll road passed through the land bought for the new purification works. To divert the traffic, and to save paying tolls, the trustees have bought about a mile of this turnpike, and are constructing a piece of new road. They have also made a contract with a railway for changing its track from narrow to standard gage. A spur about 5,000 ft long will be built by the city from the railway to the pumping station. This will be available for the use of the contractors. It will include a viaduct 630 ft. long, on an 8½° curve, composed of plate girders of alternate 30 and 60-ft. spans.

The five trustees of the new works are: Aug. Herrmann, President; Maurice J. Freiberg, Chas. M. Holloway, Leopold Markbreit and Wm. B. Melish.

The Cincinnati Experiments on Water Purification.

In November, 1897, the chief and advisory engineers submitted a recommendation that water purification experiments be instituted, they being

confronted with the fact that there is not sufficient reliable information or experience at hand regarding the best and most economical methods to be adopted for filtering the Ohio River water.

The engineers did not doubt the success of slow sand filtration abroad, but they said that the water there differed materially from that of the Ohio for at least six months of the year. They also desired information to enable them to decide between slow sand and mechanical filtration, and more light on sedimentation. They considered that it would be wise to spend in experimental work 3% of the estimated cost of a purification plant and advised

the construction of settling tanks and filters of sufficient capacity to purify Ohio River water at the rate of 250,000 gallons per 24 hours for a period of eight months.

Mr. Bouscaren estimated that the desired experimental work could be carried out at a cost of $23,000 for construction, and $9,000 for operation for eight months. Mr. Geo. W. Fuller, who had just finished his experimental work on water purification at Louisville, was engaged as chief chemist and bacteriologist to take direct charge of the Cincinnati tests. On March 28, 1898, the experimental plant at Cincinnati was put in operation, and it, as a whole, has not shut down since, running days, nights and Sundays. It is expected that the experiments will be continued until at least Jan. 1. The following information regarding the scope of the experiments, and the factors involved, were obtained from Mr. Fuller.

The drainage area of the Ohio River above the new intake is about 71,000 sq. miles. The turbidity of the water ranges from 5 to 2,500 parts per 1,000,000 of total matter in suspension, by weight. The minimum amount of suspended matter is practically all clay, while of the maximum a large percentage is silt and coarse clay, suspended matters in the water being divided conventionally into sand, silt and clay, according to their hydraulic subsiding value. Between the limits named there are all sorts of variations and combinations in the amount and character of the suspended matter. This will be better appreciated on noting that the drainage area of the Ohio includes many variations in surface geology, and that the rainfall and runoff causing increases in turbidity may cover the whole drainage area, or any of its several sections having different geological formations. The maximum turbidity may occur several times in a year. As compared with the Merrimac River at Lawrence, water from which has been used for the Massachusetts experiments on slow sand filtration, the turbidity of the Ohio River is enormous, for, while at rare intervals, say, perhaps, four or five times in a century, the Merrimac River in freshet may carry 1,100 parts of suspended matter (silt), there is generally so little that chemists do not take the trouble to determine it. The bacteria in the Ohio River water range from 1,000 to 100,000 per cu. cm., with an average of about 10,000. The suspended organic matter ranges proportionately with the total suspended matter, but of the fairly constant dissolved organic matter it is hard to distinguish between that of sewage origin and that washed from the surface of the earth.

The experiment station at Cincinnati is located immediately below the retaining wall of the Eden Park Reservoir, so water may be taken from the force main leading from the main pumping station and pass through the purification plant by gravity. This secures water as nearly as possible like that of the river, at the intake of the present pumping station. The unit basis of the plant being a daily capacity of 100,000 gallons, four settling tanks, each of that available capacity, were provided and are used in rotation. These are of steel, 25 ft. in diameter, and 34 ft. high. They are designed for quiescent subsidence, being filled from the bottom and emptied through valves placed at different levels, the upper valves in succession being opened first. The average total subsidence is designed to be three days, figured from the time the tank is full until it is half empty. It takes about four hours to fill each settling tank.

The water passes by gravity from the settling tanks to an equalizing tank, in which it is held automatically at an approximately constant level. From this box the water flows through valves kept wide open, for constant flow, to the top of the filter beds, which are all at the same level.

There are 15 wooden tanks used for filter beds, in three sets, of five each. The diameter of each tank is 11.78 ft., or 1-400 acre. In each set of five tanks one is 10 ft. deep, three 8 ft. and one 6 ft., the shallower tanks being blocked up to bring the tops all to the same level. Each of the 15 tanks has gravel layers at the bottom for supporting the filtering sand, similar to those at the Lawrence Experiment Station. The 10-ft. tanks contain 5 ft. of filterng sand; the 8-ft., 3 ft.; the 6-ft., 1 ft. The available water space above the sand in each tank is 4 ft., before the depth of the sand is decreased by scraping. To prevent the water from rushing down the sides of the tanks in channels there is a series of horizontal grooves about 1¼ in. wide and ⅝-in. deep, 6 ins. c. to c. They seem to be successful. Each set of five filter tanks is filled with coarse, medium and fine sand, with effective sizes of 0.34, 0.27 and 0.20 mm., respectively. The sand was taken from the bed of the river, in the vicinity of the site for the new works. The inlets to the filter tanks enter at the sides, about 2 ins. above the original sand surface. The filtered water is drawn from the bottom of the tanks, near the sides. The outlet pipes extend to a meter room beneath the filter platform, there being a meter for each filter. On each outlet pipe there are two valves, one close to the tank, which is kept wide open, and one in the meter room, which is used to regulate the rate of filtration.

All the filters operate on the continuous plan. The rates of operation, for each set of five, are, three at 2,600,000 gallons acres per day, these having, respectively, 5, 3 and 1 ft. of filtering sand; one at 4,000,000, and one at 1,500,000 gallons, each having 3 ft. of sand.

The laboratory is a temporary one-story building, of wood, about 30 × 65 ft. It contains a full chemical and bacteriological equipment. Besides Mr. Fuller, who is Chief Chemist and Bacteriologist, there are six trained assistants, three of whom, ranking as first assistants in their respective departments, were with Mr. Fuller on the Louisville work, as follows: Chas. L. Parmelee, Engineer; Jos. W. Ellms, Chemist; Geo. A. Johnson, Bacteriologist.

As to the results of the experiments it is not fitting to speak, in view of their present uncompleted state, further than to say that on the whole satisfactory progress is being made, and that the bacteria are more easily removed than the turbidity. This last is not surprising, in view of the fact that at times the particles of clay in suspension are much smaller than the bacteria. When the Cincinnati report is published we shall have for the first time, so far as we know, detailed information regarding the possibilities of combined sedimentation and slow sand filtration for the removal of bacteria and turbidity from a water liable to be frequently high in both.

A COOLING TOWER AND CONDENSER INSTALLATION.*

By J. H. Vail.†

The conditions existing prior to the installation of the plant referred to in the following paper were as follows: The electric light station was equipped with 27 boilers, 48 ins. in diameter, 20 ft. long, with 22 5-in. tubes. The engine capacity and the load on the station already taxed all the boilers to the limit of their steaming capacity.

Plans had been prepared and estimates made for enlarging the building and increasing the boiler capacity.

After an investigation of the existing conditions, the writer recommended that by the putting in of a cooling tower and a condensing system, the engine capacity of the station could be increased, leaving the boiler capacity the same, thus saving the cost of adding more boilers and enlarging the building, and at the same time obtain better economy, as well as a greater capacity for production.

To determine the steaming capacity of the boilers, two tests were made with one pair of boilers, which showed that under regular working conditions, with Shenandoah pea coal, each 48-in. by 20-ft. boiler would evaporate into steam 4,281 lbs. of water per hour, giving a capacity of 115,587 lbs. steam per hour with every boiler in operation. Coincident with the boiler test, one 18½ × 30-in. Buckeye engine was using the steam from the boilers

*Condensed from a paper presented at the New York meeting of the American Society of Mechanical Engineers.
†Chief Engineer Pennsylvania Heat, Light & Power Co., Philadelphia, Pa.

PROGRESS ON THE NEW WATER-WORKS FOR CINCINNATI, O.

(With two-page plate.)

The most comprehensive scheme of water-works improvement now being carried out by a single city in this country is the one at Cincinnati, O. Here work is well under way on a new supply, which will include a river intake pier and tunnel, a primary pumping station, large settling reservoirs, filter plant, clear water basin, long gravity main, second pumping station and a force main to the present distributing reservoir, for all of which $6,500,000 of bonds have been authorized by the legislature.

The need of a new water supply at Cincinnati has long been recognized. The present intake is located on the river front in the heart of the city, below a large number of sewers. The water of the Ohio River at its best is so laden with sediment that few Eastern men or women would tolerate it for a moment, while at its worst it is shunned even by Cincinnatians. The people of Cincinnati, and the West in general, feel very kindly towards the Ohio and Mississippi water, especially when the mud has been removed from it, and speak scornfully of the "vegetable tea" served up by water-works officials in the East. There is some reason for this, for these Western waters, minus their loads of mud, are very palatable. Besides the sewage and mud in the present supply, the old Front St. pumping station at Cincinnati has a far from modern equipment, being sometimes referred to as a museum of pumping machinery.

Mechanical filtration was mentioned as worthy of consideration.

A few days after receiving the report just named the trustees appointed Mr. Gustave Bouscaren, M. Am. Soc. C. E., of Cincinnati, as its chief engineer, and later it selected Mr. Geo. H. Benzenberg, M. Am. Soc. C. E., of Milwaukee, and Mr. Charles Hermany, M. Am. Soc. C. E., of Louisville, as Consulting and Advisory Engineers.

A member of the editorial staff of this journal visited Cincinnati early in October, 1898, saw the work then in progress, and through the courtesy of Mr. Bouscaren, secured the information and material for illustrations from which the remainder of this article has been prepared. It was found that contracts had already been let, as follows: For the intake pier, tunnel and pump pit, to F. H. Kirchner & Co., Cincinnati, who had sublet the pneumatic work to John Monks & Son, of New York city; for grading levee, filter grounds, railway spur and Miami River protection work, to the David Folz Asphalt Paving Co., of Cincinnati; for three 30,000,000-gallon vertical triple expansion pumping engines, boilers and an electric traveling crane at the primary pumping station, to the Lane & Bodley Co., of Cincinnati. Work was already well under way in October on the caisson to be used in sinking the pump pit and on the grading contract. Detailed plans for the pumps had not yet been submitted by the contractors. Experiments, described further on, were in progress to determine the design of the purification works, more especially of the filter plant. The present article will be confined almost wholly to the caisson and the purification experiments.

water reservoir and the city pumping station, where it will be repumped to the Eden Park distributing reservoir. The works are being designed for an average daily consumption of [illegible]000,000 gallons, at the outset, with provisions for a future increase to 80,000,000 or 90,000,000 gallons. Some of the principal elevations of the works will be as follows: Low water at the California, or primary, pumping station, 3.5 ft.; subsiding basins, range, 141 to 110 ft.; clear water basin, range, about 96 to 76 ft.; bottom of well at Pendleton, or second pumping station, about 34 ft.; Eden Park Reservoir, high water, 240.78 ft. The capacity of the Eden Park Reservoir is 100,000,000 gallons.

A cross-section through the California pumping station and pit, showing the caisson at the bottom, is shown by Fig. 4, and the details of the caisson shoe by Fig. 5. The five views, Figs. 6 to 10, show the caisson in its early stages of construction, but before it was completed ready to begin sinking it. The caisson, except for the working cells and air locks, is a solid oak structure, 127 ft. in diameter and 20 ft. high, resting on a steel shoe. It contains about 2,250,000 ft. of oak timber, 12 × 12, 12 × 16, and 12 × 18, every stick of which is planed, and much of which is sawed to special shapes, there being some 15 miles of band saw work on 12-in. oak. Drift bolts, mostly 30 ins. long, 1½ to 2 ft. apart, are used vertically and horizontally to such an extent that their combined length would be about 40 miles.

The girders shown in the section, Fig. 4, and in the views, Figs. 6 and 7, divide the lower portion of the caisson into 21 working cells, each 22 ft.

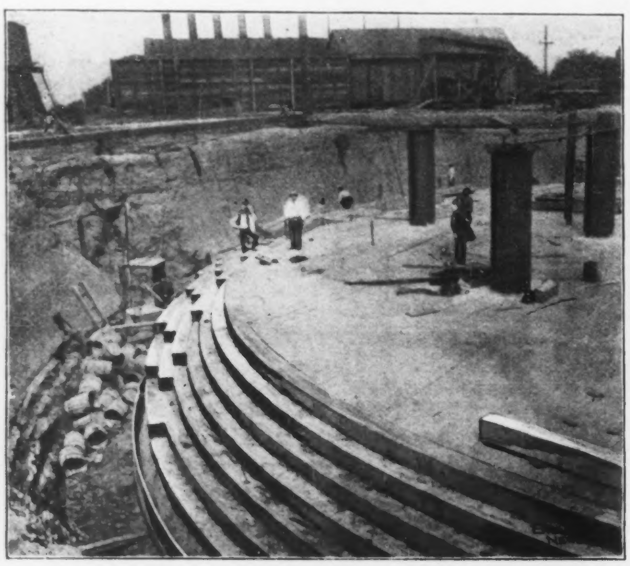


Fig. 9.—Curved Timbers of Triangular Section in Place.

Fig. 10.—Part of Outer Staves and Lining of Central Shaft in Place.

VIEWS OF CAISSON UNDER CONSTRUCTION; THE NEW WATER-WORKS FOR CINCINNATI, OHIO.

In our issue of April 2, 1896, we reviewed briefly a report on a new water supply for Cincinnati, made by Messrs. John W. Hill, Samuel Whinery and Geo. H. Benzenberg, Mems. Am. Soc. C. E., a commission appointed by the Board of Administration of Cincinnati. In its broad general outlines the plan recommended by the commission was similar to that now being carried out, but in its particulars there was much difference. After the appointment of a body officially styled "Board of Trustees, 'Commissioners of Water-Works'," to build new works, the original plans were referred to a new commission for its opinion. The members of this commission were Messrs. Charles Hermany, M. L. Holman, Clemens Herschel, Henry Flad and Samuel M. Felton, Mems. Am. Soc. C. E., and a note giving the main recommendations of its report was published in our issue of May 6, 1897. One of the most significant of the recommendations was that before making designs for a slow sand filtration plant "further investigations be made as to the most advisable method of rendering the water of the Ohio River beyond criticism as to appearance or suspicion as to potability."

Description of the Caisson and General Notes on the New Works.

The map, Fig. 1, shows the location of the new intake works in relation to the city and its Kentucky suburbs, while Fig. 2 shows the general plan of the intake, pumping station and purification works. Alternative areas for the filter plant are shown, one for slow sand, the other for mechanical filtration. The river channel here is near the Kentucky shore, necessitating an intake pier in the river and a tunnel with a clear diameter of 7 ft., and a length of about 1,400 ft., as is shown in the plan and profile, Fig. 3. The difference between high and low water in the Ohio River is about 70 ft., which accounts for some of the features of the design of the pumping station, and for the rather unusual appearance of the Covington pumping station, which may be seen on the opposite shore in some of the views. The water will be pumped to two subsiding reservoirs having a combined available capacity of about 345,000,000 gallons, from which it will flow by gravity to the filter plant, and thence to the clear

square and 8 ft. high, above the level of the cutting edge of the shoe. The cross walls are 3½ ft. thick, including the 3 × 12-in. planking. The inside walls are calked both before and after applying the planking, and the outside walls and the top are calked once. The joints of each horizontal course of timber are grouted with Portland cement and lime, 4 to 1 by weight, after being cleaned with an air blast.

As shown by the views, Figs. 6, 7 and 8, the cross walls, or girders, were first constructed, the first course of roof timbers put on, and then the inclined staves set. After this, the lower, outer part of the caisson was brought to a cylindrical form by adding horizontal timbers, sawed to the proper curves. The inner timbers had their inside faces sawed to fit a conical surface and their outer faces sawed to the radii of the proper circles. These timbers were 12 ins. high, 1½ ins. wide at the bottom, and 13½ ins. at the top. Compressed air was used to bore the holes for the drift bolts and to drive the vertical drift bolts. The pneumatic work and the building of the caisson is in charge of Mr. Daniel E. Moran, M. Am. Soc.

particular case it would not have been safer to reverse the ordinary practice and cross the weak structure at high speed. A query of this character has recently been brought to our attention by a well-known engineer who gives it his own answer, and states the reasons upon which that answer is based in the following interesting communication. We shall be glad to give space to the narration of similar incidents of trains jumping weakened bridges by any of our readers who may have observed the circumstances. Our correspondent writes as follows:

I believe it possible, if not probable, for a passenger engine running 50 or more miles per hour, actually to leap a clear opening of say not over one-third its stiff-frame length. I would not care to be on the engine, but still I believe such an occurrence is possible. The "leaps" on which I base my opinion were not over clear openings, but over structures that had none or little supports other than the track rails, strength of bolster bolts and stiffness of bolsters (or corbels), stringers and undermined masonry. Though the following trains in each case were wrecked, yet, had their engines been running light at the time, the engines would not have even left the rails but have passed on in safety. These are all authentic occurrences as the newspapers of the dates, the trials in the courts, and the records of the several roads will verify, and I was the Chief Engineer of the roads at the time.

The Blue River accident was at Salem, Ind., and my memory is that the bridge consisted of four spans of 18 ft. (total length, 72 ft.), made up of two new oak stringers, 12 x 16 ins., under each rail, long bolsters of the same size crossing each pier, having 1-in. bolts. All the piers, three in number, were entirely washed out and gone. The engine crossed and stopped (off the rails) safely, and I think, uninjured, on the top of the embankment at the south end of the span.

The White River bridge at Broad Ripple, near Indianapolis, had two spans of Howe truss, about 100 ft. long each. We were putting in new stronger end rods in the south end of the north span and moving the old rods towards the center, throwing away the old center rods. The foreman (a smart Alec), against orders, permitted an accommodation train, going south, to run onto this span while only the four temporary 2½-in. diameter construction rods were in, instead of the six new 2-in. rods, which he was just preparing to put in. One of these 2½-in. rods broke. The span broke in two at the north end of the first south panel. The locomotive went over safely, stopped, just off the rails, on the north end of the south span, and was not injured. Both these accidents occurred between 1881 and 1885, and Engineering News, I am sure, gave an account of them.

The Ten-Mile bridge accident, on the Louisville, Cincinnati & Lexington R. R. (Cincinnati Branch), occurred so long ago (between 1875 and 1881) that I have forgotten whether it was two 100-ft. spans of Fink trusses or only one. I think it was two. However, the center pier or one of the abutments was undermined and fell while a train was on the bridge. The engine in this case also went over safely and stopped on the embankment near the bridge.

A few miles north of Crawfordsville, Ind., a light engine I was on, was flagged by the carpenter foreman just as we rounded a curve. The engineer reversed and when we stopped the center of the engine was exactly over a 10-ft. opening. The engine was going north and the north end of the stringers were entirely unsupported by anything, the embankment bent having fallen out.

At the Wea trestle, a few miles south of Lafayette, Ind. (spans c. to c. of bents 15 ft., stringers 15 ft. long, two under each rail, I think, 10 x 16 ins., with bolsters of the same size and about 8 ft. long, bolted with 1-in. bolts through the bolsters and stringers at each end of the bolsters, the stringers being 15 ft. long and cut off over each bent), a freshet at night washed entirely away the second bent at the north end. The Superintendent of Bridges was sent by me to see what damage the freshet had done, if any, as the last engineer over the trestle reported something wrong. The superintendent and all his men with him, after repairing the rocks misplaced at the embankment end, reported the trestle safe—did not miss the missing bent. The engine drivers for a week reported "track not good at Wea trestle," but said it was only a "little rough." The section foreman, who crossed every day and who had repaired the surface at the north end, also reported everything safe. A week after the freshet I went to Lafayette, took a "hog," and with the roadmaster, went to the trestle, went below, to one side where I could see the whole trestle, took a look; asked the roadmaster if he thought the trestle safe, who answered, "Yes." I told him I did not think so as one bent was gone, and pointed to the space. The "hog," waiting for us to get through looking at the trestle, was standing with its tender on the embankment and the pilot over the lost bent space. I motioned the engineer to back up slowly, and he moved his engine onto solid ground. Politics (?) retained the bridge superintendent and roadmaster, but I could and did fire the section foreman who lived near by and saw the trestle twice a day. I wanted to fire the other two but could not. Every train on this division of the road passed over this 30-ft. opening supported by the rails, and eight 1-in. bolster bolts only, for a week, and the only report from the engine-men was that "track was rough on Wea trestle."

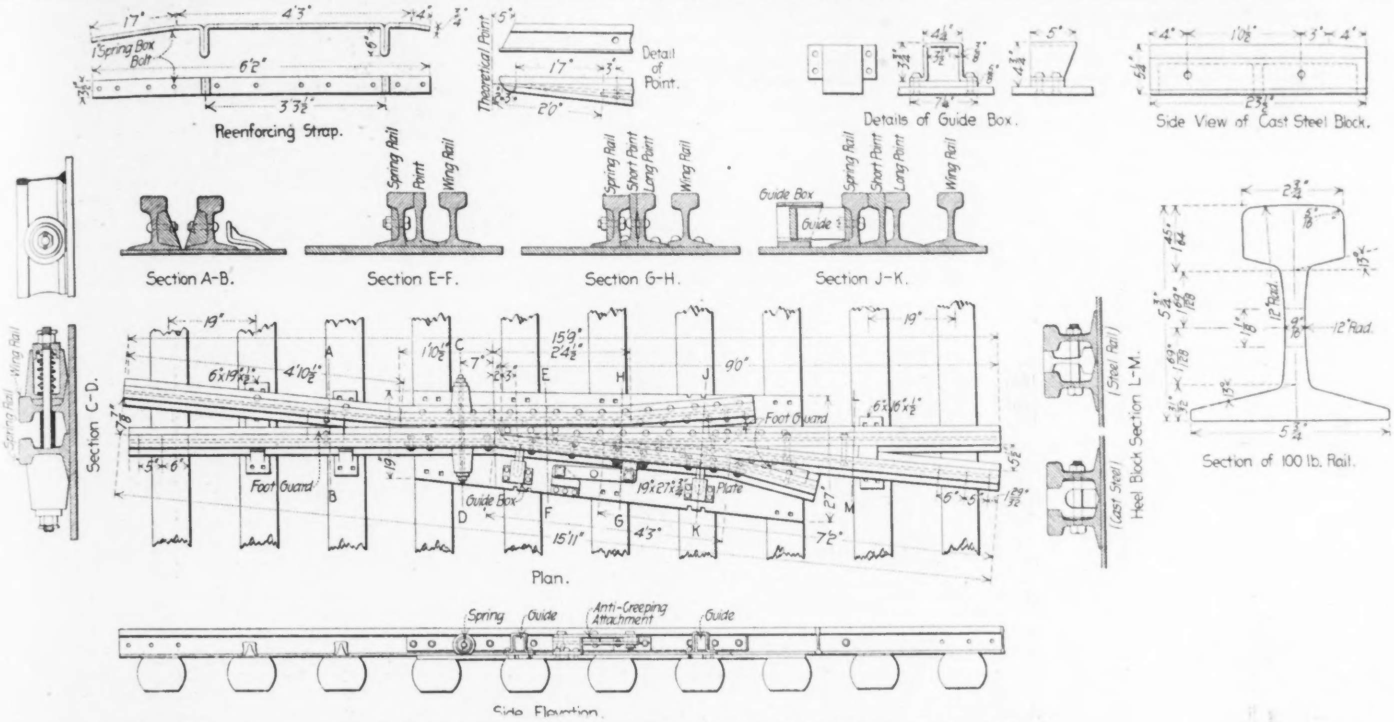


FIG. 2.—NO. 10 SPRING-RAIL FROG WITH 100-LB. RAILS; D. & I. R. R. R.

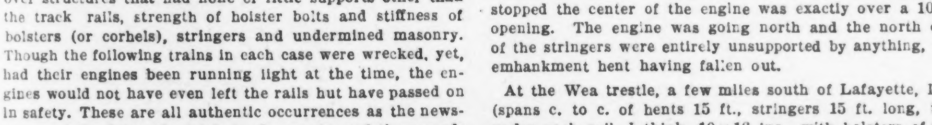


FIG. 3.—ANGLE IRON GUARD RAIL FOR FROGS WITH 100-LB. RAILS; D. & I. R. R. R.

The White River bridge, consisting of three spans of Howe trusses, over 100 ft. each (I think 110 or 120 ft.) between Mitchell and Bedford, Ind., had been inspected(?) once a year for 20 years regularly, and probably once a month irregularly, during these years, and always reported sound and safe. I inspected it myself and after removing the weatherboards—snow protection—on the inside of the east truss at the north end of the north span, I found under the end of the end braces and posts that the bottom chord was entirely eaten away by ants. This truss of this span, for no one knows how many of the 20 years, had sustained itself and the live loads by "force of habit" for there appeared nothing else to do it.

All these bridges (and trestles) were located where trains ran fast. In four of the cases engines went over safely, and in the others trains did so.

The question then which comes directly to my mind is, is it not a fact that gravity can to a very considerable extent be overcome by the momentum of swiftly moving trains, and in short spans, say 30 ft. and under, is there not an excess of factor of safety generally used by engineers in designing such spans? I fully approve of using the excess, but I think that a similar excess should be used as well, in long spans, though this adds to cost, on the theory that it is money well spent when spent on the side of safety. But this does not change the question in my mind as to how much impact, weight, gravity, or whatever it may be called, does a rapidly moving rolling object put upon a structure or track. This subject has all come about by my being called upon as a witness in a case of a trestle falling where everything went into the "hole" but the engine, which went over safely. Under oath I was asked: "Which would you consider safest, to pass over a structure (like the one in question whose spans were only 12½ ft., the stringers 25 ft. long, packed to break joint over bents, and composed of two piers of 9 x 16-in. yellow pine) where one of the bents is badly decayed, at a fast rate of speed, or at a slow rate of speed?" I answered I would rather risk my life on the fast train. The reason? I have already stated it. In conclusion, I would very much like to hear of the experience of others on this subject. We learn by experience of others, but some are afraid to tell their experience. I am not, for if I am wrong on any of my theories I want to be corrected as soon as possible before I make a mistake that will ruin the company or kill its patrons. Experiences, as well as appearances, sometimes are deceiving.

under test. The result from the engine test and average of all cards showed a steam consumption of 46.8 lbs. steam per I. HP. per hour. [This high figure is no doubt largely due to extremely variable loads.—Ed.]

The writer recommended that the Buckeye engine should be converted from the 18½ × 30-in. hugh pressure engine into a 14¼ and 25 × 30 tandem compound condensing engine. Also that an additional 750-HP. tandem compound condensing engine should be erected in the station, together with a cooling tower and the necessary condenser equipment, and that the only change in boilers should be to raise the working pressure. No increase of boiler capacity has been made.

After investigation, the Barnard type of cooling tower was selected as desirable to best meet the conditions existing at this plant, which were, minimum floor space, and minimum weight, and a considerable elevation above floor level of engine room.

Details of Cooling Tower.

The cooling tower is of the twin type, having two chambers, with a pair of fans supplying a strong draft of air to each chamber. The interior dimensions are 12 ft. 3 ins. by 18 ft. by 29 ft. 6 ins. high. The shell of the tower is of steel, 3-16 and ¼-in. plates, reinforced with angle and channel irons.

The hot water from the condenser discharge is delivered through a 10-in. wrought-iron pipe, extending the whole length of each chamber, slotted on top, and perforated at the bottom, giving equal distribution to a series of 96 distributing pipes, extending across the tower, each pipe being slotted and perforated, thus insuring a very uniform distribution of water.

Means are provided for cleaning these pipes, which is found necessary in cold weather, when the cylinder oil from the exhaust steam is liable to clog the pipes and interfere with uniform and free distribution of the water.

The hot water falls from the distributing pipes over 42 galvanized wire mats, made of No. 19 steel wire, woven to No. 5 mesh. Each mat is 12 ft. by 15 ft. 6 ins., affording a total of 8,064 sq. ft. of cooling surface. Each mat is suspended by galvanized iron hooks, and is easily removed for cleaning or repairs. In actual service it is found that the water is uniformly distributed.

The circulation of air is furnished by two pairs of 8-ft. diameter fans, each pair of fans being mounted right and left on a 2 15-16-in. shaft, and the four fans being capable of delivering 360,000 cu. ft. of air per minute when driven at a speed of 150 revolutions per minute. The air entering the tower chambers at the lower section is deflected vertically from each fan, thus avoiding cross currents, and affording a uniform blast through and between the mats.

The rated capacity of each section of this cooling tower is to cool the circulating water needed to condense 12,500 lbs. of exhaust steam, from an initial temperature of 132° F. to 80° F. when the atmospheric temperature does not exceed 75° F., nor the humidity 85%.

The circulating water is handled by a Blake vertical twin air pump and jet condenser.

In an equipment of this kind it is important to have facilities for driving the fans at variable speeds; this requisite flexibility has been obtained by using a small vertical engine without a governor direct connected to the shaft of each pair of fans.

The accompanying table, extracted from the log records for many months, shows details as to temperatures, speed of fans, reduction of temperature of condenser discharge, etc.

As previously noted, the 18½ by 30 Buckeye engine was changed to a 14½ and 25 by 30 tandem compound condensing engine by bolting new tandem cylinders on the existing frame and making necessary alterations in valve rods, etc.

Specimen cards, taken from this engine as in daily service, give the following data:

Revolutions, 137; steam pressure, 113 lbs.; mean effective pressure, 50.16 lbs.; vacuum per gage, 26 ins.; I. HP. developed in high pressure cylinder, 163.42; I. HP. in low pressure cylinder, 168.48—total, 331.9 HP., and of this 90.52 HP. is below atmospheric line. The work is divided almost equally between the high-pressure and low-pressure cylinders; all cards show similar results.

In addition to the tandem Buckeye engine a tandem compound condensing engine, 20 and 36 by 42 ins., 120 revolutions per minute, Corliss type, built by Pennsylvania Iron Works, was installed to drive a direct-connected Stanley 500-K-W. two-phase A. C. generator. This engine works 15 to 17 hours per day.

The usual work required from the cooling tower and condenser varies from 7 to 17 hours per day. A notable record was made on Aug. 2, 1898, when the run was from 7 a. m. till 12 midnight, and from the daily records, the following data are extracted:

	Maximum.	Minimum.
Temperature, atmosphere	103°	83°
Temperature, condenser discharge to tower	128°	106°
Temperature, condenser suction	98°	91°
Degrees of heat extracted, through tower	32°	21°
Speed of fans, revolutions per minute	160	140
Vacuum at condenser	26	20
Strokes of condenser pump	50	38
Pounds boiler pressure	121	100
Temperature, boiler feed	212°	200°
Engine, HP. developed	900	400

A continuous heavy load was carried during the entire 17 hours' run. This was not a test record, but simply daily service.

Indicator diagrams, Nov. 5, 1898, from the 20 and 36 × 42 tandem compound condensing Corliss engine, gave the following:

Engine revolutions	120 per min.
Steam pressure	112 lbs.
Vacuum at condenser	25 ins.
Work done in high-pressure cylinder	311.8 HP.
And in low-pressure cylinder	31.5 HP.
	643.3 HP.
Work done in low-pressure cylinder below atmospheric line	185.1 HP.

Simultaneously with the engine, the pump and fan engines were indicated. The cards showed:

Work done by the pump	13.75 HP.
Work done by the fan engines	13.5 HP.
Total external work	27.25 HP.

which if deducted from the work done below atmospheric line in low-pressure cylinder 185.1 HP. leaves a net gain of 157.85 HP. from the use of the condenser and cooling tower.

It will be noticed from the previous data that the feed water shows a temperature above 200° F. There are two feed-water heaters in connection with the condensing plant. First, an intermediate tubular heater in the line of exhaust between low-pressure cylinders and condenser. Second, an auxiliary feed-water heater was also attached, receiving the exhaust from the condenser and boiler feed pumps, and any other auxiliaries.

The feed water is first heated in a tank that receives the exhaust from the general line of high-pressure engines. The feed water then passes through the intermediate heater, and thence through the auxiliary heater, and reaches the boiler at a temperature of upwards 200° F.

The condensing plant has increased the station capacity about 1,000 HP. with the aid of a condensing system, using the same water in continuous circulation, while the boiler plant, previously stated to be fully loaded, supplies steam for this additional work with boilers to spare.

SWITCHES AND FROGS FOR TRACK OF 100-LB. RAILS; DULUTH AND IRON RANGE R. R.

The use of 100-lb. rails is not yet so extensive but that switches and frogs built up of such rails have a sufficiently striking appearance to attract attention from and be of interest to the users and makers of track equipment, and it is interesting to note that equipment of this kind is now being introduced on the Duluth & Iron Range R. R. The present track of this road is laid with 80-lb. rails, but we learn from Mr. R. Angst, Chief Engineer, that his road is now laying about 4,000 tons of 100-lb. rails (of the section recommended by the rail committee of the American Society of Civil Engineers), and has adopted standard plans for the switches and frogs, as shown in the accompanying drawings.

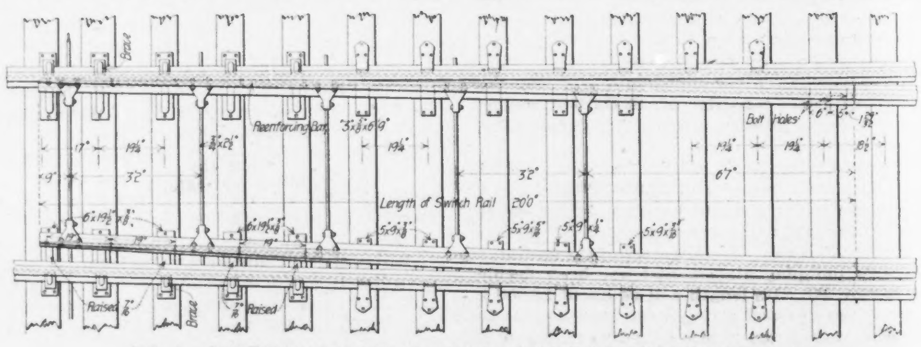


FIG. 1.—SWITCH WITH 100-LB. RAILS; DULUTH & IRON RANGE R. R.
R. Angst, Chief Engineer.

The switch, Fig. 1, has switch rails 20 ft. long, the throw at the toe being 5 ins., and the width over gage lines at heel, 6½ ins. These rails are connected by five tie rods ¾ × 2½ ins., the ends of which are fitted into sockets in large heads bolted to the rails. The front rod is 9 ins. from the toe, and the rods are spaced 38 ins. c. to c. Near the ends, the switch rails are stiffened by reinforcing bars ⅝ × 3 × 81 ins., each bar being secured to the outside of the web of the rail by ⅝-in. rivets. The ties are spaced 19¼ ins. c. to c., except that those at the heel and toe are 17 ins. and 18½ ins. apart, respectively. On every tie are tie plates or slide plates for the switch rails, and rail braces outside the stock rails. The plates vary in size from 6 × 19½ ins. to 5 × 9 ins., the former being ¾-in. thick, with slide seats raised 7-16-in., while the smaller plates range from ⅝-in. to 3-16-in. in thickness.

The frogs are of the spring rail type, as shown in Fig. 2, which represents a No. 10 frog. The frog is riveted to a ¾-in. plate, 7 ft. long, and 19 ins. and 27 ins. wide at the ends, on which are the springs, guides and anti-creeping attachment. The main rail is carried to the point, its end being beveled, and 5 ins. from the theoretical point, having a thickness of 7-16-in. The heel block, or raising block, is either a steel casting or an inverted piece of the rail planed to shape. Wooden footguards are fitted to the throat, and at the ends of the spring and wing rails. The frog is 15 ft. 11 ins. long over all, and has a spread of 7⅞ ins. at the mouth and 5½ ins. at the heel, while the width of throat and flangeway is 2 ins. The connections to the lead rails are made with six-bolt splice bars. The movable rail is held by double coiled springs, placed at the throat, 12 ins. from the point. The frog rests on ten ties, 19 ins. c. to c., the toe being over the sixth tie from the heel.

Perhaps the most interesting feature of all, however, and one which is certainly novel, is the use of a heavy angle iron instead of the usual piece of track rail for the frog-guard rail, as shown in Fig. 3. This guard rail is made from a piece of commercial angle iron ¾ × 6 × 6 ins., 20 ft. long. It gives a flangeway 1¾ ins. wide for 8 ft., and then flares out to an entrance width of 4½ ins. The guard rail is fastened to the ties by spikes in ¾-in. square holes, and is secured to the track rail by seven ⅞-in. bolts with cast spacing pieces or fillers. This arrangement reduces the field work on the metal to the drilling of a few holes in the main rails, makes a neat job, and ensures uniformity.

The switch rails, frog and frog guard rails for each turnout are ordered in one lot.

	1898.					
	Jan. 31.	Feb.	June 20.	July.	Aug. 26.	Nov. 4.
Time	9 p. m.	8 p. m.	8 p. m.	8 p. m.	8 p. m.	5.35
Temperature atmosphere	30°	36°	78°	96°	85°	59°
Temperature condenser discharge to cooling tower	110°	110°	120°	130°	118°	129°
Temperature condenser suction returned from tower to tank	65°	84°	84°	93°	88°	92°
Degrees of heat extracted through tower	45°	26°	36°	37°	30°	37°
Speed of fans at tower, R. P. M	36	0	145	162	150	148
Vacuum at condenser	25½	26	25	24½	25½	25
Strokes of condenser pump	30	30	37	44	43	28
Lbs. boiler pressure	110	110	120	120	120	112
Temperature boiler feed	212°	212°	210°	211°	213°	213°

IS IT SAFER TO RUN FAST OR SLOW OVER A WEAK BRIDGE?

The precaution most commonly adopted to avoid accident in the case of a weak railway bridge is to reduce the speed of crossing trains. The wisdom of this practice can hardly be questioned when we consider all the conditions in the majority of cases, but occasionally the question arises whether in a

THE NEW COVERED FILTER BED FOR THE WATER-WORKS OF SOMERSWORTH, N. H.

The second slow sand filtration plant built in this country and covered with a masonry roof is located at Somersworth, N. H. This filter was put in operation about April, 1898. Like the filter beds at Ashland, Wis., described in our issue of Nov. 25, 1897, the Somersworth plant was designed and constructed by Mr. Wm. Wheeler, M. Am. Soc. C. E., of 89 State St., Boston, and, like the earlier plant, this one also has an area of one-half acre.

The population of Somersworth was 6,207 in 1890, and is about 7,000 at present. From 1864 to 1896 the water supply was furnished by the Great Falls Manufacturing Co. In 1896 the city physical examinations indicated that the Salmon Falls River, at a point above the city, would be the best source. A description of this source, accompanying a sample sent by Mr. Wheeler to Dr. Edw. S. Wood, of the Harvard Medical School, for analysis, gives the following information:

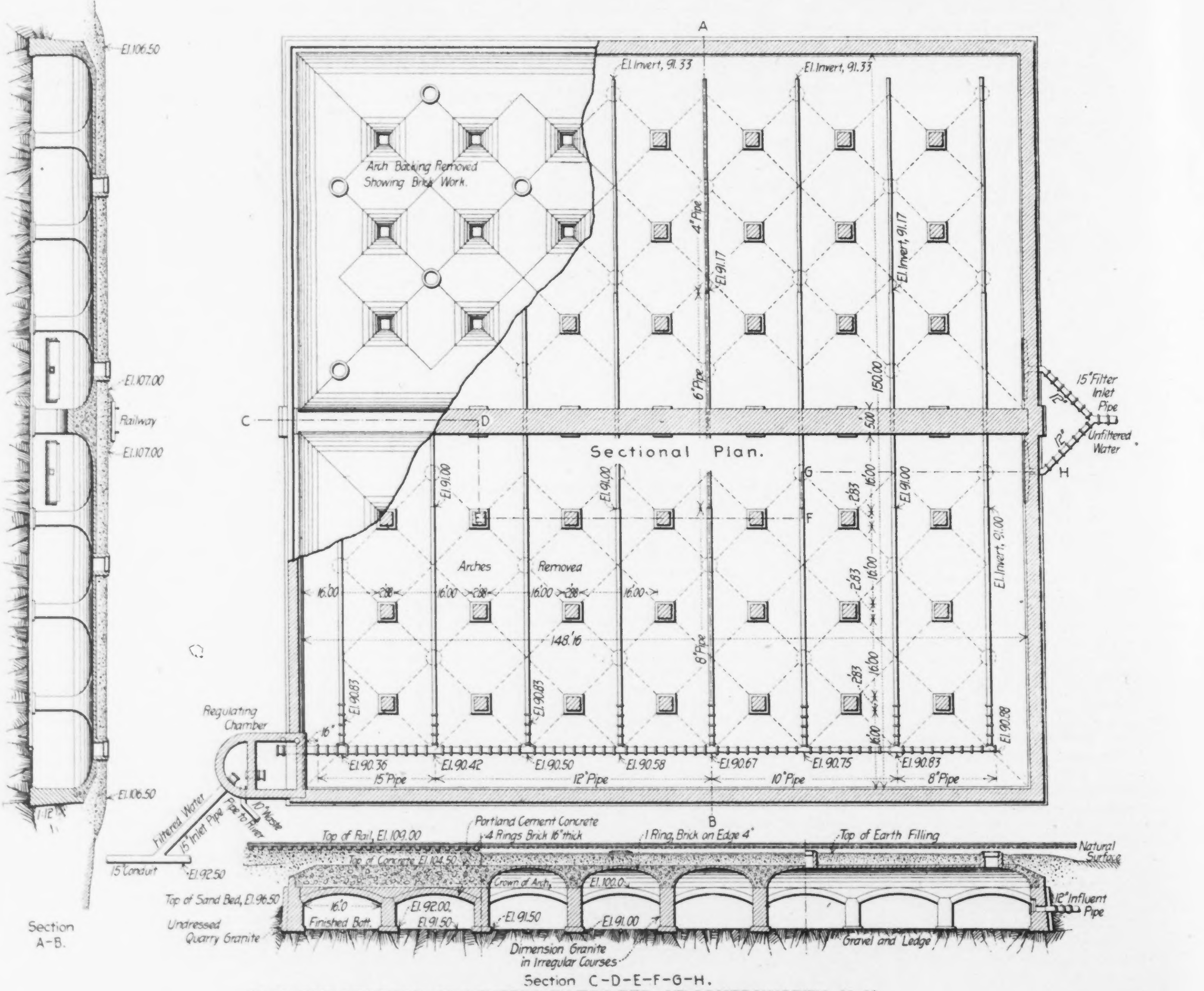
> Salmon Falls River has its source in Great East Pond in Acton and Wakefield, 18 miles distant. Only two places on river above here, Milton (14 miles distant), about 1,000 inhabitants, and East Rochester, about 1,500 inhabitants, 7 miles distant. After leaving Milton, river flows over rapids for several miles; also after leaving East Rochester. No buildings or houses along the river banks except at these points.

The chemical determinations of the Salmon Falls water, in parts per 100,000, were as follows: Transparency, clear; color, 0.3; odor, slightly earthy; chlorine, 0.06; albuminoid ammonia, 0.0174; free ammonia, 0.0072; nitrates, 0.014; total residue, 8.40, of which 1.60 was fixed and 6.80 volatile, there being considerable blackening on ignition. This sample was pronounced by Dr. Wood as the best of samples submitted from three sources, so far as he could judge "without knowing anything about their surroundings or history," which information he requested. On receiving this Dr. Wood wrote as follows:

> The objection to the Salmon Falls River is the existence of the towns above. If, however, the thickly settled parts of the towns are not on the banks of the river, there is probably little danger from their drainage at present.
>
> That is, however, a question for you to decide rather than for me. Certainly, the Salmon Falls River water as it flows in the stream is the best of the three, and if the danger of sewage pollution from the towns above is practically absent, I should recommend its water rather than Nos. 1 and 2.

Mr. Wheeler believed that the limited size of the two communities named, their remoteness from Somersworth and the understanding that they had no sewerage system practically precluded immediate danger from sewage pollution. In case such danger should arise in the future he stated that appeals could be made to the legislature or the courts for protection, or the water might be filtered. The city at once requested information regarding filtration, and eventually it was decided to put in slow sand filters. Bids for such a plant were received on Sept. 22, 1896, the prices, based on the estimated quantities, ranging from $22,037 to $36,303. The contract was awarded to the lowest bidder, Ames & O'Shea, of Somersworth, at the price named. The contractors threw up the contract when about one-third of the work, in value, had been completed. The contract for completing the plant was awarded to the Great Falls Granite Co. (Spence & Coombs). The original contract price of $22,037 did not include certain accessories necessary to the operation of the plant. The engineers' estimate for the beds and all these accessories was $29,892, and the work actually cost $32,720, minus an amount to be recovered upon the bond of the first contractors, Ames & O'Shea. This amount is made up of sums paid the second contractor that were chargeable to the first.

The filter bed is located between the river and the pumping station, only a short distance from each. Its design is shown by the accompanying plan and sections. Water flows from the river to



PLAN AND SECTIONS OF COVERED FILTER BED AT SOMERSWORTH, N. H.
Wm. Wheeler, M. Am. Soc. C. E., Engineer.

bought the distributing system, except the portion supplying the property of the company. This portion, together with the old pumping plant, reservoir and stand-pipe, the company retained for the supply of its mills.

The water delivered by the company was taken from the Salmon Falls River, at a point below one of its mills and also below a part of the town. This water was sometimes objectionable to sight and taste, and quite a strong feeling against it developed. In the discussion leading up to the establishment of municipal works the general desire seemed to be to substitute spring or well water for the river supply, but attempts to find such in suitable quantities failed. Of the available surface supplies, chemical analyses and the filter bed, and from it to the pump well, by gravity. There is a screen chamber at the river and a regulating chamber at the other end of the bed. The filter is in one compartment, as shown by the plan, but water is admitted to it over two 12-ft. weirs, which, with the regulating chamber, are described by Mr. Wheeler in his report to the Committee on Water Supply, as follows:

The raw water enters the filter through a conduit leading from the screen well to a point opposite the middle of the northeasterly side. It is of 15-in. vitrified pipe and is divided at the point just indicated into two lines, each of 12-in. pipe, which enter through openings in the wall of the filter at grade 95.50 (center of bore), each 10.50 ft. from, and upon opposite sides of, the central line of the lintel piers above described. At each influent point a horizontal pocket or chamber is formed in the face of the wall, 12 ft. long, 25 ins. high, and 12 ins. deep. Covering the lower part of each of these influent pockets or chambers is a removable flashboard or sand-stop, resting in angle iron fastenings, its upper edge being at or slightly above the level of the top of the sand bed, over which the water enters the filter in two streams, each having a width of 12 ft., thus obviating any objectionable disturbance of the surface of the sand bed.

The regulating chamber is about 13 ft. long and 10 ft. wide. It is divided by a brick partition into two compartments, one receiving the clear water from the filter through the main collecting pipe, and containing the apparatus for regulating the rate of filtration so as to maintain uniformity therein, the other an effluent compartment connecting directly with the main conduit leading from screen well to pump well. The enclosing walls and partitions are of brick, laid in Portland cement mortar upon foundations of Portland cement concrete, which form also the floors of the two compartments, that of the first being at grade 89.50 and that of the effluent compartment at grade 92.00.

The connections between the filter and first compartment, between the two compartments, and between the effluent compartment and the conduit to pump well, are made in each case through 16-in. flanged pipe castings, built into the walls and fitted with Eddy gate-valves, the stems of which extend up through the floor of the room above, to be operated by hand wheels suitably mounted on gate stands.

The ordinary level of the river at the intake is about grade 100.

The filter bed has a total depth of 5 ft., there being 1 ft. of selected gravel at the bottom, overlaid by 4 ft. of sand fairly uniform in size, and with 10% of its total, by weight, composed of grains of from 0.30 to 0.45 mm. (0.012 to 0.015 ins.) in diameter. The dimensions of the underdrains are shown on the plan. They are laid with their bottoms at such a grade as will bring the tops of the pipes of different sizes all to the same level, and thus give the same depth of filtering material above them. The net area of the filtering material is 21,780 sq. ft., or practically one-half acre. The combined area of the 49 piers is 444 sq. ft. The middle row of piers is larger than the others, since it has to support a railway siding. This siding is available for handling filtering material when the bed is being cleaned or renewed. Besides supporting the railway siding the heavy piers were designed to withstand the thrust from the covering of one-half the beds. The contract required at least one-half the centers for the covering arches, or all those on one side of the center line, to be placed complete and not removed or struck until the roof on that side was finished.

The material at the bottom of the excavation for the filter bed was of gravel and ledge, at an elevation about 8½ ft. below the ordinary level of the river. The filtering material rests on this surface. The outer walls of the filter bed are laid in American Rosendale cement, but Portland cement was used for all the rest of the stone and brick masonry, and for the concrete.

When it is desired to clean the filter bed the water can be drawn down to about the level of its upper surface by the regular pumps, then completely drawn out by a centrifugal pump, built by the Lawrence Machine Co., located in the house which covers the regulating chamber. After the filter had been in operation about three months, the water was pumped out. It was found that the top of the sand, only, was discolored, and that but slightly. No cleaning was done then, nor had any been done up to Sept. 16, when a member of the editorial staff of this journal visited the plant. No analyses of the filtered water have been made.

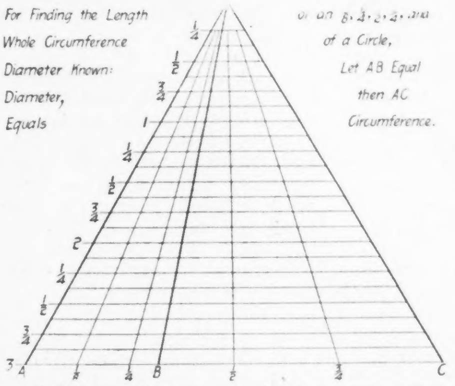
Two 1,500,000-gallon pumps lift the water to a stand-pipe about 40 x 95 ft. The storage afforded by this structure is thought to be sufficient to allow the shutting down of the filter bed for cleaning.

We are indebted to Mr. Wheeler for the drawings and some of the other matter used in the preparation of this article, and to the local officials in charge of the water-works for information given when our representative visited the plant.

A UNIVERSAL CIRCULAR SCALE.

In our issue of March 30, 1893, was published a universal scale for dividing a line of unknown length into any number of equal parts, or for dividing a line of known or unknown length proportionally to another line of known or unknown length. The scale here illustrated is based upon a similar principle, and has for its purpose the finding of the length of the circumference of any circle, or the length of an arc equal to an eighth, quarter, half or three-quarters of the total arc, when the diameter is known.

This scale takes the form of an equilateral triangle, of which the base, A C, is equal to the circumference of a circle whose diameter is the distance A B. The other radial lines shown cut the base, A C, at points equal to ⅛, ¼, ½ or any desired division of the length of the total arc, or circumference. The lines drawn parallel to the base serve two purposes: those with figures attached give a graphic table of circumferences for circles whose diameters are 1, 1¼, 1½-in., etc.



A Graphical Method of Finding the Circumference of a Circle or Any Fraction Thereof, the Diameter being Known.

In the second place, these lines serve as a guide to the eye in using the scale.

In using this scale mark off on the edge of a strip of paper the length of the diameter as taken from the object or drawing. Fit this distance between the radial lines, A and B, always keeping the edge of the strip parallel to one of the horizontal lines; then mark on the strip the point where the radial line, C, strikes it, and the distance between the marks, A and C, measured by the same scale as the diameter, will be the length of the circumference. Points taken on the other radial lines will, in a similar manner, give the length of arc for the ⅛, ¼, ½ and ¾ of the total circumference, or for any other division of the circumference as originally laid out on the base, A C.

The designer of this universal scale and the one previously referred to, is Mr. J. Ernest G. Yalden, Superintendent of the Baron de Hirsch Trade Schools, of New York, and he regards it as the most accurate and least complicated of the many geometrical constructions proposed for determining the length of the circumference, or divisions of this arc. It can be made of any size, and with any fractional part desired; and will prove useful to draftsmen, and especially to sheet-metal workers. For general trade purposes it is to be preferred to calculation where dimensions are given in inches, as it is difficult to use the fractional parts of an inch.

TESTS OF FORMALDEHYDE AS A DISINFECTANT AT NEWTON, MASS.

The report of the Massachusetts State Board of Health for 1897 contains an interesting review of some formaldehyde tests at Newton, Mass. The review was contributed by the Board of Health of Newton, and is as follows:

During July and August, through the kindness of Prof. S. Burrage, of Purdue University, Lafayette, Ind., the board was enabled to make some interesting and valuable experiments at the Newton Hospital as to the value of formaldehyde as a germicide. The tests extended over a period of about six weeks, and the results have been made the subject of a paper by Professor Burrage, which is too long to be included in this report, but a short resume of the subject will be of interest.

The original intention was to determine what form of formaldehyde generator was the most efficient and best adapted for use by the average unskilled operator. Four different styles of generators were used in the tests, two producing the gas from the 40% solution, and two testing it directly from wood alcohol.

The results taken as a whole showed that formaldehyde is not as fatal to disease germs as is generally claimed, at least when the exposure is for so short a period as six hours.

There was no great difference in the efficiency of the different forms of generator, the results being practically the same with each. A number of tests were made with each generator, in order to have as large an amount of information as possible upon which to base conclusions.

No record was kept of the amount of gas evolved by each generator, although the same amount of solution (about one quart) was used in each of the first form, and about one liter of alcohol was consumed by each of the second form. This would give, approximately, 16 ozs. of formalin and 500 cu. cm. of alcohol to 1,000 cu. ft.

The practical conclusion to be drawn from these tests is that, while formaldehyde remains the most practical gaseous disinfectant which we possess, a number of elements must be taken into account in order to obtain satisfactory results. The length of time of the exposure, the amount of gas used per 1,000 cu. ft., and the care with which crevices are closed to prevent the diffusion of gas, are all of importance and must be taken into consideration.

After the tests with formaldehyde had been finished, dry sulphur fumes were used under the same conditions, with the result that it was shown that they had absolutely no effect upon the test cultures, those which were exposed to its action growing as rapidly and luxuriantly as the controls.

While the city is well equipped for house and room disinfection by the use of formaldehyde, it is still without the proper method of sterilizing the more bulky of household furniture, such as carpets, mattresses, etc., into the substance of which the formaldehyde does not penetrate. For this purpose a steam disinfecting plant is needed, and it is with great satisfaction that the board is able to report that such a plant will be erected in the near future, in connection with the proposed new heating and power plant for the municipal buildings. The sterilizing chamber will be of the most approved construction, and large enough to take the most bulky articles, being 7 x 5 ft.

Reports from other local boards of health in Massachusetts show that at least 14 boards adopted formaldehyde in 1897.

THE NEW YORK RAPID TRANSIT COMMISSION, at its last meeting considered the situation created by the inability of the enlarged city of Manhattan to borrow the sum required to build the road in the manner planned. The two courses open, says President Orr in his statement on behalf of the Commission, are these: Request legislation making the rapid transit road an exclusive asset of the County of New York, or the boroughs of Manhattan and the Bronx, and charge the debt exclusively to this county; or, request legislation enabling the Board to sell a charter for the road to private capitalists. The statement issued explains how either of these alternative propositions may be provided for in one legislative act, and enters into a discussion of the county charge and gives legal opinions on the proposed action.

MUNICIPAL OWNERSHIP OF WATER-WORKS at Indianapolis has been under discussion for some time past, but now seems likely to be postponed for a number of years unless the Indianapolis Water Co. will make the city a more favorable offer than the one recently submitted. The city is unable to issue bonds to pay for the works, so the company proposed to transfer its stock to the city for $200,000 cash, and an agreement to pay the company $120,000 a year for 25 years, the stock, however, to be subject to a mortgage indebtedness of $3,350,000, of which $2,850,000 bears 6% and $500,000 bears 5% interest. To cancel the debt, the water company would pay off $75,000 a year for five years, and increase the amount annually thereafter by the amount of reduction in the interest charges. It was calculated that at the end of the 25 years the bonds would all be paid. Mr. John W. Hill, M. Am. Soc. C. E., of Cincinnati, was engaged to report on the physical condition and the value of the water plant. The cost of duplication at present prices Mr. Hill placed at $1,950,000, from which he deducted $270,000 for depreciation, leaving $1,680,000 as the present value of the works, on this basis. This allows nothing for the franchise. He also presented figures regarding the value of the plant as determined by its earning power, which, with the other parts of his report and the company's proposition to sell the plant to the city, have all been printed in pamphlet form and can doubtless be obtained from Mr. Hill by those interested. The city authorities, having declined to accept the proposition, basing their decision largely on Mr. Hill's report, from which they conclude the price to be paid is excessive.

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The invitation of the Quebec Bridge Co. for designs and bids for the construction of a bridge across the St. Lawrence River, near Quebec, was discussed by a correspondent in our last issue, who suggested that before bridge companies expend any considerable sum upon designs and estimates in response to this invitation, they would do well to investigate the financial status of the company and the prospects that it will be able to secure the funds to carry out its enterprise. The subject is again taken up in our present issue by another correspondent, who tells the story of how another Canadian bridge company, which also proposed to bridge the St. Lawrence, offered prizes for the best designs for its structure, and after the prizes were awarded failed to pay them.

As most of our readers know, architects, who meet much more frequently than engineers the calls for the submission of designs in a competition, are generally opposed to competitions, and approve them only when they are conducted under a stringent code of rules laid down by the Architectural Societies. It would be well, it seems to us, if Engineering Societies would follow this example and formulate rules to govern competitions for engineering work. Among the first of such rules, judging by past experience, should be the requirement that the amount of the prizes should be paid over to the expert commission which is to decide upon the relative merit of the plans (this payment to be made at the time when the call for plans is announced), and should be by it paid over to the successful competitors, coincident with the announcement of their names. Such a rule would not only cover the case of the financial inability of the party ordering the competition to pay the prizes after their announcement, but would also prevent such an overruling of the experts' decision as occurred a short time ago in the competition for the Pennsylvania State Capitol.

The average architect or engineer knows little or nothing as to the financial responsibility of any concern asking for competitive plans; and manifestly cannot afford to spend much to find it out. He judges of the competition, in most cases, by the character of the experts who are to pass on the plans. In the case of the Montreal Bridge Company, for instance, we presume that many engineers relied on their use of the name of Mr. Walter Shanly as their consulting engineer, as evidence that a fair award would be made, and that the company had at least a moderate financial standing. But, while Mr. Shanly appears to have had a free hand in the award of the prizes, he had neither the authority nor the power "to draw blood from a turnip," and thus it happens that the prizes remain unpaid to this day.

It may be interesting in this connection to explain something of the financial status of such Canadian engineering enterprises as the two which we have been discussing. By a long-established precedent Canada is committed to the policy of subsidizing public works of various kinds, and this is now so well understood that in the London money market, where nearly all Canadian enterprises are financed, it is well-nigh impossible to secure funds for any such work as these St. Lawrence bridges unless the promoters can show something in the way of a Government grant in aid of the project. On the other hand, if a fair-sized subsidy is once secured, it is easy enough to get funds to cover the remaining cost. The mountain load of public debts which Canada has piled up, however, is getting so serious a matter that the way of the subsidy-seeker has become a hard one. It is, in fact, we believe, only a question of time when public opinion will become so strong that the whole corruption-breeding system of subsidies to public works will be abolished, and the country will get down to the safe and sound basis of letting private capital undertake such enterprises as promise a fair return on the money invested.

Meanwhile, engineers and manufacturing concerns engaged in engineering work will do well to inquire closely into the financial standing of Canadian enterprises before expending any considerable amount of either time or money upon their work.

The severe snowstorm which swept over the Eastern States on Nov. 26 gave a crucial trial to the conduit electric street railway lines in New York city.

The various lines were tied up from ten to fifteen hours by the storm. The main cause of the blockade was the depth of snow on the tracks. In this respect the conduit system was no more interfered with, of course, than any other surface railway system would have been, except perhaps the cable. The secret in keeping a street railway or a steam railway open during severe snowstorms is first to keep the tracks clear by running snowplows frequently enough to prevent the accumulation of drifts; second, run no more cars than the motive power can haul. The difficulty which a street railway manager finds in putting these rules in practice is that when he cuts down the number of his cars, those that remain are overloaded, and the traveling public bitterly complains because the cars run at longer intervals than usual just when they are most in demand.

Besides the difficulties with the snow obstructing the track, however, the movement of cars on the electric conduit roads was more or less interfered with by some other troubles of a more novel character, resulting from the accumulation of snow in the conduit. Of course, in any driving storm, more or less snow sifts in through the slot, and when a car runs along, a suction is created behind the plow that draws down a shower of snow from the cloud stirred up by the wheels. Past experience with this type of road, both in Washington and New York, has pretty definitely established the fact that water or slush, if allowed to accumulate in the conduit in sufficient amounts, will short-circuit the conductors, throw the station circuit-breakers, and thus interrupt the current supply to the flooded section. That snow would do the same thing would hardly be expected with the comparatively low voltages used, since snow is practically distilled water, and when dry is made up of a mass of ice crystals with air spaces interspersed.

Experience in the recent storm, however, showed that short circuits did occur at several places on the line, and in several instances they were accompanied by a pyrotechnic display of flames shooting from the slot in sufficient volume to cause considerable alarm to passengers and to excite a large amount of speculation as to their cause. From the best information we have been able to obtain, it appears that the chief cause of the short-circuiting was the salting of the tracks for the purpose of melting the snow—a relic of practice in the old horse-car days. The snow alone in the conduit, it is stated, had not enough conductivity to set up an arc; but when the salt slush dripped down upon it, its conductivity was increased enough to start an arc. The salt solution also short circuited the plows and caused arcing, which sometimes ran along the conducting rails for some distance before it was broken.

In some previous storms, the conduit lines have had some trouble with the collection of ice on the conducting rails in the conduit. In the present storm, however, the atmospheric conditions were such that this did not occur.

An amusing incident in connection with the recent storm was an interview with President Vreeland, of the Metropolitan Traction Co., published in one of the daily papers, in which that officer was made to say that the cause of the stoppage of the cars was the formation of ice on the rails, preventing the flow of current from the wheels to the rail. It is, of course, not to be supposed that Mr. Vreeland is ignorant of the fact that in the conduit system, both positive and negative conductors are in the conduit and no current flows from the car wheels to the rail. The error was doubtless due to the reporter's misunderstanding. A discriminating electrical journal of this city, however, picked up this interview, swallowed it whole, and proceeded to preach a sermon to the Metropolitan Street Ry. Co. on the folly of spending so much money on its conduit systems and failing to provide "a complete metallic circuit without regard to the rails."

COMMERCIAL EDUCATION IN THE UNITED STATES.

The rapid growth in American exports of manufactured goods during the past four years has made plainly evident the need of specially-trained men to conduct our export business in foreign countries, and especially in those regions of Asia, Africa and South America, for whose trade all civilized nations are in keen competition. It is true that we are rapidly increasing our exports of manufactured goods in many lines; but we are doing it largely by virtue of superior facilities for production, which enable us to undersell our rivals. When it is a question of working up new trade, however, or meeting our competitors upon even terms as regards price and quality, it is generally admitted that our salesmen in foreign countries cannot compare with the Germans in point of efficiency. Germany has led all other nations in the establishment of schools designed especially to train those who are to follow commercial life.

In the United States, it was not until 1881 that any of our institutions of learning recognized the need of any such special training. In that year the University of Pennsylvania opened a department known as the Wharton School of Finance and Economy, with a four-year course and a curriculum embracing public law and politics in this and other countries; mercantile law and practice, including accounting; history economics and social science, including banking and currency and the revenue systems of governments, etc. The University of Chicago and the University of California also have separate departments of this sort recently established; while Harvard, Yale, Columbia and a number of other prominent universities offer special courses to students which cover this field.

For a higher education in this direction these schools are doubtless doing good work; but they aim too high for the average young business man.

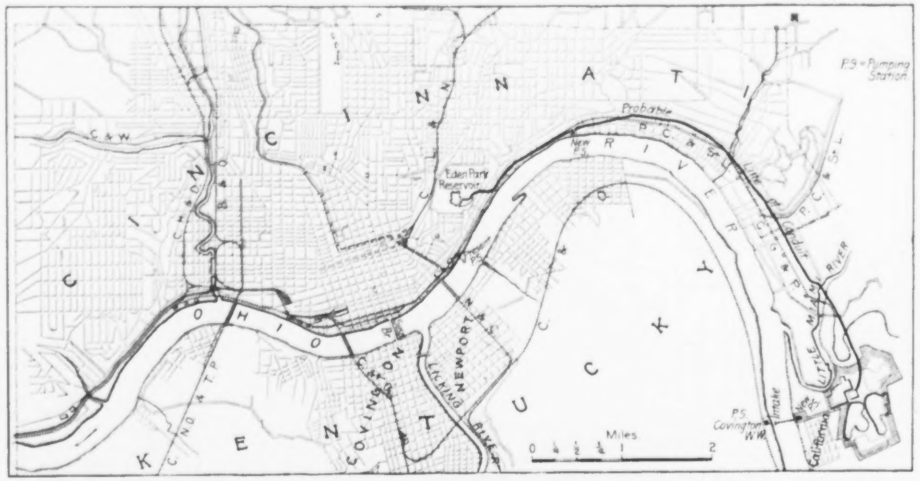


FIG 1. MAP SHOWING LOCATION OF THE NEW WORKS IN RELATION TO THE CITY

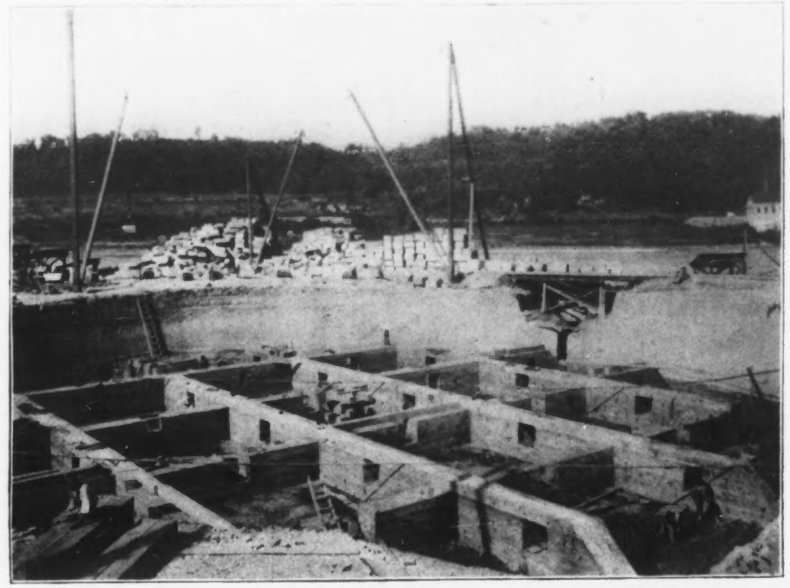


FIG. 6. CAISSON WITH STIFFENING GIRDERS OR CELL WALLS NEARLY COMPLETED.

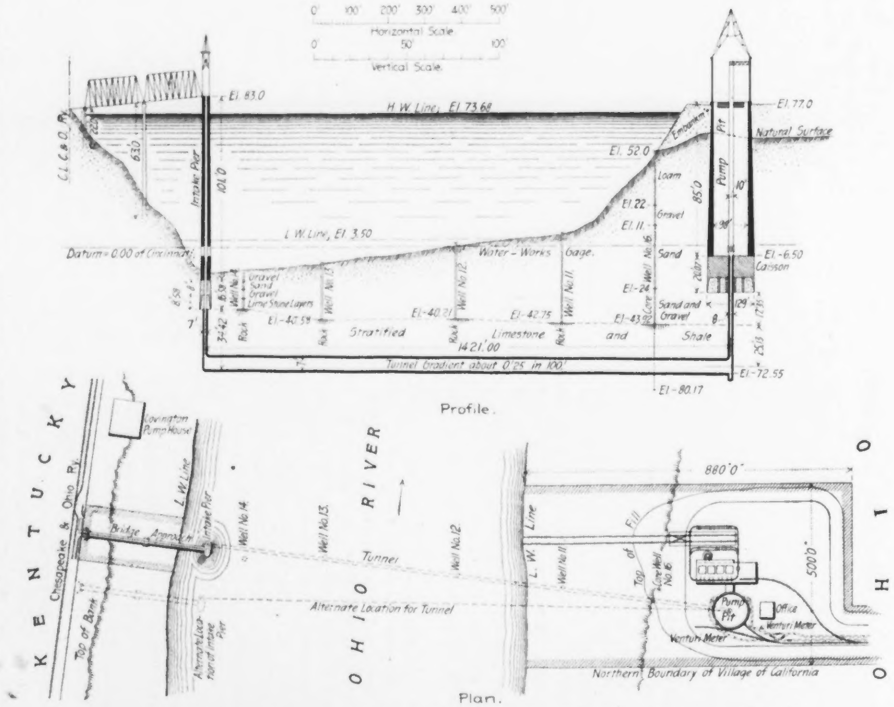


FIG. 3. PLAN AND PROFILE OF INTAKE PIER, TUNNEL AND PUMP PIT.

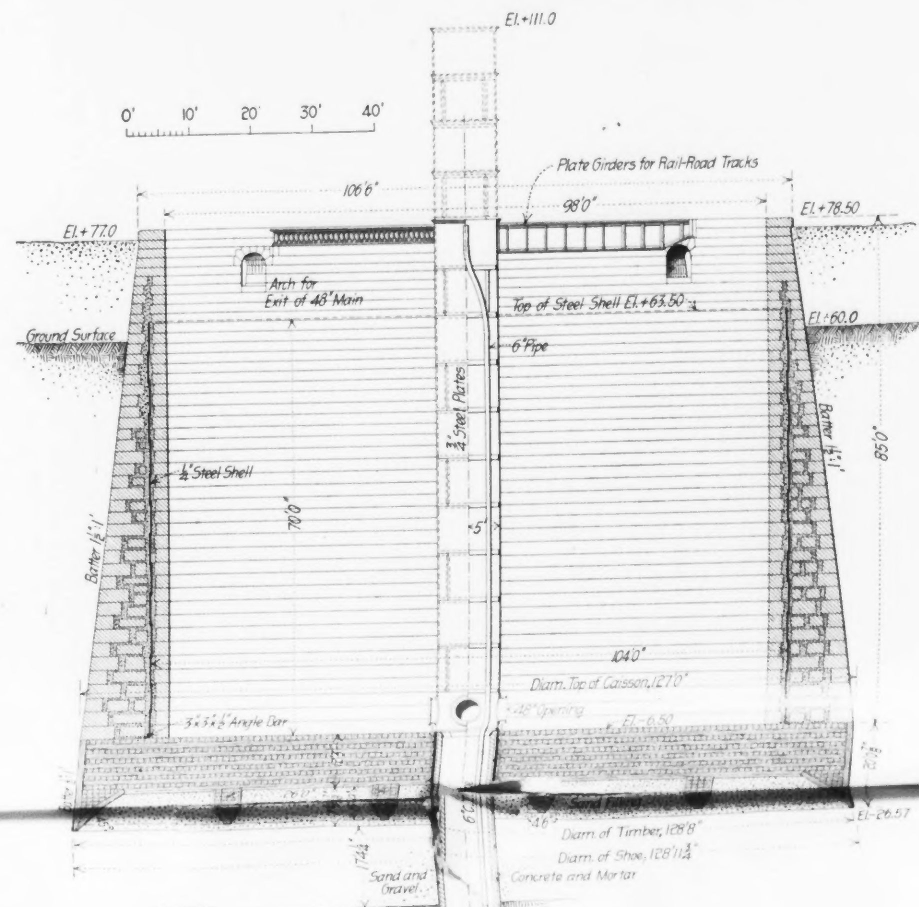


FIG. 7. END OF TWO GIRDERS READY FOR SHEATHING AND INCLINED STAVES; ALSO SHOWS SHOE BEING ASSEMBLED.

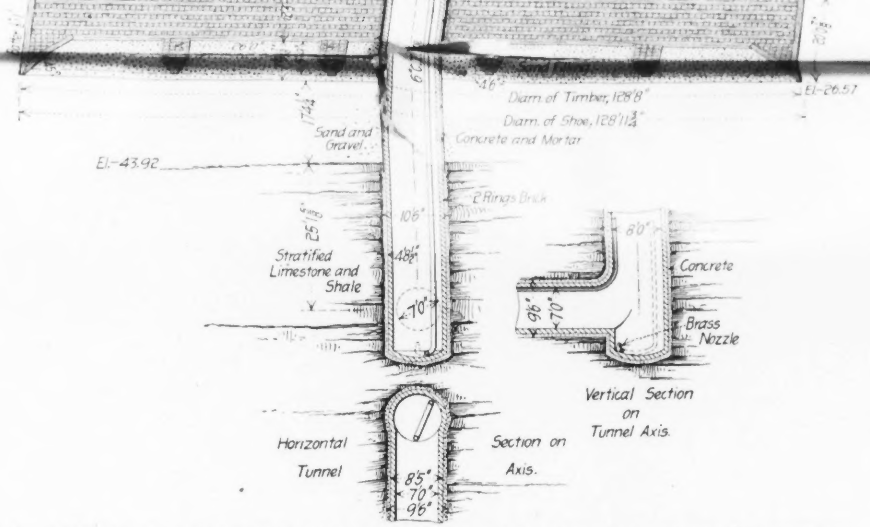


FIG. 4. SECTION THROUGH PUMPING STATION AND PIT SHOWING CAISSON AT BOTTOM.

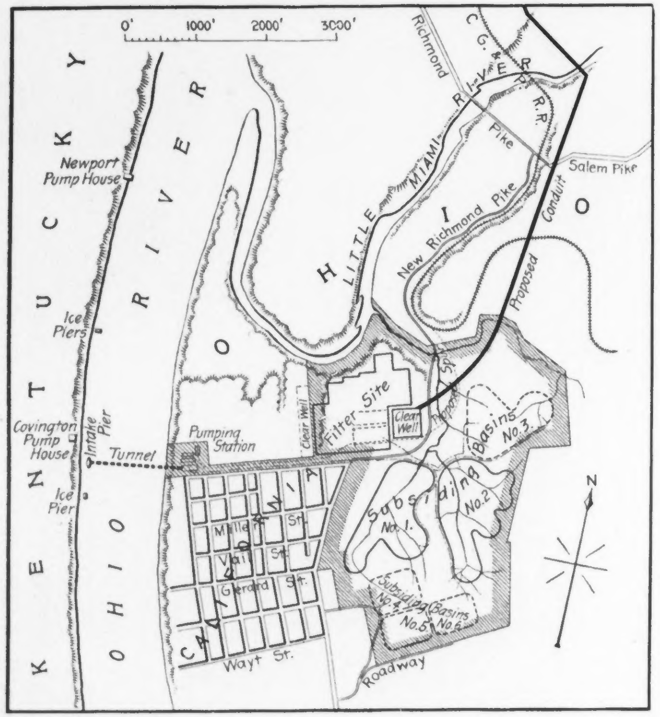


FIG 2. GENERAL MAP OF NEW WORKS AT CALIFORNIA.

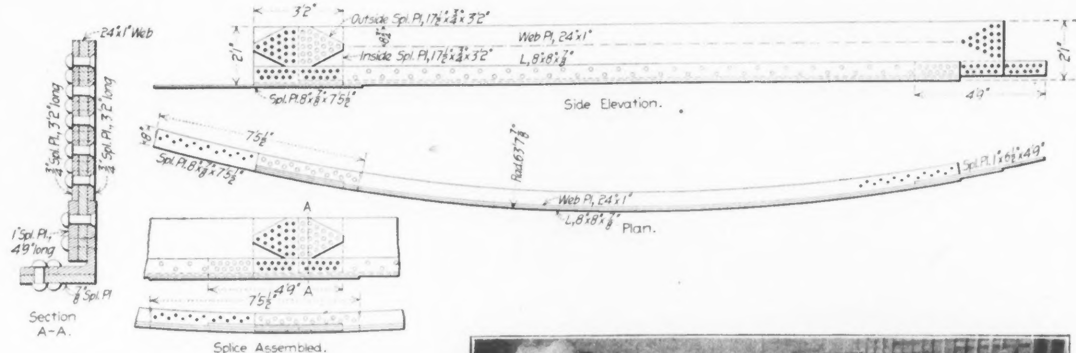


FIG. 5. DETAILS OF SHOE FOR CAISSON.

PROGRESS ON THE NEW WATER-WORKS FOR CINCINNATI, OHIO.

G. Bouscaren, M. Am. Soc. C. E., Chief Engineer.

G. H. Benzenberg and Charles Hermany, M's. Am. Soc. C. E., Consulting Engineers.

FIG. 8. FIRST COURSE OF ROOF COMPLETED AND SOME STAVES AND AIR LOCKS IN PLACE.

and do not reach the same number or class of individuals as are served by somewhat similar European institutions. The phenomenal trade expansion of Germany is the direct outcome of her system of technical education. She has sent out men carefully trained to study the resources and wants of other nations; and by thoroughly-equipped technical and commercial schools, she has fitted those who carry on her manufactures and commerce how best to supply these wants. The advantages possessed by a graduate of one of the German commercial schools are very evident when we consider that he is required to conduct an "office correspondence" in German, French and English, and must be able to converse in one other language, either Spanish, Italian or Dutch; he must be familiar with the geography of foreign countries, their history and commercial conditions and customs; and at the school well-filled museums make him familiar with the animal, vegetable and mineral products of other lands. When such a man goes abroad to take a place in the foreign house of a German exporter, he is able to almost at once begin the work of forming acquaintance and business connections, whereas the average graduate of an American high school or college, having at best only a smattering of any other language than his own, and ignorant of the machinery of commerce, finds that he has everything to learn, and that learning under such circumstances is a very difficult task.

That a knowledge of the conditions to be met in foreign markets is of value to those at home as well as those abroad, is shown in the November issue of "Consular Reports." In that issue we find four American consuls criticising American trade methods, due purely to ignorance or to disregard of the directions of foreign importers. The chief complaint is that of bad packing, and the non-observance of foreign customs law. Few of our shippers seem to know that in some countries duties are levied on the gross weight and determined upon the highest-priced article within the package; and a single gold watch packed in a box of cheap cotton prints would result in the computation of the duty as if the case contained only gold watches. The bad condition of American cotton bales, received at Liverpool, occasioned a loss of $500,000 to exporters last season. The Egyptian and East Indian cotton bales are much more compressed, have a stronger and better covering than those coming from the United States, and always arrive in almost perfect condition. A failure to observe the explicit directions of importers, as to dimensions and methods of packing, or to consider the customs and superstitions of possible consumers also stand in our way, and damage the sale of otherwise excellent goods. In China, a fanciful Chinese dragon, as a trademark, will sell goods better than if the housemark were used; in Russia, German makers took away from English firms a considerable trade in handkerchiefs for the head, simply by making them of the peculiar dimensions which the people preferred. Peculiar patterns and colors of calico prints, to suit the fancies of special races, and special forms of tools for farmers or artisans are often necessary to secure the trade of a particular section.

In other words, if we propose to extend our commerce, there is very much to be learned.

Some American manufacturers have already been shrewd enough to appreciate these facts. In Nicaragua, we are told that practically all the machetes used are made by Collins, of Hartford, Conn., who has produced a blade of exactly the shape the natives desire, and as a consequence they will not buy a machete unless "Collins" is stamped on the blade.

It thus appears that if we are to compete for the world's trade in all lines, and not merely those in which our wealth of natural resources gives us a large advantage, there is much to be learned both by our manufacturers at home and by their agents sent abroad. To obtain this knowledge we must make a beginning, at least, in what may be called popular commercial education. The models exist in European institutions of a similar character, though these would doubtless have to be modified to suit our conditions. In this connection, it is an encouraging indication of the appreciation of the need of such training to note that a committee of the New York Chamber of Commerce was recently appointed to prepare and submit a plan for the establishment and development of better commercial education in our secondary and higher schools. England has been forced to similar action, because German and other foreign clerks, on account of their superior commercial training and ability, were rapidly supplanting young Englishmen in positions of trust. The London Chamber of Commerce now grants commercial certificates to candidates who produce evidence of proficiency, according to certain prescribed branches of study, including, at least, two languages, and elementary drawing, chemistry and physics. The Paris Chamber of Commerce manages the Paris Commercial High School; and exemption from military service, for more than one year, is an inducement held out to attend this school. The action of the New York Chamber of Commerce is timely, and it is to be hoped that good results will follow its recommendations.

LETTERS TO THE EDITOR.

Canadian Bridge Schemes and Ethics for Engineers.

Sir: In your issue of Dec. 1, 1898, in answer to the article by "A. P. B.," on "An Opportunity for Bridge Engineers to Practice Engineering Ethics," Mr. Barthe affects a great deal of righteous indignation because "the Quebec Bridge Co. is so sorely arraigned before the tribunal of public opinion" on the general charge of "deliberate attempt to get something for nothing," and because of the "imputation that this company, composed as it is of 200 of the best citizens of Quebec, is unable to pay a few thousand dollars for the technical information it requires," etc.

A. P. B.'s stand is well taken, though one course that he mentions—that of offering prizes for the best plan—has its disadvantages.

In this connection, attention is called to another Canadian case of "gall unparalleled" in which the attempt to get something for nothing was successful.

In the spring of 1895 the Montreal Bridge Co. called for competitive plans for a proposed bridge across the St. Lawrence, and offered prizes for the first and second best plans, of $1,000 and $500, respectively. A large number of plans were submitted and the awards were made; but neither of these prizes has ever been paid.

In view of this fact, engineers are justified in questioning the methods and intentions of the Quebec Bridge Co.—even if it is composed of "200 of the best citizens of Quebec."

Yours very truly,

A. L. Bowman.

71 Broadway, New York city, Dec. 3, 1898.

(We have commented on this letter in our editorial columns.—Ed.)

A Battle of Quotations.

Sir: Some time ago those of the trunk line railways which have long been allowed to charge a differential fare to Western points under the agreement were surprised to learn that the "standard" lines had put into effect lower rates from Buffalo to the Pacific Coast, and had requested Western connections to so arrange their rates as to make them the same as the rates enjoyed by the differential lines. The steps were taken somewhat secretly, and the differential lines did not learn of the change until some time after the circulars had been sent out. A meeting was held in New York last week by the differential lines to discuss the matter. David B. Martin, Manager Passenger Traffic of the Baltimore & Ohio R. R., was chosen chairman, and Charles S. Lee, of the Lehigh Valley, acted as secretary. After some discussion, the following telegram was sent to Geo. H. Daniels, of the New York Central; A. J. Smith, of the Lake Shore; O. W. Ruggles, of the Michigan Central; J. R. Wood, of the Pennsylvania; E. A. Ford, of the Pan Handle, and E. O. McCormick, of the Big Four:

We learn with regret that at this most inopportune time, without conference or advice, you have arbitrarily reduced regularly established fares from common points in our territory to Pacific Coast points, and by request upon initial lines at the Pacific Coast, succeeded in obtaining similar reductions in authorized fares eastbound. We deprecate such arbitrary action as tending to demoralization, and calculated to provoke retaliatory measures and unnecessarily reduce the revenues of all lines. We therefore, respectfully enter this, our protest, against such unwarranted action on your part, suggesting that in our opinion, when changes in authorized fares are contemplated, due notice should be given to all interested lines, in accordance with the established usage, and would request immediate restoration of rates to those in effect Nov. 1, 1898, and ask your prompt reply, to be addressed to D. B. Martin, Baltimore, Md.

One of the first replies was received from George H. Daniels, of the New York Central, and read as follows:

D. B. Martin, Baltimore, Md.:

I think it would be an opportune time for you to read the 41st verse of the 6th chapter of the Gospel according to St. Luke.

Mr. Martin, after some difficulty, found the verse, which reads as follows:

And why beholdest thou the mote that is in thy brother's eye, but perceivest not the beam that is in thine own eye.

Mr. Martin undertook a little Biblical research on his own book, and wired Mr. Daniels as follows:

Answering yours of Dec. 2, we have been guided through life by the teachings of St. Luke, and fully concur that his sixth chapter is very appropriate to the case in point, and for your personal application would advise reading last half of verse immediately following.—D. B. Martin.

The last half of the following verse reads as follows:

Thou hypocrite, cast out first the beam out of thine own eye, and then shalt thou see clearly to pull out the mote that is in thy brother's eye.

Yours truly, J. F. M.

Baltimore, Md., Dec. 5, 1898.

(We can add to our correspondent's story that Mr. Daniels has now taken up the study of Shakespeare, and was about to refer his adversary to a certain passage in "The Merchant of Venice," Act I., Scene 3.† The reflection that it might be used as a two-edged sword, however, caused him to refrain.—Ed.)

The "Board of Awards" at Baltimore and Other Features of the New City Charter.

Sir: In your issue of Nov. 24 you comment on that part of the new charter of Baltimore which provides for the letting of contracts for work done and material furnished the city, by a Board of Awards, certain city officials, ex-officio, composing the board. You call attention to the defect in the provision which requires the award to be made to the "lowest responsible bidder," in that the lowest bid may be too high, etc., and which, in the absence of this requirement, would warrant the board in rejecting all bids. This requirement that the lowest responsible bidder shall always be awarded the contract has been defended by saying that it prevents crookedness between the board or some of its members and an irresponsible or dishonest bidder.

An answer to this would be that in a board of city officials whose standing in integrity is that of a Mayor, Comptroller, City Register, City Solicitor and the President of one branch of the city council, the chances of collusion with a dishonest contractor, while possible, are rather remote.

Another defect (though not a serious one) is the requirement that the successful bidder shall give bond in double the amount of the contract price. This is excessive and entirely unnecessary in protecting the city's interests. Contractors in making up their estimates for work or material advertised for will not fail to add the premium on this bond to their proposal, and for this the city will have to pay. Take for example the paving of a street estimated at a cost of $50,000. This, of course, means a $100,000 bond. Moreover, if the contractor were sued on his bond, for failure to comply with specifications or complete the contract, the court would very likely award the city only damages equal in amount to the loss sustained, which in hardly any case could exceed the amount of the contract, and in many cases would be but nominal. Previous to the adoption of the new charter it had been the custom in the City Commissioners Department to fix the bond at about one-third the amount of the contract. This proportion was increased in special cases, such as the erection of a bridge or in emergency work.

Shortly after the new charter went into effect the City Commissioners Department solicited, among other material for constructing a sewer, bids for about 200 barrels af natural cement. The specifications contained the usual provisions for tensile tests (for 1, 7 and 28 days). Two of the brands of cement (offered by different bidders) differed in price by about 4 cts. per bbl. Both kinds satisfied the specifications, but the higher priced was much the better and considerably exceeded the requirements of the specifications, as shown by tests made in the Department. The board had no discretion in the matter but to award the contract to the party offering the lower priced material. The difference in the cost on the estimated amount was about $8, whereas the better quality of the higher priced cement, as shown by the tests, would probably have allowed a lower proportion in the mortar and thereby made it the cheaper in the end.

It is simply one of those cases where it is difficult to draw the line guarding the interest of the taxpayer without encroaching on ordinary business principles. A most excellent provision in the new charter is that all appropriations for public improvements exceeding $2,000 shall, before being passed by the City Council, be referred to the Board of Public Improvements and to the Board of Estimates, in case it has not already been included in the Board of Estimates' budget for that year. The first-named board passes on the value of the measure as a public improvement, and the Board of Estimates passes on the probable cost and availability of the funds to pay for it.

†"The Devil can cite Scripture for his purpose."

The council will hereafter be unable to appropriate money not provided for and included in the Board of Estimates' annual report for the year. By this means the "floating debt" will be avoided, which has heretofore been the "bete noir" of the party in power and has been the subject of some extravagant oratory and literature in political campaigns.

James A. Paige.

Baltimore, Nov. 28, 1898.

The New Printing Plant of the W. B. Conkey Co.

Sir: In Engineering News, of Nov. 17, we notice the article and the editorial regarding our new establishment.

Regarding the editorial, the gentleman who wrote it evidently did not grasp the plan of our building. I have asked our architect, Mr. Geo. C. Nimmons, to take up the matter and write you concerning it, as the great feature of our plant is its fireproof construction, the absolute impossibility of burning and the ease of exit for employees in case of fire, there being large windows only 2½ ft. from the ground. The entire structure is fireproof, including the roof, which is of heavy galvanized iron, the supports being iron columns, and every partition of fireproof tile 4 to 6 ins. thick. The floor is laid upon cinders solidly packed against the wood, which is 2-in. Norway pine, and 1-in. tongued and grooved maple floor on top. There are also 2-in. fire hose connections to every 100 ft. of floor space, with 50 ft. of hose attached, throughout the building, and our rate of insurance is only 0.5%. In Chicago we carried an insurance of $450,000 on stock and machinery, and in Hammond we carry only $25,000 on machinery and $100,000 on stock.

We recently had a call from the President of the Society of Engineers of London, England, together with such gentlemen as the business manager of the Curtis Publishing Co., New York city; Mr. Talhelmer, general manager of the American Book Co.; Mr. A. G. Spaulding, and many representatives of large manufacturing concerns, who have been more than astonished and pleased with the wonderful results that have been attained by this new construction scheme for manufacturing plants.

I mention the three gentlemen above, because they are immediately going to construct new plants, and will adopt our plan, which is thought quite the most perfect scheme for a manufacturing plant that has ever been conceived. There is no question but that the erection of our plant has demonstrated a new condition which will mark a new era in manufacturing plants. Believe me,

Very truly yours,

W. B. Conkey Co.,

W. B. Conkey, Pres.

Hammond, Ind., Nov. 23, 1898.

Sir: I am much pleased to note from the article in your issue of Nov. 17 that you have been interested in the new methods of construction adopted for the plant of the W. B. Conkey Co., at Hammond, Ind., of which I was the architect. As, in your editorial discussion of the subject, you have raised the point as to its fireproof qualities, etc., and as a number of other large manufacturers are about to adopt this style of building, a further description of this plant will, I trust, be of interest to you and also to the readers of your valued publication.

The plant consists of a main factory building one story high, covering about four acres of ground, and is nearly square in plan. It has no interior light courts or areas, as the light all comes from the roof, and the floor and roof are therefore continuous over the entire space of four acres. The office building, with its various apartments, and the employees' entrances, dining rooms, bicycle rooms, toilet rooms, hospital, etc, for the employees, adjoin the main factory and extend clear across the east side, which is the front, and which faces on a park of five acres, landscaped especially for the recreation and enjoyment of the factory hands, having a lake, walks, drives, flower gardens, etc.

Adjoining the north side of the main factory building is the building for the generating plant, which was described in your previous issue.

The roof of the main factory building is perhaps the most striking feature of the construction. The idea for this was borrowed from Europe, principally from the National Fire Arms Works, of Belgium, and an immense bicycle factory in Paris. Both of these works are built on this scheme of obtaining north light only, through a series of windows arranged in parallel rows over the entire roof, thereby admitting only the north white light and no sunlight, but in such quantities as to flood the building with pure white light, over every square foot of floor surface.

The first objection that is likely to occur in reference to this kind of roof, is the possibility of snow collecting in the valleys between the skylights. This is guarded against in a manner similar to that employed for hot-houses, by keeping the bottom of the gutter and the glass heated so as to melt the snow as it falls. This condition produces another difficulty, greater than all to care for, and that is the condensation on the under side of the glass, etc. In order to care for this, a complete system of condensation gutters has been made which collects all the condensation and conducts it to the outside of the building.

The heating and ventilating of the building is accomplished by a blast system, with the heating ducts under the floor, which supply registers throughout the plant, arranged on the side walls of each department. The placing of the heating ducts under the floor does away with the objectionable large galvanized iron ducts usually placed on the ceiling. The heating system can be made to produce a mild heat for the seasons of spring and fall, and can also be turned into a cooling system for summer, by running cold water through the steam pipes at the fans and changing the air every 15 minutes with cool air in hot weather.

The fireproof qualities of the building were among the principal features considered, and it was constructed in accordance with the advice and suggestions of the fire underwriters, who have placed a very low rate of insurance on the building. The building is practically fireproof from the nature of its construction. Fire cannot get under the floor nor through the walls dividing the different departments, as the walls are made of heavy tile; the iron columns in the wall are fireproof, and the openings are closed with iron fire doors. The office department has a thick brick fire wall dividing it off entirely. The floor is built of heavy plank and finished maple laid on sleepers which are bedded in cinders rolled with a six-ton roller, which leaves no space under the floor for fire or vermin, and incidentally permits the floor to be loaded almost indefinitely. Under these conditions, fire cannot get under the building, nor through the partitions, nor spread any further than the department in which it starts. As an additional safeguard, hose pipes with reels have been placed so as to cover every part of the building with water in case of a fire. It is also true that panics among the employees in the time of fire would not be likely to occur.

The advantages to be gained by this kind of a building in a general way over the ordinary ones of two or more stories, or of a plant that consists of a number of one-story isolated buildings, are, first of all, that it brings the different departments into closest contact and saves much time and expense in handling the product and in superintending the men and work, as it is all under one roof and on one floor, with no elevators or stairs, and all concentrated within the smallest possible area. A building, therefore, arranged with all its departments as nearly a square as possible, with the raw material traveling in the smallest possible circle, is the most economical arrangement, both as to handling goods and as to cost of buildings. A building, square in plan, with say 32,000 sq. ft. of floor area, costs just half as much to enclose with a brick wall as two buildings of the same area each 40 ft. wide by 400 ft. long, a width not uncommon in factory plants.

The roof of the square building would cost more than the others, on account of the extra glass, but the saving in the outside wall would more than make up for this extra expense. In a two or more storied plant the saving of the heavy floor supports by the one-story square building is also great enough to make up for the greater cost of a glass roof. It is also true that a building of the type used for the Conkey plant, with the perfect north light, is cheaper to build than either the one-story building with the old lantern-shaped roof, or the mill constructed building of two or more stories.

Factory buildings of this country, as a rule, have received comparatively little study by architects, and are very often defective as to their arrangement and light. As competition at home and with foreign countries becomes closer among manufacturers, it is evident that the problem of planning factory buildings grows in importance, as a great deal can be done by the architect in planning the buildings so as to reduce the cost of producing goods.

George C. Nimmons,
Architect.

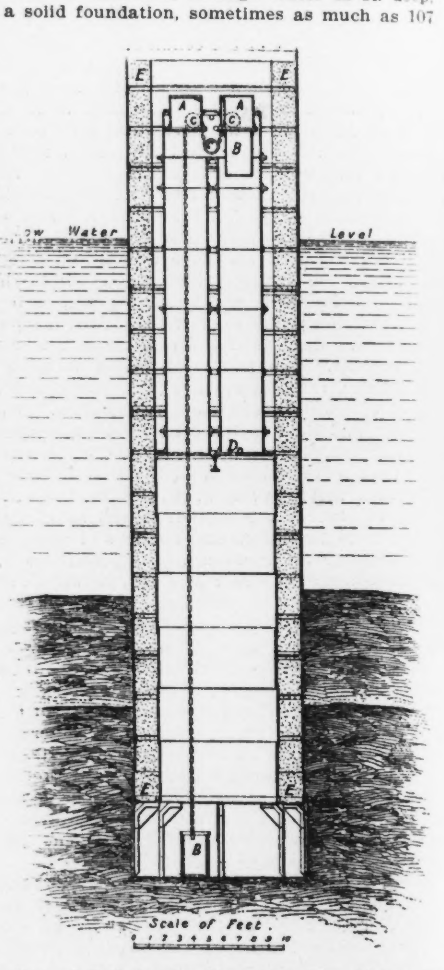
94 La Salle St., Chicago, Nov. 28, 1898.

(We give space with pleasure to the above communications; but are obliged to confess ourselves still unconvinced as to the wisdom, from the standpoint of fire protection, of putting such a great area of buildings under what is practically a single roof. We freely admit that the division of the building by solid fireproof partitions is calculated to lessen materially the risk, but we do not see that it is equivalent to the distribution of the risk into separate buildings, far enough apart to permit the firemen to work between.

It must always be remembered, of course, in the study of questions of fire protection, that although a building itself may be incombustible, its contents generally afford material enough to feed a brisk fire, especially in any manufacturing plant where the floors gradually become more or less saturated with oil. Admitting, then, that fire is always liable to occur, the question is how its spread may be checked. The weak point in the Conkey establishment, it seems to us, is that all the work in fighting fire must be done on the inside. The fire resisting partitions, if the openings in them are closed by good fire doors, may do their work, but if one department gets ablaze, will not the flames burst through the glass of the roof, and in case of high wind, be carried into other departments through the breaking of other skylights by the heat? As we write this, the eight upper floors of one of New York's finest office buildings are in ruins through flames which were spread through the glass windows, from a fire in an adjacent building. The trifling resistance that glass offers to fire is now well known; and the question concerning the Conkey plant is whether a fire-fighting force in one of the rooms of the building could keep flame from entering from an adjacent department through the roof skylights. Probably it could do this, under favorable circumstances, but in other cases it seems likely that the smoke and heat might be carried in such volume through the broken skylights as to compel the defenders to retreat.—Ed.)

THE HUGHES AIR LOCK; VALPARAISO HARBOR.

The late Mr. John Hughes, M. Inst. C. E., of England, was the engineer for the wrought iron pier built in 1873-83, in the harbor of Valparaiso, Chili, by the Chilian Government. This pier was made by sinking wrought-iron cylinders, 11 ft. 4 ins. outside diameter, through water 48 ft. deep, to a solid foundation, sometimes as much as 107



Section of Cylinder for Steamship Pier, Valparaiso Harbor, Chili, Showing Operation of Hughes Air Lock.

ft. below the water surface. These cylinders were filled with concrete and braced, and supported the pier platform. They were sunk by the use of the pneumatic process, and the novel air-lock employed is illustrated and described in "The Engineer," of Sept. 9, 1898, from which the following brief account is taken:

The main cylinders were made in 8-ft. sections, with angle-iron connections, and they were sunk from a temporary staging supporting a traveling crane. There were, in fact, two cylinders; an inner one, 8 ft.

in diameter, and made of ½-in. plate, and an other one made of ⅜-in. plate; the annular space between the two was filled with Portland cement concrete after the bottom was reached, and this weight was sufficient to ballast the cylinder and counteract the buoyancy of the compressed air inside.

After the main cylinder was in the water and floating by reason of the unfilled annular space, a wrought-iron cover was bolted onto the inside cylinder, and on this cover two lengths of 3-ft. shaft cylinder were bolted, and additional lengths of these and the outer cylinders were added until the cutting-edge was on the bottom, with the top of the cylinder rising above the temporary staging. As the cylinder sank, the annular space between the two cylinders was filled with concrete.

The pneumatic apparatus was then put in place, and this was designed with the purpose of requiring no men to be under pressure except those actually engaged in excavation at the bottom. As shown in the figure, the two D-shaped cases, A, were provided with covers opening downward and opened or closed by an outside hand lever fixed on the bar forming the hinge, and passing out through a small stuffing-box; the joint between the case and the lid was made tight by an india-rubber ring attached to the lid. A similar ring was fastened underneath the bottom of the case, A, which was open, intended to form an air-tight joint with the bottom portion of the air-lock, or skip-case, B. This latter was suspended by two chains of gaged links, one on each side, passing a bar of iron was thrust, as the skip was raised out of the air-lock, and to the projecting ends of this bar the tripping, or dumping chain was attached.

This air-lock plant was equipped with a signal gong, pressure-gage, safety-valve, and air-connections, fitted with a check-valve and stop-cock, to be used in the event of a rupture of the 3-in. hose-pipe leading to the air compressing plant. There was also a 3-in. valve and connections in the 8-ft. cylinder for ejecting water from the cylinder, otherwise than by forcing it out under the bottom edge. A small flexible pipe was provided for drawing off compressed air to work a pump for supplying water for the concrete, and a wire rope-ladder, hung beside the air lock shafts, enabled the workmen to pass to the bottom. The air-compressing plant was placed on the shore, and the compressed air was led in an iron pipe to the 3-in. flexible hose referred to.

When the cylinder had been sunk to the required depth, sometimes 107 ft. below the water surface, 8 or 10 ft. of concrete was carefully deposited in the bottom under air-pressure. This concrete was lowered in the skip-cases, B, and these were tipped like ordinary buckets. During the hardening of this concrete the safety valve came into play, in maintaining an even requisite pressure and obviating the possibility of the compressed air blowing out at the bottom and causing unsound work. Two men only were employed at a time under pressure in each cylinder, working in 4-hour shifts. While the usual results of working in proximity to older buildings having foundations of shallower depth without injuring or disturbing the existing structures. The success in this direction is also exemplified in the present work. The chief interest of the work, to engineers, however, lies more especially in the cylindrical wooden stave caisson employed, the special form of caisson shaft, and the patented air lock designed by the engineer and contractor, Mr. John F. O'Rourke, M. Am. Soc. C. E., of New York city. The accompanying cuts illustrate these and such other features of the foundation construction as are of most interest.

General Description of Foundations.—The area occupied by the building is about 45 × 100 ft., and is rectangular in form. Eight pneumatic caissons filled with concrete and capped with brick masonry above the cellar floor carry the iron work for the building, which is five stories high. The caissons are placed in two rows of four caissons each along the two longer sides of the rectangle, the distance of the two rows apart transversely being about 25 ft. c. to c. of caissons for the front caissons and 29½ ft. for the others. Each caisson is 6 ft. 7½ ins. outside diameter, and they are sunk from 40 ft. to 52 ft. below the curb to solid rock. The material penetrated is rock filling, mud and clay, and hardpan and boulders, in the order named, and in the case of the front caissons an additional layer of clean, sharp sand just above the hardpan and boulders. The plant used in sinking the caissons and the progress and success of the work will be mentioned further on.

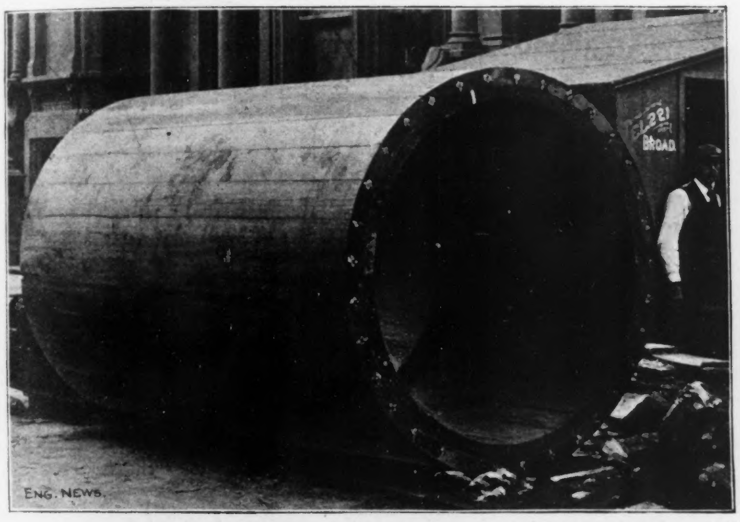


Fig. 1.—View Showing Slip-Tongue Connection of Staves.

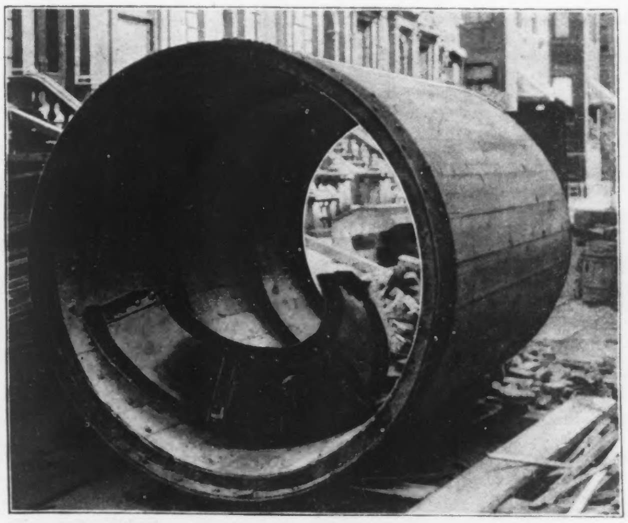


Fig. 2.—View of Cutting Edge Showing Detached Section of Roof.

FIGS. 1 AND 2.—WOOD-STAVE CYLINDRICAL PNEUMATIC CAISSONS FOR THE FOUNDATIONS OF A PRIVATE RESIDENCE AT 11-13 EAST 62D STREET, NEW YORK CITY.

John F. O'Rourke, M. Am. Soc. C. E., New York City, Designer.

around the chain-sheaves, C, so that when both chambers, A, are closed at top and compressed air is admitted to them, one skip-case, B, can be raised and the other lowered simultaneously, by means of a winch on the outside, with the main shaft passing through the sides of the lock in stuffing-boxes. As the top of the skip-case, B, comes in contact with the bottom of the chamber, A, the compressed air may be let out of A and B, and the skip removed; the pressure of the air within the main cylinder forces B against A and makes the joint tight in this case. The cocks for the inlet and outlet of compressed air are 1½-in. diameter, and are linked together so as to be worked by one lever from the outside; smaller cocks, of ½-in. diameter, are provided on the inside for the use of workmen passing in or out. The original article gives no dimensions for the lock chambers; but the cases, A, were apparently about 2½ ft. diameter and 3 ft. high, while B was somewhat less in diameter and about 4 ft. high.

The buckets or skips for hoisting the material from the bottom, were made to closely fit the inside of the skip-case, B; and to assist in dumping them, when hoisted from the skip-case by a steam crane, a pipe was run through each bucket near the bottom, from side to side. Through this pipe compressed air were noted, there was only one death. This one fatal case resulted from the workman failing to give the signal that it was a man, and not material, that was coming up; the consequence was that the pressure was released suddenly and the man was paralyzed from the waist downward. He at once went under pressure again and was released gradually; but the mischief was done, and he died in the hospital, about three months later, from the indirect effects of the paralysis.

A NEW AIR LOCK AND CYLINDRICAL WOODEN PNEUMATIC CAISSON FOR FOUNDATIONS.

An entirely new system of pneumatic caisson foundations is being employed in constructing the new residence of Mrs. Elliott F. Shepard, on 62d St., near Madison Ave., in New York city. In passing it may be noted that so far as we are aware, this is the first use of pneumatic caissons for dwelling house foundations, although they have been frequently employed heretofore in the foundations of mercantile and office buildings. In New York city particularly the value of this style of foundations has been fully proved, especially where deep foundations have to be sunk in close

Cylindrical Caissons.—Figs. 1 and 2 show quite clearly the construction of the wooden caissons. Each is a cylinder 6 ft. 7½ ins. in outside diameter composed of staves cut with radial sides, and having inside angle hoops bolted to the staves. The staves are made of 4 × 6-in. plank dressed to 5½ × 3½ ins., and have 1-in. square slip tongue joints. At first these tongues were covered with whitelead, but it was found that this prevented the tongue from swelling and finally the painting was abandoned.

As will be seen from Fig. 2 and the general drawing, Fig. 3, showing the caisson, caisson shaft and air lock assembled in position ready for work, the wooden cylinder is provided with a metal cutting edge consisting of an angle and plate. Fig. 3 also indicates the construction of the double angle joint connecting two lengths or sections of wooden cylinder. The roof of the working chamber is formed by a ring-shaped diaphragm of steel attached at its outer edges to a special angle ring which was very strongly connected to the staves by a countersunk rivet in each stave, and to its inside edges was attached the bottom of the caisson working shaft. Fig. 2 shows a section of the steel roof ring lying inside the caisson cylinder. It will be noticed that it is detachable and can be used over and over again, like the caisson shaft and air lock.

Caisson Shaft.—The construction of the caisson shaft is shown by Figs. 3 and 4. Briefly stated, the objects sought in designing this shaft were to provide a shaft having no interior projections to catch and otherwise obstruct the hoisting of the

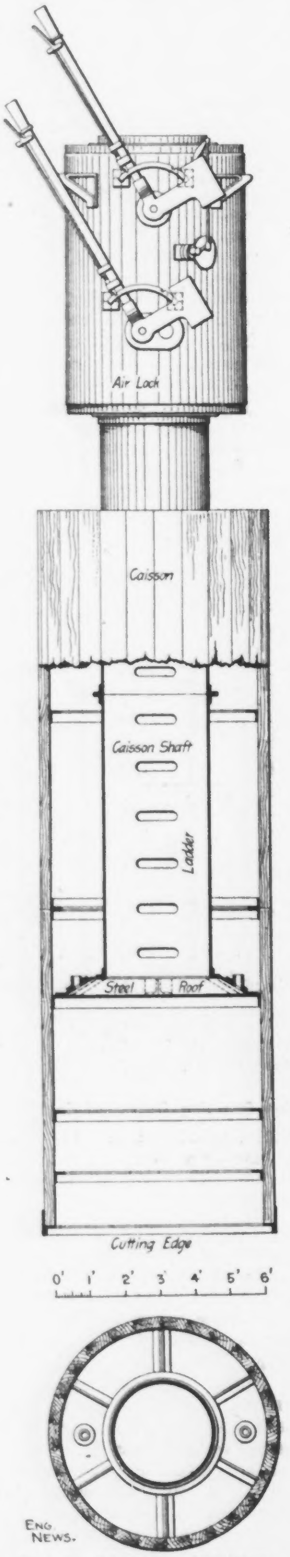


Fig. 3.—Sectional Elevation of Wooden Cylinder Caisson, Caisson Shaft and Air Lock Combined.

bucket, and permitting of its use as a "man shaft" when fitted with a suitably designed lock for that purpose, and also one which would afford a ready means of escape by providing holds by which the men could climb up the inside of the shaft. It was necessary also that all of this should be accomplished without danger of the air escaping and without weakening or greatly increasing the cost of the shaft.

Referring to Fig. 4, it will be seen that the shaft is simply a steel cylinder, in one side of which is cut a series of horizontal oblong holes, one above the other, at convenient distances apart to enable a man to step from one to the other. These slots, it will be seen, form a ladder, no part of which projects into the interior of the shaft. To prevent the air escaping through the slots, they are provided with a cover of the same material as the shaft, which bulges outward enough to permit the insertion of the hand or foot into the slot. This cover extends the full length of the shaft, and is riveted to it at the edges, as clearly shown. To prevent the shaft from bulging under the air pressure or the cover plate from being forced inward by any ordinary accident, it is stayed by bolts, which extend through the cover into the shell of the shaft. The shaft, of course, may be provided with any number of these ladders which space will permit and which may be thought necessary.

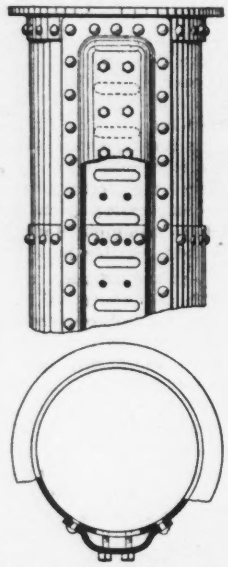


Fig. 4.—Sketch Showing Ladder Construction in Caisson Shaft.

Air Lock.—The several sections and elevations in Fig. 5 show the construction and operation of the air lock. The lock has an essentially cylindrical body, A, which has a top opening, B, and a bottom opening, C, of the requisite size to permit the passage of a bucket or cage through it. Around the top opening is a circular ring, D, on the inside. This opening is closed by the oppositely-arranged convex swinging gates, E, the meeting edges of which are packed so as to make an air-tight closure. The opposite edges are provided with flanges, F, adapted to close against the ring, D, these flanges having flap-gaskets which protrude into the air lock so that the air pressure striking them will make an air-tight seal by pressing them against the ring, D. While ordinarily all the pressure on the doors, E, is taken by the shafts, G, and the actual closure is made by the flap-gaskets, yet the ring, D, may be made to act as an emergency bearing to take the pressure.

The gates, E, are cut away at the center of the meeting edges, as shown at H, to receive and fit snugly upon the stuffing-box, J, banded with rubber, and having a hole through the center for the passage of the hoisting rope. The gates are hung by the arms, K, to the common shafts, G, one (M) being fixed to the shaft, and the other (N) running loose. This arrangement, by means of the bevel gears and idler m, n and o, allows the two doors to be moved in unison and in opposite directions. This hanging of the opposite gates on a single center obviates the necessity of piercing the shell in more than two places, and, therefore, reduces leakage and simplifies the construction. The manner of rotating the shafts, G, by the levers, O, is obvious from the drawing. It will be noticed that the levers have counterweights which balance the doors and thus enable one man to operate the lock.

The air lock has its lower end closed by similar oppositely-arranged swinging gates, P, which near their outer edges have the seats, Q, which fit against the ring, R, with gaskets to secure a tight fit. The castings forming the ring, Q, it will be noticed, have flanges, q, r and s, forming rungs continuing the shaft ladder previously described, and being continued itself by the ladder-like structure, S. Unlike the upper gates, E, the lower gates, P, are swung by the arms, T, from separate centers or shafts, U and V. The gate arms are rigidly fixed to the shafts, and turn with them. To secure opposite motion to the shafts one is operated by a spur wheel from the other, as shown at t and v, the actuating force being obtained through the lever, O. The admission and discharge of air to and from the lock is controlled by the three-way cock, X, operated by a lever and bevel gear and connected with suitable piping to the air shaft, there being no independent connections with the compressors, as is usually the case.

To operate the lock, therefore, the bucket being at the bottom, and the bottom gates, P, necessarily open, the bucket is raised up into the air lock and the gates, P, closed behind it. The air is then discharged by the valve, X, from the lock and the top gates, E, are opened. This allows the bucket to be hoisted out and dumped, or loaded, as may be desired. In the return process the bucket is hoisted into the lock and the top gates closed, care being taken to place the rope stuffing-box, J, approximately in place; air pressure being then admitted, the bottom gates are opened and the mitted, the bottom gates are opened and the bucket is allowed to descend into the working chamber. This operation usually takes about ten seconds, and is accomplished by one man without difficulty. While the drawings show the gates operated by hand levers, other methods may be employed. One of these is a system of oscillating cylinders, and such a system was described and illustrated in the original patent specifications, No. 591,633. After trying both systems the levers were found simpler and cheaper.

It will be seen by examining Fig. 3 that when the bucket is at the bottom of the working chamber everything is open clear to the very top of the air lock, and with the ladders provided in the shaft and lock the men can, in the case of a sudden inrush of water, scramble to the top above danger

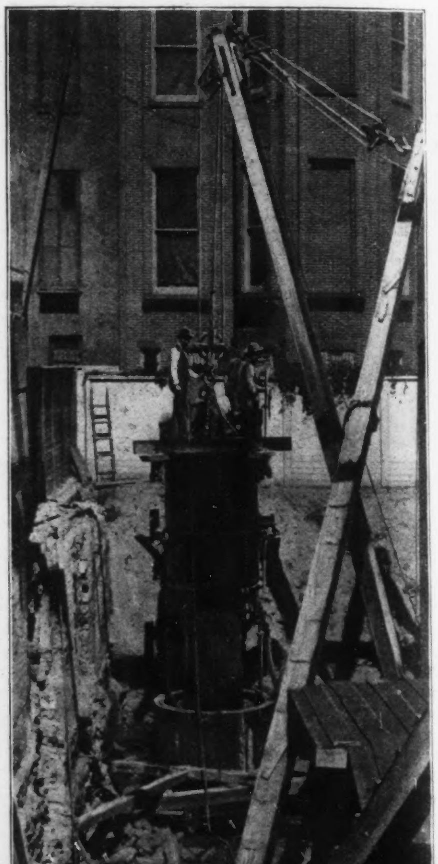


Fig. 6.—View of Wooden Cylinder Caisson with Shaft and Air Lock Attached in Working Order

in all but exceptional cases. Another feature of the system is the dissociation of the air lock, shaft and working chamber from the parts remaining permanently in the foundations. In the foundation work, described above, only three sets of these metal parts were used in sinking the entire eight caissons. As soon as a cylinder had been sunk and filled with concrete up to the working chamber roof so as to seal the bottom, the roof, shaft and lock were raised out and the remainder of the filling was done in the open air. A water-tight layer of tar and tar paper was embedded in the concrete near the bottom of the chamber to ensure a perfect seal.

As indicating the rugged construction of the wooden stave cylinders as designed, it is stated that in sinking one of them 40 blasts were fired inside the working chamber, using a half a stick of dynamite each, and beyond some of the staves being scarred by flying stone no damage was done. The calking was not affected enough to cause any leaks, and the roof plates and connections were not broken, although the concussion was sufficient to jounce the load of pig iron resting on the roof an appreciable distance into the air.

Fig. 6 shows quite clearly the appearance of one of the caissons with the shaft and air lock complete; the fall block attached to the air lock being operated from the boom of a derrick not shown

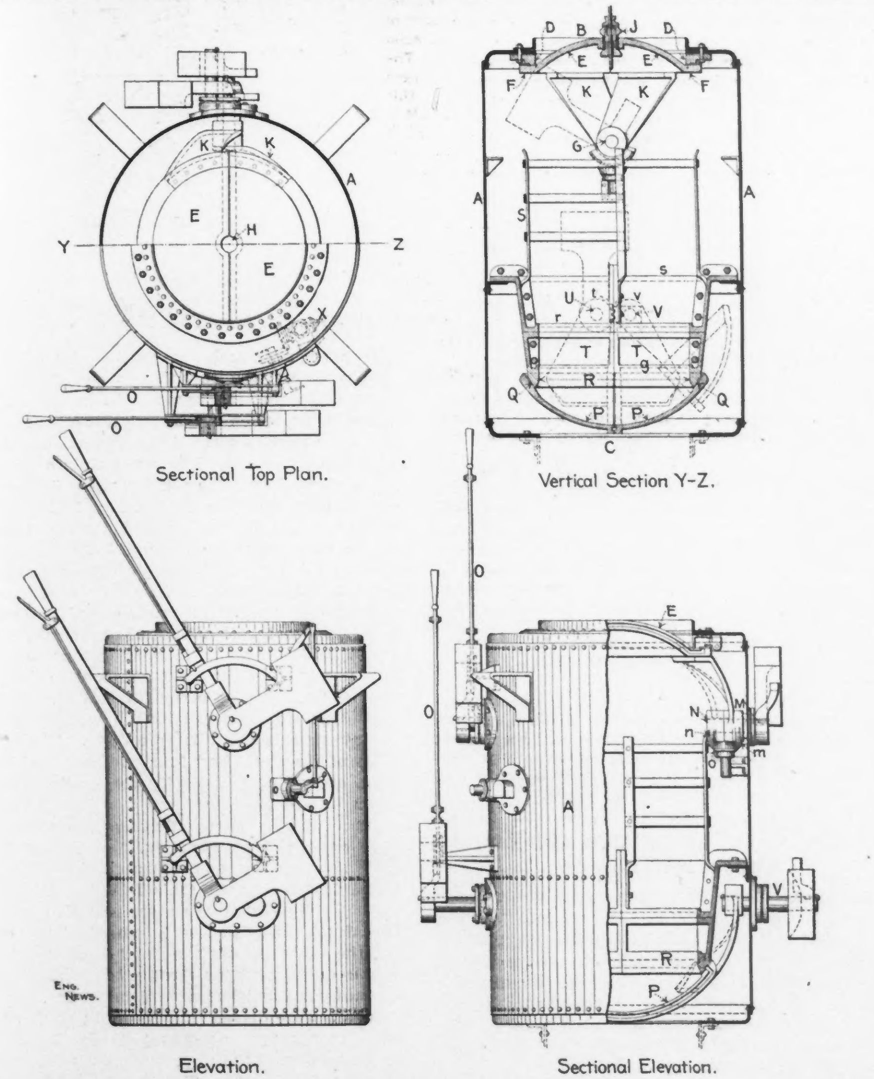


FIG. 5.—PLAN, SECTIONS AND ELEVATIONS SHOWING CONSTRUCTION AND OPERATION OF AIR LOCK.

in the engraving. At the time the photograph was taken the air lock had just been hoisted to place. After this was done the falls were unreaved and the excavating bucket was attached to a "single whip." Two derricks were employed, placed near the ends of the lot and covering the entire area with the combined swing of their booms. Between the derricks were situated the two hoisting engines, and their boilers and the duplicate air compressors with their receiver. With this plant the cylinders were sunk to the depth before stated, in periods ranging from 30 hours to eight working days. The largest amount of time was consumed in penetrating the rock fill. Three men were worked in the caisson chamber, one operated the air lock, and another regulated the admission of the air. Absolutely no disturbance of the neighboring foundations was caused. The contractor was Mr. John F. O'Rourke, M. Am. Soc. C. E., the inventor and patentee of the caisson plant used. We are indebted to Mr. O'Rourke for the information from which this article has been prepared. The architects for the building were Haydel & Shepard, of 156 Fifth Ave., New York city.

BETWEEN THE MINE AND THE SMELTER.*

Let us suppose that, as in nine cases out of ten is the fact, you have decided to locate a smelter at a point where fluxes and fuel are more available than at the mine, or to ship your ore to some custom works, at a point so distant in either event that it necessitates railway transportation. The first problem which will usually concern you will be that of freight contracts. There are some railways, like the Great Northern, for instance, that were built through an almost uninhabited country with the express purpose of building up that country and reaping profits in future, and such roads make very liberal rates to miners and smelters along their lines, as well as to other settlers. But there are other roads primarily built perhaps to secure land grants, or, which run from one populous district to another, almost regardless of grades, and, to some extent, of distance; the longer the distance the more land to be obtained from the government. The policy governing such roads has, generally speaking, been unfavorable to industrial development, unless indeed at points where some of the gentlemen interested in the railway were interested in the local development.

When my firm began receiving shipments from Montana, in 1880, the freight rates were from $40 to $60 a ton. They probably do not exceed $18 at this time. One of the most conspicuous instances of the separation for economic reasons of works and mines is that of the Boston-Montana Co. in the state of Montana. Their mines are at Butte, and their works at Great Falls, a distance of 175 miles apart, with one of the main ranges of the Rocky Mountains between. At Great Falls was unlimited water power and cheap fuel; at Butte was not enough water for concentration, and expensive fuel. Before the works at Great Falls were started a freight contract was entered into, the rates of which are popularly supposed to be not much over $1 per ton of ore for this 175 miles of haul over an elevation of 6,000 ft. By way of contrast, I examined a mine in Nevada, only 100 miles from fuel and water by rail, but $3.50 per ton was the lowest freight named for a 7% copper ore.

Recently, competition between railroads and falling prices for metals, have introduced into the question of transportation a new factor, that of the application to ores of the "milling in transit" applied to wheat. You know that a railroad will take a contract to carry wheat from Dakota to New York at a certain price, consenting that the wheat shall be stopped at Minneapolis, turned into flour, packed in barrels, and the flour go forward under the original contract. There are likewise shipments of ores in which the freight contract is based on the number of pounds of copper and lead which they contain, as determined by assay, the contract covering the transportation of the ore from the mine to the smelter in the Middle West, and the bullion from the smelter to the Eastern market; all considered under one contract, not completed until the bullion is delivered. You can readily see the necessity for carefully considering the question of transportation before deciding where to locate works, from this brief outline.

There is still another question of transportation which has been often overlooked by producers of precious metals by smelting, whose product is in the form of rich lead or copper bullion; and when I have suggested that it was worthy of consideration, I have been met sometimes with incredulity until the interested parties began to figure: that is, the difference between freight and express rates on precious metals from the Rocky Mountains to, say, New York.

Take, for illustration, the Anaconda Copper Mining Co. The freight on its product in the form of converter bars or anodes, probably does not exceed $15 per ton to the Atlantic seaboard, and, of course, the gold and silver contained in the copper pay the same freight by the ton. During the fiscal year ending June 30, 1896, the Anaconda company shipped about 108,000,000 lbs. of copper, containing about 6,000,000 ozs. of silver and 16,000 ozs. of gold. The freight on these 206 tons of gold and silver at, say, $15 a ton, amounted to not much over $3,000; but had this material been refined entirely in the West, and the fine gold and silver all been sent forward by express, the expressage and insurance at 2 cts. per oz. would have amounted to $120,000, difference enough to erect an electrolytic refinery in the East from the saving of two years. In the East, labor is cheaper, sulphuric acid is cheap, and there is a market for the incidental sulphate of copper produced. Then again, the distance from market of the finished product has great influence with the location of works, especially for ultimate refining, as freights are higher as a rule on finished products.

As a result of these conditions, slowly realized, sentiment at present is strongly in favor of the erection of copper refining works on the Atlantic coast, or at least in the East, and it is doubtful whether any of the large copper producers would have put up their electrolytic plants in the West had they realized that the conditions of to-day would prevail, unless it be those fortunate enough to be located on the Great Northern, with the water power of the whole Missouri at Great Falls to draw upon.

Of the 15 electrolytic refineries in the United States, all are east of Chicago, except 3. One-half of the output of the Anaconda is refined in Baltimore, and for the next two or three years all of the United Verde Copper Co.'s output, of Arizona, will also be refined near the port of New York. The entire product of the Canadian Copper Co.'s copper-nickel mines at Sudbury, Ont., is also refined near New York, and all the copper producers west of the Mississippi treat their material, ultimately, in the East, except three. Of course, what has been said does not apply to gold milling, nor in so great a degree to lead smelting, although much Western lead is refined in the East.

While the mining engineer and metallurgist—unless, indeed, the electrical engineer can be called a metallurgist—will find their greatest opportunity in the West, the analytical chemist, assayer and sampler, will find, in all probability, his largest opportunity in the East, or at least as far east as the great manufacturing and refining centers of Omaha and Chicago. He must remember, in choosing his location, that not alone is he to be called upon to handle material going to buyers' works, or those of refiners on toll, but also material destined for export to Europe, and, moreover, a commercial laboratory should seek all branches of analysis.

In 1880, when my laboratory was opened in New York, there was very little assaying of ores or metals at this port, excepting iron ores. The chief support of an analytical laboratory was from manufacturers of chemicals, fertilizers, etc. In those days chemists received from $5 to $7 for a nitrogen determination, and $4 for determina-

*Extract from a lecture delivered before the graduating class of the School of Mines, Columbia University, and published in the "School of Mines Quarterly," July, 1898.

tion of phosphoric acid. To-day, some are glad to receive \$1 for nitrogen determination, and from \$2 to \$2.50 for phosphoric acid. Not only has the price fallen, but the demand for rapid work has become more exacting. One of the first things the chemist discovers on graduation is that he must invent short-cut methods if he would keep his business. I was "brought up" on Fresenius and taught, for instance, that phosphoric acid could only be safely determined after fusion, separation of silica, solution in nitric acid, precipitation as phospho-molybdate: this after 12 hours' standing dissolved in ammonia, precipitated as ammonia-magnesia phosphate—after standing 12 hours filtered, ignited, etc., etc.

This means at least 48 hours; but I was startled upon opening my laboratory to have the first man who brought in a sample of phosphate say he must have the results before 3 o'clock the same day. All business changes. The assayer of the last two decades has seen the testing of chemicals, drugs, etc., almost disappear from his laboratory, if unwilling to accept nominal prices, and sometimes because trade customs have eliminated analysis. For instance, all the bleaching powder and all the alkalis imported used to be sold on American test. Now the European test is accepted on these in spite of the fact that the trade chemists of England still use an admittedly erroneous atomic weight in calculating the analyses of potash compounds. The analyst, moreover, finds keen competition in his business arising from old established firms, nevertheless alive to modern methods, or from other chemists who can, and will, perhaps, work more cheaply than he. There are foreigners in this business here, who in some cases, live over their laboratories, or in them, whose highest ambition is, apparently, an income of \$100 per month, and who have brought the price of sugar testing, for instance, from \$2 per sample down to 25 cts., within my memory. Then, there are trade newspapers, who, by way of advertisement, have laboratory annexes, and at reduced rates issue certificates of test for dye-stuffs, groceries, drugs and chemicals; and then in some centers there is the additional competition of men employed by manufacturing or other institutions, with assured salaries, but with the privilege of doing outside work, who do not depend upon their laboratories alone for a living, and who can cut prices proportionately. There is nothing whatever in this competition that is unprofessional or unfair, but it must be reckoned with, and a specialty should be chosen, if possible.

While the analytical business has suffered, the assaying of ores and metals has increased in the East, and in the '80's there seemed to me to be an opening for an ore sampling plants at this port. Here again the transportation problem had to be considered. It is vitally important for such works to be on a line or at a point where railway pools cannot bottle you up, as it is doubtful if your prestige and reputation would be sufficient to bring business to your works, in the face of switching charges or higher freight rates than those obtained over other roads and at other points.

In locating our sampling works, having ascertained the amount of business likely to be brought to the road upon which we located, we interviewed the general managers of several trunk lines terminating at this city. Their reception was characteristic of the roads. The manager of one line did not exactly quote the language of its "Commodore" when he expressed contempt for the general public, but he evidently had no use for ore samplers. Another line offered a piece of ground on the meadows several miles from water transportation, but would make no guarantee against competitive freights. A third road not only gave the land at a nominal rental, but contributed a considerable proportion of the labor and material necessary to erect the works, entered into a contract that it would protect the sampling works against cut rates offered by other roads; and in addition, agreed that ore or other products coming to this port could be stopped not only for sampling but for storage, and upon completion of the sampling or storage, the road would take them over again and complete the haul and lighterage under the original bill of lading. This is storage in transit. It may be said that this road construed this contract with extraordinary liberality. For instance: When, in 1889, Mr. Sécrétan, of Paris, cornered the world's output of copper, buying the entire visible supply, and the entire product of nearly all the mines, sampling was pretty lively at the works mentioned. As the syndicate approached its disastrous end, copper matte began to halt at the sampling works until nearly 8,000 tons had accumulated. Then the syndicate went to pieces, and its creditors fell foul of one another in dividing up the assets. The copper matte was the subject of protracted litigation. It remained in the sampling works—most of it—seven years, at the end of which time the original bags had rotted and carloads were inextricably mixed. Upon the settlement of the dispute at law the matte was ordered out. The musty bills of lading and liter notices were produced, and the railroad sent its empty cars, transported and lightered to ocean steamers some 7,000 tons, seven years after it had started from its Western point of production. These sampling works in turn brought to the Erie Ry. for several years a business of 50,000 tons annually. Choose your location with care.

We have found as another bit of experience that not simply must one be sure of the road's ability to meet its obligations, if we are obliged to tie ourselves up to one line, but must forecast as far as possible conditions of routing and export. Some two years ago roads running southeast from Kansas discriminated against the port of New York, and not only did they quote a lower freight to Gulf ports, but via Gulf ports to Europe. The result was, much of our sampling had to be done on the docks at Galveston, New Orleans, etc. This has temporarily been put a stop to by the Cuban war, and New York is again securing the bulk of lead and copper freights, even when the material is produced in Arizona.

Of late years there has grown up in this, as in other lines of business, the endeavor to get rid of the middle man—in this case the public sampler and assayer—and buyers and sellers have entered into contracts in which the sampling is to be done at buyer's or seller's works by representatives of both parties. There have been such contracts recently entered into, and questions are already arising which cause one or both of the parties most interested financially to regret them. Buyers and sellers are necessarily suspicious of one another on general principles, especially in dealing with material of great value and some are beginning to realize that it is unwise to place themselves under suspicion, however unjust. In one works, owned by the same people who own the mines, such serious differences arose recently between the respective superintendents that it ended in an agreement, not only that they should revert to independent sampling, but that the material should be sampled on neutral ground. It is perhaps justly said that it is too much to expect of average human nature that impartial sampling shall exist at the works or the mine of an interested party. The office sees so much lead, copper, gold and silver charged on the books and holds the works responsible for this amount either in inventory or shipments. The smelter, therefore, must "protect itself against the office," and if mistakes are made they are apt to be on the safe side where sampling is at either seller's or buyer's establishment.

Neither sampling nor assaying is an exact branch of science especially when dealing with materials containing the precious metals. Your practice in assaying has shown you what variation you can get in any samples, as you vary fluxes, temperature and time of fusion or cupellation. Let me strongly advise you to make every effort, whether you are a seller, buyer or sampler of ore or furnace products, to have the sales contract specify how the assay shall be made.

Now as to sampling methods: In the early '80's our chief export of furnace material was in the form of copper ores. We sampled hundreds of cars of ore from Montana, running 50 to 60% of copper. The lead ores then, as now, stopped in the West, only the bullion coming to the seaboard for export or refining. Then came a period of enormous exports of copper matte; next began the era of bessemerizing, applied to copper, and converter bars became the chief support of the sampler. These mattes contained less than 30 ozs. of silver to the ton on the average, and no silver was paid for unless there was over 30 ozs.

Then the electrolytic refinery came in, and as silver and gold were more easily extracted, the mines sought out gold and silver-bearing ores and run up the values present. To-day, the exports and treatment of furnace products near New York consist of quite two-thirds converter copper bars, as compared with one-third mattes.

THE EXPOSURE FIRE IN THE HOME LIFE INSURANCE BUILDING, NEW YORK CITY.

One of the most severe attacks of fire which a modern tall, steel skeleton, fireproof building, has ever undergone was sustained by the 16-story office building of the Home Life Insurance Co., at 256 Broadway, New York city, on the night of Dec. 4. This building was erected in 1893, and was flanked on one side by the 14-story office building of the Postal Telegraph Co., and on the other side by the 5-story clothing store occupied by Rogers, Peet & Co. The relative location of the three buildings is shown by Fig. 1, from which it will be seen that the 5-story clothing store abutted close against an air and light shaft which recessed the north side of the Home Life Insurance Co.'s building. It was this 5-story building which first caught fire, and which was the torch that communicated the flame to the other structures. The conditions were, indeed, almost typical of what may be seen repeated a score of times in every large city; viz., a tall, steel skeleton, fireproof office building standing by the side of a low, combustible structure whose destruction is nearly certain if fire once catches it, and which is, therefore, a constant menace to its costly neighbor.

The Home Life Insurance Co.'s Building is of the steel skeleton type, all the exterior walls except the front wall, which is self-supporting, being carried by the steel frame. The building has a frontage on Broadway of about 56 ft., and a depth of 107 ft. 6 ins. Two air and light shafts, faced with white enameled brick, with terra cotta trimmings, recess the north and south sides. The exterior walls are brick, except the front wall, which is of white marble elaborately carved. The floor girders run transversely across the building, there being one row of interior columns, and are knee-braced to the columns to resist the wind pressure. The floor beams are supported at each end by angle brackets attached to the girders, and are spaced about 4 ft. 6 ins. apart c. to c. The columns are H-section, made up of plates and angles.

All the steel work is protected by a fireproofing of clay tile. The floor arches are of hard-burned tile, and are 10 ins. thick and of side construction, each arch having two skewback blocks turning underneath to protect the lower beam flanges, four haunch blocks, and a key block. Each block has

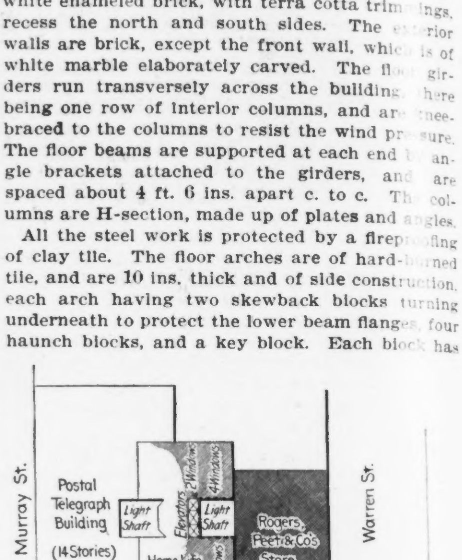


Fig. 1.—Sketch Map Showing Location of Burned Buildings in the Fire of Dec. 4 at Broadway and Warren St., New York City.

two horizontal and one vertical interior ribs or diaphragms. The partitions were of 4-in. porous terra cotta tile, the upper 4 ft. in the hall partitions being taken up by windows. The column tile were porous terra cotta tile, ribbed inside to give two air spaces. The main girders, which projected down below the ceilings, were filled in above the flanges with tile blocks, and had their lower flanges wrapped with expanded metal lath. The whole was haunched around by a thick coat of plaster. A plaster finish, of course, covered the column and partition tile.

The foregoing gives a fairly complete idea of the fireproof construction. Another structural failure of the building which it is important to mention, however, is the light shaft adjacent to the Rogers, Peet & Co. store. To the level of the sixth floor this shaft was inclosed by the wall of the store, but above this point it was open. The two side walls of the shaft had four windows each at each floor, occupying practically the entire area. The other side of the shaft had two smaller windows at each story. None of these window openings were protected by shutters, and it was through them that the flames penetrated the offices of the Home Life Insurance Co.'s Building.

As already stated, the store occupied by Rogers, Peet & Co., and filled with haberdashery, clothing and the extensive shelving and counters of a store of this character was the torch. According to all accounts, it furnished a very fierce fire, the flames of which were driven into the light shaft as a flue by a very severe northeast wind. These flames soon penetrated the unprotected window openings and set fire to the office furniture, fittings and woodwork; thus extending gradually to the farther sides of the building. An excellent description of how the fire made its progress is contained in the following excerpt from the New York "Sun":

> The clothing store was all in a blaze in a quarter of an hour. Then it burned as a whole until the floors fell, one after another. At 11 o'clock there was nothing left to burn. Meantime, the big insurance building, against which this white hot mass of fuel had been sending up steady sheets of flame for a full hour, had just begun to catch fire, this notwithstanding the fact that the windows had no iron shutters on them.
>
> In the middle of the north side of the Home Life Building, the deep light shaft that ran from the bottom to the top was entirely open on the side toward Warren St. When the clothing store became like the inside of a stove the airshaft, far up to the height of the clothing store, was a most effective chimney. The flames swept up that shaft in a solid column, spreading out in clouds of sparks when they reached the top. When the flames above the roof of the clothing store began to die down a little it was seen that every window along the shaft was crackling and blazing. The woodwork around the windows seemed to be all on fire at once.
>
> On every floor the firemen were fighting to keep these flames on the light shaft windows confined to the windows.

Hose had been carried up the elevators, which were in the middle of the building. But the heat was so great that it was impossible for the men to work in the rooms along the shaft. It was half past 10 o'clock when the flames broke into the twelfth floor of the building and began to work away from the shaft and into the building. The fire reached the elevator shaft, in the center of the building, at a quarter of 11.

There are fire mains in the building with connections on the street that the engines can pump water into, and outlets to which hose and nozzles can be attached on each floor. With the constant aid and reinforcement of the furnace in the airshaft, these inside mains were powerless against the flames that were eating from the airshaft toward the front and the back of the building. When the fire once had a firm grip on the twelfth floor there was nothing to do but let it burn. From the buildings on the other side of Warren St. no stream could be sent that would half way reach it.

Here came the exhibition of the difference between the modern construction of the Home Life Building and the old-fashioned plan of the clothing store. This one floor was so thoroughly on fire that spouts of flame were shooting from every window, but the windows of the floor below and the floor above, except on the airshaft, were dark. The fireproof floor kept the fire on each story separate from the others. But the firemen could not keep up the fight above the twelfth floor. Window by window, from office to office, the fire worked its way forward through the 14th floor, skipping the 13th. It worked along the offices on the north side of the building until it reached Broadway, and then south to the Postal building, the windows of each office popping out by pairs. The 14th floor was as thoroughly afire as the 12th at 11:25 o'clock. Ten minutes later the 13th floor windows began to light up. But the floors were standing the test well. The fire was working not from above or below but from the airshaft inward. This was true of every floor that burned. First the heat drove the firemen out, and then the flames followed them.

Substantially the same account of the progress of the fire is given by other observers; that is, that the fire caught and progressed on each floor independently, and did not communicate to any extent from one floor to another. An examination of the burned floors the day after the fire also indicated that the elevator shaft and stairway had not acted to any extent as passages for the flames from story to story. The floors proved to be almost perfect barriers. Only two floor arches altogether had broken through, one on the 15th floor and the other on the 10th floor. On the 10th floor the failure of the arch was due to the fall of a safe. From all the evidence which is available, therefore, it seems fair to assume that there was almost no communication of the fire from floor to floor inside the building. In this respect the fireproof construction served its intended purpose almost perfectly.

The greatest damage was done from the 11th floor up, and in that part of each floor comprised in the wings on each side of the light shaft. It was evident from the ruins that the flames entered the windows on the sides of the shaft, and worked inward and around the front and rear walls to meet in the rooms opening onto the light shaft adjacent to the Postal Telegraph Co.'s Building. The damage was greatest in the rooms near where the fire entered and it gradually decreased as the center of the opposite side was approached. It was also more severe, taking the building as a whole, in the rooms fronting on Broadway. The windows opening onto the elevator wells did not communicate the flames to any very great extent, owing largely to the fact that the elevator enclosure and the adjacent hallway and staircase finishing was incombustible, being either stone or metal.

From the 11th to the 15th floor, inclusive, the damage was about the same on each floor. The condition of the floor arches has already been stated. The partitions were broken down in places and the doors and windows and their casings in the partitions were burned away. Much of the partition damage was evidently done by the firemen, who knocked them down to get at the flames, but water and fire were also responsible to a great extent. The column protection was knocked off in patches, but not very generally. The lower flanges of the floor beams still retained their fireproofing almost perfect as a rule. The main floor girders, which projected below the ceiling, however, had suffered more; the tile filling blocks and the expanded metal and plaster flange wrapping in the places where the fire was hottest being quite frequently either torn off entirely or else hanging loose, leaving the metal bare. The appearance of the metal indicated, however, that the protection had stood long enough to preserve the beams from injury.

The examination, in fact, showed practically no damage done to the steel work, with the exception of two girders on the 15th floor, which had been left unprotected. It may be possible, of course, that a more minute inspection when the debris is removed will show somewhat more damage to the steel framework than now appears; but it hardly seems likely that it can be serious enough to require any great amount of new material. The brick exterior walls may possibly have to be taken down in a few of the top stories, but this will not be known certainly until a closer examination can be made. The marble front, however, in the stories where the fire was hottest is so badly cracked and spalled away that it will certainly have to be rebuilt.

From the 11th floor down the damage gradually decreases, until on the 7th floor it is due mostly to smoke and water. This was probably owing to two things: First, the blast of the flames against the light shaft windows was greater above than below the 7th and 8th floors, but second, and more important, the firemen were able successfully to use their hose up to the 8th story. Above this point the pressure and volume of water obtainable with the ordinary fire apparatus were not efficient against so hot a fire. This was recognized by the fire department at the start, and the 8th floor was established as the level below which the flames must not be allowed. Above that level, after they were once established, they were allowed to burn unhindered.

From what has been said it will be generally admitted by those competent to judge, we think, that the value of its fireproof construction was proven by the Home Life Insurance Co.'s Building. Its weak feature was the unprotected window openings in the light shaft. To this single instance of neglect, we believe, the damage of the building by fire was entirely due. Indeed, we have no hesitation in saying that had the light shaft windows been protected by good fireproof shutters, and been set in metal frames and sash, the flames would never have entered the building with the firemen behind with hose to keep the shutters cool. The building was well fireproofed in every respect except to withstand an exposure fire, and with the tinder-like clothing store by its side an exposure fire was the one which the builders had most reason to expect. As it was, the building kept the fire confined so that its spread was easily prevented under conditions of high wind and bad facilities for fighting flames so far above the ground. Had the whole block been made up of buildings like the clothing store, it is safe to say that it would have been swept clean by the conflagration.

The total damage done by the fire is now estimated at about $600,000. No one was killed, and only two or three of the firemen received slight injuries. For information respecting the construction of the Home Life Insurance Co.'s Building we are indebted to Napoleon Le Brun & Sons, 1 Madison Ave., New York, the architects. A personal examination of the burned building was also made the second day after the fire by a member of the editorial staff of this journal.

NEW BATTLE REGULATIONS FOR WARSHIPS have been framed by the Navy Department, as a result of experience in the late war. The new instructions leave little to the discretion of officers. Above all else woodwork must be sacrificed in an emergency to guard against danger of fire. All furniture will be reduced to a minimum in war times; camp-stools will take the place of chairs, and swinging tables will replace the substantial mahogany tables of peace times. All articles on deck not needed in action must be stowed below or cast overboard; proper fire apparatus must be installed and hose led to all parts of the ship with a full head of water constantly maintained; all glass, lights and illuminators above the engine-room are to be taken away; and even boats are to be disposed of, because they would be riddled and useless anyhow in close action. Guns are to be loaded as soon as the ship leaves port, and projectiles are to be kept conveniently near; chains are to be unshackled at the first shackle, so that if the anchor is cut away the whole chain will not go with it. Ships are to be painted a dull gray, with a yellowish shade, as approximating most closely the color of rock, and of an obscuring horizon.

ANOTHER ELECTRICAL EXHIBITION will be held in New York city in 1899. This was decided at the annual meeting of the stockholders, held Nov. 22, at which the following officers were elected: Pres., C. O. Baker, Jr.; Vice-Pres., F. W. Roehling; Secy. and Treas., Geo. E. Porter; General Manager, Marcus Nathan.

A MOTOR CARRIAGE CONTEST was held in Boston, Mass., on Nov. 9, under the auspices of the Massachusetts Charitable Mechanics' Association. There were four types of contests—speed, brake efficiency, manageability, and hill-climbing. The De Dion gasoline tricycle covered two miles in 5 mins. 1⅗ secs.; the Riker electric carriage stopped in 6 ft. 1 in. The De Dion tricycle, 3 ft. 4½ ins. wide, won the manageability contest, which consisted in passing between six sets of posts and turning around and coming back to the line. The Riker carriage, with a width of 4 ft. 8 ins., also made an excellent showing. In the hill-climbing contest, the lighter carriages made the best showing. Prizes to the amount of $1,100 were awarded.

A TELEPHONE CIRCUIT OF 1,900 MILES was talked over on Nov. 28 by Mr. Charles J. Glidden, President of the Southwestern Telegraph and Telephone Co. Mr. Glidden, from his office in Little Rock, Ark., held a distinct conversation with the office in Boston, Mass. Satisfactory tests were also made from the Little Rock office with Memphis, Chicago, Minneapolis, Dallas and Galveston.

500,000 TONS OF STEEL RAILS were ordered in three days, Nov. 25, 26 and 28. Of this amount 275,000 tons were booked by the Carnegie Co., and 225,000 tons by the Illinois Steel Co., which is now a part of the Federal Steel Co. The prices mentioned are $19 per ton at Chicago, and $18 at Pittsburg.

FREIGHT RATES from Duluth to New York by all-rail routes are said to have been recently quoted as low as 10 cts. per 100 lbs., or $2 per ton. Calling the distance 1,500 miles, this is equivalent to only 1⅓ mills per ton-mile. The "New York Journal of Commerce" also says:

It is reported that early last week one of the lines made a contract with a large exporting firm to carry wheat from Chicago to New York for 8 cts. per 100 lbs. From this rate is to be deducted 3 cts. per 100 lbs. for lighterage in New York, making a net rate for the railroad of only 5 cts. A rate of 9 cts. per 100 lbs. on wheat from Chicago to Baltimore was made recently by another line, but no lighterage charge was to be deducted from that figure.

SMOKE PREVENTION IN PITTSBURG, PA., is to be considered by a commission, which Director E. M. Bigelow, of the Department of Public Works, has asked the city council to appoint.

A CUSHION TIE-PLATE for deadening sound is being used abroad on street railway lines. This mat, according to "Iron Age," is made of wool thoroughly impregnated with oils and the whole covered with a mixture composed of glue, sodium bichromate and formaldehyde. The mat is then compressed to form a plate, the thickness depending upon the conditions of service. The material is also recommended for use under engine and machinery foundations.

BOOK REVIEWS.

DISTRIBUTION DE L'ENERGIE PAR COURANTS POLYPHASES.—By J. Rodet, M. E. Paris: Gauthier-Villars. 5½ × 8¾ ins.; paper; pp. 338; illustrated. 8 francs.

This book presents the subject of distribution of energy by electricity by means of alternating currents, of two, three or more phases. The present state of the art is briefly treated, the effort being to give a clear insight into definite practice rather than to present a theoretical discussion of non-essential matters. By this we do not mean that equations and mathematics are entirely missing, for this would be a harsh criticism, as it is impossible to enter into the realm of alternating currents without employing a certain amount of mathematics. The equations included are essential and are given in a brief but clear manner. Important relations and principles are given in italics, while the general text is simple, straight forward language. Time has not permitted more than a casual examination of the book, but such items as have been examined indicate that the material contained is reliable.

There are seven chapters in all, covering the history and general principles governing the two-phase and three-phase currents, the generation, transmission, transformation use for motors, instruments, and last a description of several installments using polyphase apparatus.

THE DESIGNING OF CONE PULLEYS.—A Non-Approximate, Graphical Solution for the Problem of Proportioning Cone Pulleys, with Concise, Practical Rules. By Walter K. Palmer, M. E., School of Engineering, University of Kansas, Lawrence, Kan. Pamph.; 6 × 9½ ins.; pp. 35. Price, 50 cts.

The mathematical analysis of the solution of the cone pulley problem is complex, and all practical approximate solutions hitherto proposed are either inconvenient to use or otherwise unsatisfactory. Mr. Palmer takes the analysis given in Reuleaux's "Constructor," modifies it at one stage so as to make a more simple graphical construction, and then develops a new diagram from which the problem can be completely and easily solved, for all practical conditions. The author seems to have made a most valuable contribution to the subject.

THE NEW YORK MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

We gave last week an account of the sessions of the meeting held on Tuesday and Wednesday, Nov. 29 and 30. The session on Thursday morning was devoted to the presentation and discussion of professional papers. The first paper was by Prof. C. V. Kerr, of Chicago, entitled "Theory of the Moment of Inertia." The paper is long, abstruse and mathematical, bristling with diagrams and calculus. The author has a theory that the moment of inertia is something different from what it is said to be in the text-books. Those who took part in the discussion held that the books were right and that the paper was all wrong.

The next paper was entitled "Improvements in Steam Boilers," by W. Barnet Le Van, of Philadelphia. It described a horizontal return tubular boiler, with the tubes placed higher in the shell than usual, so as to raise the water level nearly to the top of the shell, thus lessening both the area of disengaging surface and the steam room. It was provided with a long horizontal steam drum, connected to the boiler by a single neck. The paper was roughly handled in the discussion. The boiler was condemned as being no improvement over the plain horizontal tubular boiler, and it was shown that the author had described the same boiler in the Journal of another society as much as 13 years ago.

The next paper was by R. Van A. Norris, of Wilkesbarre, Pa., entitled:

"The Generation and Utilization of Steam by the Lykens Valley Coal Co. and Summit Branch Coal Co., Dauphin Co., Pa."

The paper describes the results of investigations made to discover, and, if possible, to remedy a large discrepancy in the amount of coal used for firing boilers at the two collieries. The work done by the engines at the two collieries was about the same, but at the Lykens Valley mines the boiler horse-power was 3,323 and the coal used per month of 26 working days 4,381 tons, while at the Summit Branch mines the boiler horse-power was 5,313 and the coal used 7,306 tons. The paper includes records of tests of boilers, and engines, indicator cards, investigations of leaky pipes, loss by friction, etc. All sorts of losses of steam and of coal were found; cylinder boilers with stacks red hot, engines so greatly underloaded as to cut off at less than 5% of the stroke, other engines without lap on the valves, carrying steam full stroke, leaky pipes and valves, blowing off of steam with drips from pipes, on account of the absence of traps, etc. A great waste was due to the use of steam jet blowers for forcing the fires under the boilers, some of them taking about 8% of the whole amount of steam made by the boiler.

The discussion of the paper brought out the fact that some of the pumps were over 25 years old. An experiment on fans and steam jet blowers was referred to, in which the steam jet required over 38 HP. of steam and the fan not over 5 HP.

Mr. John A. F. Swenson, of Chicago, then read a paper entitled:

"The Valve Gear of the Willans Engine."

The Willans engine has been well known for many years in England, but is much less known in this country, although it has been made in Chicago for some years. The paper describes the action of the hollow piston rod, which performs the function of a seat for all the valves. The engine may have applied to it an automatic cut-off, the arrangement for effecting the variable cut-off being a rotary sleeve surrounding that portion of the hollow piston rod which travels in the steam chest, the rotation being effected by a shaft governor.

A summary of the advantages claimed for this valve gear is as follows:

Minimum number of parts and simplicity of form and construction; a free inlet and release, and a cut-off so sharp as to rival even a Corliss; a balanced valve of the piston type, with very small clearance spaces, and which by virtue of its position is easily kept steam tight; great facilities for varying the cut-off; perfect adaptability to the difficulties of high rotative speed.

One shortcoming is that the limit of its general adoption is reached in an engine having single-acting cylinders only. Another is the difficulty of arranging it to run reversing.

Mr. J. H. Vail's paper on "A Cooling Tower and Condenser Installation" was next considered. We give an abstract of this paper elsewhere in this issue. A long discussion followed. Mr. F. Meriam Wheeler exhibited some drawings showing recent arrangements of cooling towers, condensers and air pumps, including one of a duplex pump, in which one of the pump cylinders handled the water from the jet condenser while the other one pumped the air and vapor.

The next paper was by Prof. D. S. Jacobus, of Hoboken, N. J., entitled "Methods of Testing Indicators." It describes the method used at the Stevens Institute of Technology, which the author considers superior to the mercury column method. No discussion followed the paper.

"The Variation of Belt Tensions with Power Transmitted," by Prof. W. S. Aldrich, was the next paper. The object of the paper is stated to be to open up a discussion of the questions: In what way are the belt tensions altered as the load is applied? What effect has the change of the load on the sum of the tensions? Is there any relation between the belt tensions which does not involve the coefficient of friction? The author condemns the old logarithmic formula for the ratio of the tensions on the tight and slack sides, and derives an empirical formula from the results of the experiments of Mr. Wilfred Lewis, as follows:

$$\frac{T_1}{T_1 - T_2} =$$

e raised to a power whose exponent is the fraction

$$2\,T_2 \div (2\,T_1 - T_2),$$

in which T_1 is the greater and T_2 the lesser tension, and e the base of the Naperian logarithms, or 2.7183. Written discussions were presented by Mr. Lewis, who disputed some of Prof. Aldrich's conclusions, and by Mr. Carl G. Barth, who gave a new logarithmic formula, based on theoretical considerations, which is more formidable in appearance than either the old established one or the one proposed by Prof. Aldrich. Mr. Barth's discussion, when printed in the Transactions, will be interesting to those who enjoy studying the mathematical theory of belt tensions

On Thursday afternoon a visit was made to the General Post Office, on invitation of Postmaster Van Cott, to inspect the Batcheller system of pneumatic transmission. The system is working to perfection, and the machinery is a marvelous example of inventive and mechanical skill in solving a most difficult problem.

No programme was prepared for Thursday evening, and the members were left free to their own devices. At the session on Friday morning the first paper was one by R. S. Hale and Henry J. Williams, on

"The Calorific Power of Weathered Coals,"

This paper gives the proximate and ultimate analyses of eight different coals, both before and after weathering. Crushed samples of each coal were exposed out of doors for eleven months. The heating values were calculated from the ultimate analyses by Dulong's formula, and from the proximate analyses by interpolating them on a curve derived by Mr. William Kent from the calorimetric results obtained by Mahler on European coals. Direct determinations of the heating power of three of the coals were also made by Mr. Williams' bomb calorimeter. The conclusions of the authors are that the average heating power of the eight coals was decreased about 2%, according to calculations from Dulong's formula, and that of the three coals about 0.5%, according to the calorimeter. The results obtained from the curve indicated an average increase of 1%. A summary of the results is given below:

Name of coal.	B. T. U. — Heating value per lb. combustible, unweathered.	Decreased by weathering — Calculated.	Decreased by weathering — By calorimeter.
George's Creek, Md.	15,989	427	90
New River, W. Va.	15,913	208	..
Portland, O. (C)	15,403	611	160
Portland, O. (B)	14,406	341	..
McDonald, Pa. (K)	14,622	Inc. 63	..
McDonald, Pa. (O)	15,231	220	40
Pittsburg, Pa.	15,003	95	..
Pittsburg, Pa.	15,353	93	..
Average	15,240	241	97

The heating values of the coals given above are calculated by the Dulong formula from the ultimate analyses. The heating values of three of the coals were determined by a bomb calorimeter, with results as follows: George's Creek, 16,048; Portland, O. (C), 15,461; McDonald, Pa. (O), 15,240. These figures show a remarkably close agreement to the figures calculated from the analyses. In the case of the weathered coals, however, the calorimetric results were occasionally quite different from and always higher than the calculated figures, as is indicated by the figures in the last column. The Portland coal (C) after weathering had a heating value, according to the analysis, of 14,792 B. T. U.; while the calorimeter gave 15,301, a difference of 509 B. T. U., or over 3%.

The next paper was by Mr. William H. Bryan, of St. Louis, entitled

"The Mechanical Plant of a Modern Building."

It was a very elaborate description of the method pursued by Mr. Bryan in planning the installation of boilers, engines, dynamos, elevators, heating, lighting and ventilating apparatus, etc., of a large retail store building in St. Louis, with a description of the apparatus finally installed, the reasons for its adoption, its cost, etc. We shall give an abstract of this very valuable paper in an early issue. A long discussion followed the presentation of the paper, which was participated in by Messrs. George Hill, R. P. Bolton and others who have done work of the same character as that described in the paper. Some of the details of Mr. Bryan's specifications were objected to, and doubt was expressed as to the sufficiency of the heating system in the coldest weather. The plan of asking contractors to bid on two or three alternate kinds of apparatus was criticised, and it was said that the architect and consulting engineer should make up their minds exactly what kind and size of apparatus they want before asking for bids. The discussion showed that a wide difference of opinion exists among engineers who make plans and specifications for the mechanical appliances in large buildings, and the paper, with the discussion, when printed, will be full of interest to such engineers.

The next paper was by Prof. R. C. Carpenter, of Cornell University, entitled "Experiments on the Flow of Steam Through Pipes." The object of the experiments was to determine the coefficient of friction of steam flowing at different velocities through pipes and fittings. The author accepts the formula of Unwin, showing that the coefficient f varies with the diameter and that for a velocity of 100 ft. per second it may be expressed by the formula

$$f = K\left[1 + \frac{3}{10}\,d\right],$$

in which d is the diameter of the pipe in feet and K is a coefficient to be found by experiment. Prof. Carpenter's experiments were made on a pipe 90 ft. long and 2 ins. diameter, and he obtained values of K varying from 0.00093 to 0.00360, which would indicate either that K is not a constant, or that there were large errors of observation, but he takes an average value of 0.0027, and constructs from it a series of tables giving the flow of steam in different diameters and lengths of pipes. The paper was severely criticised in discussion, on account of its drawing conclusions from too few data. Prof. Jacobus gave an account of experiments on flow of steam in pipes of different diameters and lengths, made by Prof. Ledoux, in France, some years ago, and published in the "Annales des Mines," and promised to contribute it to the discussion to be printed in the Transactions.

The last paper of the meeting was read by Mr. Chas. L. Newcomb, on "Experiments on the Flow of Streams from Fire Hydrants." This paper had not been printed in advance, and was read from manuscript. It describes an extensive series of experiments, and gives the curves plotted from the results. It will no doubt prove to be an important contribution to the subject, when printed. The paper was discussed by Mr. John R. Freeman, who is well known as an authority on the subject.

This was the last of the regular papers. Several "queries" that had been printed in the programme of the meeting were then brought up for discussion, as follows:

(1) Does it pay to pickle ordinary castings? The replies were to the effect that it depends on the kind of castings. It rarely pays to pickle a heavy casting, but small pieces, such as hardware castings, may be pickled to advantage. The use of hydrofluoric acid as a very effective pickle was mentioned, and the sand blast was commended as far superior to pickling.

(2) Has any improvement in foundry practice been observed from the recent investigations into the physics of cast iron? No one had any reply to make to this question.

(3) What is the strength of pipe fittings made by a casting process? It was explained that this query arose from trouble experienced by exporters of pipe and pipe fittings to foreign markets. The fittings in this country are usually of cast iron, and they are objected to by foreign purchasers, since the foreign practice is to make them of wrought iron. No definite answer was given to the query, but it was stated that cast-iron fittings are strong enough for all purposes except that of withstanding water ram in large pipes, and that no fitting will resist.

(5) What constitutes a seamless tube? This question arose from some makers of a tube which is not seamless giving their product the name "seamless." A seamless tube was defined as one which had no line of union, and which never had two portions or edges brought together which were at any time separated since the metal was an ingot. A tube made by cupping and drawing from a sheet, or drawn from an ingot which had a hole cast or bored in it was properly called seamless.

(6) On how small a tool does it pay to put an individual electric motor? The question being taken to relate to machine shop tools, it was replied that it generally does not pay to have any electric motor in the shop of less than 5 HP. Smaller units are apt to give trouble, as they are too delicate an instrument for an ordinary shop. The best plan for small tools is to drive the line shafts by motors, and belts from these shafts to the tools.

(7) Have you any new notions on machine shop floors? Several members discussed this question, not claiming to have "new notions," but relating their experience with floors of various kinds. Spruce floors 3 ins. thick, overlaid with 1¼ ins. of hard rock maple, were commended as being about the most durable floor that can be made.

(8) Is it of real advantage to submerge the smoke-box of an upright boiler, to prevent expansion of the tubes? No answer was made to this question.

These queries were the concluding business of the session. The retiring president, Mr. Hunt, after a few remarks, handed the gavel to the newly elected president, Chief Engineer Melville, who made a brief address, and the meeting was then adjourned. The members and guests registered as in attendance at this meeting numbered 493, over a hundred less than were present at the last annual meeting, but the decrease in attendance was easily accounted for by the severe snowstorms which had prevailed throughout New England and New York state, blockading the railways and making travel unpleasant. The next meeting, in May, 1899, will be held in Washington, D. C.