ENGINEERING NEWS AND AMERICAN RAILWAY JOURNAL.

VOL. XLI. No. 4.

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EXAMINATION FOR SHIP DRAFTSMEN will be held Feb. 8 to 10 by the U. S. Civil Service Commission in every city in the United States where the commission has a board of examiners, and where applicants will advise the commission by letter or telegram stating where they desire to be examined, in sufficient time to enable it to ship examination papers. The examinations will be be on the subjects mentioned below, which will be given the following per centages of weight in marking the papers:

Ship Draftsman Examination—

1.—Applied mathematics	15%
2.—Ship calculations	15%
3.—Ship drafting	30%
4.—Practical shipbuilding	15%
5.—Technical education and experience	25%
Total	100%

The time allowed is four days, divided as follows: First day, subject 1, five hours; second day, subject 2, six hours; third day, subject 3, seven hours; fourth day, subject 4, six hours.

Assistant Ship Draftsman Examination—

1.—Pure and applied mathematics	20%
2.—Practical shipbuilding	20%
3.—Ship calculations	20%
4.—Ship drafting	20%
5.—Technical education and experience	20%
Total	100%

The time allowed is three days, divided as follows: First day, subjects 1 and 2, seven hours; second day, subject 3, seven hours; third day, subject 4, seven hours.

Competitors will be supplied with all necessary writing papers, drawing papers and tracing linens for the examination; but they must bring pens, inks and all the instruments and other materials likely to be used in the examination. Competitors may bring standard engineering handbooks, logarithmic and other numerical tables; but they may, or may not, be permitted to refer to any or all of them, depending upon the nature of the questions. Instructions in this particular will accompany the list of questions, and will be rigidly observed. The age limit for entrance to these examinations is 20 years or over. Further information can be had by applying to the commission at Washington, D. C., by letter or in person.

THE DEEP WATERWAYS COMMISSION, on Jan. 4, submitted a progress report to Congress, outlining the engineering work so far done. The work reported on is confined to the control of the level of Lake Erie, the projected Niagara ship canal, the Oswego-Oneida-Mohawk route, and the St. Lawrence-Champlain route for a canal. The discharge from Lake Erie has been measured and the hydraulic slopes in the Niagara River determined. Two routes were surveyed for the Niagara River ship canal. One leaves the river at Tonawanda, passing west of Lockport and reaches Lake Ontario at Olcott. The other leaves the Niagara River at La Salle, five miles below Tonawanda, and enters the Niagara River again near Lewiston. The Oswego-Oneida-Mohawk route for a ship canal, ending at Watervliet, has been surveyed, and so has the St. Lawrence-Champlain route, excepting a few miles near Massena. On all these lines certain rock borings have yet to be completed; but two or three months work will finish the investigations in the field.

THE GEORGIANA BAY CANAL SCHEME was discussed and approved at a mass meeting held in Ottawa by order of the Mayor on Jan. 17. The project calls for a 14-ft. waterway from Montreal to Lake Huron, to cost from $17,000,000 to $20,000,000, as estimated by Mr. Thomas C. Clarke, M. Am. Soc. C. E. The meeting passed a resolution to present to the Government of Canada a request for the necessary guarantee to the Montreal, Ottawa & Georgiana Bay canal, in order to insure its immediate commencement and speedy completion.

A PRELIMINARY SURVEY OF THE PHILIPPINES and Guam is to be made by the new survey steamer "Pathfinder." The Coast and Geodetic Survey will send the vessel East by way of Suez.

STATISTICS OF RAILWAY CONSTRUCTION in the United States during the year 1898 have been collected by the "Railroad Gazette" and the "Railway Age." These records show totals of 2,867 and 3,018 miles, respectively, as against 1,865 and 1,828 miles, for the year 1897. The mileage constructed in each state, as given by these two journals, is tabulated below, and the earlier records will be found in our issues of Jan. 7, 1897, and Jan. 2, 1896:

States.	Miles. "Gazette."	Miles. "Age."	States.	Miles. "Gazette."	Miles. "Age."
Alabama	161.23	154.00	Nebraska	3.50	0.60
Alaska	20.00	20.00	New Jersey	0.24	2.00
Arizona	88.30	99.40	New Mexico	90.10	162.88
Arkansas	140.10	157.51	New York	64.46	43.95
California	115.68	118.55	No. Carolina	92.65	121.60
Colorado	33.10	36.85	North Dak.	77.50	77.50
Connecticut	.....	6.75	Ohio	55.20	91.00
Delaware	1.50	2.00	Okla. Ter.	157.00	147.00
Florida	59.00	50.80	Oregon	59.55	58.00
Georgia	104.33	117.75	Pennsylvania	53.44	105.42
Idaho	21.00	21.13	So. Carolina	16.00	16.00
Illinois	8.50	12.98	South Dak.	11.00	11.00
Indiana	11.00	32.00	Tennessee	8.00	8.00
Ind. Ter.	81.75	58.89	Texas	188.83	182.93
Iowa	42.00	48.65	Utah	38.00	39.40
Kansas	51.00	.....	Vermont	.....	2.00
Kentucky	0.40	15.40	Virginia	51.00	50.00
Louisiana	171.17	158.35	Washington	19.70	14.20
Maine	123.31	124.10	W. Virginia	30.50	38.50
Maryland	.....	15.30	Wisconsin	51.00	48.50
Massachusetts	10.00	.....	Wyoming	6.30	7.00
Michigan	104.00	97.30			
Minnesota	253.30	250.01	Total, U.S.	2,867.14	3,018.38
Mississippi	41.50	40.50	Canada	448.25	427.28
Missouri	111.50	119.68	Mexico	412.00	442.62
Montana	39.50	39.00			

A general review of the most important lines comprised in the past year's railway construction was published in our issue of Nov. 17, 1898.

THE LONG ISLAND R. R. TUNNEL under the East River between Brooklyn and Manhattan Island, which has been discussed for several years, is revived by three special bills introduced into the New York State Legislature by Senator Marshall. This tunnel scheme was fully described in Engineering News of Jan. 14 and Nov. 11, 1897. The first of the new bills repeals the city charter provision limiting the life of franchises to 25 years, etc., in the case of "tunnel railways underneath the surface of the streets," and authorizes the Municipal Assembly to grant to such tunnel railways, at its discretion, franchises in perpetuity. The second bill provides for the proposed tunnel under the East River as already planned, and the third bill provides for the depression of the Long Island R. R. tracks for several miles along Atlantic Ave., in Brooklyn. A notable provision of this last bill is one stating that where a company depresses its tracks it shall not lose its right to the surface of the streets, but may operate another road thereon with any motive power except steam. The bill provides also that the city shall share the cost of depressing the tracks with the railway.

THE MOST SERIOUS RAILWAY ACCIDENT of the week occurred on the Erie R. R. at Great Bend, Pa., on Jan. 21. As a result of spreading rails the engine and two forward cars of an express train jumped the track and rolled down a 20-ft. embankment. The fireman was killed and two men were injured. The engine was the famous 499 built by the Brotherhood of Locomotive Enginerrs for the World's Fair.

AN 18-FT. FLYWHEEL burst Jan. 16 at the Deering Harvester Works, Chicago. The wheel was built in halves, and in breaking the spokes were stripped off close to the hub. One man was killed and considerable damage was done to the building in which the engine was located.

THE CAUSE OF THE COLLAPSE OF THE GAS TANK in New York city on Dec. 13 (Eng. News, Dec. 15 and 22, 1898), is still a mystery, and on Jan. 24 the coroner's jury rendered a verdict that it was unable to decide what caused the accident, which resulted in the death of 8 persons and the injury of several others. The jury, however, recommended that steps be taken to insure municipal supervision of the design and construction of holders built in the future.

ASPHALT LINING FOR RESERVOIRS is in use at two of the reservoirs of the Denver Union Water Co., of Denver, Colo. One is lined with Trinidad asphalt and the other with California asphalt. These reservoirs have been in use since 1892, and were not leaky before being lined. Mr. C. P. Allen, chief engineer of the company, wrote us a short time ago, stating that he was very particular in the construction of the banks, rolling them as they were built, afterwards trimming and rolling the slope with a special roller built for that purpose. Both of these reservoirs were lined with a mixture similar to street paving mixture. The first lining, made with Trinidad asphalt, contained about 15% asphalt, and the lining made with the California asphalt contained about 22%. Both were painted with an asphalt cement, which was supposed to be a pure mixture ⅛-in. thick. Mr. Allen found, upon examination, that the California asphalt above the water line is in very good condition, but that the lining below the water line is disintegrating in both reservoirs. From the experience he has had with this material for lining reservoirs, he believes that reservoirs can be lined with an asphalt mixture which will be permanent, and his judgment is that the mistake at Denver was in not using a rich mixture of asphalt paint before applying the heavier material; that is, he believes that as much care should be employed in making the lining tight upon the surface where the lining is applied as upon the surface where the water comes in contact with it.

A NEW WATER FILTRATION ORDINANCE has been introduced in the Philadelphia Select Council. It provides for a contract with the Quaker City Water Co. under which filtered water would be supplied to the city for 75 years. The plant would be at Lardner's Point, on the Delaware River, and would have a daily capacity of 300,000,000 gallons at the start, which would be increased to 400,000,000 by the end of six years from the date of the contract, and still further if the consumption demanded it. The city would guarantee to use 250,000,000 gallons a day at the start and up to 75% of the capacity of the plant at all times thereafter. The city would pay $12.50 per 1,000,000 for all water furnished up to 300,000,000 gallons a day, with decreasing rates for increasing amounts until $8 is reached for daily quantities between 500,000,000 and 600,000,000. In addition, $1.85 per 1,000,000 gallons would be paid for cleaning the filters and the city must put $35,000 a year into a guarantee fund for the maintenance of the company's works. This money would be available for repairs to the plant made by the city in case the company failed to do so. At the expiration of the 75 years the guarantee fund, if any of it remained, might be paid to the company, in return for which the filter plant would be delivered to the city. Slow sand filtration would be used, supplemented by sedimentation or auxiliary filtration. A 300,000,000-gallon conduit or conduits would lead from the plant to the city, with branches to the several pumping stations now owned and operated by the city. The company would deliver water into basins provided at the stations by the city, and would not be required to deliver it under a head. The proposed contract is silent regarding a bond for its fulfilment and the rate of filtration. Regarding the quality of the water to be furnished, it merely says the plant "shall at all times be maintained by the water company in such a state of cleanliness and efficiency that the water passing therefrom into the conduits shall be pure and wholesome." The company is the successor, it appears, of the Schuylkill Valley Water Co., regarding which there was such a scandal last year. It was incorporated on Dec. 30 with an authorized capital of but $15,000, and with W. J. Moore, 32 South st., Philadelphia, as Treasurer. The real head or manager of the enterprise is said to be Mr. Nelson G. Green, of 309 Broadway, New York city, who also managed the affairs of the Schuylkill Valley Water Co.

STREAM ANALYSIS of the Desplaines, Illinois and Mississippi Rivers, through which the waters of the Chicago Drainage Canal will flow, are to be made by the committees of the Board of Trustees of the Sanitary District of Chicago on federal relations, health and public order. The analysis will be conducted under the direction of Health Commissioner Dr. W. R. Reynolds, of Chicago, by the chemical department of the universities of Chicago, Illinois and Missouri, and the samples will be taken at all of the larger cities along the streams mentioned and under all kinds of meteorological conditions. The object of the analysis is to secure definite evidence of the quality of these streams previous to their receiving the Drainage Canal waters in case the claim is afterward made that they are being polluted. The analyses will be begun at once.

THE MOSCOW & ARCHANGEL RAILWAY is to be extended from Archangel to the mouth of the Kulol River. The Russian engineers, Oldendorff and Tokaroff, who were given up as lost in the Polar coasts, have returned and report that the Kulol River is ice-free throughout the year and affords navigation to Mezen Bay, in the White Sea, about 150 miles northeast of Archangel. In this bay navigation is open for four months in the year.

the third factor is the Upper Mississippi, which, rising later than the Ohio, serves to prolong the high-water, and thus increase the overflow.

The committee finds no evidence that the destruction of timber near the headwaters of streams tributary to the Mississippi tends to cause or promote floods. Where forests are removed a growth of underbrush springs up which holds the rainfall quite as well as the original forest. The five reservoirs at the headwaters of the Upper Mississippi, already constructed, modify to some extent the floods in the river bottoms above Lake Pepin; but they have no perceptible effect upon the river below that point. A reservoir on the Missouri River, above Great Falls, would be useful for irrigation; but it would have no considerable effect upon the floods in the Mississippi nor on the navigation of the Missouri River. On the Ohio River and its tributaries, where reservoirs would probably be most effective in suppressing floods, there are no suitable locations where they could be constructed at any reasonable expense or without doing far-reaching damage; provided that they were large enough to retain the outpour from innumerable mountain torrents. There are no great basins adequate for reservoir purposes on the Monongahela, Allegheny, Tennessee or Cumberland rivers. The only reservoir site sufficiently large to afford any practical relief is found in the St. Francis basin; but the cost of building and maintaining reservoirs in that basin would be enormous, and would far exceed the cost of leveeing the entire river front of the basin. In short, the committee found no prospect whatever of flood abatement by reservoir construction.

Relief by artificial outlets was also found impracticable. Below Red River the Atchafalaya iRver and Bayou Lafourche have, for years, formed two important natural outlets, and a third, at Bayou Plaquemine, is now closed pending its reopening by a system of locks and dams. But these outlets afford no perceptible relief to the river above; and the St. Francis, Yazoo, White and Tensas basins can get no relief from any practical outlet system.

The history of levee construction on the Mississippi River begins in 1717, when a levee, one mile long, was built to protect the then village of New Orleans. This levee was 4 ft. high and 18 ft. wide at the top. But 50 years after this levee was built the settlements extended only 30 miles above and 20 miles below the embryo city. It was only after Louisiana was ceded to the United States that levee extension was undertaken on an enlarged and systematic scale. By 1828 inferior levees had been extended almost to the mouth of the Red River. They were gradually increased in height, beginning with 4 ft., until the present average height above New Orleans is 12 to 13 ft.; and this height was found insufficient in the flood of 1897, when the water rose 1⅓ to 3½ ft. higher than in any previous flood. This increased flood level was partly charged to the increase and improvement of levees and the closing of former flood outlets.

The levees in the Yazoo basin were only 4 ft. high in 1858; between 1874 and 1882 they were raised to 7 or 8 ft.; and the flood of 1882 caused them to be raised to 13 or 14 ft.; even this latter height failed to keep out the water of 1897. Since the floods of 1882-3-4, the White River basin, the Upper Tensas basin and much of the St. Francis basin have been enclosed; and this, taken in connection with the raised levees in the Yazoo basin, has greatly raised the flood levels on this reach of the main river. The flood of 1897 showed that a complete enclosure of all the river basins would require an increase of from 4 to 6 ft. in the height of the Yazoo levees.

FIG. 4.—MOLD AND CENTERING FOR MELBER CONCRETE ARCH BRIDGE.

The White River basin, between 1888 and 1897, was enclosed by a levee averaging 12 ft. in height, but this was utterly inefficient in 1897, and it was clear that an increase of 6 ft. was required in the levees of this basin, or 18 ft. in all. In 1897 the Upper and Lower Tensas basins had levees 13 ft. high; but these, too, should be about 18 ft. high The St. Francis basin has a continuous levee, about 9 ft. high and 127 miles long, extending from Point Pleasant, Mo., to Chute 28, Arkansas; but 100 miles more of levee is required to enclose the basin, and all the levees should be at least 2 ft. higher.

A due consideration of the testimony taken convinced the committee that the flood of 1897 was greatly enlarged and aggravated by the extensive enclosure of basins and enlarged levee construction since 1884; but it is doubtless true that if no levees at all had been in existence a larger area would have been submerged, as is plainly shown by Major Starling in the paper referred to.

The construction and repair of levees was first undertaken by riparian owners; then by parishes and counties; then by the State, or levee districts under the States, and finally by the Federal Government and the States combined. The Government first gave material aid in 1850, and in the same year Congress authorized a survey and investigation of the Mississippi River. This latter work was carried on for ten years under Captain Humphrey and Lieutenant Abbott, and they made their final report in 1861. This thorough and exhaustive report made it clear that no substantial relief from floods could be obtained from outlets or reservoirs, and that properly-constructed levees could alone be depended upon. The Senate Committee says that all the testimony and data secured by it tend to confirm these conclusions. The great flood of 1874 proved the inadequacy of the State levee building, and Congress appointed a commission of five engineers to again investigate and report upon the best means of relief. This commission reported in 1875, and came to the same conclusions as did Humphreys and Abbott in 1861. Nothing was done, however, until 1879, when Congress created the Mississippi River Commission, with power to make plans and estimates for permanently locating and deepening channels, protecting the banks, improving navigation, preventing destructive floods, and generally promoting and facilitating commerce, trade and postal service. Between 1879 and 1882 Congress appropriated $1,475,000 for expenditure by this commission, for surveys and improving navigation; but nothing was spent on levee construction. In 1882 the gross sum of $4,123,000 was appropriated, and from this amount about $1,300,000 was for the first time directly allotted for levees. This work consisted of the improvement of the Yazoo, Tensas, White and St. Francis basins. In the respective levee districts, the State and Federal engineers, while acting in harmony, each work on distinct portions of the river.

A table prepared by the late Captain Waterman, Secretary of the Mississippi River Commission, shows that 164,860,375 cu. yds. of levees have been constructed under Federal, State, local and private authority, at a total cost of $47,631,503. Of this total the Federal government built 68,570,431 cu. yds., costing $13,320,708. It is estimated that to complete the entire levee system, from the head of the St. Francis basin to the Head of the Passes, at a grade sufficiently high and strong to afford complete protection against the highest probable stages of water, would cost from $18,000,000 to $20,000,000, and four to five years of time.

At the mouth of the Mississippi River, prior to the improvement of the South Pass by jetties, navigation was chiefly confined to the Southwest Pass, with Pass a Loutre utilized to some extent. In 1839 the Southwest Pass was 15.2 miles long, with 13 ft. of water on the crest of the bar, and a channel about twice as wide as that in the South Pass. Up to 1877 something was done towards deepening this channel by dredging, stirring up with drags and scrapers, etc., and a depth of 18 ft. was secured for a short time on the bar. In 1874 the Southwest Pass was 18 miles long, with 15 ft. on the bar; but in February, 1898, this pass was 18½ miles long, with only 9 ft. of water on the crest of the bar. To aid the improvement of the South Pass, commenced in 1874, Captain Eads placed a mattress sill across the head of the Southwest Pass, and this, with a little dredging, is all that has been done to this pass since 1875. In 1858 there was an 18-ft. channel in Pass a Loutre, and, being the shorter pass, it was utilized until the channel was destroyed in 1875 by "a large mud lump." Since then nothing has been done there, except the placing of a mattress sill at the head of the pass, and the recent attempt to close a large crevasse in the south side.

In 1838 the South Pass was 11.3 miles long, 700 ft. wide, and 8 ft. deep on the crest of the bar; and the length and width were about the same in 1875, except that the water was only 7 ft. deep on the bar. In 1875 a board of engineers recommended the improvement of the South Pass by jetties; and in March, 1875, Captain James B. Eads and his associates undertook this work. The original act provided for a channel 30 ft. deep and 350 ft. wide; but in 1878 it became evident that such a channel could not be secured by the work then laid out, and in 1878-79, Congress reduced the requirements to a depth of 26 ft. and a channel 200 to 250 ft. wide, and on this basis the work was completed in 1879. As a part of this improvement the sills were laid across the heads of Southwest Pass and Pass a Loutre, and training dikes were built at the Head of the Pass. In 1891 the west end of the Pass a Loutre sill was carried away and a large crevasse was formed on the west bank, about 1⅛ miles below the head of the South Pass. This break was not yet closed when the committee reported, in spite of attempts to do so, and as a consequence the inflow of water into South Pass

CONCRETE AND EXPANDED METAL HIGHWAY BRIDGE CONSTRUCTION IN ALLEGHENY COUNTY, PA.

We illustrate in the accompanying engravings two methods of employing concrete and expanded metal in the construction of country highway bridges. The bridges illustrated are both located on the Evergreen Road, near Pittsburg, in Allegheny County, Pennsylvania, and were erected last summer under the supervision of Mr. F. W. Patterson, Engineer of County Roads. One of the bridges, shown by Figs. 1 and 2, was designed by Mr. Patterson himself, but the other was built from designs submitted by Mr. F. Melber, Civil Engineer, of Pittsburg, Pa., who has applied for patents on certain features of the construction.

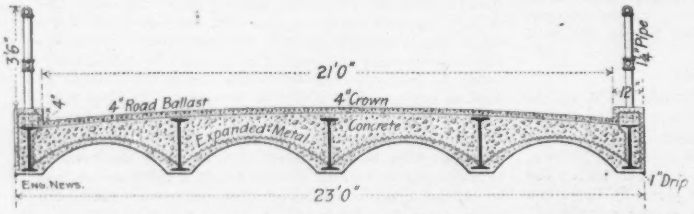

FIG. 1.—CROSS-SECTION OF HIGHWAY BRIDGE OF CONCRETE AND STEEL I-BEAMS, EVERGREEN ROAD, PITTSBURG, PA.

The simpler bridge of the two is that shown by Figs. 1 and 2. The construction here consists simply of concrete and expanded metal arches sprung between and embedding I-beam girders. The outside I-beams were 18 ins. deep, and the intermediate I-beams 20 ins. deep, and the concrete was composed of 1 part Portland cement, 2 parts sand and 3 parts Ligonier screenings. The span of the bridge is 28 ft., and its width out to out is 23 ft. It has a roadway 21 ft. wide in the clear and is designed to carry a 12-ton steam road roller. Fig 1 shows clearly the arrangement of the expanded metal, hand railing, concrete guard rail, etc. The reason for the discrepancy between the drawing, which shows the outside girders embedded in concrete and the engraving from the photograph, which shows them bare, is not explained in the information which we have received.

The second bridge shown by Figs. 3, 4 and 5 is much more complex in its construction, as will be seen from the illustrations. It consists of six arched girders of concrete, strengthened by round metal rods, with a floor system of concrete arches sprung between the ribs. Fig. 3 shows the bridge complete, and Fig. 4 is a view of the mold and centering ready for the placing of the concrete. The molds for the arch ribs, arch ring facing and railing are all very clearly shown by this last illustration. As will be seen, the bridge is built on a skew. It has a clear span of 28 ft. and a length over all of 38 ft. The rise of the arch ribs is 4 ft. 1 in., and the width of the bridge is 20 ft.

The construction of the arch is partly explained by Fig. 5. The metal skeleton employed is of a compound nature, and is explained in a general way by the following letter from the designer, Mr. F. Melber:

> The expanded metal is nowhere inserted to take up the strains from the loads. It greatly assists the members composed of mortar during their stage of setting and hardening and afterwards, of course, reinforces those secondary members by what the steel represents. For instance, in constructing the brackets which hold the enclosures over the end arches, which have to take up the pressure from the filling and the passing loads of this bridge, have imbedded at the proper place a rod, which is to transmit this pressure to the floor girders. Besides this rod, however, there is through the center of the entire web a sheet of expanded metal, having no other function than to prevent shrinkage in the plane of the web, to protect the cement mortar during setting and hardening, and afterwards, of course, to add so much to the strength of that web, as is represented by the amount of steel in the mesh. There is nothing thicker than 2 ins. in the whole bridge, except the main arch girders. If there have been places thicker than specified, it was the cause of trouble in ramming, which was the only drawback I found in the use of expanded metal for vertical surfaces. I would certainly give you a minute description of the main point at issue, which makes this system a typically new one from an engineering point of view, but before so doing I wish to protect the system by letters patent. I have used in this case round bars from the mill, and have provided steel for shearing and tension purposes. With a given cement I figure mathematically correct, both the area and location of my steel for tension and shearing, and I let, of course, the cement take care of the compression and a small amount of tension and shear too. I use a mesh of some kind, however, as stated, to resist shrinkage in directions where it is not wanted, and to equalize the density, so to speak, of the concrete during setting and hardening. Owing to a simple mechanical operation, I assure the perfect adhesion of the cement to the steel. Not knowing of a case where these features have been covered, I call this my system.

Tests made after the bridge was completed showed no deflection of the arch due to its own weight. For the photographs from which illustrations have been prepared we are indebted to the New York Expanded Metal Co., of New York city.

FIG. 5.—CROSS-SECTION OF CONCRETE BRIDGE WITH CONCRETE ARCH RIBS AND FLOOR ARCHES.
F. Melber, Pittsburg, Pa., Designer.

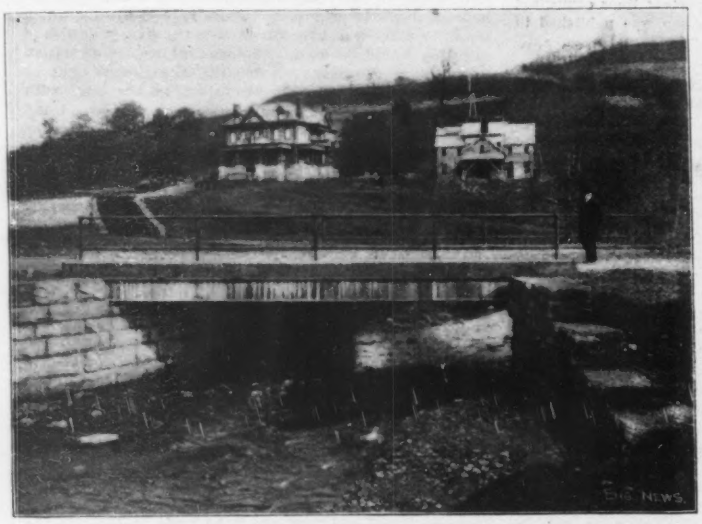

Fig. 2.—I-Beam Girders with Concrete and Expanded Metal Floor Arches.

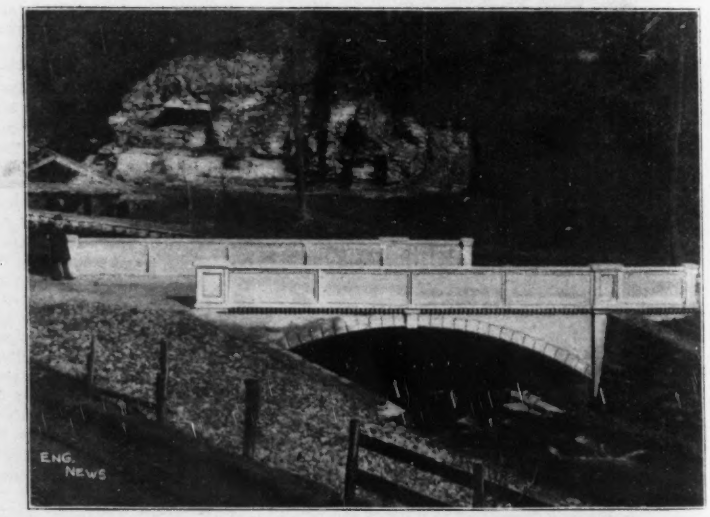

Fig. 3.—Concrete Arch Ribs with Concrete Floor Arches and Expanded Metal Binder.

FIGS. 2 AND 3.—CONCRETE HIGHWAY BRIDGE CONSTRUCTION ON THE EVERGREEN ROAD, NEAR PITTSBURG, ALLEGHENY COUNTY, PA.
F. W. Patterson, Engineer of County Roads.)

TESTS OF POWER BRAKES FOR STREET CARS are proposed to be made shortly in New York city, under the direction of Mr. C. W. Barnes, the electrical expert of the State Railroad Commission. Invitations have been sent out to persons interested in power brakes to take part in a competitive test.

THE MISSISSIPPI RIVER FLOODS AND METHODS FOR THEIR CONTROL.

The Committee on Commerce of the U. S. Senate has made a report upon the Mississippi River floods in pursuance of a Senate resolution of the 55th Congress. The instructions to this committee embraced an examination of and report upon the causes of floods, the effect upon them of the destruction of timber near the headwaters of the Mississippi and its tributaries, reservoirs on these rivers for flood protection, the levee system and its present condition, the continuance of the present Mississippi and Missouri commissions, and the legislation necessary to prevent the destruction of property by floods. A subcommittee of seven Senators made a personal inspection of the river and some of its tributaries, and took a large amount of testimony. They credit much of the information received to the paper on "The Floods of the Mississippi River in 1897," by Major Wm. Starling, Chief Engineer of the Lower Yazoo District, published in Engineering News in June, 1897, and also to another paper on the same subject prepared by Mr. Park Morrill, of the U. S. Agricultural Department. We abstract the report of the committee as follows:

The principal territory submerged or affected by the floods of this river, below Cairo, are included in the basins of the St. Francis, White, Yazoo, Tensas and Atchafalaya rivers, and Lake Ponchartrain, with an aggregate area of 29,790 sq. miles. The Mississippi River, at Cairo, is made up of the Ohio, Upper Mississippi and the Missouri rivers, with a great diversity of annual normal rainfall in their basins. The greatest and most destructive floods generally come from the Ohio River, and these floods are frequently reinforced, after passing Cairo, by floods from the White and St. Francis and other central valley streams. Mr. Morrill summarizes the cause of floods on the Missippi, by saying that the Ohio basin, with its steep slopes, brings down the heaviest rains in the spring, when the normal rise in the Lower Mississippi has brought that river almost to the dangerline from Cairo to the Gulf. In times of greatest flood we also find that a heavy rainfall over the great swamp region is an important factor; and

Mineral constituents:		
Silica (SiO_2)	5.0	0.291
Alumina (trace of iron) (Al_2O_3).	7.6	1.784
Magnesium (Mg)	10.1	0.589
Sodium (Na).........	4.7	0.274
Chlorine (Cl)	5.0	0.291
Sulphuric (SO_4)	10.7	0.624
Carbolic acid (CO_2) (calculated).	65.4	3.813
Nitrate, less than	1.0	.....

The above mineral constituents are probably combined as follows:

	Parts per 1,000,000.	Grain per U.S. gall.
Sodium chloride	8.25	0.478
Sodium sulphate	4.57	0.2[illegible]7
Calcium sulphate	11.10	0.642
Calcium carbonate	70.75	4.120
Magnesium carbonate	35.30	2.060

The arrangement of the piping above the boilers allows any battery to be cut out at any time, and by means of a double system of main steam piping that loops completely around both engine and boiler-rooms, Figs. 3, 4 and 7, any engine or boiler or any length of pipe can be cut out should occasion members. The inclined floor of the bin, which is supported by these columns and trusses is made up of 12-in. channel stringers, supporting 12-in. I-beams. Between these are turned arches of No. 20 corrugated iron, and the whole is then covered with concrete. The unit strains allowed in the various members of the coal bin are shown in Table II.:

TABLE II.—Unit Strains Permitted in the Steel for the Coal Bin.

Shapes and eye-bars, in direct tension.	15,000	lbs. pr sq. in.
I-beams & ch'n'ls, extreme fiber stress,	16,000	" "
Shapes, extreme fiber stress...........	12,000	" "
Pins, extreme fiber stress............	22,500	" "
Pins and rivets, bearing..............	20,000	" "
Pins and rivets, shearing..............	10,000	" "
Columns, 90 radii and under	12,000	" "
Columns, $57 \frac{l}{r}$ over 90 radii........	17,100	" "

For bolt stresses allow ⅔ above rivet stresses.
For field rivets allow ¾ above rivet stresses.

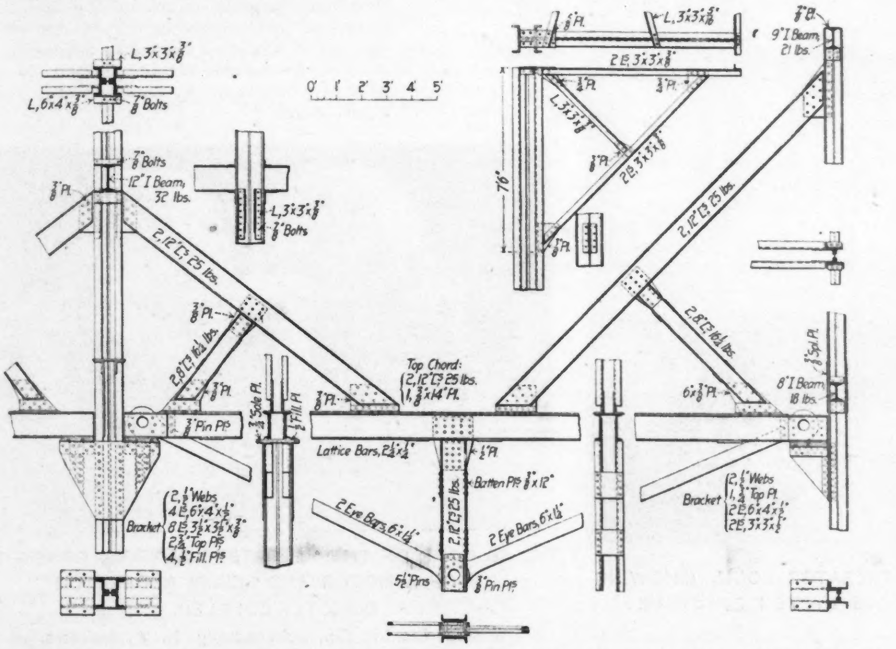

FIG. 7.—DETAILS OF THE TRUSSES, COLUMNS AND FRAMING OF THE COAL STORAGE BIN.

sion require, without interfering with the running of the plant. Chapman valves are used, designed for a pressure of 200 lbs., although the initial steam pressure is at present only 140 lbs. At the eastern end of the boiler-room connection from side to side of the loop is made by an intermediate pipe. The main steam line is of 12-in. pipe, the auxiliary of 10-in. pipe, and the intermediate steam line of 8-in. pipe. At the two points where the intermediate pipe joins the main the auxiliary piping, a steam separator is provided. All piping is protected by a Keasbey & Mattison magnobestos covering 2 ins. thick.

Behind the boilers space has been left for the installation of economizers, should their use be decided upon. Behind the boilers also have been fitted up a bath-room for the engineer and lavatories for the men.

One of the features of this plant of much interest is the large coal storage bin over the boiler-room, Fig. 1. Its construction is so fully shown in the various illustrations accompanying this article, Figs. 1, 2 and 6, that it is only necessary to call attention to the general plan of its construction. Further details of the bin are shown in Figs. 13 and 14.

The bin consists of two parallel-shaped troughs, Fig. 2, joined to form in section the letter W, 58⅛ ft. across the top, 27½ ft. across the bottom, and 15¾ ft. in greatest depth, outside of the I-beams, of which it is constructed. The bin extends the full length of the boiler-room, about 162 ft., and has a total approximate capacity of 2,000 tons, an amount sufficient to run the entire plant under normal conditions for about 20 days. The entire structure is supported upon three rows of Z-bar columns. Spanning the space from column to column in the central row are trusses; and at right angles to them to span the space from each central column to the side columns are other trusses, with 6-in. eye-bars for their ten-

The corrugated iron arches were cut to fit the lower flanges of the I-beams and to bring the crowns 2 ins. below the tops of the I-beams. All corrugated iron was laid with one corrugation side lap and at least 4 ins. end lap. The concrete covering of these arches was made up of the following proportions: 1 barrel Portland cement; 10 cu. ft. clean, sharp, river sand; 22 cu. ft. clean gravel, medium size.

The finishing coat on the inner surface of the coal bins and the passage-way was proportioned as follows: 1 barrel Portland cement; 9 cu. ft clean, sharp, river sand; 18 cu. ft. granolithic (granite).

The Portland cement was slow-setting "Germania," or "Dykerhoff."

The finishing coat was required to be not less than 1 in. thick, and sloped down to 2 ins., to rest on the I-beams. It was checked on the surface by grooving along opposite the center of each I-beam for the full length, the transverse grooving was about 6 ft. apart.

Owing to the shape of the bin, the coal in the rear portion will be used only for an emergency, and on such occasions it will be run down diagonal chutes into the conveyor, where it runs through the ash tunnel under the boilers. The conveyor then carries it up and over the bin from which the boiler supply is taken.

The coal is taken directly from the canal barges on the Chesapeake & Ohio Canal by coal-handling machinery furnished by the Steel Cable Engineering Co., Boston, Mass., and operated by electric motors in the hoisting tower, and at the east end of the boiler room just above the bin.

This coal conveyor is of the endless pan and bucket type, running on wheels and track provided with the necessary guides, trippers, supporting chairs and take-up. It is driven by a special, dust-proof, Westinghouse motor of compound shunt-wound type, geared for a conveyor speed of 50 ft. per minute at a capacity of 25 to 30 gross tons per hour. Trippers are placed to dump the contents of the buckets opposite each coal spout. Another tripper is arranged to dump the contents of the buckets into the ash bin outside of the boiler-house. The conveyor runs upon a track of T-rails of suitable stiffness to span the supports above the coal bins, Fig. 1, and upon a similar track in the ash tunnel below the boilers. Under each boiler is an ash hopper of 1,800 cu. ft. capacity. These are furnished with gates for controlling the discharge of the ashes, so that there will be no spilling when feeding into the conveyor, or any overloading of the buckets. There are also 5 feed hoppers, to feed into the conveyor when moving the coal in the storage bins, as already described. The coal spouts for the boilers are 12 ins. in diameter, and are provided with spreaders, Fig. 6, to distribute the coal in the stoker hoppers, and with gates for controlling and measuring the quantiy of coal supplied to each stoker. All the above coal spouts are hinged and provided with lifting chains so swung them out of the way when required. The spouts supplying the stoker hoppers have a measured capacity of 1,000 lbs., and gates for controlling the rate of discharge.

There is a steel unloading tower, Fig. 1, at the end of the boiler-house, covered and roofed with corrugated iron, strongly built and braced to resist shocks when hoisting the loaded coal tubs, and also to bear a wind pressure of 50 miles per hour. This unloading tower is equipped with friction hoist, driven by a special dust-proof, Westinghouse motor, properly geared to give the necessary speed for handling 25 to 30 gross tons per hour.

Below the hoisting apparatus is a coal crusher of 30 gross tons capacity per hour, placed in the tunnel over the coal conveyor, and arranged to receive the coal from the weighing hopper. This is operated by the motor that drives the friction hoist.

An ash bin is provided in the unloading tower, having a capacity of 1,800 cu. ft., and provided with a spout and gate to deliver the ashes into canal boats or carts for removal.

The engine-room, Figs. 3, 4, 5 and 8, at the east end of the building, is 134½ ft. long and 62 ft. wide, open to the roof and well lighted by large windows on both sides.

The engines, Fig. 8, of which there are five, are Reynolds horizontal tandem compounds, built by the E. P. Allis Co., Milwaukee, Wis., with 1890 frame, each 20 × 40 × 42 ins., rated at 800 HP., at 100 revolutions per minute, with steam at 130 lbs. They are provided with double-ported valves and double eccentrics, and the ball governors have a safety attachment which automatically shuts the steam off from the cylinder in case the governor belt should break. Each flywheel is 16 ft. in diameter, and weighs 50,000 lbs. The engines can be run condensing or free exhaust, for which separate exhaust pipes are provided, Fig. 3. Each engine is an entirely separate unit with primary feed water heater, receiver and condenser. The receivers are each 30 ins. inside diameter and 12 ft. 6 ins. long. The condensers are of the jet type, built by the Deane Steam Pump Co., and the condenser valves are controlled by valve standards on the engine-room floor. In the event of accident to the condensing apparatus an automatic action opens the valve from the engine into the free exhaust pipe through which the steam passes to the open air. Bundy steam traps are provided, one to each receiver and one to the main steam lines.

Lubrication of the engine cylinders is effected from two pressure oil tanks in the basement, provided with a 3-in. 30-ft. water column to assist the steam pressure in forcing the oil through a system of brass pipes into the cylinders. A third tank supplies the oil for the boiler-room pumps and engines. Ashton sight feed lubricators enable the supply of oil to be regulated as desired. Lubrication of the bearings is effected by a gravity system, the oil descending from a 50-barrel tank on the east wall, whither it is pumped up again after use, after first passing through filters.

The generators are directly connected to the engine shafts, and four are set in pairs, each pair facing each other, that is, with the two commutators on the inside. The commutator of the fifth faces engine No. 4. The generators are set in a was lessened. Before the break the latter pass received from 10 to 11% of the water in the main stream; after the break this inflow was only 7%. The scouring force in the South Pass has thus been somewhat reduced, and some dredging has been necessary to maintain the channel. About 300 ft. of the jetties at the sea end have been washed away, as have about 150 ft. of jetty on the west side; the east training dike, 1,250 ft. long, at the Head of the Pass, has also been destroyed, and none of these have been replaced.

Up to 1889 the channel was maintained at the required depth substantially without dredging. Since then considerable dredging has been necessary, or an average of 100 days dredging for each of the last four years. The committee concludes that this pass is not adequate now for vessels drawing 24 ft. of water, and modern commerce demands from 27 to 30 ft. draft, as being more economical than smaller vessels; and it deems it doubtful if a channel sufficient for the larger vessels can be obtained in the South Pass, though Major Quinn, of the U. S. Engineer Corps, maintains that it can. The committee contends that, to say the least, the cost would be enormous and the results problematical. The committee believes that the commerce of the Mississippi Valley is entitled to a much deeper and broader channel to the sea than that now afforded, or likely to be afforded, by the South Pass. Many believe that the Southwest Pass is the cheapest and most feasible route through which to obtain the requisite deep water navigation. But until the engineers now at work on the surveys have reported, under the provision made by Congress, the committee believes it is premature to suggest or advise.

The Missouri River Commission has charge of the river from Sioux City to its mouth, and in recent years its work has been chiefly confined to the improvement of navigation on about 46 miles of the river, and to protecting the river fronts of towns. The committee believes that the work done has been beneficial for the purposes intended and the appropriated money has been judiciously expended. In view of the great agricultural wealth of the Missouri River basin, the committee recommends the improvement of navigation by the government, and the carrying out of the system recommended by the commission of improving the river by reaches, commencing at the mouth. Congress has heretofore interfered with this system by permitting the appropriations to be diverted to local improvements, which, being isolated and unsupported, are usually swept away in the annual floods.

THE POWER STATION OF THE CAPITAL TRACTION CO., WASHINGTON, D. C.

(With two-page plate.)

In two previous issues of Engineering News (Feb. 24 and June 23, 1898), we have described the plant of the Capital Traction Co., of Washington, D. C. In the first article the method of changing the road from a cable to a conduit electric system was explained, and in the second was given an illustrated description of a large passenger station built by this company at its Western terminal.

In the present issue we describe and illustrate the new electric power station of the company. The site of the building is especially advantageous; along one side runs the Chesapeake & Ohio Canal, affording a supply of fresh water for boilers, condensing and fire purposes, and bringing coal direct from the mines. On the other side is a main street, at a lower level, and the Potomac River, only a short distance further to the south, and near enough, however, to furnish water, should the canal fail, by placing a short pipe line.

The building is a substantial brick structure, 298 ft. long, 62 ft. wide and 65 ft. high. Unfortunately, the long, narrow shape of the lot necessitated an arrangement of boilers and engines not the most efficient, and required very long steam pipes. A heavy brick partition wall was erected separating the building into two portions, of which the western, 162 ft. 9½ ins. long, forms the boiler-room, Figs. 1, 2 and 6, in which, upon suitable foundations, were erected the boilers and chimney.

The boilers, eight in number, are of the Cahall, Babcock & Wilcox horizontal water-tube type, of 300 HP. each. They are arranged in four batteries of two boilers each. The total actual water heating surface in each boiler is approximately 3,300 sq. ft. The total grate surface per boiler is 75 sq. ft. The tubes are 18 ft. long, and a steam pressure of 150 lbs. is carried. Previous to installing the boilers the sections and mud drums were tested at the works under a hydrostatic pressure of 300 lbs. per sq. in., and the steam and water drums were tested in the same way under a pressure of 250 lbs. per sq. in. When erected they tested the complete boilers under a hydrostatic pressure of 250 lbs. per sq. in.

The uptakes of these boilers all pass into flues that lead toward the center of the boiler-room and into a brick-lined steel stack, Fig. 1.

This chimney is 150 ft. high by 9 ft. internal diameter. The lower part of the chimney has a 4½-ft. fire-brick flue extending 15 ft. above the base plate. There are eight anchor bolts 25 ft. long by 2¼ ins. diameter in the body with upset ends, and wrought-iron foundation plates 2 ft. square by ¾-in. thick, stiffened with four angle-irons. These foundation bolts bear on heavy built-up lugs or brackets attached to the bell of the chimney, and passing through cored holes in the cast-iron base plate; these lugs extend at least 3 ft. above the bottom of the base plate. The cast-iron base plate is 15 ft. inside diameter, and 19 ft. outside diameter and 2½ ins. thick, with flanges 1 in. thick on each side of the base of the bell.

The steel plates are ⅜-in., 5-16-in. and ¼-in. thick, with a tensile strength of at least 60,000 lbs. per sq. in., and elongation of 20 to 25%. The chimney has an ornamental top and a ladder. The lining is built up of good light red brick, using mortar made of fresh burned lime and cement. Care was taken to lay the lining up in sections with time allowed for setting before continuing.

The inside of the chimney was given one coat of asphaltum paint, and allowed to dry before the brick lining was placed, and the outside of chimney was given two coats of asphaltum paint on the completion of the work. The foundation was solid brickwork, 25 ft. high, into which were built the 8 bolts already referred to. The stack was built by the Cambell & Zell Co., Baltimore, Md., and is provided with Locke regulators and dampers. The furnaces are provided with Roney mechanical stokers, driven by three small Westinghouse engines.

Water for the boilers is pumped from a well in the basement of the engine-room, supplied from the canal, into a 4,000-gallon tank, Fig. 3, from which it passes into two Loomis-Manning filters having a capacity of 300,000 gallons in 24 hours, thence through Deane feed pumps to the primary heaters, then into a supplementary Berryman heater, and thence to the boilers. Water can also be taken from the city mains. In which case, after entering the main tank its course is similar to that of the canal water. Should the main feed lines or pumps break down from any cause, two Metropolitan injectors can be brought immediately into action on the auxiliary feed. Previous to deciding upon the use of the canal water for steam purposes, an analysis was made, with the results given in Table I.:

TABLE I.—Analysis of Water Taken from Chesapeake & Ohio Canal.

	Parts per 1,000,000.	Grain per U.S. gall.
Total solids	176.0	10.360
Volatile and organic matter	60.0	3.499
Suspended matter	15.0	0.874
Total hardness	124.0	.....
Temporary hardness	94.0	.....
Permanent hardness	30.0	.....

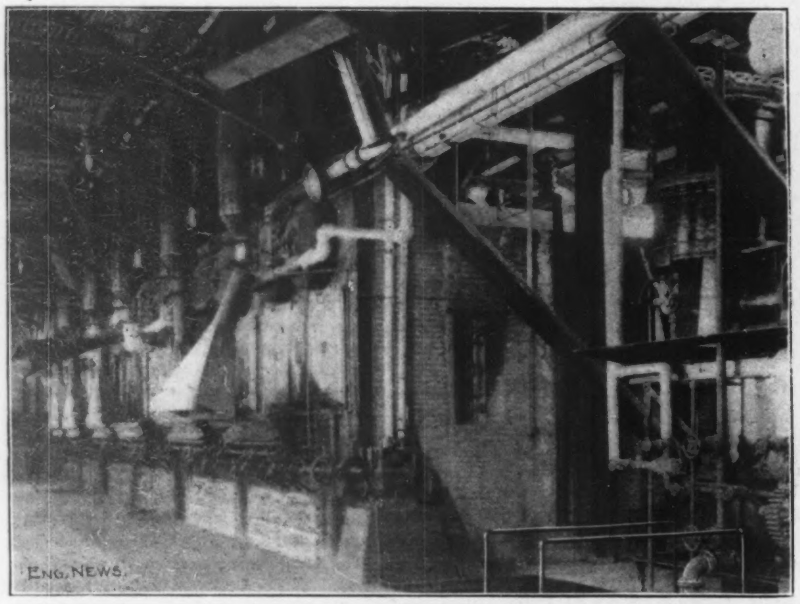

FIG. 6.—GENERAL VIEW OF THE BOILER ROOM. (SHOWING COAL CHUTES, MECHANICAL STOKERS AND THE TRUSSES OF THE COAL BIN OVERHEAD.)

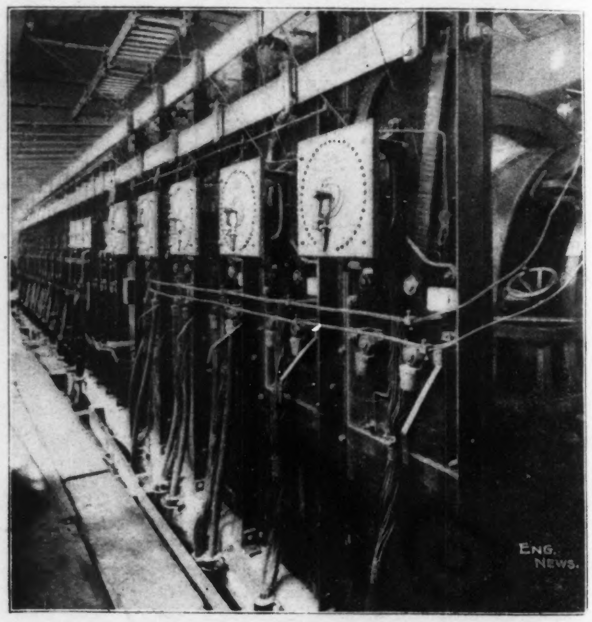

FIG. 9.—REAR VIEW OF THE SWITCHBOARD LOOKING FROM THE GENERATOR PANELS. (SHOWING VOLTAGE REGULATORS, BUS-BARS, ETC.)

VIEWS IN THE POWER HOUSE OF THE CAPITAL TRACTION CO., WASHINGTON, D. C.

line down the south side of the engine-room, Figs. 3 and 8, and are faced by the switch-board on the south wall. They are standard General Electric, 8-pole, 525 K-W. dynamos, delivering current at 550 volts at no load and 600 volts full load when running at 100 revolutions per minute; or a current output of 875 amperes. Each generator weighs, complete, 69,000 lbs.

In order to compensate for drop on the Mt. Pleasant and Navy Yard lines, 4 miles long in the first case, and 5 miles in the latter, three boosters have been provided, Fig. 10, two between engines 1 and 2 and one between engines 3 and 4. These boosters, Figs. 8 and 10, are generators, series-wound for a maximum load of 550 amperes at 180 volts, and so proportioned as to give practically a straight line from zero potential to 100 volts. They are 6-pole machines, each of 100 K-W. capacity, running at 600 revolutions. Each booster is driven by a 6-pole 110-HP., 600-revolution motor, wound for 550 volts, and taking current from the main railroad circuit.

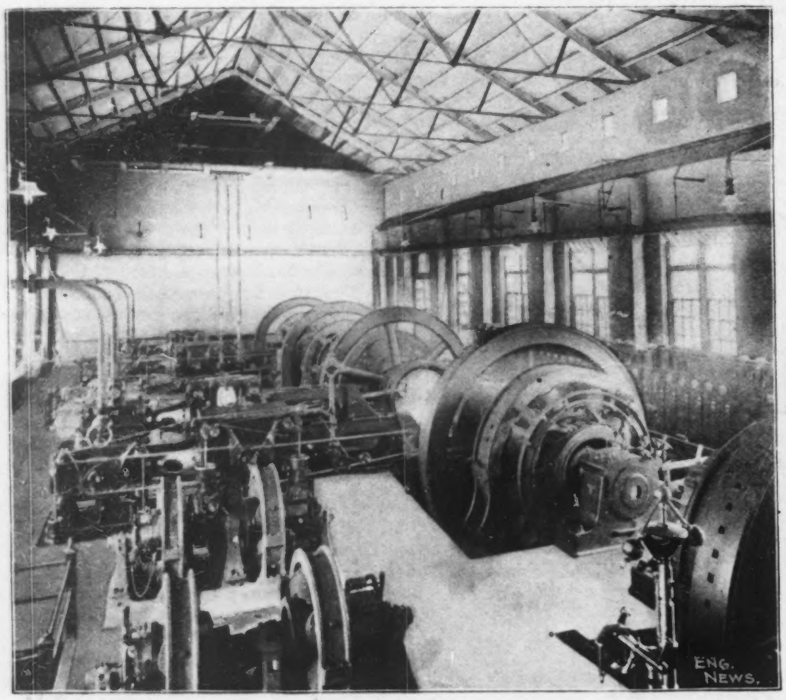

FIG. 8.—GENERAL VIEW OF THE ENGINE AND GENERATOR ROOM. (SHOWING ENGINES, GENERATORS, BOOSTERS, DUPLICATE SYSTEM OF STEAM MAINS, ETC.)

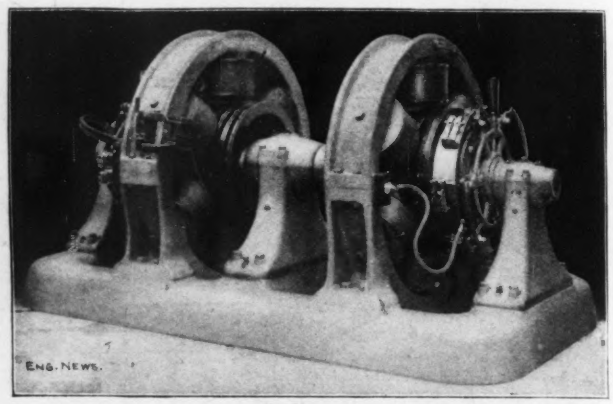

FIG. 10.—ONE OF THE "BOOSTER" OUTFITS, CONSISTING OF A MOTOR AND SERIES GENERATOR DIRECTLY COUPLED.

General Electric Co., Schenectady, N. Y., Builders.

The switch-board, Figs. 8 and 9, about 50 ft. long, stands 5 ft. away from the south wall. It is built of standard General Electric panels, and includes 5 generator panels, 1 station panel, 3 booster motor panels, 8 pairs of feeder panels, 2 booster generator panels, 2 pairs of panels for the 4 booster feeders, 1 rheostat panel, and a special panel for controlling the power-house and shop motor circuits and 500 volt lighting circuits.

The lighting of the power-house, shops and car barns, and the Union Station building (Eng. News, June 23, 1898), is effected from a 50 K-W. 125-volt General Electric machine, directly connected to a 75-HP. Harrisburg Ideal engine, the set occupying a position at the west end of the room next to the partition wall. The lighting is effected by General Electric enclosed arc single globe and reflector lamps and incandescent lamps. The enclosed arc lamps in the engine-room are swung on brackets, Fig. 8, made up of a 12-ft. length of gas pipe so hinged that they may be swung against the wall to allow of the passage of the 15-ton Case traveling crane which travels the length of the room. Ten arc lamps illuminate this room, two over each engine, and each lamp is provided with its own knife switch; 6 arc lamps are used in the boiler-room. The incandescent lamps are set in three-light clusters scattered throughout the room. These clusters are made up of two railway lamps, one on each side of a 120-volt incandescent lamp. A similar system is followed in the lighting of the basement and the boiler-room. All the arc, incandescent and railway branch lighting circuits in the engine-room run in tubing.

The railway feeder cables drop from the switch-board to the basement, to the ceiling of which they are attached by insulators, rise up the partition wall and run along it to the canal side of the power-house. They are then carried to a rack along and over the north side of the boiler-room to a bridge crossing the canal. Passing across this bridge they drop down into a manhole and proceed underground to their several destinations, where they are connected to the conductor rails by taps and clamps, such as are shown in Fig. 11.

Mr. D. S. Carll, Chief Engineer of the Capital Traction Co., and Mr. W. B. Upton, Principal Assistant Engineer, prepared all the plans and superintended the construction of the plant, and we are indebted to both of them, as well as to the General Electric Co., Schenectady, N. Y., for the information from which this description was prepared.

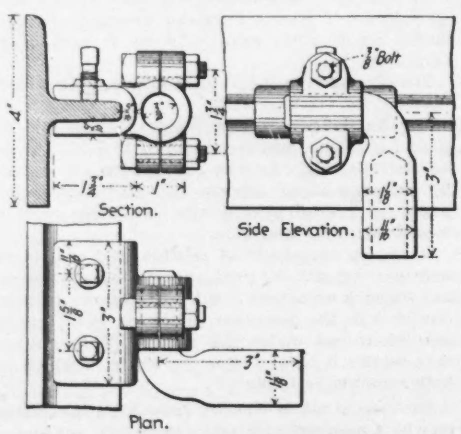

Fig. 11.—Device Used to Connect Feeder Taps to Conductor Rails.

THE REPORT OF THE CHIEF OF THE BUREAU OF STEAM ENGINEERING.

The annual report of Commodore Melville, Engineer-in-Chief, the head of the Bureau of Steam Engineering of the Navy Department, is a printed pamphlet of 55 pages, most of it in fine type, with 22 large folding plates of illustrations of the machinery of recently designed naval vessels. The report is of unusual interest, chiefly on account of the lessons it draws from the operations of the navy in the late war.

One of the lessons learned is the advantage in keeping all naval stations equipped with good tools and well stocked with materials for repair work. The value of this was made evident last summer, especially at the Key West station, where defecting lighting at night, lack of facilities for quickly reaching the ships, and small available shop-room greatly increased the cost of repair work, and made dispatch almost impossible. An example of how good work may sometimes be done in a hurry was the fitting of three old monitors with new boilers at the League Island yard. The report says:

> The old single-turret monitors were susceptible of fair use as harbor-defense vessels, if they could quickly be made seaworthy, and one of the most notable engineering feats was in connection with this work. This consisted in the actual cutting out of the old and worn-out boilers of the monitors "Manhattan," "Mahopac," and "Canonicus," at League Island, and erecting new boilers in their places without cutting the decks, and all within the space of 30 days. The boilers as cut up were passed out through the smoke-pipe opening, and the new sections put down the same way. The work was done by the Babcock & Wilcox Co., under contract, and this firm deserves great credit for the expedition with which the work was done. . . . In less than five hours after the new boilers were authorized, the work of building them was commenced. . . . The performance of the vessels with the new boilers exceeded that when their original boilers were first built.

The greatest amount of labor brought to the Bureau was through the necessity of fitting out the auxiliary navy, consisting of 110 vessels of all kinds, from tugs and ferry-boats to ocean steamers. Many of these vessels arrived at Key West in a crippled condition, the chief cause of which was the novelty of the machinery to the inexperienced crews. The work of preparing them for service was done in an almost inconceivably short space of time through the earnest co-operation of the officers selected to superintend the work, and also through the provision of ample funds, enabling the Bureau to purchase all needed material by telegraph. Much delay, however, resulted through the very slow and uncertain delivery of material to Key West. This shows the necessity of having this least accessible naval station not only modernized in outfit, but of having it most amply stocked with stores for machinery repair work.

The record made by the repair-ship "Vulcan" is referred to as follows:

> This floating shop was of inestimable value off Santiago, and there is no more important feature to-day in the Navy than the maintenance of such a ship, well-stocked, with every large fleet.

The great need of distilling ships, to accompany a fleet in Southern waters, is also pointed out. The evaporating plants on the war vessels, usually found sufficient in ordinary cruising, are in-adequate to meet the demands for fresh water in hot climates, where the high temperature of the sea-water used in condensing the steam from the evaporators reduces their efficiency below the normal.

The working of the steam machinery during the war is thus commented on:

Barring the torpedo-boats, there was a remarkable absence of casualty in the machinery department of the vessels of the fighting squadron. Even in action, when forced draft conditions were in operation, and the excitable natures of the men most wrought upon by the surroundings, the reports show that the machinery not only worked well generally, but that in no case was it greatly distressed. This is as fine a commentary upon the personnel as on the machinery.

It is greatly to be regretted that the torpedo-boats cannot show the same excellent records for their machinery. Nearly every one has had some accident. . . . This condition of affairs seems attributable to two causes, the absence of trained engineering supervision, and the use of the boats for duty to which they were not adapted. . . . This experience with the torpedo-boat is, indeed, an excellent illustration of the benefits to be anticipated from the passage of the Personnel Bill. Only a few officers can be carried, but when everyone is an engineer by experience and training, there is an assurance that these machines will have trained supervision and be kept in good order.

The report recommends that the Boston Navy Yard be thoroughly equipped with modern machinery. Its advantages as a repair station were well illustrated during the war. Thoroughly protected from attack, and practically on the sea-coast, it affords opportunity for work in time of war superior in point of safety to any other yard equally accessible to our ships. Recommendations are also made for the improvement of the New York Navy Yard. The League Island Navy Yard, Philadelphia, is said to be the ideal place for laying up in reserve such vessels as are not needed in commission in times of peace. The Norfolk Navy Yard is next in importance to the New York yard as a repair station, and the shops have the highest class of equipment. During the year 72 vessels were repaired or fitted out at this yard. New shops are urgently needed at the Mare Island Navy Yard, Cal. The naval station at Bremerton, Wash., will be the great docking point on the Pacific coast, and new tools will be sent there as soon as the necessary buildings are erected.

The report contains a long table showing the condition of the machinery, together with useful data of the ships of the navy. The Bureau's former recommendations in favor of water-tube boilers for all naval vessels are repeated. The report says:

At the present day it would be hard to find any design for the machinery of new naval vessels which does not include water-tube boilers. The demands upon the engineer for great power on small weight, in order to secure the highest speeds for all classes of vessels which are now common, have practically ruled out the cylindrical boiler on account of its weight and inability to carry the high pressures needed. The tactical importance of water-tube boilers is also being thoroughly recognized, and has been emphasized by the conditions which were obtained in our blockade of Santiago and the great victory of July 3. . . As the new battleships on the contractors' plans will also use water-tube boilers, we have definitely taken the step of adopting them for all our vessels, and there can be little doubt that the efficiency of the fleet will be increased in consequence.

SOME FORMULAS FOR DISK FANS.*

By Professor J. H. Kinealy.†

I have been trying for a long time to get some formulas for disk fans that would be of practical value in designing. I cared very little about the pressures produced by the fans, as I knew, as I know now, that such fans are not adapted for working against pressure, and that whenever they are used the entry and exit for the air should be made as direct and free from obstruction as possible. What I wanted were really but two formulas: one to enable me to determine the proper number of revolutions at which a fan of a given diameter should be run; and the other to enable me to determine the number of cubic feet of air which a disk fan of a given diameter ought to be expected to deliver per minute when working with a practically free inlet and exit.

It would seem that, when one would be satisfied with two such apparently simple things in the way of formulas, it ought to be easy to obtain them. But I have found it extremely difficult to get anything to suit me. I have found several formulas based upon theoretical reasonings, but they always involved some constant or other which I was unable to determine.

After a good deal of work I have deduced the following formulas which I submit to the consideration of the Society:

Let D be the diameter of the fan in inches, and N the number of revolutions at which it may be run per minute. Then

$$D\,N = 21{,}000. \qquad (1)$$

This formula enables us to determine the number of revolutions at which a disk fan of any type, either straight-vaned or curved-vaned, as the Blackman fan, may be run. It is based upon the fact that the speed at which a disk fan may be run depends only upon the stress set up in the vanes by the centrifugal force. We know that a cast-iron wheel may have a peripheral velocity of from 80 to 100 ft. per second without undue stresses being set up. And the peripheral velocity in feet per second of a fan whose diameter in inches is D, when making N revolutions per minute, is equal to

$$\frac{3.14\,D\,N}{12 \times 60} = \frac{D\,N}{229}.$$

If we say that this shall be equal to 90, we have

$$\frac{D\,N}{229} = 90, \text{ or}$$

$$D\,N = 21{,}000, \text{ about.}$$

The maximum number of revolutions at which a fan should be run may be taken as about 10% greater than given by the formula.

When a disk fan with straight vanes, set at an angle between 40 and 45°, revolve just outside of a delivery tube whose diameter is slightly greater than the diameter of the fan, the number of cubic feet of air delivered by it per minute is given by the formula

$$C = 7\,D^2. \qquad (2)$$

C is the number of cubic feet of air delivered per minute, and D is the diameter of the fan in inches.

For a Blackman fan revolving just at the entrance of the delivery tube we may say

$$C = 11\,D^2. \qquad (3)$$

Formula (2), for fans with straight vanes, is based upon the results of experiments made by W. J. Walker, given in a paper on "Propeller Ventilating Fans," read before the Institute of Mechanical Engineers in 1897. Mr. Walker made a great many experiments, which he quotes at length in his paper, but the ones upon which formula (2) is based were made with two straight-vaned fans, each 23¾ ins. in diameter, revolving at a speed of 600 revolutions per minute just inside of a delivery tube 24 ins. in diameter. He determined the number of cubic feet of air discharged by each fan when the vanes were set at different angles, and found that both gave the best results when the vanes were set at angles of about 40 or 45°. If we call the diameter of the tube equal to the diameter of the fan, as we may without much error, the area of the tube in square feet is $\frac{3.14\,D^2}{4 \times 144}$, when D is the diameter of the fan in inches. The mean velocity of the air in the delivery tube is the number of cubic feet of air delivered per minute divided by the area of the tube. That is, if V be the mean velocity of the air, and C the number of cubic feet of air delivered per minute, we have

$$V = \frac{4 \times 144\,C}{3.14\,D^2} = \frac{183.4\,C}{D^2}.$$

The peripheral velocity, V_0, of the fan is

$$V_0 = \frac{3.14\,D\,N}{12} = \frac{D\,N}{3.82},$$

where N is the number of revolutions per minute.

From these two equations we find that

$$\frac{V_0}{V} = \frac{D^3\,N}{3.82 \times 183.4\,C} = \frac{D^3\,N}{701\,C}.$$

From Walker's experiments I found that when the vanes of the two fans were set at an angle of about 40 or 45°, $\frac{V_0}{V}$, was 4.5 for one, and 4.2 for the other. Taking the average of these values we get

$$\frac{V_0}{V} = 4.35 = \frac{D^3\,N}{701\,C}.$$

From which we have

$$C = \frac{D^3\,N}{4.35 \times 701\,C} = \frac{D^3\,N}{3{,}050}.$$

If now we take D N as equal to 21,000 we have

$$C = \frac{21{,}000\,D^2}{3{,}050} = 7\,D^2, \text{ about.}$$

From the results of the experiments quoted by Geo. H. Babcock, in the "Transactions of the American Society of Mechanical Engineers," Vol. VII., 1886, I find that $\frac{V_0}{V}$ for a Blackman fan is about 2.68. So that for a Blackman fan

$$C = \frac{D^3\,N}{1{,}880}.$$

And if, as before, we take D N as equal to 21,000 we have

$$C = \frac{21{,}000\,D^2}{1{,}880} = 11\,D^2, \text{ about.}$$

At the meeting at Munich, in August, 1898, of the Heating and Ventilating Specialists, Engineer A. Marx, assistant in the Technical High School of Berlin, read a paper on "Screw Ventilators," in which he gave a number of formulas for disk ventilators, with the constants which make the formulas applicable to the ventilators made by two European firms and one English firm.

Among the formulas which he gave is one which, when put into English units and D N taken as equal to 21,000, becomes for the fans made by the Blackman Ventilating Co., London,

$$C = 9.3\,D^2.$$

Where C is the number of cubic feet of air supplied by the fan per minute when working with free exit and entry, and D is the diameter of the fan in inches.

For the fans made by G. Schiele & Co., Frankfurt, A.M., Germany, the formula, when English units are used, becomes

$$C = 9\,D^2.$$

For the fans made by Sulzer Bros., of Winterthur and Ludwigshafen, A. Rh., Germany, two formulas are given: One, for low pressure ventilators, which is

$$C = 8\,D^2.$$

and one, for medium pressure ventilators, which is

$$C = 9\,D^2.$$

Mr. Marx gives a number of other formulas besides those which I have quoted, such as formulas for determining the pressures produced by these ventilators when revolving at different velocities and delivering different quantities of air. But as these formulas are quite complicated, I have not considered it advisable to quote them here.

The formulas which I derived were deduced some time before I received a copy of the paper read by Mr. Marx before that German society, which corresponds to the American Society of Heating and Ventilating Engineers. And I present the formulas to this Society with the hope that they will be thoroughly criticised, and, if the constants which I have given are not the proper ones to be used, that others will be given by those who may have more knowledge of disk fans than I have. The formulas will, I think, commend themselves to all on account of their simplicity, and the ease with which they can be used. While I appreciate that it is more important that a formula should be correct rather than simple, yet I feel that it is almost impossible to obtain a formula that will be rigidly correct for all makes of disk fans, even though the fans may be of the same general type. And, therefore, I submit my formulas as simply giving fairly close approximate result for straight-vaned fans and fans of the Blackman type.

*Paper presented at the New York meeting of the American Society of Heating and Ventilating Engineers.

†Professor of Mechanical Engineering, Washington University, St. Louis, Mo.

THE PROPOSED EAST CHANNEL IMPROVEMENT in New York harbor has been reported upon by the Board of Engineers in answer to the joint resolution of Jan. 12, 1899. The report recommends a channel at least 35 ft. deep at mean low water, and 2,000 ft. wide; the estimated cost is $4,510,000. But the board, in anticipation of the construction of vessels of deeper draft, says this channel should ultimately be 40 ft. deep, and it submits an estimate of $6,688,000 for such a channel. The board prefers the East channel, because it is five miles shorter from New York to the ocean than by the main ship channels; the bends are slight, while there is a bend of 115° in 6,000 ft. in the old course; and in the East channel the currents are nearly straight, while there are cross-currents, though not strong, in the main ship channel.

CHICAGO RIVER IMPROVEMENT is agitating the navigation and railway interests of Chicago, Ill., and the River Improvement Association, at a recent meeting, passed resolutions urging the city to adopt coercive measures to get rid of such of the present obstructions as are maintained by private interests. In a recent report made by Major W. L. Marshall, U. S. Engineer Corps, to the Congressional committee upon river and harbor improvements, it is pointed out that it is necessary to lower the tunnels under the river and to take out the center pier bridges before any money can be spent to advantage in deepening and widening the stream. These committees, as a result, express themselves against making further appropriations, and also against taking the initiative in compelling the removal of the obstructions, which, they maintain, the city of Chicago is responsible for and must get rid of. The cost of removing all of the center pier bridges and substituting bascule spans, and of lowering the tunnels, has been estimated by City Engineer Mr. John Ericson at $6,000,000, one-half of this sum being for the tunnel work. This great sum is more than the city has power or means to raise, it is claimed, and this, coupled with the fact that the tunnels are used exclusively by the street railways, has urged the Mayor and others, including the River Improvement Association, to demand that the railways shall defray the cost of lowering them. To bring the street railway companies quickly to terms it is urged that all franchises or extensions of franchises asked by them shall be refused until they agree to lower the tunnels sufficiently to insure a depth of water of 26 ft. in the river over them at all times. The River Improvement Association has appointed a committee to carry its resolutions before the citizens, the city officials and the business associations of the city.

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Ever since Lord Kelvin visited this country, some 18 months ago, the American daily press has contained glowing accounts of the possibility of furnishing steam to drive electric lighting and other power plants from the heat generated by the burning of garbage. The number of these articles had diminished of late, but with the receipt of new information from England regarding the Shoreditch combined electric light and dust destructor plant during the first year of its operations, stories of this so-called "latest miracle of modern science" have begun to circulate with increasing frequency and enthusiasm. In our issue of Aug. 27, 1897, we commented editorially on "Garbage as a Fuel for Electric Light Stations" and showed some of the drawbacks to the plan in general and to its execution in America in particular. The chief difficulty in America would be the poorer heat producing quality of American garbage, as compared with English "dust bin refuse." Even where we allow the mixing of ashes with garbage there is generally less combustible material in the former than in English ashes, which are likely to contain much unburned or partially consumed coal from open grates, Englishmen being so attached to the cheerful open fireplace that they will not give it up, regardless of the waste of fuel occasioned thereby. Our garbage not only contains less unburned coal and cinders than the English refuse, but it probably has a much greater proportion of wet, green vegetable matter, and consequently is more difficult to burn.

In another column we give, through the courtesy of one of the Shoreditch Vestrymen, Mr. Kershaw, a brief review of the first year's work of the Shoreditch electric light plant and refuse destructor. Unfortunately the figures are not sufficiently complete to enable us to say just what the plant is accomplishing in the way of supplying steam for the generation of electricity. Mr. Kershaw states that "the contractors' guarantees of raising a certain quantity of steam from the burning of our refuse in 24 hours have been amply satisfied," but the "Trading Account" which he has sent us gives no figures on the subject. The combined undertaking has been profitable during the first year, the account states, and with lower lighting rates than prevail elsewhere in London. The account shows no fuel purchased for burning refuse, and Mr. Kershaw assures us that none was used. If our American garbage furnaces could burn garbage without other fuel than that afforded by the wastes many of our cities would congratulate themselves for that and not ask for the generation of electricity in addition. The item in the "Trading Account" that strike us as most remarkable, providing we understand the figures, is a total expense for labor of only 53 cts. per short ton of refuse consumed. With no fuel to handle except the refuse itself, this figure seems high. Other items, including some that are conveniently omitted from American balance sheets, bring the cost of consuming the refuse up to 82 cts. per ton, or $1.09 if capital charges are added. The net cost is much less, but these are the debit items. Can it be that the attempt to utilize the heat contributes largely to this expense, which, as stated, includes nothing for fuel? The capital charges are materially increased in this way, both for boiler plant and the Druitt-Halpin thermal storage system.

Thermal storage thus far has not been a success, as is stated elsewhere in this issue, and there are at least slight indications in the information at hand that it will never be successful. It is at least fair to ask if the storage is not at the wrong end, or if electric storage batteries would not be better than thermal storage? The latter involves storage capacity for all the losses during storage and during conversion of the heat to electricity, which would be avoided in the storage batteries.

In our discussion of this subject, we should not be understood as criticising, on the whole, the design of the Shoreditch plant. The point which we have desired to make clear is that what has been done there has been done under peculiar circumstances, which could be duplicated at few places probably, even in England. The wild talk in which certain newspapers and certain distinguished British scientists have indulged, concerning cities getting their electric light for nothing by burning their daily wastes, sounds very foolish to those who are most familiar with the actual work of garbage cremation.

The question of the advisability of making public the names and materials of articles submitted to competitive test was discussed incidentally at the January meeting of the Western Railway Club. The paper presented was one by Mr. Robert Quayle, Superintendent of Motive Power of the Chicago & Northwestern Ry., upon tests of locomotive boiler coverings. Several different coverings were tested, but in the paper they were distinguished only by letters, and not even the character of the material was given. It was pointed out in the discussion that this robbed the paper of much of its value. It showed that out of six coverings tested some were better than others, but that on the whole there was comparatively little difference. It does not need a scientific investigation to tell us that boiler coverings are of varying efficiency; and in view of the number of coverings on the market it may reasonably be assumed that several of them are practically equal in efficiency. What a man having boilers under his charge wants to know, and what he expects to find in a paper on this subject, is how specific coverings or kinds of coverings compare in point of efficiency. In the discussion, Mr. A. M. Waitt, of the Lake Shore & Michigan Southern Ry., referred to the policy of the Master Car Builders' Association in giving full publicity to names and materials in its very valuable report on brakeshoe tests. On the other hand, he mentioned a report on paints issued by the Car Painters' Association, which is absolutely valueless, since the paints are distinguished only by the materials of which they are composed, so that paints made of the same materials show very different results, but what these paints were nobody knows. Prof. W. F. M. Goss, of Purdue University, who was the referee for the railway and the manufacturers in these tests, said that Mr. Quayle did not feel at liberty to publish the names of the manufacturers. It seems to us unfortunate that the tests were undertaken with any such reservation, whether definite or implied, and that under such conditions it would have been better to keep the information for the private use of the C. & N. W. Ry., rather than to have given it out in the incomplete shape as presented in Mr. Quayle's paper. This was evidently the view of most of the members present, a resolution being passed, on motion of Mr. Waitt, to the effect that Mr. Quayle be requested to allow the names of manufacturers and materials of the coverings to be given in the paper when published in the proceedings, if such action is consistent with his arrangements with the manufacturers.

THE NICARAGUA CANAL IN CONGRESS.

On Jan. 21 the Senate passed the Nicaragua Canal bill, which it has had under discussion ever since the beginning of the present session; but it incorporated such radical amendments before the final passage, as to remove several of the serious objections which were brought against the original bill. For example, it is now provided that the payment to be made to the Maritime Canal Co. of Nicaragua shall be only such an amount as the "rights, privileges, franchises and property of the company are actually worth in cash." The appraisal is to be made by three commissioners to be appointed by the President. Another amendment provides that:

> No payments shall be made under the provisions of this act to or for the benefit of the stockholders of the Maritime Canal Co., or for any of its property, unless the President shall decide to construct a canal under the concessions granted to said company.

In view of the fact that the concession expires next October, it appears extremely doubtful whether the stockholders of the Maritime Canal Co. would be able to secure anything from the Government under the terms of this bill.

Another amendment was the following:

> If the President shall be unable to secure from the Governments of Nicaragua and Costa Rica such concessions as will enable the United States to build and perpetually own and control said canal, the President is authorized to negotiate for a control of or a right to construct, maintain and perpetually control some other canal connecting the Atlantic and Pacific Oceans, and the President is requested to negotiate for the abrogation or modification of any and all treaty obligations, if any such exist, as shall in any wise interfere with the construction, ownership and perpetual control of any such canal.

It will be seen from the above that, under the bill as passed by the Senate, the Government is enabled to open negotiations with the Panama company, if Nicaragua and Costa Rica refuse to grant the necessary privileges to the United States on reasonable terms. Besides this, the above quoted section also makes provision for negotiations by the State Department with England for the abrogation of the old Clayton-Bulwer treaty, and it is the general belief that little difficulty will be found in effecting this.

But despite these amendments, the bill, as it finally passed the Senate, was conceded to be, even by many of those who voted for it, an objectionable and unsatisfactory measure. It keeps alive the skeleton of the old Maritime Co. of Nicaragua, and proposes to have the Government masquerade as a private corporation in carrying out the construction of the canal, and the very general expression of opinion in the Senate debate was to the effect that if the United States is to undertake this work, it should do so outright, without any complications in the way of issues of corporation stocks and bonds.

The reason why the bill was finally passed by the Senate was that it was well understood that the House would make radical changes in it in any event, and it was deemed best to expedite the chances of some legislation upon the subject by the present Congress, by sending the bill to the House at once without attempting farther amendment or modification, inasmuch as the whole matter will have to be gone over again in any event by a conference committee.

Meanwhile the House Committee on Commerce has been holding public hearings on the Canal question, and from this and other sources it is possible to obtain a clear idea of the present situation, and of the prospects of Canal legislation at the present session of Congress.

Taking up first the Maritime Canal Co.'s concession, the opinion appears to be gaining ground that the position of Nicaragua that the concession expires next October is entirely sound, and that the company has no claim that it can maintain to an extension or renewal of the concession. We reviewed briefly this matter in our issue of Dec. 15, and in the Senate discussion the legal aspect of the case was fully elucidated.

It thus appears that Nicaragua was acting wholly within her legal rights when she granted a concession last fall to Messrs. Eyre & Cragin, to take effect when the Maritime Canal Co.'s concession expires.

There has been a great deal of foolish criticism concerning this Eyre-Cragin concession. It has been alleged that the granting of it by Nicaragua was an unfriendly act, and that those who secured it did so, not with any intention of building the canal, but for the purpose of obstructing it. Both these ideas are now known to be absurd. The fact that Mr. Warner Miller, who has been for years the most conspicuous figure in the Maritime Canal Co., has identified himself with the syndicate which secured the Eyre-Cragin concession, is excellent evidence that this syndicate is not organized merely to pursue obstructive tactics. It is also instructive as showing what Mr. Miller apparently thinks as to the continued validity of the Maritime Canal Co.'s concession.

Besides this, we have now a definite statement from the syndicate holding the Eyre-Cragin concession, headed by Mr. Wm. R. Grace, of New York, as to their purposes. It appears that they propose to go ahead and build the canal as a private enterprise. The list of those who compose the syndicate includes Messrs. John Jacob Astor, Levi P. Morton, Robert Goelet, John A. McCall, W. D. Sloane, W. R. Grace and many others whose names are synonymous for financial strength. This syndicate has expressed its willingness to assent to Government control and participation in the enterprise to a reasonable extent, including the Government regulation of rates of toll, provided the Government will lend its guarantee to $50,000,000 of 3% bonds; but it is apparently the intention of the syndicate to proceed with the work whether this guarantee is made or not.

It must be frankly said that at the present time the Grace syndicate is apparently the only concern which has the legal right to cut a ship canal across Nicaragua. Notwithstanding this, so far as we have been able to gage current opinion at Washington, there seems to be very small prospect that Congress will accept the proposition which the syndicate has made. The prevailing sentiment is in favor of steering clear of all alliances with corporations; and while the proposition that the canal shall be built by private capital, and at private risk, without draft on the national treasury, will probably find not a few supporters, the majority are pretty certain to favor the absolute construction, ownership and control by the Government.

There is undoubtedly a strong popular demand from all sections of the country for the passage of a Nicaragua Canal bill by the present Congress, and there is an overwhelming sentiment in both Senate and House in favor of such action. At present, however, the prospect seems to be that if such a bill is passed it will provide for Governmental construction, and for such negotiations with Nicaragua and Costa Rica as will give to the United States a free hand on the Isthmus, and the annulment of all canal concessions previously granted to other parties.

A word may be appropriate here respecting the Panama enterprise: We gave publicity last fall to General Abbot's excellent paper on the present status of that enterprise, as a matter of general public interest; but we see small reason to expect that the United States will refrain from pushing the Nicaragua Canal on account of the prospects of the resumption of work at Panama. If those who are in charge of that enterprise proposed to step out and let this Government control and carry out the entire work, they might have some small chance of success; but there is as little chance that they will do this as there is that the Grace syndicate will turn over their concession to the Government—a thing which the concession itself distinctly forbids.

As to the relative engineering merits of the Panama and Nicaragua routes, too few definite facts are made public regarding either to make a reliable comparison possible. From the limited information at hand, it will apparently take about as many years and as many dollars to complete a canal at Panama as at Nicaragua. We are aware that the partisans of each canal have made extravagant statements respecting the cost and the difficulties in the way of the rival enterprise; but until either party can submit more definite facts concerning their own route than have yet been made available, such statements deserve little credence.

It seems to us that if the House Committee on Commerce really desires to secure the passage of legislation for a trans-isthmian canal at this session, the course for them to pursue is plainly marked out. Let them discard entirely the absurd Senate bill, with its needless perpetuation of the bankrupt Maritime Canal Co., its confusion of contradictory clauses and its bungling and awkward method for carrying out the canal work. Let it frame in its place a simple, brief, measure, instructing the Executive to negotiate with Nicaragua and Costa Rica for the privilege of constructing and controlling the canal across their territory; also with any concessionaries claiming prior rights to secure a relinquishment of their concessions, and also with England for the abrogation of the Clayton-Bulwer treaty. All these things must be done in any event before actual construction on the canal can be proceeded with, and they cannot be dispensed with even by an Act of Congress. There is no harm at all either in giving the President a free hand, so that if Nicaragua or Costa Rica or those who hold their concessions be disposed to make unreasonable demands, negotiations with the Panama company can be undertaken.

So far as the legal steps necessary to give us a right of way across Nicaragua are concerned, we do not see that Congress can do any more, or that it is its place to do more. It can, however, if it desires to hasten the date when actual construction can begin, lay down the general financial and administrative plan on which the canal shall be built. If it does this, it should discard wholly the clumsy "dummy corporation" scheme laid down in the Senate bill, and provide for the carrying on of the entire work by means of a permanent commission, the members of which should be appointed by the President. Experience has amply proved that no system of carrying out large public works is so productive of good and sound work, so economical of public funds and so free from corruption and jobbery, as the method by appointive commissions.

If Congress, in addition to authorizing the Executive to smooth away the legal difficulties, should provide for the appointment and organization of such a commission, and supply it with funds for a year to come, it will have done all that it can possibly do to hasten the date when the work of construction on such a canal can begin. It must be plainly understood that a great amount of further surveying and engineering work must be done, in any event, before contracts can be let; and this work can go forward at once, without waiting for the removal of the legal barriers, if Congress so orders. The months that will elapse before the next Congress begins its sessions will be none too long for the selection and organization of the commission, the formation of its engineering staff and the carrying out of final definite location surveys and detailed plans for the various structures. This engineering work must precede construction in any event; and if its beginning is postponed until all the legal obstacles are removed, the chances are that it will be so hurried by the public demand for a beginning to be made upon the actual work of construction that many mistakes will be made.

The excuse made by many Senators in voting for the Morgan bill, which they acknowledge to be a highly objectionable measure, was that it was the only way to expedite the beginning of actual work upon the enterprise. We have opposed the Morgan bill from the beginning, however, because it has seemed to us more likely to hinder than to hasten the work of canal construction. The United States can get a new and perfect concession on its own account from Nicaragua more easily than it can persuade her to extend the old Maritime Canal concession, which she has already declared to be forfeited, and which is highly objectionable on other grounds. It provides, for example, that another canal must be built from Lake Nicaragua to Lake Managua, a piece of work which has absolutely nothing to do with the ship canal, and for which no surveys or even approximate estimates have ever been made.

Why, then, should the United States urge the renewal of this old concession? Why not secure on its own account the necessary rights from the Central American states? Why not, while this work is in progress, let the administrative and engineering organization necessary to carry out this work in a proper manner be perfected? If the House shall pass a simple measure to effect these ends, there can be little doubt that it will receive the approval of the Senate. Such a bill, moreover, might, without objection, carry a clause providing for the payment to the Maritime Canal Co. of the actual cash value of its plant and its surveys, to be determined by disinterested appraisers. It would then do everything for the stockholders of this company that the Morgan bill, as amended in the Senate, apparently will do, so far as its vague, ambiguous and contradictory phraseology can be understood.

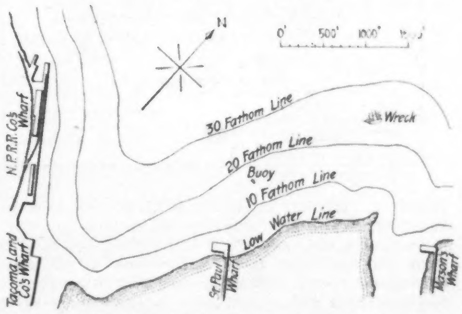
LETTERS TO THE EDITOR.

The Capsize of an English Freight Steamer in Tacoma Harbor, Wash.

Sir: An unusual and remarkable disaster occurred in the harbor of Tacoma, Wash., on the night of Jan. 13, or early the next morning, when the ship "Andelana" "turned turtle" and went to the bottom, with all on board.

The "Andelana" was a four-masted, bark-rigged British ship, 304 ft. long, 42 ft. beam, and 25 ft. deep, built entirely of steel, and of a gross tonnage of 2,600 tons. She entered the harbor a week previous in ballast, to load wheat for England. On Jan. 13, the work of unloading ballast was completed, the ship lying at the City buoy (marked in the accompanying sketch) while this was going on, as, owing to the great depth of water, there are no restrictions placed upon dumping ballast overboard anywhere in the harbor. She was to be hauled into berth at the elevator on the next day, and, meanwhile, as a precaution, had fastened two stays, or ballast logs, on either side by chains.

In the night a strong southwest wind blew, reaching 39 miles an hour in one 5-minute record, and 42 miles an hour for one minute at 2:20 a. m. (Jan. 14). Other ships in the harbor reported minor mishaps and had extra men on watch. For several hours after daylight no one noticed the absence of the "Andelana." When search was made for her only one of her boats, a few oars, and the starboard stay log were found. A tug was put into service dragging over the ground, where she lay the day before, and it soon brought up on some wreckage which it was unable to move.



Sketch of Portion of Harbor, Tacoma, Wash., Showing Location of Wreck of Steamer "Andelana."

As this wreck lies in 23 fathoms of water the task of wrecking will be a difficult one. As the extreme distance from keel to truck is only 145 ft., she might stand upright and still be entirely submerged at high water. As may be seen from the sketch, the slope of the bottom in the ship's vicinity is too steep to admit of "beaching" by lifting with the tides. As the ship is nearly new and worth fully $150,000, strong efforts will be made to raise her by some means. Very truly, A. McL. Hawks.

Tacoma, Wash., Jan. 16, 1899.

A Proposed Standard Size and Form for Business Cards.

Sir: The various sizes and styles of business cards make it exceedingly difficult to preserve them in a convenient form, and the consequence is that they generally find their way into the waste basket in a short time after being presented. It is the practice of the writer to transcribe the information contained on a business card to an ordinary blank card such as is used for filing in the cabinet of the Library Bureau Company. By doing this, all addresses are easily preserved and the cards are filed under the name of the business instead of the name of the firm or individual presenting the card. This transferring of the record from the original card to the card in filing cabinet would be avoided if a uniform size and style of business card were adopted, and it would appear that it would be in interest of all concerned if this could be accomplished.

The size of the standard card for filing in the cabinet mentioned is 3×5 ins., which is sufficiently large to permit of all necessary matter to be printed thereon. The sample card, sent herewith, shows the face of a plain business card with hole punched in proper place. The first line or heading denotes the business of the company offering the card, and this is placed as an index for filing, and with this system all cards would be filed under the title of the business or the article manufactured. This is done to secure a system of filing which will at all times furnish the information desired. As an example: There are a number of makers of car wheels. If the card were filed under the name of the individual presenting it, or the title of the manufacturer, the person seeking information from the card must remember at all times either the name of the individual or the manufacturer; whereas, if these cards were filed under the name "Car Wheels" as indicated on the upper left hand corner of the card they would all be together in the file, and no effort of memory would be required. In this manner the name of the various supplies necessary to be purchased would be together in alphabetical order, and if it were desired to have a card under the name of the individual or the manufacturer, a separate drawer in the cabinet could be used.

Each drawer will hold about 800 cards, and with this system we have a complete index of all firms manufacturing the various supplies, which is especially desirable for Purchasing Agents, and this cabinet will not occupy a space of more than 6½×13½ ins. on the desk.

The back of the cards may be used for noting quotations and will be found of great convenience in recording the visits of the representatives and quotations made at that time, and as such quotations cancel any previous figures, the old card will be removed from the cabinet and destroyed and a new card inserted in its place. We believe that a neatly printed card in this form will be of much greater value to all than the most expensive lithographed one which is not made in such a manner as to be

SIGNALS, INTERLOCKING & SWITCHES.

The Union Switch & Signal Co.

OWNERS OF

THE NATIONAL SWITCH & SIGNAL CO.,

THE JOHNSON RAILROAD SIGNAL CO.

CHARLES HANSEL C. E.,

MANAGER
DEPARTMENT OF SALES AND INSTALLATION.

43 CEDAR STREET,
NEW YORK.

preserved. The only catalogues which are sure to be kept and referred to are those which are made to conform to the standard size, and if the Purchasing Agents of the Railroads and other large corporations would request all business houses with whom they deal to furnish their representatives with a card made in the manner hereinabove described, we believe that it will be but a short time before all business cards conform with this principle.

Yours truly, Charles Hansel.

43 Cedar St., New York, Jan. 11. 1899.

(We reproduce herewith Mr. Hansel's own business card, reduced in size one-half. On the back of the card is printed in red ink headings and blanks for "Quotation, Month, Day, Year." The advantages of such a uniform style and size of business cards as Mr. Hansel suggests are obvious and we commend his suggestion to the Master Car Builders' Association and the American Society of Mechanical Engineers, the two organizations which have hitherto done most toward standardization of the sizes of trade publications. —Ed.)

The Organization of a Railway Engineering Department.

Sir: In the issue of Dec. 10, 1898, of the "Railway and Engineering Review," appeared an extract from an article read before the St. Louis Railway Club, entitled "Organization of a Railway Engineering Department," by W. Beahan, C. E. It is the opinion of the writer that many of the statements set forth in the article referred to do an injustice to hundreds of the faithful, conscientious and painstaking railway engineers of American railways, and it was expected before this time to note some defense taken in behalf of our maligned brethren.

The author of this paper opens with the statement "that being an engineer, it is his privilege to criticise sharply that department—its past deeds and its future weaknesses, due to its structure and its history." The writer has in vain attempted to ascertain what the author really intended to convey by this statement. That he intended to cover the entire ground is the only obvious inference. His right to criticise is not questioned, and, indeed, no opportunity has been lost to exercise that right, even to the extent of making his paper nothing but a criticism of engineers and their practices, with the result that no new ideas or valuable information found room in the paper. Past misdeeds have been criticised, but no good deeds eulogized. As to future weaknesses, "due to its structure and history," the writer's judgment is that the engineer and his profession will in the future not be ashamed of its history, nor will the structures that he rears by his earnest efforts lose any of their strength when compared with the efforts of any other class of men in the railway or other fields of activity. We have faith that its past deeds will guarantee that "its future weaknesses" will prove of all requisite strength.

Again the author states that "the service rendered by maintenance-of-way engineers is too little." The writer knows one instance, at least, where one engineer has charge of nearly 500 miles of line, and is personally performing the duties formerly devolving upon four men. There are, doubtless, hundreds of similar instances on the railways of America to-day, and the service rendered by these trained men is as faithful and conscientious as any rendered the railways, and less richly rewarded than any other service considering the training and capability of the men. The popular idea of the engineer is fairly set forth in the paper as credited to the late G. S. Noble, of the Texas & Pacific Ry., that "an engineering department is a necessity during location and construction, and a necessary evil in operating a railway." The author further states that many railway managers to-day have an engineering department because they have not succeeded in avoiding it, and that "the managers do not know how to use their engineers and most of the money paid for them is wasted."

The facts fail so utterly to bear out these statements that it is useless to controvert them. But this idea of the superfluity of the engineer, is happily not shared in by the best railway executive officers of the day. We need point to out one instance to prove that when the engineer has located, constructed and completed the railway ready for operation, the same skill that solved the difficult feats making necessary the operation, was found to be ready and able to successfully carry out the "operation." The Pennsylvania Railroad stands to-day the peer among American railways. Its late lamented President, Geo. B. Roberts, began his railway career as a rodman on the engineering corps in locating the lines. He won his way by successive steps until he reached the head of that vast corporation. No such statement could be attributed to him that "the engineering department was a necessary evil in operation." He wisely chose from his department the operating officers for the system, a practice that is being followed out almost exclusively to-day on this system, and the results show the wisdom of the policy. It is not difficult to determine why this policy has been so successful on the Pennsylvania Railroad, as well as other lines where it has and is now being adopted. The technical training of the engineer, the subsequent handling of problems requiring thought and close attention to detail, the handling of men and materials, naturally qualify him successfully to undertake the problems of "operation." Compare this training and experience with that of a trackman, roadmaster, train conductor, telegraph operator and train dispatcher, and which would make the most "capable operating officer?" The results on railways managed by two classes referred to may be appealed to for an answer to this question.

The author would put in charge of maintenance-of-way a division superintendent, even though he knew absolutely nothing about track, bridges, etc. In other words he would place in charge of important matters a person ignorant of these matters. It would be as rational a procedure to call in a lawyer to discharge the functions of a physician, or vice versa. The maintenance-of-way is important enough to be under the jurisdiction of men who understand it and its principles, and the best results are not otherwise attained.

It appears to the writer, therefore, that the best organization of an engineering department would be to have the maintenance-of-way work entirely under engineers, be they Superintendents, who are engineers, Engineers Maintenance-of-Way, or Chief Engineers. The Chief Engineer should report to the General Manager; the Engineer Maintenance-of-Way or Division Engineer should report to the Chief Engineer. This is at once most direct and satisfactory for the operation of the railway. What a useless waste and extravagance of both time, correspondence and money to have Engineers Maintenance-of-Way reporting to an operating officer, who in turn must refer all these matters to a Chief Engineer, who in turn instructs the operating officer to instruct the Engineer Maintenance-of-Way? It is a system of interpretation that in fact requires no interpreters.

Finally, as the ability of engineers to make operating officers and successful ones, is appreciated and the practice of the best lines of the country followed, the science of railway operation, whose foundations are laid in the "Engineering profession" will be perfected, and the proper organization of the engineering as well as other departments of the railway will be established beyond peradventure. Railway Engineer.

Jan. 17, 1899.

Notes and Queries.

C. M. P., Toledo, O., asks for information as to the comparative strength of buckle plates when laid with their convex face up and when laid in the reverse position.

Buckle-plates are always laid with the convex face up, so far as we are aware. If laid in the reverse position they would fail by the tearing out of the bolts or rivets securing them to the floor beams.

E. A. Leigh, 35 Mason Building, Boston, Mass., American representative of Mather & Platt, of Manchester, England, informs us that his firm controls United States patents on the Archbutt-Deeley process of water purification, described in our issue of Dec. 22.

ANNUAL REPORT OF THE CHIEF OF THE BUREAU OF YARDS AND DOCKS, U. S. NAVY.

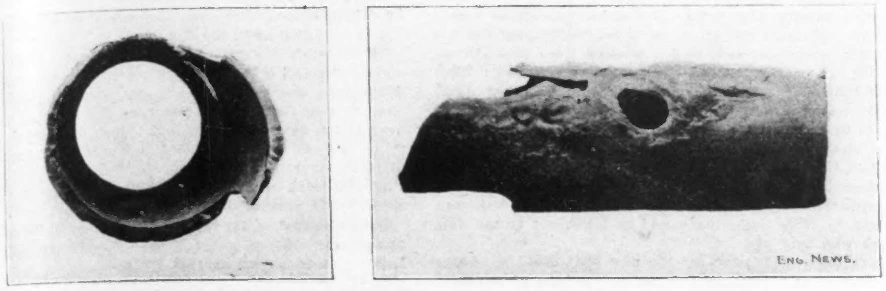
The first annual report of Commodore Endicott is a decided innovation compared with previous reports from this bureau in the amount of practical information contained. In addition to the reports upon operations at the individual naval establishments under the direction of the Bureau, this report contains plans showing each establishment in detail, including in these the new station at San Juan, in Porto Rico, and the coaling station at Pago Pago, on Tutuila Island, in the Pacific Ocean. This is information both new and interesting to the public, and it makes the report correspondingly valuable for reference. The total expenditures at navy yards and stations, during the year ending June 30, 1898, was $1,772,155, including in this $832,378, for yard improvements and $537,570 for repairs and preservation. The regular estimates for the year ending June 30, 1900, call for a total expenditure of $605,225.

In concluding his report Commodore Endicott calls the attention of the Department and Congress to the importance of organizing the Corps of Civil Engineers of the U. S. Navy upon a somewhat different basis from that now existing. The Corps now numbers only 18 officers, all with the grade of full civil engineers. The suggestion is made that Congress should permanently fix the method of admission to this Corps, so that appointments to it should be made from civil life only after a competitive examination, or, after careful selection, from the Naval Academy. The grade of Assistant Engineer should be created; and the number in this grade should be variable, at the discretion of the President, to suit the requirements of the service. There would be no additional expense to the government, as the establishment of this grade would obviate the present necessity of employing an equal number of young men from civil life, under the various titles of draftsmen, transit men, levellers, etc., now paid from appropriations made for the works upon which they are engaged. The new assistants, being commissioned officers, would have the requisite authority and status for performing work to which they are assigned and could properly represent the Civil Engineer in his absence. Graduates of the Naval Academy, who have completed the two years' cruise and final examination, and are naturally fitted for and inclined to become civil engineers, might be assigned to such duty under the Civil Engineer of some navy yard. After three months of such duty, if found qualified, the Chief of the Bureau of Yards and Docks could then recommend to the Department that such officers be ordered to some engineering school for such a post-graduate course as would best fit them for the duties of a civil engineer in the Navy. On the completion of such a course they would be commissioned as "Assistant Civil Engineers, U. S. N." Commodore Endicott proposes later to submit the draft of a bill making examinations for admission obligatory and embodying these recommendations.

FIRE DESTROYED THE STEAMER "OUACHITA," of the Memphis & Vicksburg Packet Line, on Jan. 19, while she lay at her wharf in Memphis, Tenn. Three persons were killed.

AN EXAMPLE OF ELECTROLYSIS OF WATER MAINS IN BROOKLYN, N. Y.

On Dec. 11, 1898, a 4-ft. water main, located in the eastern part of the city of Brooklyn, N. Y., burst, doing a great amount of damage to adjacent property, and cutting off the water supply over a large area of the city. A brief description of the accident was given in Engineering News for Dec. 15, in which the cause of the break was stated to be a defective casting. We have since been informed, on the authority of an engineer who examined the pipe shortly after the break occurred, that the broken section displayed unmistakable evidence of electrolytic action. The place where the break occurred is in the vicinity of an electric railway power station, and it is generally understood that ground currents from the electric railways are to be found on the water mains in many parts of Brooklyn, and were recently shown to have even crossed the Brooklyn Bridge and made themselves evident on the lower part of Manhattan Island. In self-defense, the Fire Underwriters may be forced to increase insurance rates in cities where water mains have been injured by electrolysis.



SIDE AND END VIEW OF A SECTION OF 8-IN. WATER MAIN.
(Showing the Result of About Four Years of Electrolytic Action.)

The accompanying illustration is reproduced from photographs of a section of an 8-in. water main recently taken up. It is of interest as an example of the effect of electrolysis in thinning iron pipe, and also as a piece of circumstantial evidence upon the causes of the break in the 4-ft. main above referred to. The hole in the upper side was originally plugged by a brass corporation cock. The pipe was originally of fairly uniform thickness (about one-half inch) throughout its circumference, as shown by inspection of the pipe at a point two or three feet from the corroded section.

This specimen of corroded pipe was recently presented to the Executive Committee of the National Board of Fire Underwriters, together with a report upon it by the expert engineer of the Board, from which we quote as follows:

Owing to the bursting or giving way of a 4-ft. water main in Brooklyn, the attention of the community of Greater New York has recently been somewhat startlingly called to the destruction that is going on underground upon the water-pipe systems, and an examination made by the undersigned of a portion of the removed pipe once more gives evidence of what has been claimed would happen if the authorities did not take necessary and proper steps. In other words, the imperfect construction of trolley roads is causing slowly, but surely, the destruction of water and gas services throughout the country.

In regard to the probable condition of the water pipes in Brooklyn and that portion of New York city immediately above and to the north of the Harlem River, the undersigned begs to state that a careful inquiry made among the employees of the Water Board in Brooklyn brought to light the fact that they (the employees) were fully aware of the conditions as they existed and do exist at the present time, as they have been knocked down by the current while working upon water mains, and, in some cases, severely injured, and in other cases badly burned. Yet in this community such a state of affairs is permitted to exist, and, as far as the records show, no effort has been made on the part of the insurance authorities to prevent it. And yet it could have been prevented, and if I may be permitted to say so, must be stopped now or the community at large will inevitably meet with nothing less than a conflagration when the conditions for such an event happen; and when they do happen, the events will be coincident, and it may not only be a large loss of property by fire, but it may mean the loss of a great number of lives.

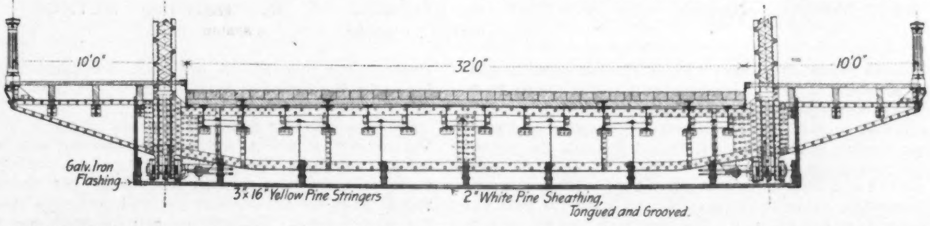
Let us suppose, for instance, a case which can be readily imagined. What would have happened if a fire had occurred in Brooklyn among the frame buildings in the neighborhood of the break in the 4-ft. water main? This particular locality, as far as the buildings are concerned, would have been completely wiped out of existence, and lives would certainly have been lost in the general panic. This statement is not made by the undersigned for the purpose of appearing as an alarmist, but simply as an actual state of affairs as they exist to-day, only in far worse condition in other parts of Brooklyn. For instance, one of the head employees of the water-works in Brooklyn made the statement to the writer that one of the railroads was absolutely using a 6-in. water main as a return feeder, and the authorities were not objecting. Admitting, if you please, that this is a fact, what would be the natural result in a short space of time? You can form your own opinion when intelligent expert engineers have proved beyond peradventure that 1 5-10 volts difference in potential between the water pipe and rail is dangerous; and here we have a railroad company deliberately transmitting an enormous current at a voltage anywhere from 250 to 400 between the trolley wire and the underground pipes. If they were simply transmitting a current with a difference of potential of 15 or 20 volts, enough facts have been presented to prove that this amount of voltage carries with it a current that would, of necessity, under the natural laws, cause enormous destruction. In proof of this, permit me to call your attention to another exhibit and complete report recently published by the trustees of the Dayton, Ohio, water-works. I will quote from that report for your information: "At 4 5-10 volts it has been shown that 6-in. pipe can certainly become useless in five years." Query: What is now the condition of the 6-in. water pipes in Brooklyn, if what the employee has said is true, that a 6-in. pipe has been used as a return feeder with from 200 to 300 volts pressure upon it? Again: "It is known to the department that certain pipes have been destroyed beyond the limit of the danger district at 1,300 ft."

The natural query is, Can the destruction of these pipes be prevented, and how? It can, and there are several methods. The most absolute way of preventing the destruction of underground pipes in a large community like this (New York and Brooklyn) is to compel the overhead trolley to go underground, and use double-metallic circuits, as has been done on the Metropolitan Ry. lines on Manhattan Island. Admitting, for argument's sake, however, that the railway cannot, without undue expense make this change, they should at least be compelled to immediately rebond their roads and run return feeders, having a conductivity and capacity equivalent to the greatest amount of current that may be required at any one particular time during the operation of the road, and they certainly should not be permitted to humbug the authorities in the matter of bonding as they do now in the majority of cases. For instance, they should not be permitted to bond or electrically connect two sections of 70-lb. rails with a No. 0000 B. & S. wire, and consider that they have done their duty in the way of providing a return path for the current; inasmuch as a single track of two rails (70 lbs.) has an equivalent of 17,405,000 circular mils, whereas a No. 0000 bond wire is equal in circular mils to 212,000, a difference of 17,193,000 circular mils.

WOODEN CEILING PROTECTION OF AN OVERHEAD BRIDGE FROM LOCOMOTIVE GASES.

We illustrate in the accompanying cut the method adopted to protect the underside of the 21st St. bridge in St. Louis, Mo., from corrosion by the smoke and gases from locomotives passing on the tracks below. The ceiling extends over a portion of the railway yards, where, with a clear height of 17 to 18 ft., a great amount of switching had made all previous attempts to keep the metal covered with paint utterly futile. The hot steam would hardly allow the paint to harden, and even when it became hard the cinders thrown out from the smoke stacks against the metal-work, it is stated, scratched the paint off as effectively as sand blast could have done. The steel work of this bridge had therefore suffered very much during the six years since its erection and the adoption of some other mode of protection had become a necessity.

The details of the ceiling are shown in the cross-section, Fig. 1. The joists are of yellow pine (it is important to make them of hard wood, so that they hold the spikes better when the lumber shrinks), and are supported by the bottom flanges of the floor beams and by hangers. The sheathing consists of 2×6-in. white pine planks, planed, and tongued and grooved, to keep cinders out and to present an even surface where hot cinders cannot lodge, so that the risk by fire is reduced to a minimum. The corners of the ceiling are furthermore protected by a galvanized iron flashing. The loss of clear height from top of rail to the underside of the structure is less than 3 ins. The metal-work thus protected is accessible and can be painted and inspected, not conveniently, but effectively. It is stated that possibly the ceiling will be extended. Portions of the 18th St. bridge in St. Louis were similarly protected last summer. This method of protection was designed by Mr. Carl Gaylor, M. Am. Soc. C. E., Bridge Engineer, St. Louis, Mo., to whom we are indebted for the information from which our description has been prepared.



TRANSVERSE SECTION OF 21ST BRIDGE, ST. LOUIS, MO., SHOWING WOODEN CEILING TO PROTECT THE STEEL FROM CORROSION BY GASES FROM LOCOMOTIVES PASSING UNDERNEATH.

A NEW PAINT FOR PRESERVING IRON WORK.

An English patent—No. 28,484, 1897—has recently been taken out by H. Loesner, who is well known to all readers of German industrial chemistry as a painstaking investigator of the relative protective capacity of different varieties of paint and varnish. His process sonsists in grinding some color into linseed oil in the presence of a certain proportion of hydraulic cement, or cement diluted with sand. Precautions are taken to prevent the cement from absorbing water before the paint is applied to the iron-work; so that when the film is finally exposed the new ingredient is slowly caused to set by means of the moisture present in the surrounding atmosphere; at length producing a thin layer of hardened cement, or cement-mortar embodied in a paint of conventional composition, in which the former provides the waterproofing qualities, and the latter the color and general appearance of ordinary paint. The patentee claims that the introduction of cement in this fashion does not militate against the proper spreading of the material, and that the product is satisfactory in every respect, being absolutely damp-proof and permanent.

The same chemist has also elaborated a quick method of testing paints to determine their moisture-resisting power. This is known as a "steam test," and, being simple to carry out, may conveniently be described here. Pieces of sheet iron are thoroughly freed from rust on one side by friction with emery cloth, then coated with a thin film of paint, and set aside to dry for four days. A second coat is next applied, and also allowed to harden for the same period of time. A vessel containing water is made to boil vigorously, narrow strips of wood are laid across it, and over them are placed the pieces of iron, painted side downward, in such a manner that the films are completely surrounded by the rising steam. The water bath is so arranged that the level of the liquid can be maintained at a uniform position, which is, throughout the whole test, always 50 mm. below the metal plates. After about fifteen hours' boiling the paint is dried at 100° Cent., removed from the iron by the aid of aniline and a brush, and the surface of the metal is carefully examined for spots of rust. If the iron be not corroded the paint may be considered fairly weatherproof; for the author calculates that one hour of his steam test is equivalent to two or three ated from the refuse is used to operate the machinery about the destructor plant, we suppose; how much we do not know.

The combined destructor and lighting plant made a net profit of some $6,000 for the year, after allowing for interest charges and reduction of the debt, and including a credit item for the saving effected by burning the refuse instead of towing it to sea. It appears from the statement that this last item might have been made larger, as the actual cost of barging the refuse was 50% greater than the allowanace, without including capital charges. The combined plants, therefore, seem to be making a good financial showing, especially for the first year of service. How much of this is due to the rates collected from consumers of electric current, rather than steam raised by the destructors, we cannot say. The electric lighting rates are said to be the lowest in London.

One thing is certain, and that is that the Druitt-Halpin storage system has thus far been a drawback, instead of an aid to the scheme, for it was not used at all during the year under review, and consequently did not meet its own capital charges. We have this information from Mr. Kershaw, who wrote us on Dec. 28, as follows:

The thermal storage cylinder has never been perfected It is now working farily satisfactorily, but is not doing all that was claimed for it, mainly because we have not that use for it now, as our electricity load is far away in excess of the steam we can get from the burning of the ash-bin refuse, and we are now firing up with coal under our secondary furnace—that is, the ordinary grate under the tubular boiler—every night. But the item of coal you refer to for our first year's working was what we used in the same secondary furnace during the period stated when we could not get sufficient refuse from our scavenging department—such as on Saturday evenings and Sundays until early Monday morning; but in no instance do we ever mix the coal with the refuse, and the contractors' guarantees of raising a certain quantity of steam from the burning of our refuse in 24 hours have been amply satisfied.

Brief descriptions of the Shoreditch plant were given in our issues of Aug. 5 and 27, 1897. In the last-named issue was an editorial discussion on "Garbage as a Fuel for Electric Light Stations," in which we expressed the opinion that the possibilities in this line had been overestimated, especially for American conditions.

HEATING A PRIVATE RESIDENCE WITH A WARM-AIR FURNACE.*

By B. Harold Carpenter.

After all has been said and done regarding the heating of residences by various methods, is not the much abused warm-air furnace system, at least theoretically, the best adapted for residences of moderate size? Acting on this line, we have endeavored to overcome some of the weak points common to this mode of heating.

In the first place, all the air to be warmed should be brought from outside of the building. To accomplish this, we have set the furnace over a pit built of brick and cement, which is connected to the outside of the building by a brick duct as straight as possible, avoiding angles, and of ample size to admit the air freely.

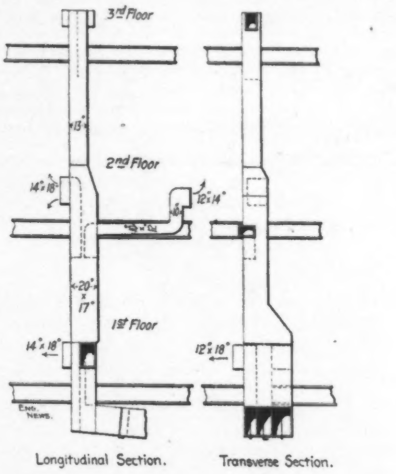
In the second place, gases and overheating the air should be avoided. To accomplish this a furnace was provided with as few joints as possible, these joints so constructed that they could be made practically airtight. To prevent overheating the air the furnace should have a large radiating surface.

In the third place, all the rooms should be heated evenly at all times, by concentrating and combining all the warm-air outlets.

The furnace is the round, portable type, with base, fire pot and body of cast iron, body of dome and radiator of wrought iron or steel, top of dome and top and bottom of radiator of cast iron. All is encased in a double galvanized iron jacket. The grate being 30 ins. in diameter, has a surface of 4.9 sq. ft. The total radiating surface of fire pot, body, dome and radiator is 107 sq. ft., or a ratio between grate and radiating surface of 1 to 21.7. The contents of the house heated is 38,800 cu. ft., which gives a ratio, between the radiating surface and the cubical contents of the house, of 1 to 365.

The grates used are of a triangular pattern and can be used with pea coal, though for heavy firing in severe weather larger coal is more effective. A point frequently overlooked in the selection of a furnace and yet one of considerable importance is to have a reasonably deep ash pit, so that the ashes may be kept free from the grate with ease.

The air passage between dome and radiator is 8 ins., and the air passage between radiator and casing is $4\frac{1}{2}$ ins.; this gives a total of 12.5 sq. ft. warmed flue space for the incoming air. The bonnet on the furnace is 24 ins. high above the radiator, or somewhat higher than usual. This is necessary so that the larger pipes can be taken off above the radiator. Prof. Carpenter gives the velocity of air at this latitude to the first floor from 2.5 to 4 ft. per sec., to the second floor 5 ft. per sec., and to the third floor 6 ft. per sec. This would give an average of 4.8 ft. per sec., or 288 ft. per min. By multiplying the flue space by the speed we have 3,600 cu. ft. of air per min. This being rightly distributed throughout the



Flues for Securing an Even Distribution of Air from a Warm Air Furnace.

ducts and registers would be sufficient (the contents of the house being 38,800 cu. ft.) to change the air throughout the building every eleven minutes.

The furnace is set over a brick pit, which is connected to an opening on the north side of the building by a brick duct 12 sq. ft. in area. Partitions extend from the top of bonnet to the top of the pot in the hot air chamber.

The furnace bonnet is connected to the rising pipes by galvanized ducts. There are but five rising pipes in the building, A, B, C, D and E. A is connected to six rooms, B to six rooms, C to four rooms, D to three rooms and E to one room.

The cut gives a detail of riser A, with its various branches; it also shows the valves V at the foot of riser, which are placed to control the amount of air admitted to the various rooms. For a first-floor room a division is placed in the main duct, extending down to the elbow and about two feet into the horizontal duct in the basement where the valve V is placed. This also shows the method of running risers to second floor. In all cases where branches are taken off the main riser, the branches or divisions extend into the main riser 2 to 4 ft. All elbows, where possible, are made round. All rising pipes are well covered with asbestos paper wired fast. We have endeavored to proportion the rising pipes so that each branch may get its proper proportion of air, the risers being reduced in size as each branch is taken from it. To obtain the proportion for size of pipe we use the following rule:

To find cubic feet of air passing through pipes to—

1st floor,	multiply	area	in sq. ins. by	1.25
2d floor,	"	"	"	1.66
3d floor,	"	"	"	2.08

There is a large return register under wash basin in the rear hall. This is connected to the cold-air duct in the basement, and may be used at any time to warm the house quickly and economically by opening the return register and closing the valve in cold-air box at the entrance to the basement. This allows the air in the rooms to return to the basement, where it is again warmed.

We know from experience that this arrangement of heaters, pipes, etc., is very satisfactory in operation and economical in fuel. The loss by radiation of exposed pipe surface in basement is reduced from one-half to two thirds.

The above arrangement has been used in a number of residences in our city, and by anemometer tests it shows that every room in the house gets its proportion of warmed air, pure and fresh.

Discussion.

The discussion of the paper covered a wide range, including the comparative merits of warm air furnace, steam and hot water systems. The lack of experimental data upon which to design warm air systems was commented upon. The construction described in the paper was praised by some members, but others doubted whether the combined flues were as good as separate flues. It was pointed out in criticism of a few of the statements made in the paper that the requirement that all the air warmed should be brought from the outside of the building entailed a great waste of fuel, that it was violated even in the design proposed, in having an air inlet from the hall as well as from out doors. It was also shown that the calculated quantity of air warmed, 3,600 cu. ft. per minute, could not be heated from 0° to 70° or upwards by the furnace, and that if it could be it would require an unreasonable expenditure of fuel. There was no need of changing the air for ventilation every eleven minutes, as stated in the paper; once or twice an hour is sufficient in residences, and if such an amount of heated air is required for heating purposes then the greater part of it should be taken from within the building and only a sufficient amount for ventilation from out of doors.

*Condensed from a paper presented at the New York meeting of the American Society of Heating and Ventilating Engineers.

CAPACITIES FOR CULVERTS AND FLOOD-DISCHARGE.

At a recent meeting of the Institution of Civil Engineers, Mr. George Chamier, M. Inst. C.E., presented a paper with the above title, which is here given in abstract:

All calculation of flood-discharge are primarily based on the catchment-area, rainfall, amount of discharge surface, and the diminution in proportionate flood-discharge due to area. In connection with the catchment-area, it is important to note the form and greatest length, the outlines of the principal valleys, and the distances traversed by the main water-courses. The general declivity of the ground and the average fall of the valleys towards the outlet are also of importance as affecting flood-velocities. In taking this catchment-area as a factor for calculating maximum flood-discharge it must be assumed that the rain is general over the whole area, and that the rainfall is of sufficient duration to allow the flood waters from all parts of the drainage area to reach the outlet at one time.

The amount of rainfall and duration of the rain are the important elements. The average rate of precipitation is found everywhere to vary inversely as its duration. In temperate zones as much as one-fourth of the mean yearly rainfall has been known to occur in one day; and about one-fourth of the maximum daily fall has been registered in one hour. In designing drainage works for towns, therefore, it is required to decide on the greatest rainfall in one hour; and for highway and railway culverts provision may have to be made for the greatest anticipated fall in one-half hour. The safest rule is to take the greatest rainfall, as recorded, for such a time as is required for the flood-water to reach the outlet from the extremes of the catchment-basin.

A certain portion of the rain falling on the surface need not be taken into account in calculating flood-discharge. Some is lost from absorption, depending mainly on the porosity of the soil and its condition at the time; a part is evaporated, depending on temperature and time of exposure; another part passes by percolation into subterranean channels. The coefficient of discharge, or the portion that immediately flows off the surface, is thus extremely difficult to estimate. As a general rule, the coefficient of surface-discharge may be taken between one-third and two-thirds of the total rainfall, in times of flood. The author gives the following approximations:

	Per cent. of run-off.
Flat country, sandy soil or cultivated land........	25 to 35
Meadows, gentle declinations, absorbent soil....	35 " 45
Wooded hill-slopes and compact or stony soil.....	45 " 55
Mountainous and rocky country, or non-absorbent surface	55 " 65

For naked, unfissured mountains, very steep ground or paved streets, the coefficient may exceed 80%; but a coefficient of 65% may be assumed as a maximum for ordinary cases.

Flood-volumes are inversely proportionate to the extent of the catchment-areas, though the ratio is not determined with certainty. The rainfall and physical conditions of various countries differ so widely that no formulas admit of general application. But judging from experience and a number of observations the author proposes for average

cases $\frac{M^{3/4}}{M}$ as the ratio of decrease due to area.

Here M = area of catchment in square miles.

With the above data ascertained, the calculation of the greatest discharge is simple. In the formula

$Q = A \times R \times C \times \frac{M^{3/4}}{M}$; for A we may substitute

its value in square miles, or 640 acres; Q = discharge in cu. ft. per second; R = the average rate of greatest rainfall anticipated, in inches per hour, months' exposure to wind and rain. Twelve hours may be taken as the minimum period of resistance for a good paint; scarcely any kind of composition will withstand the steam longer, except the patent material described in the last paragraph.—"The Engineer."

REPAIRING A TUNNEL ON THE WESTERN & ATLANTIC R. R.†

By W. H. Whorley.*

The Western & Atlantic R. R. passes through a ridge in the Chattanooga Mountains by a tunnel 1,477 ft. long.

This tunnel was one of the first built in the south, being constructed in the years 1848 and 1849. Work was begun on July 15, 1848, and was carried on from both ends. A junction was effected on October 31, 1849, and the first train passed through on May 7, 1850. The work was executed by J. D. Gray & Co., contractors, under direction of Chief Engineer W. L. Mitchell, and the immediate supervision of Assistant Engineers D. C. Morse and D. E. Wells.

The tunnel is lined with a full-centered arch, built of brick resting on stone walls, the springing line being about 10 ft. above the base of the rail. The arch was intended to have a radius of 6 ft. 6 ins.; but in building it was allowed to vary considerably. At the junction point of the excavation from each end, there occurred a bulge in the alinement, the wall on one side being set back and the other wall projecting out into the tunnel.

The track at this place was nearly one foot out of line, in order to conform to the walls as built. In several places the walls gave evidence of failure, and were pushing out into the tunnel. This, in connection with the fact that large cars suffered more or less damage in passing through the tunnel, by striking projecting points on the walls, and low places in the arch, made it advisable to do some repair work on the walls and to increase the size of tunnel at the smallest places.

Preliminary to determining the amount of work to be done, a center line was run through the tunnel and cross sections taken every 50 ft. From these sections a minimum width of 11 ft. at base of rail and of 12 ft. 10 ft. above, was determined on as being a size that could be obtained without excessive work. A template was made conforming to this size and passed through the tunnel. All projections that would not clear the template were marked and afterwards bull-pointed off. When this was impossible, owing to the proximity of wall, the wall was taken down and set back. The new work was set back to 6 ft. from center line at base of rail, and 6½ ft. 10 ft. above.

When torn out, the portions of the wall which had given way were found to have been built on the sloping sides of large bowlders, and the insufficient footing had caused failure of the wall. Fig. 1 shows a section of the wall as torn out at Station 113 + 10 and as rebuilt. The smallest cross section occurred at a bulge, near Stations 114-115, and it was determined to take down all of the projecting wall, about 170 lin. ft., and set it back to correct position.

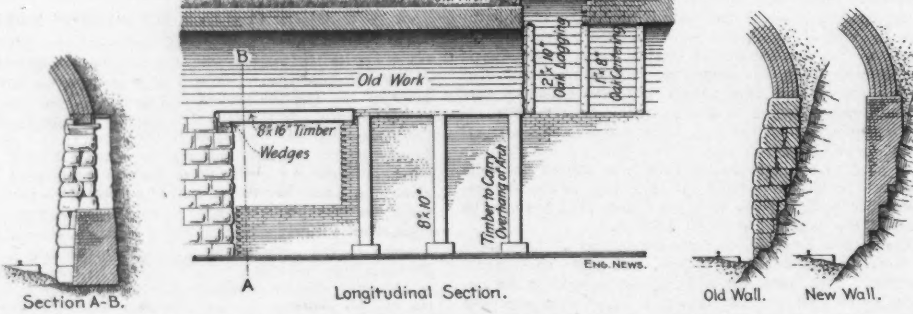
Owing to contracted space in the tunnel, it was necessary to remove all men, tools, and material, whenever trains were to pass through, and in order to do this, a work train of three cars was fitted up with the necessary scaffolds and supplied with gasoline torches for lighting purposes. Mortar was mixed on the cars, and all material remained on them until used. Debris torn out of the old wall was loaded on the cars and hauled to the waste bank. A siding was built near the west end of the tunnel for the use of this train, and a telephone system installed. This consisted of three stations—one in office of the agent at Tunnel Hill, one at this siding, and the third at the east end of the tunnel. Semaphore signals at each end of the tunnel, in connection with the telephone system, were used to protect the workmen and work train.

In the original work, Howard cement, manufactured on the line of Western & Atlantic R. R., was used, and was found to be very hard and extremely difficult to cut out. However, owing to the slow setting quality of Howard cement, it was deemed best to use Louisville cement in the repair work. On account of the contracted working space and the greater ease with which brick could be handled, it was decided to rebuild the walls out of brick instead of stone.

In tearing out the old wall, a hole was first cut through the three bottom courses of the arch and gradually widened. As a stone in top course of masonry was uncovered, it would be removed. When the opening became four or five feet long, a small jack was placed near the center of it and brought to a bearing against the arch to sustain it. After cutting the opening to a length of from seven to ten feet, depending on the stability of the earth backing, the jack was removed and a piece of 8 x 16-in. timber placed in the opening under the arch and brought up to a bearing with jacks. One end of the timber rested on the old wall; the other, on a seat built into the adjoining section of new wall. Wedges were then driven under the ends of timber and the jacks removed. With this timber in place, the old wall could be taken down with ease, the only trouble being that small stones and earth would fall in from above and behind the arch. This was obviated by placing a 2-in. plank across the opening and just back of the 8 x 16-in. timber. At several points, however, the earth backing was saturated with water, and it became necessary to put in lagging as the old wall was removed. This timbering would be taken out as the new work was built up.

A suitable foundation for the new wall could generally be secured at a depth of 2 ft. below the base of the rail; but in the wet places, 3 or 4 ft. below would not secure it, and a concrete footing had to be used. The section of new wall would then be built up as near to the 8 x 16-in. timber as the men could work, the timber removed, and the new wall built up and keyed under the arch. Pieces of slate were used in keying up, being driven into the mortar joints of top course of brick.

With the timber removed, the old arch sustained itself for a span length of 10 ft., without sign of failure, but was allowed to remain in this position for only a few moments at a time, as care was taken to maintain a bearing under the center of span, except at the time of putting in and of removing the timber.



SECTIONS OF TUNNEL ON WESTERN & ATLANTIC R. R., SHOWING METHOD OF REPAIRING LINING.

The new wall has a minimum width of 2½ ft. at the top, and 4 ft. at base of rail, and was provided with weep holes at intervals. In the wet portion of the tunnel the water does not come through these holes, but forces its way through the thickness of the wall, and wets the entire face of same. To facilitate matters, work was carried on simultaneously at two or three different places, the intention being to get one place torn out and ready for the bricklayers by the time they completed a section of the new wall at another place.

Fig. 2 shows the method of underpinning the arch and of rebuilding a section of the wall, and also a section of the arch.

In rebuilding the arch, sections extending from the springing line up as far as was necessary to obtain the desired clearance, and from 2½ to 4 ft. in length, would be removed. Near the sides, the earth above the arch was a stiff clay, which was self-sustaining; but near the center occurred a stratum of gravel and clay saturated with water. This gave considerable trouble, falling through almost continuously until timbering could be placed. One end of this timber rested on the old arch; the other, on the adjoining section of the new work. As the new work was to be set back from the old from 6 to 18 ins., it was necessary to block up this distance on top of the old arch, to carry the end of the lagging timber, in order that the timber would be clear of the new arch. Clearing a place for this blocking was a patience-trying job, owing to the regularity with which mud and gravel fell from above. At one point, before lagging could be placed, material had fallen through until there was a balloon-shaped hole above the arch, about 10 ft. high and 8 ft. across at the widest place. This void could not be found when the adjoining section of the arch was torn out, material having fallen from above and filled it.

Owing to the small clearance between the car roof and the arch, a special form of centering was required, one that would occupy as small space as possible. Bar iron, 1 in. thick, 4 ins. wide, and 20 ft. long, was curved to a radius of 6½ ft., and on the underside of this was riveted a 6-in. plate, ¼-in. thick. This plate projected 1 in. on the side of the centering and carried the ends of the 1-in. boards used for lagging. The rivets were counter-sunk on the outside of the centering, to present a smooth surface next the arch.

In keying up a section of the new work, a space about 18 ins. square had to be left open for the use of the workmen. As soon as the next section had been torn out, this space could be, and was, built up. In building up the last section, this space had to be filled from below, and proved to be a tedious undertaking. The opening was gradually reduced to a size of 10 x 18 ins., and the top ring then completed and keyed up, the adhesion of the mortar holding the bricks in place until the key could be driven home. The next ring was treated in a similar manner, and so on to the face ring.

Of the walls 412 lin. ft. were taken down and rebuilt, and of the arch 178 lin. ft. None of the arch was taken down from one wall across to the other, but only sufficient to gain the required clearance and to bring the arch over to the new wall. The width torn out varied from 5 ft. to 14 ft. at the widest point, or about two-thirds of the distance across.

302,000 brick and 592 bbls. of cement were used in the work, which amounted to 607 cu. yds. of masonry.

The total cost of the work amounted to $7,440, divided as follows:

Labor cost of tearing out old work......		$1,733.60
Cost per cu. yd., including half train crew	$3.82	
Labor cost of building in new work......		1,466.15
Cost per cu. yd., including half train crew	3.38	
Labor cost of train crew................		1,173.15
Cost of material........................	3.82	2,321.85
Company service, freight on material....	1.22	745.25
Total	$8.42	$7,440.00

Nine alcoves, or niches, were built at suitable distances through the tunnel, to secure for trackmen a place of refuge from passing trains. They are 18 ins. deep, 30 ins. wide, and arched over at a height of 6 ft., except that the two nearest the center of the tunnel were made 4 ft. wide.

The regular trains arrived at Tunnel Hill so frequently that slightly over two hours was the longest working time between any two schedules, and usually less than one hour at a time was all that could be used. In addition to the regular trains, a large number of extra trains, moving troops, had to be avoided.

Work was in progress eight months, and during that time there was not one moment's delay to a passenger train, and only once was a freight train held longer than twenty minutes. This showing and the success of the work are largely due to the care and good judgment of Foreman of Construction A. H. Richards. The repairs were completed last August, and a recent examination failed to reveal any sign of settlement cracks at the junction points of new and old work.

*Engineer Western & Atlantic R. R., Atlanta, Ga.
†A paper read before the Engineering Association of the South.

THE FIRST YEAR'S WORK OF THE SHOREDITCH, ENGLAND, GARBAGE FURNACE.

The Shoreditch Dust Destructor, or garbage furnace, located in London, England, regarding which there was so much talk during its installation, consumed 25,913 short tons of garbage during the year ending June 24, 1898, or an average of 71 tons a day. The total charges of the plant for wages, supplies, carting away clinker, insurance, taxes, lighting, water and sundries were $21,280, or 82 cts. per ton. The cost of labor alone was 53 cts. a ton, and carting away the clinker, 11 cts. a ton in addition. No fuel was used to aid the combustion in the garbage furnaces. On the contrary, the waste heat of the plant was used to generate steam for the electric lighting station, in connection with which it is operated, and to heat the public library. The amount of this steam is not stated in the printed report, or "Trading Account," of the destructor and electric lighting plant kindly sent to us by Mr. H. E. Kershaw, chairman of the committee having the plant in charge. The destructor is credited with labor for other departments of the vestry, trade refuse receipts, and a charge of 47 cts. per long ton saved the scavenging department for relieving it from towing the refuse to sea, leaving the net cost of operating the destructor $8,550, about 33 cts. per short ton. To both the gross and net cost, as given above, should be added $6,970, or about 27 cts. a ton, for interest and repayment of capital. This would make the total charges for the destructor $1.09 a ton, and the net charges, without allowance for heat utilized, 60 cts. a ton. What should be allowed for heat furnished the electric light plant cannot be stated, as the report gives no data from which even an estimate can be made, except the tonnage of garbage burned. It has been claimed for the plant that every 10 lbs. of refuse destroyed by it would raise as much steam as 1 lb. of coal, but some of the heat generthe span. About 24 ft. of the 30-in. water main and also of the 12-in. gas pipe were exposed unsupported.

With the culvert stopped up the roadway embankment acted as a dam to the stream above, and the water rose to a height of 10 ft. above the top of the culvert by 4 p. m., Jan. 14, and to 15 ft. above by 4 p. m., Jan 16. The next day, Jan. 17, the rise was 1 ft. more, and finally at 12 m. (midnight) the water broke through the embankment where it was weakened by the cavity caused by the bursting water pipe. The four pedestals of the 60-ft. span were soon carried down (Fig. 1) with the crumbling earth, but the girders and trestle columns were upheld by the adjacent spans of the structure. Fig. 2 shows the appearance of the washout and the bridge at 9:15 a. m., Jan 18. At this time the deflection in the top chords of the girders was about 4 or 5 ins. The reason why the masonry pedestals were torn away from the trestle legs with so little damage to the latter was because the nuts of the holding down bolts had been removed in anticipation, probably, of just what occurred.

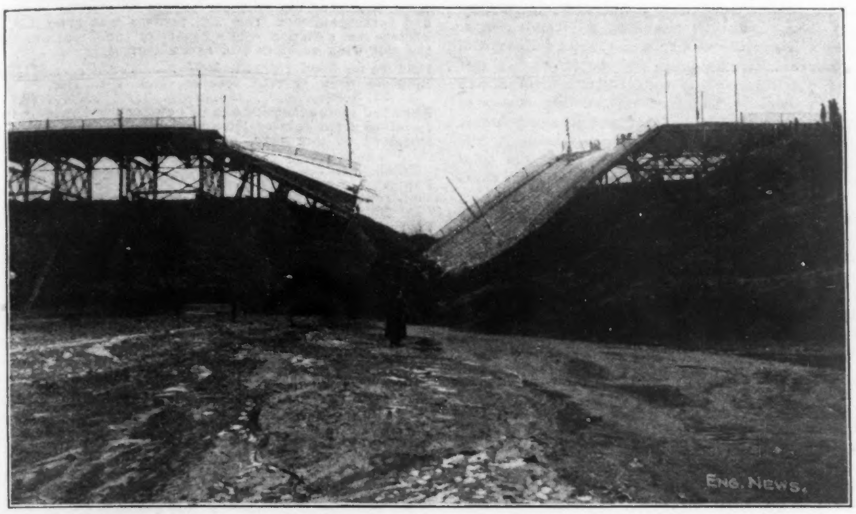


FIG. 3.—VIEW LOOKING EAST TOWARD WILSON AVE. BRIDGE, SHOWING EXTENT OF THE WRECK.

(The foreground shows evidence of the outrush of the water, which tore through the embankment from the opposite side.)

At about 10 a. m., Jan. 18, the west pedestal of the pair still standing south of the opening, which is shown at A, Figs. 1 and 2, was carried down, and the bridge commenced to settle slowly, and finally, with scarcely any noise, it reached the bottom of the washout, leaving a gap of 180 ft. between the portions of the bridge undisturbed. The water which had accumulated above the embankment soon passed off without doing any further damage to amount to anything. Figs. 3 and 4 show the extent and appearance of the wreck so clearly as to make a description of it unnecessary. Fig. 4 was engraved from a photograph taken within an hour after the final collapse, and Fig. 3 is from one taken the day after the wreck, and looking east.

The city is preparing to construct a temporary trestle across the opening made in the viaduct for the accommodation of the street cars and other traffic pending the reconstruction of the damaged portion of the structure by the railway company. For the information from which this description of the accident has been prepared we are indebted to Mr. James T. Pardee, Assistant Engineer in Charge of Bridges and Viaducts, Engineering Department, Department of Public Works, Cleveland, O. The photographs and rough sketch from which our illustrations were made, were furnished us by Mr. C. H. Haupt, Assistant Engineer, in the same department.

THE VENTILATION AND HEATING OF TALL BUILDINGS.*

By Henry C. Meyer, Jr.

The demand for proper ventilation in the modern office buildings is of recent origin and it is very seldom, even now, that means are provided for furnishing a supply of pure air. The increased cost of a ventilating system over the ordinary heating job would make such a slight addition to the cost of a large building that it would seem good engineering on the part of the architect to provide for it, and a good business investment on the part of the owners to pay for it. Of course, the cost of operating the ventilating system is greater than the cost of heating alone, but the increased cost would have such a slight effect upon rental values that the installation of a ventilating plant certainly ought to attract raher than keep away tenants. In considering the cost of a ventilating system it should not be forgotten that the number of really cold days in a year in the latitude of New York and Chicago is not very great, and also that in almost all the tall buildings there is considerably more exhaust steam than is needed to do the simple heating of the building.

One of the earliest really tall buildings in which provision was made for an air supply was the Manhattan Life Building in New York city. In this the building is warmed by direct radiators placed inside of the windows. Long narrow slots were cut in the window sills admitting fresh air over the radiators, so that it would meet and mingle with the column of heated air rising from the radiators. To make the air supply independent of the force and direction of the wind, each room is connected to one of four systems of foul-air ducts carried above a suspended ceiling in the corridors, each of the ducts connecting with a flue or shaft leading to a fan chamber on the roof, where a powerful exhaust fan tends to create a vacuum throughout the building, which insures a flow of fresh air through the window openings. Messrs. Kimball & Thompson were the architects of this building, and Messrs. Gillis & Geoghegan the heating contractors.

A novel ventilating plant for a tall building is to be found in the 11-story Real Estate Exchange, in Buffalo, where a blower system is relied upon entirely for heat and ventilation, there being no direct radiation in the building. Two independent hot-blast coils and fans are employed. The building is E shaped in plan. Near each angle in the building is a shaft running from the cellar to the upper floors and containing a number of galvanized iron flues, one independent flue being carried up from the coils to each of the upper floors. Each flue supplies one-half of a floor, and does this by means of a duct located above a suspended ceiling, the duct supplying registers opening into the top of each room. The air passes out of the rooms through registers into the corridor and leaves the building through openings over the elevator shaft. The architects of the building, Messrs. Green & Wicks, of Buffalo, informed the author but a few weeks ago that the plant cost but little more than the ordinary heating system, and had given excellent satisfaction, so much so that they would install the same system again if opportunity offered. The Buffalo Forge Company were the contractors for the heating system. In this building the temperature of the rooms is regulated by controlling the amount of heated air admitted, as all of the air must be raised to a temperature necessary to warm the most exposed rooms. The ideal arrangement would be to have a double-duct system, that is, a hot and cold air duct, with a mixing damper for each room, but the cost of such a plant would make it almost out of the question. It might be well, therefore, in such a system of air supply, to depend partly on direct radiators, say to put in enough to supply the heat transmitted by the walls and windows, and depend upon the blower system for air for ventilation only.

Still another type of ventilating apparatus is found in the American Surety Building, in New York city, of which Mr. Bruce Price was the architect. Mr. Alfred R. Wolff, who designed the ventilating system, provided an extensive Sturtevant hot-blast plant in the basement, supplying about four changes of air per hour to the seven lower stories. From each of these foul air was drawn by flues to fan chambers on the roof. The plant of the Singer Building, in New York, and that of the Carnegie Building, in Pittsburg, both designed by Mr. Wolff, are arranged with the direct-indirect system of supply with an exhaust ventilating system, and both are said to have been very satisfactory. In all probability this last-mentioned type of plant or that used in the Buffalo building mentioned will be most used in the future, as the flues required in the system where the air is both supplied and removed by a blower system takes up so much room as to render them objectionable, particularly if the building is a tall one.

*Condensed from a paper read at the New York meeting of the American Society of Heating and Ventilating Engineers.

CONTRACTS FOR SANITARY WORKS AT HAVANA, Cuba, were nearly ready for signature when the Spanish-American war began. The negotiations were resumed after the conclusion of peace and were nearing the point of final execution when the U. S. Evacuation Commission requested and secured the suspension of these and some street railway franchise negotiations then in progress. As far back as 1894, M. J. Dady & Co., Brooklyn contractors, sent an engineer, Mr. A. T. Byrne, to Cuba to make plans and estimates for sewers, paving and garbage disposal. Mr. Byrne made a comprehensive report on the subject in April, 1895, and a contract, based on these plans and the report, has been under consideration for a long time. The contract price for the improvements named was about $12,600,000, and the contractors were to take 6% bonds at 10% discount for the work, or about $14,000,000 in all. The work was to be done in five years, but recently the contractors have offered to do it in much less time. A partial separate system of sewerage was proposed, with chemical precipitation for the sewage proper. The effluent was to be discharged into the bay, but on the recommendation of a Spanish engineer the plans were changed and the price increased to provide for pumping the effluent over a ridge and out to sea, the sewage to be lifted some 120 ft. or more altogether. The contractors, M. J. Dady & Co., 40 Court St., Brooklyn, N. Y., have issued pamphlets containing Mr. Byrne's report and a transcript of the lengthy proceedings of the Havana City Council and other officials in this matter. A brief has been submitted to the U. S. Government asking that the negotiations be allowed to proceed. On Jan. 23, the U. S. Attorney-General recommended that the restraining order be continued until affairs in Havana become more settled.

BOOK REVIEWS.

THE DESIGNING OF DRAW SPANS.—By Charles H. Wright, M. Am. Soc. C. E. New York: John Wiley & Sons. Cloth; 6 x 9 ins.; pp. 307; illustrated; $3.50.

Although the author does not mention the fact in his preface, this book is really an enlargement of the work bearing the same title which was published by him about 18 months ago (Eng. News, May 27, 1897), and we are pleased to say that it is a much superior work in many respects. Many of the faults of the original book, and they were quite numerous and important, have been remedied, with the result that the author has produced a useful treatise on a branch of bridge engineering concerning which there was not much information in handy shape for consultation.

Part I. of the book takes up Plate-Girder Draws, and is practically identical with the original volume mentioned above. A fault which this part of the author's work still contains is the publication of a large number of drawings of different forms of turning and end-lifting machinery without any text to describe them and to point out their salient features and points of advantage and disadvantage. In this part also are given formulas and tabular information of various sorts relating to the design of shafting, gearing, bearings, pivots, springs, cams, lever ruptures, etc., which are likely to be useful to the designer. Many of these are taken from the shop records of prominent bridge companies, and have been proven by practice, while others are selected from the works of such well-known authorities as Reuleaux and Unwin.

In Part II. the broader questions of the design and construction of draw spans of various types, including swing spans, bascule spans, rolling draw spans, etc., are treated of. The principal headings explain the scope of the treatment, and these are as follows: Types of Draw Spans; Weight and Cost of Draw Bridges; General Formulas and Tables for Determining Stresses; Deflection of Truss Spans; The Forces to be Overcome in the Operation of a Draw Span: End Lifting Machinery; Turning Machinery; Power for Operating Draw Spans—Steam, Electricity, etc.; Descriptions of Various Existing Bridges; Tables and General Data for Ropes, Chains, Belts, Friction Clutches, Brakes, Strength of Pipes, Cylinders, etc.; Specifications. The text is copiously illustrated by single cuts and large plates of engravings, and an adequate index is provided. Altogether the book is a very satisfactory treatise, and well deserves a place in the library of every bridge engineer.

for such a duration as will allow the flood-water to reach the outlet from the farthest extremity of the catchment-area; C = coefficient of surface-discharge, giving the proportion of rainfall that may be expected to flow off the surface; $\frac{M^{3/4}}{M}$ is used where the water-shed exceeds one square mile in area.

To illustrate the application of this formula to a particular case, the author assumes the following data: Rainfall, 12 ins. for 24 hours, with a maximum of 3 ins. in one hour; coefficient of surface-discharge at full value of 66%; catchment-area of 75 sq. miles, with 14 miles from outlet to extreme point of basin; a rapidly discharging basin with compact, steep ground; the inclination of valleys such as to give the main stream an average velocity of 3½ miles per hour. It follows that the duration of rainfall would not be less than 4 hours, and as the greatest downpour in that time could not be expected to exceed 6 ins., the average rate would be 1½ ins. per hour. Then

$$Q = 640 \times 1\tfrac{1}{2} \times \tfrac{2}{3} \times \sqrt[4]{75^3} = 16{,}384 \text{ cu. ft. per sec.}$$

The author says this is twice the quantity given by Mr. J. T. Fanning in his table of "flood-volumes from given water-sheds" for an area of 75 sq. miles. He explains this by saying that while the Fanning tables are based on a maximum rainfall of 12 ins. in 24 hours and a two-thirds discharge, as above, the rainfall is taken as uniform for the whole day, or 1½ ins. per hour. This the author objects to as inaccurate. He claims that with 12 ins. rainfall in one day, the maximum for one hour should not be less than 2 ins. In Sydney, for example, the records of 25 years show that the heaviest rain for one day was nearly 12 ins.; for 4 hours nearly 6 ins., and for one hour about 2¼ ins.

With the greatest discharge at the outlet calculated, the area of the opening will depend on the greatest velocity of flow deemed safe or advisable. If the culvert or conduit is subject to a constant discharge, as in sewers, a slow and steady flow is best, to avoid erosion; under such conditions 5 ft. per second is a usual limit. But for short waterways, used at long flood intervals, a velocity of 10 ft. per second may be safely allowed. As a maximum of rainfall has been provided for in the calculation, there is no necessity for a margin of safety in the dimensions of the outlet.

In cases actually tested by the author, he found the following results between calculation and measurement of discharge:

(1) Area, 586 acres; flat gully with steep hills at sides; clear, grassy land; coefficient of surface-discharge taken at 40%; heaviest rainfall, ¾-in per hour.

Maximum discharge by formula = 176 cu. ft. per sec.
" " by measurement = 122 " " "

(2) Area, 2½ sq. miles; creek bed very crooked; 2 miles to foot of steep hills; greatest distance of water-travel 4 miles, taking fully 2 hours; coefficient of surface-discharge taken at 50%; greatest rainfall not certain, but estimated at nearly ½-in. per hour.

Maximum discharge by formula = 319 cu. ft. per sec.
" " by measurement = 210 " " "

(3) Area, 49 sq. miles; principal valley, 13 miles long, with a rise of 20 ft. to the mile; water-travel over 20 miles, requiring 7 to 8 hours; rainfall, 3-7-in. per hour; coefficient of surface-discharge, 40%.

Maximum discharge by formula = 2,035 cu. ft. per sec.
" " by measurement = 1,820 " " "

(4) Area, 418 sq. miles; main water course extending back 26 miles, with many miles of branches; a flat valley inclined 142 ft. in 15 miles; one day assumed as time to traverse the whole length of the basin; rainfall, nearly 4 ins. in one day had fallen, but an average rate of 1-6-in. per hour taken; land partly arable, but hills steep and wooded; coefficient of surface-discharge taken at 45%.

$$Q = 640 \times .45 \times 1\text{-}6 \times \sqrt[4]{418^3} = 4{,}435 \text{ cu. ft. per sec.}$$
Actual discharge by measurement = 4,681 " " "

THE WILSON AVENUE BRIDGE DISASTER, CLEVELAND, O.

The accompanying illustrations show very clearly the cause and nature of the wreck of the bridge carrying Wilson Ave. over the Cuyahoga River at Cleveland, O., which occurred on Jan. 18, and was briefly noted in our last issue. This bridge was opened for traffic on March 3, 1898, and was built by the New York, Chicago & St. Louis Ry. and the city of Cleveland, under an agreement made in 1882. Its total cost was about $115,000.

To understand the accident the nature of the bridge site needs a little explanation. In 1872 Wilson Ave. was extended across the valley of Kingsbury Run by constructing an embankment about 500 ft. long, 70 ft. wide on top, and about 45 ft. high. A culvert 9 ft. in diameter and about 200 ft. long was built to carry the stream under and through this embankment. This culvert had a manhole located as shown by the sketch, Fig. 1, and lengthwise of the embankment there ran a 30-in. water main, two 8-in. water pipes, and a 12-in. gas main, all four of which are shown by Fig. 2, where the gas main appears unbroken, and held up by ropes.

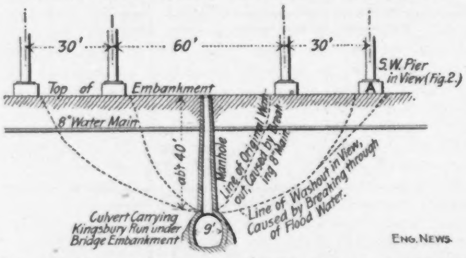


Fig. 1.—Sketch Showing Cause and Progress of Washout Which Wrecked the Wilson Ave. Bridge, Cleveland, O.

The valley of Kingsbury Run extends from the Cuyahoga River east about 1½ miles to Wilson Ave. About a quarter of a mile further east it branches, one branch extending southeast, and this branch was dammed at a point about four miles from the mouth of the run, forming what was known as Herron's Pond. The flow of water in the run was west toward the river.

The bridge was built directly over the roadway embankment, and consisted of a 60-ft. plate girder span crossing the roadway tracks and a 60-ft. lattice girder over the culvert, and a series of lattice girder spans, each 30 ft. long, for the remainder of its length. Trestle towers supported the spans, and the legs of these towers rested on stone masonry pedestals built in the old roadway. The metal portion of the bridge was 562½ ft. long, and carried a 45-ft. roadway and two 7½-ft. sidewalks. Its approaches were earth embankments 230 ft. and 345 ft. long, respectively. The steelwork was calculated for a double-track street railway and for general street traffic.

On Jan. 13 a heavy rain started at 7:45 p. m., and continued until 5:30 a. m. the next morning; started again at 7:46 a. m. (Jan. 14), and continued at intervals until 3:05 p. m., with quite a heavy shower between 10:30 a. m. and 11 a. m. The U. S. Weather Bureau reports the rainfall during this time as follows:

For 24 hrs. ending at 8 p. m., Jan. 13..........	0.11-in.
" 12 " " 7 a. m., Jan. 14..........	0.9-in.
" 12 " " 7 p. m., Jan. 14..........	0.25-in.

This rainfall increased the flow of water through the run. Early on the morning of Jan. 14, about 3 a. m., the dam at Herron's Pond, about 2½ miles east of Wilson Ave., broke. At about the same time one of the 8-in. water pipes in the Wilson Ave. embankment also broke directly over the culvert, washing the earth through the manhole into the culvert and choking it up. From appearances the brickwork of the manhole was evidently broken up and with the earth broke through the culvert. The iron cap of the manhole, weighing between 300 and 400 lbs., was afterwards found in the bed of the creek several hundred feet downstream. A hole (Fig. 1) was soon made in the roadway of the embankment under the 60-ft span, about 40 ft. in diameter and 20 ft. deep, the edges of the opening being from 8 ft. to 2 ft. from the faces of the four pedestals immediately supporting

FIG. 2.—VIEW OF WILSON AVE. BRIDGE JUST PREVIOUS TO COLLAPSE, SHOWING EXTENT OF WASHOUT.

(The damming up of the water was against the oppsite side of the embankment. At A is shown the masonry whose collapse immediately preceded the fall of the bridge.)

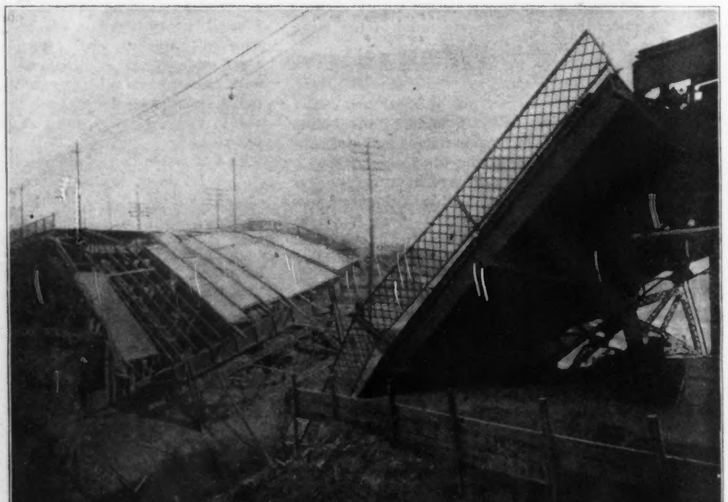


FIG. 4.—VIEW LOOKING EAST INTO WASHOUT, SHOWING APPEARANCE OF WRECKED STEELWORK.

(This view was taken one-half hour after the collapse occurred.)

BOILERS AND FURNACES CONSIDERED IN THEIR RELATION TO STEAM ENGINEERING.—By William M. Barr, M. Am. Soc. M. E. Philadelphia: J. B. Lippincott Co. Cloth; 8vo; pp. 405; 468 illustrations; $3.

The author of this work in 1880 published a book on "High Pressure Steam Boilers," which is now out of print. The present book is entirely new, the former one being "set aside as a thing of the past." The book treats chiefly of boiler construction, and fits the needs of designers and builders of boilers, rather than those of boiler users. The first chapter, of only 15 pages, is all that is given to the subject of "Furnace Construction." It treats it in the usual descriptive method. It is scarcely up to date in some of its figures, giving 772 instead of 778 ft.-lbs. as the value of the mechanical equivalent of a heat unit, and 14,500, instead of 14,600, as the heat value of a pound of carbon. It contains a table covering four pages, giving proximate analysis and calorific value of selected American coals. The calorific values are calculated on the assumption that the volatile matter of all the coals has a heating value of 20,000 heat units per pound, and that 3,600 heat units are absorbed "in the process of dissociation of the gases from the coal;" two very erroneous assumptions. They are based on experiments of Prof. E. T. Cox, on Indiana coals. Very different figures would have been found from experiments on coals of other states. The table gives 13,205 heat units for Cumberland coal, containing 9.79% ash and 1.25% moisture. This is about 6% below the probable heating value of such coal as shown by recent tests.

Chapter II discusses the materials of construction; cast iron, wrought iron and mild steel. This chapter is also scarcely up to the times. It contains the old designations of wrought iron, C H No. 1 flange, and the like, which have passed into oblivion, since iron boiler plate made from hammered charcoal blooms has been displaced by steel. Cast iron is said to have a crushing strength of from 50,000 to 75,000 lbs. per sq. in., figures far below the actual strength. The old style test piece for steel plates, with a circular groove 1 in. wide, which has been condemned by authorities for over 20 years, is said for a tensile test only, to be "perhaps good enough, the groove simply indicating where the break will take place." This is a remarkable statement, especially in view of the fact that on the next page the author gives a table which shows that the apparent tensile strength of a grooved test piece is 63,000 lbs. per sq. in., when that of a test piece with parallel sides 8 ins. long is only 55,200 lbs.

Chapter III is devoted to riveted joints. It is very fully illustrated, and contains many tables of results of tests made at the Watertown arsenal. Chapter IV treats of welding and flanging. Chapter V discusses details and strength of construction. It contains tables of working strength for various diameters, and many extracts from the rules of the U. S. Board of Supervising Inspectors, and the Philadelphia rules. Many drawings of details are given. Externally fired shell boilers are described and illustrated in Chapter VI. Chapter VII describes boiler furnaces and settings, including different forms of grate bars, mechanical stokers, etc. Chapter VIII describes internally fired boilers, and Chapter IX sectional and water-tube boilers. A table of performances of 24 different boilers, of a variety of types, is appended to this chapter, which the author says may prove "interesting, even though it had no special value." The results given are not strictly comparative, for the coals and the conditions of the tests were not the same. Chapter X describes and illustrates boiler mountings and safety appliances. Chapter XI, only 9 pages, treats of chimneys. Two tables of dimensions are given, based on certain assured conditions.

On the whole the book is an interesting and more or less useful compilation on the subject of construction of boilers. It contains many things that are not new, and some things that are not good, but it may be worthy of a place in an engineer's library for the good things that are in it. The printing is well done, and the illustrations are excellent.

COMMERCIAL CUBA: A Book for Business Men.—By William J. Clark; with an introduction by E. Sherman Gould, M. Am. Soc. C. E. New York: Charles Scribner's Sons. Cloth; $9\frac{1}{4} \times 6$ ins.; pp. 514; with maps and illustrations. $4.

This work, by Mr. Clark, who is at the head of the Railway Department of the General Electric Co., is a very timely production. As Mr. Gould remarks in his introduction: "The intolerable previous condition of affairs having been demolished by the events of the past year, the vaster task of reconstruction must now be taken in hand." Before beginning this latter work, cold facts must be ascertained and the peculiarities of the people and the resources of the islands must be carefully studied. It is the material for this study that Mr. Clark places before his readers, and in a pleasing and interesting style. Much valuable information is conveyed upon a great variety of subjects. Commencing with the manners and customs of the people, successive chapters deal with population, climate, descriptive geography, transportation, financial and legal administration, animal and vegetable life, etc., and finally various important provinces and cities are separately described. In a lengthy appendix is a directory, with the names and occupation of business men in the cities and towns of Cuba with whom it might be profitable to correspond for further business information.

According to the census of 1887, the last taken, the population of Cuba was 1,631,687; and of the 1,102,689 whites in this aggregate, 35.1% could read and write, and 11.7% of the negroes and Chinese could do the same. In 1887 the negroes formed 30.5% of the total population, as compared with 45.8% in 1804, and 50.75% in 1850. Mr. Clark estimates the present total population of Cuba at about 1,380,000 souls. The present railway system approximates 1,100 miles of track, exclusive of over 100 private railways of varying gages used in connection with plantations. This railway system commences in the east at Santa Clara and ends in the west at Pinar del Rio, the city of Havana being always the chief objective point. In this connection, Mr. Clark warns his readers of the many incorrect maps of Cuba lately given to the public. The Spaniards were themselves bad map-makers; and their mistakes have been copied, and many new errors have been made through misunderstanding of Spanish data. As to common roads, the author remarks that, instead of being a lost art, road-making is an art never yet acquired by the Cubans; and the great majority of the highways laid down on the maps are simply routes of travel with an inconceivable depth of mud in wet weather, and a most objectionable dust in the dry season. While there are some good roads immediately about the chief cities, they rapidly deteriorate as they radiate from these centers. The excuse is that road-building in Cuba is expensive, owing to the character of the soil and the tropical rains.

Under the head of animal and vegetable life, we are told that the almost untouched forests of Cuba cover from 15 to 18 million acres, with a wonderful variety of important trees, nearly all of which are useful for some purpose. But with all this forest wealth, the total export of lumber and timber from Cuba has never much exceeded $220,000 per year. Lack of transportation facilities is largely responsible for this small trade in a valuable product.

Mr. Clark plainly points out the needs and the possible vast output of this rich island, now that it is cut loose from the commercial fetters which bound it to Spain and the oppressive duties and internal taxation which effectually prevented local development. But he also shows that very much must be done in providing facilities and in teaching the people new methods before the natural wealth of this country can be utilized in commerce. But as an intelligent knowledge of existing conditions is a first step in all advance, this publication is exceedingly valuable and the best, for the purpose intended, that has yet appeared.

ANNUAL MEETING, AMERICAN SOCIETY OF CIVIL ENGINEERS.

The forty-sixth annual meeting of the Society was held at the Society house in New York city on Jan. 18 and 19, 1899. There was a large attendance of members, including quite a number from distant parts of the country, and the business meeting, lecture, reception, and the various excursions were well attended.

At the business meeting on the 18th, the time was taken up for the most part in receiving the reports of the Board of Directors, Secretary and Treasurer, and in the discussion of the reports of special committees. The following is an abstract of these various reports:

Membership.—The changes in membership during the year are shown by the following table.

	Jan. 1, 1899			Changes during the year.	
	Resident.	Non-resident.	Total.	Loss.	Gain.
Honorary members	2	7	9	...	...
Corresponding members	..	3	3	...	...
Members	253	1,078	1,331	53	83
Associate members	75	295	370	29	74
Associates	35	51	86	4	9
Juniors	95	164	259	70	39
Fellows	10	28	38	3	..
Subscribers	3	25	28	2	..
Total	473	1,651	2,124	161	205

It will be seen by the table that the net increase during the year was 44. The total number of applications for membership received during the year was 222, and action was taken as follows: Passed to ballot as members, 86; passed to ballot as associate members, 80; elected associates, 8; elected juniors, 39; total, 213; applications now awaiting action, 52. The losses by death during the year were 22.

Library.—During the year $141.08 have been expended on the library, and 1,240 bound volumes, pamphlets, charts, specifications, etc., have been added. The present number of titles in the library is now 23,161. Since Dec. 16, 1897, the house of the Society has been open every day, except Sundays, between the hours of 9 a. m. and 10 p. m.. On Sundays the hours for opening have been from 2 p. m. to 9 p. m. The resulting attendance has been gratifying. During 1898 the total attendance was 2,401, and the total attendance in the reading-room, 1,696, 39% of the latter being between the hours of 5 p. m. and 10 p. m. These figures are exclusive of the attendance at meetings. The attendance in the reading-room shows an increase of 91% over that of 1897.

During the year much attention has been given to a complete reclassification and indexing of the library. This work, which is well under way, will require considerable time for its completion. It has however, been taken up on general lines of classification, so that each section may be finished in its turn and be complete in itself. The new index for the largest section in the library, that of railways, which now contains 3,106 titles, is nearly completed, the total number of cards required for it being about 12,000.

It is the hope that arrangements may be perfected in the near future which will enable non-resident members to derive some direct benefit from the library, and the work above outlined is a necessary preliminary step for the attainment of that object. The impossibility of making the library a circulating one is well understood, but it is believed that a plan can soon be formulated by which members may secure, through the Secretary, information as to the contents of the library on any particular line of investigation; that the usefulness of this large collection of engineering works will thus be much increased, and that such service will be appreciated by those who are unable to consult the library in person.

The loan on the new Society house has been fixed at $85,000. The net cost of publications during the year has been $7,374.

Meetings.—Nineteen regular semi-monthly meetings and one special meeting have been held during the year, at which the average attendance was 115, an increase of 30% over the meetings held during 1897. Twenty-one formal papers were presented for discussion during the year. In the oral discussion of these papers 88 persons took part, and correspondence from 132 persons was presented.

Treasurer's Report.—The report of the Treasurer shows the following receipts and expenditures:

Balance on hand Dec. 31, 1897			$11,750.41
Receipts from current sources, Jan. 1 to Dec. 31, 1898.			46,160.13
Received from subscriptions to new Society house			105.00
Received from sale of Historical Sketch			410.00
Received on mortgage, new house			15,000.00
Total			$73,425.54
Payment to audited vouchers for current business Jan. 1 to Dec. 31, 1898.		$37,450.90	
Payment of audited vouchers, extraordinary expenses, Jan. 1 to Dec. 31, 1898.		28,274.73	
Balance on hand Dec. 31, 1898:			
In Union Trust Co.	$381.66		
In Garfield National Bank	6,333.25		
In hands of the Treasurer.	985.00		
		$7,699.91	
Total			$73,425.54

The Norman medal was awarded by the committee to Mr. B. F. Thomas for his paper on "Movable Dams," Mr. Henry Goldmark received the Thomas Fitch Rowland prize for his paper on the "Power Plant, Pipe Line and Dam of the Pioneer Electric Power Co." The Collingwood prize for the best paper presented by a junior member was not awarded, no paper in the opinion of the committee having been presented which merited the reward.

The Committee on the "Proper Manipulation of Tests of Cement" reported progress. Numerous replies have been received to the committee's circular of inquiry and an attempt will be made to add to this number during the next few months. The answers thus far received have been summarized and abstracted. Upon vote of the convention the report was received and the committee continued.

Mr. E. L. Corthell presented a communication relating to the organization of an Engineering Congress to be held at Paris, France, during the Exposition of 1900. This matter was at Mr. Corthell's request referred to the Board of Directors for future action. Mr. Willard A. Smith, of Chicago, recently appointed commissioner in charge of the engineering transportation exhibit of the United States at the Paris Exhibition, addressed the Society respecting its participation in the exhibit. This matter was also referred to the Board of Directors by vote of the convention.

Quite a long discussion took place regarding the 24-hour notation of time used by the society. Mr. Sanford Fleming, the chairman of the Committee on "Uniform Standard Time," presented an informal report of progress by letter, and suggested that the time was approaching when the Society could advisably discontinue the committee. Following the reading of this letter Col. H. G. Prout presented a resolution instructing the discontinuance of the 24-hour notation by the society whenever in the opinion of the Board of Directors it could properly and courteously be done. After considerable discussion, during which various amendments were offered, the resolution was by vote of the convention laid on the table. Mr. John F. O'Rourke then presented a motion that the Committee on "Uniform Standard Time" should be instructed to make its final report at the next convention of the Society, which was passed.

Mr. Francis Collingwood presented a resolution instructing the Board of Directors to take under consideration the matter of holding regular and independent meetings of the junior members of the Society, which was favorably voted upon.

The ballot for officers showed the election of the following: President, Desmond FitzGerald, of Boston; Vice-President, Robert Moore, of St. Louis, and Robert Cartwright, of Rochester; Treasurer, John Thomson, of New York; Directors: John A. Bensel, C. W. Buchholz, and Samuel Whinery, of New York; Edmund K. Turner, of Boston; Palmer C. Ricketts, of Troy, and Jas. D. Schuyler, of Los Angeles.

On the afternoon of Jan. 18, excursions were taken to visit the foundation work of the New East River Bridge, and to the dock, pier and bulkhead wall work of the Department of Docks. On Jan. 19 an excursion was made by steamer to the Crescent Shipyards at Elizabethport, N. J., and to the Brooklyn Navy Yard. At 8:30 o'clock in the evening a lecture was delivered at the Society house by Mr. E. Weyman, on "The Old Roman Aqueducts." On Jan. 20, the last day of the convention, an all-day excursion was taken to the New Croton Dam for the New York water supply, which is now under construction.