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THE U. S. BATTLE-SHIP "KEARSARGE," built by the Newport News Shipbuilding Co., had her official speed trial, on Sept. 25, on the Cape Ann course of 66 knots. Over this course she averaged 16.84 knots, subject to tidal corrections; she made the half course at a rate of 17.32 knots, but the bursting of a tube in the feed-water boiler, is said to have reduced her return speed somewhat. Her contract speed is 16 knots, but an average of 17½ knots was expected, and this speed was made at times. As to sea conditions, a moderate southeast wind raised a fair sea; but the battleship was remarkably steady; the engines worked without perceptible vibration and the ship turned with a short radius. The "Kearsarge" is a seagoing coast-line battleship with two military masts. Her dimensions are as follows: Length on load line, 368 ft.; extreme beam, 72 ft. 2½ ins.; mean draft, 23 ft. 6 ins.; displacement, 11,525 tons; gross tonnage, 6,832; twin-screw, vertical triple-expansion engines of 10,000 HP. by contract, with 1,210 tons of coal-bunker capacity. Her main battery includes four 13-in. and four 8-in. guns in superimposed forward and aft turrets, working together, and 14 5-in. rapid-fire guns. The secondary battery covers 20 6-pdrs., and 6 1-pdr. rapid-fire, 4 Colt and 2 field guns. She carries four Long-Whitehead torpedo tubes. Her side armor is 16½ ins. thick at top and 9½ ins. at bottom, or 13¾ ins. at water line; the turrets are ovoid, 17 and 15 ins. and 11 and 9 ins. thick, with barbettes 15 and 12 ins.; the protective deck is 5 and 3 ins. thick on slopes, and 2¾ ins. on flats; she carries 10,800 cu. ft. of corn-pith obturating material. The contract price of hull and machinery was $2,250,000, and the keel was laid June 30, 1896.

A GASOLINE ENGINE PROPELLED LIFEBOAT was recently tested under the auspices of the life-saving service at Marquette, Mich. The engine was placed in the after air-tight compartment and was geared to the twin screws in such a way that either screw could be stopped or reversed while the other was going ahead at full speed. thus making it possible to turn the boat in a very small space. The reservoir, containing 75 gallons of gasoline, is placed in the forward air-tight compartment. This supply, it is stated, is sufficient for a run of 280 miles at the maximum speed, which is 7½ miles per hour. The self-righting properties of the boat were not injured by the addition of the engine.

THE CAPE COD & NEW YORK CANAL CO. is petitioning the Railroad, Harbor and Land Commission, of Massachusetts, for a modification of the recent order permitting the sale of only a small portion of the $6,000,000 stock and $6,000,000 bonds authorized for building the canal. The canal company contends that the entire $12,000,000 is "reasonably requisite" for the work to be done, and it asks for their issue so that the securities may have a market value. The claims of the company were advanced by a remarkable array of legal talent headed by ex-Governor George S. Boutwell, who practically said that the projectors would abandon the scheme entirely if the authority to issue the whole sum at once were not granted. The joint committee agreed to assume that competent men were behind the enterprise, but it unanimously voted to decline to modify their order permitting the issue of only $140,000 bonds and $140,000 stock. The canal company will probably not deposit its $200,000 forfeit, on Oct. 1, and wait for further legislation.

MUNICIPAL OWNERSHIP OF ALL THE DOCKS in New York city is advocated by Controller Coler, who suggests a constitutional amendment to enable the city to acquire this property. The city docks now pay 6% on the cost of construction, and the construction bonds bear only 3% interest. The difference between the income and interest on these bonds, placed in a sinking fund, would in less than 30 years, pay off the entire principal and leave the city absolute owner of a revenue-yielding water front. This constitutional amendment would also take the $20,000,000 outstanding dock bonds out of the debt proper of the city and extend the debt limit that much.

THE PORTSMOUTH, N. H., STONE DRY-DOCK CONtract has been awarded by the Navy Department to John Peirce, of New York, for $1,089,000. Mr. Peirce owns the granite quarries at Frankfort, Me., and he is President of the company owning the Hallowell, Fox Island and Stoney Creek granite quarries, also in Maine. Work is to begin within 60 days and the concrete dock is to be lined with about 600,000 cu. ft. of cut granite.

SOME EXPERIMENTS WITH CENTRIFUGAL PUMPS designed to operate against high heads are described by Mr. L. A. Hicks in a paper read before Pacific Coast Electric Transmission Association and published in the July number of the "Journal of Electricity." With a 21-in. runner at 920 revolutions per minute the maximum efficiency of 46% was obtained when working against a head of 98 ft., the maximum head obtainable at this speed being 120 ft. The total volume of water discharged is very nearly constant with increase of head until the point of maximum efficiency is reached, after which it falls off rapidly.

THE WATER-POWER PLANT of the Kalamazoo Valley Co., at Allegan, Mich., has been completed and is now supplying current at 25,000 volts pressure to the city of Kalamazoo. A transmission line is being built which will ultimately reach to Jackson, a distance of 90 miles, making it the longest commercial line in the world. 40,000 volts will be used on this line if climatic conditions do not interfere.

THE NIAGARA FALLS POWER CO. has called for bids for the construction of a new wheel-pit. This pit is to be over 400 ft. long and 20 ft. wide and 180 ft. deep; to be cut in solid limestone. It is to provide room for ten or more 5,000-HP. turbines and will increase the total power to 100,000 HP. The bids are to be opened on Oct. 5.

SLOW SAND FILTRATION OF THE PHILADELPHIA water supply is recommended by the commission appointed last April by Mayor Samuel H. Ashbridge, of Philadelphia, Pa., to report upon the best method for the immediate improvement and extension of the water supply for that city. The Commission appointed by Mayor Ashbridge consisted, as we noted at the time, of Rudolph Hering, M. Am. Soc. C. E.; Samuel M. Gray, M. Am. Soc. C. E., and Joseph M. Wilson, M. Am. Soc. C. E., and its report was presented to the Mayor on Sept 21. This report, after considering the various alternative methods available for extending and improving the water supply of the city, recommends substantially that the water shall continue to be taken from the Delaware and Schuylkill rivers, but shall be filtered by slow sand filtration before passing to the supply mains for use. This work will require some extension and improvement of the present pumping plants and the construction of filter beds capable of filtering 200,000,000 gallons of water per day, at a total cost of $10,973,591. It is further recommended that the supply shall be metered to reduce the present great waste of water. A full abstract of this report will be given in our next issue.

A RECORD-BREAKING RAINSTORM occurred in the vicinity of Boston, Mass., on Sept. 20. A record of this rainfall, which has been sent to us by Mr. Chas. R. Felton, City Engineer, Brockton, Mass., shows a maximum rate of fall of 2 ins. per hour. There are three rain gages in this city, separated from two to four miles. Two of these are clock gages, and the other is measured by hand. They registered respectively 5.21, 5.40 and 5.85 ins., with the following extremes: 5 ins. in 7 hrs., 4 ins. in 5 hrs., 3 ins. in 3 hrs., 2 ins. in 1 hr. and 40 mins. and 1 in. in 30 mins. Another correspondent reports a rainfall of 3.34 ins. in 7 hrs. 40 mins. Sept. 20 at the recording gages of the Chestnut Hill reservoir of the Boston water-works. Rain began falling at 3:50 a. m., according to the gage, and ceased at 11:30 a. m. During this time of 7 hrs. 40 mins., 3.34 ins. of rain fell, the average rate thus being 0.44-in. per hour. In the 1 hr. and 33 mins. from 7:07 a. m. to 8:40 a. m., the rate was 0.90-in. per hour, and the rainfall 1.40 ins.; and in the 15 mins. following, 0.50-in. of rain fell, which gave a rate of 2 ins. per hour. For the 1 hr. and 48 mins. from 7:07 a. m. to 8:40 a. m., the average rate of fall was 1.06 ins. per hour.

SOOT IN PHILADELPHIA, says the "Press" of that city, has been a steadily increasing nuisance for ten years past. The cause is ascribed to the increased use of bituminous coal. Previous to 1890 about all of this coal burned in Philadelphia was included in the 250,000 tons annually consumed in making gas. Ten years ago bituminous coal began to be used for other purposes, and in 1893 the total consumption rose to 900,000 tons; in 1897 and 1898 it was 1,600,000 and 1,450,000 tons respectively, according to the government reports on "Mineral Resources" for these years. While the increase in the use of bituminous coal in Philadelphia has been 2,034,977 tons in the period 1893-98, the increased consumption of anthracite coal only amounts to 50,468 tons. The "Press" calls for the suppression of the evil, with the alternative of soon having Philadelphia "as sooty as any Western soft-coal city."

THE MOST SERIOUS RAILWAY ACCIDENT of the week occurred on the Denver & Rio Grande R. R., near Florence, Colo., Sept. 23. The Phillips-Judson excursion train from Chicago collided with a fast freight. Six persons were killed.——A passenger train on the St. Louis & San Francisco R. R. ran into a freight train 15 miles from Kansas City, Sept. 20, killing four men.——In a rear end collision of freight trains on a bridge on the Omaha R. R., near Windom, Minn., Sept. 21, four men were killed and three engines and a span of the bridge wrecked.

THE DESTRUCTION BY ELECTRICITY of the Clinton bridge over the Wabash River, in Indiana, is described by the Chicago "Inter-Ocean." The bridge was built of wood in 1853, with stone piers and abutments, and consisted of three spans, with a total length of 735 ft. The county authorities decided to replace it by a modern structure, and bought the old pier and approaches, while the owner of the wooden bridge agreed to remove it in 30 days without injuring the piers, etc. He had trouble in finding parties to do this and the 30 days had about elapsed. In this emergency, Mr. H. N. Mills, an electrician of Clinton, suggested burning the chords with an electric current, and his plan was adopted. There were 27 timbers to be cut through, each 9 ins. square and made of yellow poplar. He looped over each of these an iron resistance wire kept stretched by sash-weights, and turned on a powerful electric current at 5 a. m., and at 2 p. m. the last span fell, it having taken 1 hr. 40 mins. to wreck each of the three spans. Later examination showed that the wire had burned down 5 ins. from the top and 3 ins. deep on the sides; the timbers then broke. The cut was quite sharp and clean with the charred wood not more than 1 inch deep.

THE CAVING IN OF A TUNNEL on the Great Western Ry. of England, near Swansea, which occurred June 19, is reported by the government inspectors to have been due to disturbances of the coal working below. The disturbances are thought to have arisen from the pumping out of water from the old workings, which are about 350 ft. deep. The tunnel was cleared out by July 15, and an eight-ring brick arch has been built to replace the fallen arch, while at the east end heavy steel ribs have been put in to strengthen the lining.

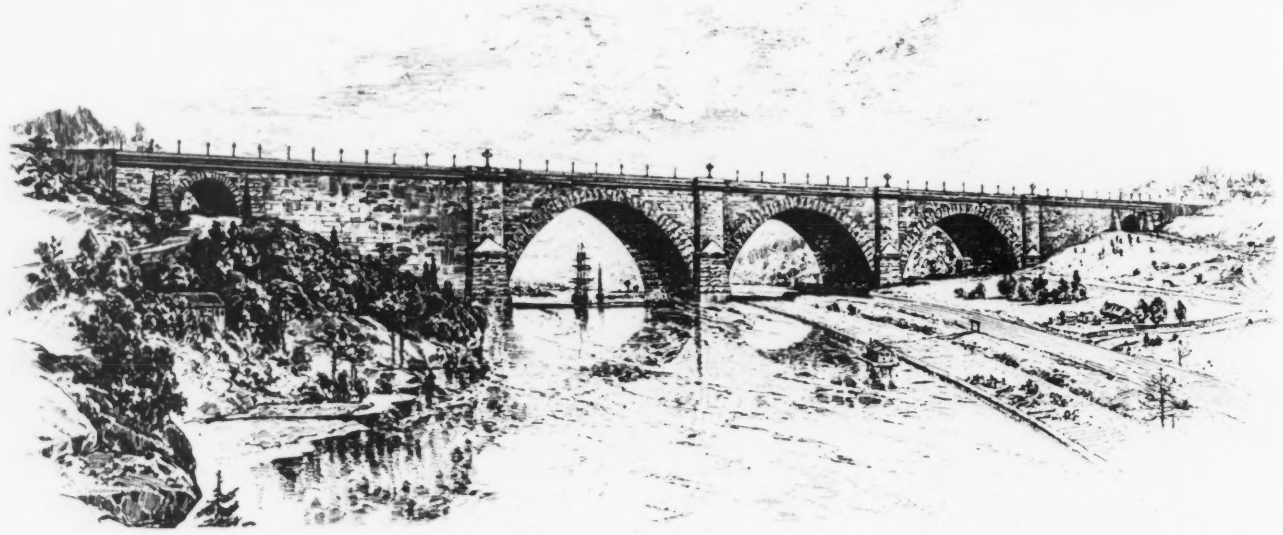
THE INDUSTRIAL GROWTH OF MEXICO is commented upon in the last annual message of President Diaz to the Mexican Congress. The Mexican railway system now aggregates 13,369 km., or 8,289 miles, including 193 km. of private lines and 432 km. of tramways belonging to the state. Among other public works, the northwestern breakwater at the port of Vera Cruz, and the accompanying jetties, are well advanced, as is the dredging of the port to a depth of 29½ ft., or 9 m. A contract has been entered into for the improvement and sanitation of the port of Manzanillo, under the law of Dec. 17, 1898, and a commission of engineers is planning the removal of the port of Altata to Tetuan. A geodetic commission has been organized, and in February, 1899, it commenced the survey of the Valley of Mexico, and is pushing that work towards Puebla to co-operate with the United States and Canada in the measurement of the grand meridian arc, which passes near that city. Electrical manufacturing plants have been installed by the Vera Cruz Co. on the Rio Blanco, to produce 1,500 HP. for the spinning factory of Santa Rosa; the Industrial Co., of Orizaba, has built a dam on the Tilapain River, and installed a plant developing 2,250 HP., which is to be transmitted to the Rio Blanco cotton mills. Other plants have been put up by the San Ildefonso Co., along the Monte Alto and Tlalnepantla rivers, aggregating 5,500 HP., which is to be tranamitted to the City of Mexico.

THE ORIENTAL DRY-DOCK, at Shanghai, is now in operation. This dock has an extreme length of 540 ft., the entrance is 80 ft. wide and the depth on sill is nearly 24 ft. at ordinary spring tides. A wooden caisson gate is used. The bottom of the dock, 75 ft. wide, is made of 7 ft. of concrete, covered with 3-in. plank; the sides are also built of concrete. The dock can be pumped out in 2½ hours by two 27 and 22-in. centrifugal pumps driven by a compound engine. The North German Lloyd steamship "Konigsberg" has already been docked here, with 2,500 tons of cargo aboard and imposing a total weight of over 7,000 tons on the keel blocks. The dock yard has a frontage of 2,000 ft., with a depth of 26 ft. alongside, and the yard is already equipped with extensive shops fitted with modern machinery for repairs to hull, engines and boilers. On one side of the dry-dock is installed a pair of steel shear legs with a lifting capacity of 75 tons.

AN EARLY DESIGN FOR A LONG-SPAN CONCRETE-STEEL ARCH BRIDGE.

Many of our readers will recall the competition among bridge engineers some fifteen years ago in the preparation of designs for the Washington Bridge, over the Harlem River, in the upper part of New York city. The design finally adopted and carried into execution for this structure embodied two steel arches of 510 ft. span; but the design at first adopted was one made by Mr. Thos. C. Clarke, then a member of the Union Bridge Co., which proposed concrete arches of 285 ft. span, the arches to be strengthened by imbedding steel in the concrete and to be faced with stone masonry. We are indebted to Mr. Clarke for the privilege of reproducing a perspective view of his design, and he sends us the following letter degarding it:

Sir: As the subject of concrete-steel bridges is now exciting attention, it may interest your readers to see a design for an arched bridge of concrete with rock-faced



AN EARLY DESIGN FOR A LONG-SPAN CONCRETE-STEEL ARCH BRIDGE.

stone masonry, designed by me in 1885, when a member of the Union Bridge Co.

The three large arches were to have spans of 285 ft. each, the bridge was to be 100 ft. wide, and the height from water to arch soffit was 150 ft. The total length was to be about 1,200 ft., and the estimated cost, $3,500,000. It was not intended to apply metal as extensively as would now be done. The tension in the soffit of the arch at the center, and in the top of the haunches only, was to be resisted by iron beams built into the concrete.

This design was accepted by the Bridge Commissioners, but was afterwards given up, on their learning that its proposed dimensions were so much greater than had ever before been attempted. In the present state of the art, no doubt, many engineers could be found who would guarantee the safety of such a bridge, if allowed to reinforce it fully with steel.

Very truly yours,

Thomas C. Clarke.

127 Duane St., New York city, Sept. 21, 1899.

THE CHOICE OF MATERIALS FOR AND THE MANUFACTURE OF CONCRETE FOR ENGINEERING WORK.*

Aggregates of Mortar and Concrete.

Sand is used in making mortar; and gravel, or saud and broken stone, in making concrete. The qualities of the sand and broken stone have an important effect upon the strength and cost of the mortar and the concrete. The effect of the variation in these materials is generally overlooked, even though the cement is subject to rigid specifications.

Sand.

Requisites for Good Sand.—To be suitable for use in mortar, the sand should be sharp, clean, and coarse; and the grains should be composed of durable minerals, and the size of the grains should be such as to give a minimum of voids, i. e., interstices between the grains.

Durability.—As a rule ocean aud lake sands are more durable than glacial sands. The latter are rock meal ground in the geological mill, and usually consist of

*Extracts from advance sheets of the ninth edition of "A Treatise on Masonry Construction," by special permission of the author, Prof. Ira O. Baker, University of Illinois, Champaign, Ill., and of the publishers, John Wiley & Sons, New York city.

silica with a considerable admixture of mica, hornblende, feldspar, carbonate of lime, etc. The silica is hard and durable; hut the mica, hornblende, feldspar and carbonate of lime are soft and friable, and are easily decomposed by the gases of the atmosphere and the acids of rain water. The lake and ocean sands are older geologically; and therefore are usually nearly pure quartz, since the action of the elements has eliminated the softer and more easily decomposed constituents. Some ocean sands are nearly pure carbonate of lime, which is soft and friable, and are therefore entirely unfit for use in mortar. These are known as calcareous sands. The glacial sands frequently contain so large a proportion of soft and easily decomposed constituents as to render them unfit for use in exposed work, as, for example, in cement sidewalks. Instead of constructing exposed work with poor drift sand, it is better either to ship natural silica sand a considerable distance or to secure crushed quartz. Crushed granite is frequeutly used instead of sand in cement sidewalk construction; but granite frequently contains mica, hornblende and feldspar, which render it unsuitable for this kind of work. However, as a rule, the physical condition of the sand is of more importance than its chemical composition.

Sharpness.—Sharp sand, i. e., sand with angular grains, is preferred to that with rounded grains because (1) the angular grains are rougher and therefore the cement will adhere better; and (2) the angular grains offer greater resistance to moving one on the other under compression. On the other hand, the sharper the sand the greater the proportion of the interstices between the grains (compare line 4 of Table I. with the preceding lines of the table); and consequently the greater the amount of cement required to produce a given strength or density. But a high degree of sharpness is more important than a small per cent. of voids. The sharpness of sand can he determined approximately hy rubbing a few grains in the hand, or hy crushing it near the ear and noting if a grating sound is produced; but an examination through a small lens is better. Sharp sand is often difficult to ohtain, and the requirement that "the sand shall he sharp" is practically a dead letter in most specifications.

Cleanness.—Clean sand is necessary for the strongest mortar, since an envelop of loam or organic matter about the sand grains will prevent the adherence of the cement. The cleanness of sand may he judged hy pressing it together in the hand while it is damp; if the sand sticks together when the pressure is removed, it is entirely unfit for mortar purposes. The cleanness may also be tested hy rubbing a little of the dry sand in the palm of the hand; if the hand is nearly or quite clean after throwing the sand out, it is probably clean enough for mortar. The cleanness of the sand may he tested quantitatively by agitating a quantity of sand with water in a graduated glass flask; after allowing the mixture to settle, the amount of precipitate and of sand may he read from the graduation. Care should be taken that the precipitate has fully settled, since it will condense considerably after its upper surface is clearly marked.

Sand is sometimes washed. When only comparatively small quantities of clean sand are required, it can be washed by shoveling into the upper end of an inclined V-shaped trough and playing upon it with a hose, the clay and lighter organic matter floating away and leaving the clean sand in the lower portion of the trough, from which it can he drawn off hy removing for a short time plugs in the sides of the trough. Sand can be washed fairly clean by this method at an expense of about 10 cts. per cu. yd., exclusive of the cost of the water. For a sketch snd description of an elaborate machine for washing sand hy paddles revolving in a box see Engineering News, Feb. 16, 1899. By this method the cost of thoroughly washing dirty sand is about 15 cts. per cu. yd.

Although it is customary to require that only clean sand shall be used in making mortar, a small quantity of very finely powdered clay will not materially decrease the strength of the mortar. In some instances clay to the amount of 10% of the sand seems not to decrease the strength of the mortar.* Mortar containing considerable clay is much more dense, plastic and water-tight, and is occasionally convenient for plastering surfaces and stopping leaky joints. Such mortar is not affected by the presence of water.

Fineness.—Coarse sand is preferable to fine, since (1) the former has less surface to he covered and hence requires less cement; and (2) coarse sand requires less labor to fill the interstices with the cement. The sand should be screened to remove the pebbles, the fineness of the screen depending upon the kind of work in which the mortar is to he used. The coarser the sand the better, even if it may properly he desiguated fine gravel, provided the diameter of the largest pebble is not too nearly equal to the thickness of the mortar joint.

Voids.—The smaller the proportion of voids, i. e., the interstices between the grains of the sand, the less the amount of cement required, and consequently the more economical the sand. The proportion of voids may be determined by filling a vessel with sand and then determining the amount of water that can be put into the vessel with the sand. This quantity of water divided by the amount of water alone which the vessel will contain is the proportion of voids in the sand. The quantities of water as above may he determined by volumes or hy weight. The proportion of voids may be determined for the sand loose or rammed, the latter being the more appropriate, since the mortar is either compressed or rammed when used. In either case it is more accurate to drop the sand through the water than to pour the water upon the sand, since with the latter method it is difficult to eliminate the air bubbles—particularly if the sand be first rammed. If the sand is dirty and the water is poured upon it, there is liability of the clay's being washed down and puddling a stratum which will prevent the water penetrating to the bottom. If the bubbles are not excluded, or if the water does not penetrate to the hottom, the result obtained is less than the true proportion of voids. Again, if the sand is dropped through a considerable depth of water, there is liability that the sand may become separated into strata having a single size of grains in each, in which case the voids will be greater than if the several sizes were thoroughly mixed. The per cent. of voids varies with the moisture of the sand. A small per cent. of moisture has a surprising effect upon the volume and consequently upon the per cent. of voids. For example, fine sand containing 2% of moisture uniformly distributed has nearly 20% greater volume than the same sand when perfectly dry. This effect of moisture increases with the fineness of the sand and decreases with the amount of water present.

Table I. shows the voids of a number of both artificial and natural sands. An examination of the table shows that the voids of natural sand when rammed vary from 30 to 37%. Sands Nos. 10, 11 and 12 are very good; hut Nos. 13 and 14 are very poor. All five are frequently employed in actual work. The best sand is that which has grains of several sizes such that the smaller grains fit into the voids of the larger, the proportion of any particular size being only sufficient to fill the voids between the grains of the next larger size.

*Report of Chief of Engineers, U. S. A., 1894, pp. 3001-10; and Trans. Amer. Soc. of C. E., vol. xiv., p. 164.

TABLE I.—Showing Fineness, Voids, and Weight of Different Kinds of Sands for Mortar. Arranged in Order of Per Cent. of Voids.

Ref. No.	Description.	Fineness. Per Cent., by weight, caught on Sieve No. 5	20	30	50	75	Per Cent passing No. 75.	Voids, Per Cent. of the Volume. Dry and Loose.	Saturated and Rammed	Weight, Lbs. per cu. ft. Dry and Loose.	Dry and Well shaken.
1	Crushed quartz	0	0	99	1	0	0	55	43	81	86
2	Crushed granite	0	0	100	0	0	0	54	41	80	87
3	Crushed limestone (flinty)	0	0	100	0	0	0	53	41	88	91
4	German standard sand	0	0	99	1	0	0	41	38	94	104
5	Bibbus's sand, Urbana, Ill., sifted	0	100	0	0	0	0	46	37.8	91	99
6	" " " "	0	0	100	0	0	0	45	36.3	88	97
7	" " " "	0	0	0	100	0	0	44	36.0	85	96
8	" " " "	0	0	0	0	100	0	45	35.7	86	97
9	" " " " unsifted	0	0	0	0	0	100	47	35.3	83	95
10	Sand from cement walk, Champaign, Ill.	0	27	21	23	9	20	41	30.0	91	100
11	"Torpedo sand," Chicago	0	13	17	24	39	5	44	36	83	97
12	Sand from municipal work, Illinois	0	41	19	18	18	3	45	37	101	113
13	Sand much used in Chicago	0	4	1	2	12	81		37*	.....	99
14	Sand from municipal work, Chicago	0	3	1	3	24	67		37*	.....	98
15	Crushed limestone (flinty)	0	67	19	32	14	8		28*	.....	106
16	Crushed granite	0	60	13	7	5	15		28*	.....	110
17	Sand artificially mixed	0	56	12	11	8	13		26*	.....	113
18		0	38†	12½	12½	12½	25‡		22*	.....	123

* Dry and well shaken. † 12½ on No. 10; 12½ on No. 15; 12½ on No. 20. ‡ 12½ passing No. 100.

Stone Screening.—The finer particles screened out of crushed stone are sometimes used instead of sand. For the physical characteristics of stone screening see Nos. 16 and 17, Table I. Experiments show that sandstone screenings give a slightly stronger mortar than natural sand, probably because of the greater sharpness of the grains. Crushed limestone usually makes a considerable stronger mortar, in tension and compression, than natural sand, and this difference seems to increase with the age of the mortar. Part of the greater strength is unquestionably due to the greater sharpness of the limestone screenings, and the part that increases with the age of the mortar seems to be due to some chemical action between the limestone and the cement.

Cost and Weight of Sand.—The price of reasonably good sand varies from 40 cts. to $1.60 per yard, according to locality. It weighs, when dry, from 80 to 115 lbs. per cu. ft. (see Table I.), or about 1 to 1½ tons per cu. yd.

Gravel and Broken Stone.

Gravel.—To be suitable for use in making concrete, gravel should be clean, and it should be composed of durable minerals, and the size of the pebbles and grains should be such as to give minimum voids. The physical characteristics of pebbles and gravel are given near the foot of Table II. Judging from the data that can be found in engineering literature and from all the information gathered by an extensive correspondence, gravels No. 16 and No. 17 of the table are representative of the gravels employed in actual work. Concerning No. 18 notice that 65% passed a No. 5 screen; and therefore this mixture would more properly be called gravelly sand. If one-fifth of the material passing the No. 5 sieve be omitted, the voids of the remainder will be only 15% when rammed: in other words, if one-tenth of this gravel were sifted on a No. 5 sieve and that portion retained on the sieve were mixed with the remainder of the original, the voids would be reduced to 15%, which would improve the quality of the gravel for making concrete. This is a valuable hint as to the possible advantage of sifting even a portion of the gravel.

Broken Stone.—Any hard and durable stone is suitable for use in making concrete. It is usual to specify that the stone for concrete shall be broken to pass, every way, through a 2-in. ring, although it is sometimes broken to pass a 1-in. ring. The stone should be broken small enough to be conveniently handled and easily incorporated with the mortar. The finer the stone is broken the greater its cost, and the greater the surface to be coated; and consequently the greater the amount of cement required. Approximately, cubical pieces are preferable to long, thin, splintery fragments, since the latter are liable to break under pressure or while being rammed into place, and thus leave two uncemented surfaces.

Voids.—The proportion of voids, i. e., interstices between the fragments, may be determined in either of two ways, as follows:

1. The voids may be found by filling a vessel with the aggregate, and then pouring in water until the vessel is full. The amount of water required to fill the voids divided by the amount of water alone in the vessel will contain is the proportion of voids in the aggregate. The amount of water in each case may be determined by weight or by volume. If the material is porous, it is best to wet it, so as to determine the voids exterior to the fragments. The proportion of the voids is found to determine the amount of mortar required to fill the voids of the concrete in place; and therefore it is better to determine the voids in the compacted mass, since the concrete is usually rammed when laid. The compacting may be done by shaking or by ramming, the latter being the better, since it more nearly agrees with the conditions under which the concrete is used; and further, since in compacting by shaking the smaller pieces work to the bottom and the larger to the top, which separation increases the voids.

Table II. shows the per cent. of voids in various grades of broken stones used in making concrete. The per cent. of voids in broken stone varies with the hardness of the stone, the form of the fragments, and the relative proportions of the several sizes present. The last is the most important. If broken stone passing a 3½-in. ring and not a ½-in. screen be separated into three sizes, any one size will give from 52% to 54% of voids loose, while equal parts of any two of the three sizes will give 48% to 50%, and a mixture in which the volume of the smallest size is equal to the sum of the other two gives a trifle less than 48%. Notice, however, that unscreened crushed stone has only 32% to 35% voids (see lines 7 and 11 of Table II.). This is a very excellent reason for not screening the broken stone to be used in making concrete. A mass of pebbles has only about three-fourths as many voids as a mass of broken stone having pieces retained between the same screens. Notice, however, that gravel, i. e., pebbles and sand, has a less proportion of voids than pebbles alone.

Cost and Weight.—The cost of breaking stone for concrete varies from 50 to 75 cts. per cu. yd., according to kind of stone and size of plant. The original cost of the stone and transportation expenses are too variable to attempt to generalize. Ordinarily the cost of broken stone is not more than $1.50 to $2.00 per cu. yd. f. o. b. cars at destination. The weight of broken stone varies from 85 to 120 lbs. per cu. ft. (see Table II.), or about 2,200 to 3,200 lbs. per cu. yd.

Concrete.

Concrete consists of mortar in which is embedded small pieces of some hard material. The mortar is often referred to as the matrix; and the embedded fragments as the aggregate. Concrete is a species of artificial stone. It is sometimes called beton, the French equivalent of concrete.

The Aggregate.—The aggregate may consist of small pieces of any hard material, as pebbles, broken stone, broken brick, shells, slag, coke, etc. Whatever the aggregate it should be free from dust, loam, or any weak material. Other things being equal, the rougher the surfaces of the fragments the better the cement adheres, and consequently the stronger the concrete.

It is sometimes specified that the broken stone to be used in making concrete shall be screened to practically an uniform size; but this is unwise for three reasons; viz.: (1) With graded sizes the smaller pieces fit into the spaces between the larger, and consequently less mortar is required to fill the spaces between the fragments of the stone. Therefore, the unscreened broken stone is more economical than screened broken stone. (2) A concrete containing the smaller fragments of broken stone is stronger than though they were replaced with cement and sand. Experiments show that sandstone screenings give a considerably stronger mortar than natural sand of equal fineness, and that limestone screenings make stronger mortar than sandstone screenings, the latter giving from 10 to 50% stronger mortar than natural sand.* Hence, reasoning by analogy, we may conclude that including the finer particles of broken stone will make a stronger concrete than replacing them with mortar made of natural sand. Farther, experiments show that a concrete containing a considerable proportion of broken stone is stronger than the mortar alone. Since the mortar alone is weaker than the concrete, the less the proportion of mortar the stronger the concrete, provided the voids of the aggregate are filled; and therefore concrete made of broken stone of graded sizes is stronger than that made of practically one size of broken stone. (3) A single size of broken stone has a greater tendency to form arches while being rammed into place than stone of graded sizes.

Therefore concrete made with screened stone is more expensive and more liable to arch in being tamped into place, and is less dense and weaker than concrete made with unscreened stone. In short, screening the stone is nearly one size is not only a needless expense, but is also a positive detriment. The dust should be removed, since it has no strength of itself and adds greatly to the surface to be coated, and also prevents the contact of the cement and the body of the broken stone. Particles of the size of sand grains may be allowed to remain if not too fine nor in excess. The small particles of broken stone should be removed if to do so reduces the proportion of voids.

Gravel vs. Broken Stone.—In the preceding section it was shown that finely crushed stone gave greater tensile and compressive strengths than equal proportions of sand; and hence, reasoning by analogy, the conclusion is that concrete composed of broken stone is stronger than that containing an equal proportion of gravel. This element of strength is due to the fact that the cement adheres more closely to the rough surfaces of the angular fragments of broken stone than to the smooth surface of the rounded pebbles. Again, part of the resistance of concrete to crushing is due to the frictional resistance of one piece of aggregate to moving on another; and consequently for this reason broken stone is better than gravel. It is well known that broken stone makes better macadam than gravel, since the rounded pebbles are more easily displaced than the angular fragments of broken stone. Concrete differs from macadam only in the use of a better binding material; and the greater the frictional resistance between the particles the stronger the mass or the less the cement required.

Since frequently gravel is cheaper than broken stone, a mixture of broken stone and gravel may make a more efficient concrete than either alone, i. e., may give greater strength for the same cost, or give less cost for the same strength.

Theory of the Proportions.—The voids in the aggregate should always be filled with mortar. If there is not enough mortar to fill the voids, the concrete will be weak and porous. On the other hand, more mortar than enough to fill the voids of the aggregate increases the cost of the concrete and also decreases its strength. The decrease in strength due to an excess of mortar is usually greater than would be produced by substituting the same amount of aggregate, since ordinarily the sand and the aggregate have approximately the same per cent. of voids, while the sand has the greater, and also the smoother, surface.

A correctly proportioned concrete is also stronger than either a richer or a leaner mixture. For the strongest and densest concrete, the voids of the aggregate should be filled with a rich strong mortar; but if a cheaper concrete is desired, fill the voids of the aggregate with sand and add as much cement as the cost will justify. In other words, to make a cheap concrete, use as lean a mortar as the circumstances warrant, but use enough of it to

*Annual report of Chief of Engineers, U. S. A., 1893, Part 3, p. 3015; do., 1894, Part 4, p. 2321; do., 1895, Part 4, p. 2953; Jour. West. Soc. of Engineers, vol. ii., pp. 394 and 400.

TABLE II.—Showing Voids and Weight of Gravel and Broken Stone for Concrete Arranged in the Order of the Voids.

Ref. No.	Material.	Fineness. Per cent. by weight not passing ring having diameter of 2″	1″	½″	Per cent. by weight on Sieve No.* 5	20	30	50	75	Per cent. passing Sieve No. 75.	Voids, per cent. of Volume. Loose.	Rammed.	Weights, Lbs. per cu. ft. Loose.	Rammed.
1	Flint (screened)	0	100	0	.....	.....	.....	.....	.....	.....	53	49	77	79
2	" "	33	33	33	0	.....	.....	.....	.....	.....	48	43	86	89
3	" "	0	25	75	0	.....	.....	.....	.....	.....	49	39	85	101
4	Granite (screened)	....	0	100	0	.....	.....	.....	.....	.....	48	44	83	86
5	" "	.....	....	0	100	0	.....	.....	.....	.....	48	44	84	87
6	" "	....	0	84	16	0	.....	.....	.....	.....	44	39	92	94
7	" (crusher run)	0	27	32	21	9	4	3	2	2	35	30	104	112
8	Limestone (screened)	0	100	....	.....	.....	.....	.....	.....	.....	51	45	84	95
9	" "	.....	....	0	100	0	.....	.....	.....	.....	45	38	93	105
10	" "	0	30	....	51	19	0	.....	.....	.....	33	28	110	118
11	" (crusher run)	4	23	24	17	19	4	2	1	5	32	27	112	121
12	Pebbles (screened)	0	100	0	.....	.....	.....	.....	.....	.....	45	42	82	90
13	" "	....	0	20	80	0	.....	.....	.....	.....	44	39	84	92
14	" "	.....	....	0	100	0	.....	.....	.....	.....	44	40	90	97
15	" "	0	26	14	60	0	.....	.....	.....	.....	41	37	100	117
16	Gravel (screened)	0	16	9	36	39	0	.....	.....	.....	37	32	115	124
17	" (unscreened)	0	10	7	24	34	10	5	7	1	34	27	120	131
18	" "	0	11	6	18	33	7	9	15	1	30	20	125	145

* The diameter of the meshes is as follows: No. 5, 0.187″; No. 20, 0.032″; No. 30, 0.022″; No. 50, 0.012″; No. 75, 0.007″.

fill the voids of the aggregate. Sand is so cheap that there is no saving by omitting it; and the use of it makes the concrete more dense. The strength of a concrete varies nearly with the amount and strength of the cement used, provided the mortar is not more than enough to fill the voids.

When mortar is mixed with broken stone, the film of mortar surrounding each fragment increases the volume of the resulting concrete. The result of fifteen experiments to determine this increase in volume, shows that if the mortar is equal to the voids, the volume of the rammed concrete is 7½% more than the volume of the rammed broken stone alone.

Water Required.—There is a considerable diversity of opinion among engineers as to the amount of water to be used in making concrete. According to one extreme, the amount of water should be such that the concrete will quake when tamped; or in other words, it should have the consistency of liver or jelly. According to the other extreme, the concrete should be mixed so dry that when thoroughly tamped moisture just flushes to the surface. The advocates of wet mixture claim that it makes the stronger and more dense concrete; while the advocates of dry mixture claim the opposite. The difference in practice is not as great as in theory; the apparent difference is chiefly due to differences in condition.

It is unquestionably true that dry mixtures of neat cement, and also of cement and sand, are stronger than wet mixtures, provided the amount of water is sufficient for the crystallization of the cement. It is also certainly true then in even dry mortar or concrete, the water is considerably in excess of that necessary for the crystallization of the cement, this excess increasing with the amount of sand and aggregate. Of course the excess water is an element of weakness. But the amount of water to be used in making concrete is usually a question of expediency and cost, and not a question of the greatest attainable strength regardless of expense.

1. Dry mixtures set more quickly and gain strength more rapidly than wet ones; and therefore if quick set and early strength are desired, dry concrete should be preferred. 2. Wet concrete contains a great number of invisible pores, while dry concrete is liable to contain a considerable number of visible voids; and for this reason there is liability that wet concrete will be pronounced the more dense, even though both have the same density. 3. Wet concrete is more easily mixed; and therefore if the concrete is mixed by hand and the supervision is insufficient or the labor is careless, or if the machine by which it is mixed is inefficient, wet mixtures are to be preferred. 4. Wet mixtures can be compacted into place with less effort than dry; but, on the other hand, the excess of water makes the mass more porous than though the concrete had been mixed dry and thoroughly compacted by ramming. Dry concrete must be compacted by ramming, or it will be weak and porous; therefore, if the concrete cannot be rammed into place, it should be mixed wet and then the weight of the stones will bury themselves in the mortar, and the mortar will flow into the voids. 5. A rich concrete can be compacted much easier than a lean one, owing to the lubricating effect of the mortar; and hence rich concretes can be mixed dryer than lean ones. The quaking of concrete frequently is due more to an excess of mortar than to an excess of water. 6. Lean concretes should be mixed dry, since if wet the cement will find its way to the bottom of the layer and destroy the uniformity of the mixture. 7. Machine-made concrete may be mixed dryer than hand-made, owing to the more thorough incorporation of the ingredients. 8. Gravel concrete can be more easily compacted than broken stone, and hence may be mixed dryer. Cement and sand alone is more easily compacted than when mixed with coarser material, particularly broken stone; and therefore mortar to be deposited in mass should be mixed dryer than concrete. 9. In mixing dry by hand there is a tendency for the cement to ball up, or form nodules of neat cement, while in mixing wet this does not occur. 10. If wet concrete is deposited in a wood form, there is liability of the water exuding between the planking and carrying away part of the cement and thus weakening the face—which should be the strongest part of the mass. The conclusion is that sometimes wet concrete must be used regardless of any question of strength and cost; while with thorough mixing and vigorous ramming, dry concrete is strongest but also most expensive to mix and lay.

The following experiments are the only ones of any importance made to determine the relative strength of wet and dry concretes. The mean crushing strength of four hundred and ninety-six 1-ft. cubes* made with mortar as "dry as damp earth" was 11% stronger than cubes made with mortar of the "ordinary consistency used by the average mason," and 13% stronger than cubes that "quaked like liver under moderate ramming." The cubes are made of five brands of Portland cement, with broken stone and five proportions of sand varying from 1 to 1 to 1 to 5; half the cubes had a little more mortar than enough to fill the voids, while the other half had only about 80% as much mortar as voids. One-quarter of the cubes were stored in water, one-quarter in a cellar, one-quarter under a wet cloth, and one-quarter in the open air; and all were broken when approximately two years old. The difference in the amount of mortar made no appreciable difference in the strength. The mean of 12 cubes of dry concrete was 51% stronger than corresponding cubes of quaking concrete.†

The amount of water required to produce any particular plasticity varies so greatly with the proportions of the ingredients, the kind and fineness of the cement, the dampness of the sand, the kind of aggregate, etc., that it is scarcely possible to give any valuable general data. The water varies from 10 to 40 lbs. per cu. ft. of concrete. The only general rule that can be given is that for dry concrete the aggregate should be wet but have no free water in the heap; and that the mortar should be damp enough to show water only when it is thoroughly rammed, or so that water will flush to the surface when it is tightly squeezed for a considerable time in the hand.

In the experiments referred to the average quantity of water for the different grades of dry mortar was 19.8 lbs. per cu. ft., and for the plastic 21.4, and for the wet 22.5, the sand being reasonably dry.

TABLE III.—Showing Crushing Strength of Portland Cement Concrete, with Voids of Broken Stone Practically Filled with Mortar; Age when Tested, 600 days.

Composition of mortar. Cement.	Sand.	No. of cubes tested.	Crushing strength. Lbs. per sq. in.	Tons per sq. ft.
1	1	3	4,467	3.22
1	2	6	3,731	2.68
1	3	6	2,553	1.84
1	4	6	2,015	1.45
1	5	2	1,796	1.29
1	6	1	1,365	0.98

Compressive Strength.—The cubes summarized in Table III. were stored under water. Companion blocks stored in cool cellar gave 82% as much strength; those fully exposed to the weather, 81%; and those covered with burlap and wetted several times a day for about three months and afterwards exposed to the weather, 80%. The cubes were mixed as "dry as damp earth." Companion blocks of which the mortar was mixed to the "ordinary consistency used by the average mason," gave 90% as much strength; and those mixed to "quake like liver under moderate ramming," 88%.

Table IV. shows the results of a series of experiments made by A. W. Dow, Inspector of Asphalt and Cement, Washington, D. C.

TABLE IV.—Showing Crushing Strength of Concrete in Pounds per Square Inch, with 1 to 2 Mortar and Other Conditions as Shown.

Aggregate in sizes from 2½-in. to 1-10-in. Broken stone.	Gravel.	Voids in aggregate. P. ct. of vol-ume.	P. ct. of voids fil'd with mortar.	Age of cubes when broken. 10 days.	3. Mos.	6.	1 year.
		Natural cement.					
6	..	45.3	83.9	228	375	795	915
6*	..	45.7	83.9	...	596	...	829
6†	..	39.5	96.2	...	...	...	800
..	6	29.3	129.1	87	361	344	763
3	3	35.5	107.0	108	593	632	841
4	2	37.8	100.6	...	...	...	915
		Portland cement.					
6	..	45.3	83.9	908	2,260	2,510	3,060
6*	..	45.7	83.9	...	1,630	1,530	1,850
6†	..	39.5	96.2	...	...	...	2,700
..	6	29.3	129.1	694	2,680	1,840	2,820
3	3	35.5	107.0	950	...	2,070	2,750
4	2	37.8	100.6	...	...	...	2,840

*Coarse.
†Three-fourths ordinary stone, one-fourth granolithic.

TABLE V.—Showing Relative Strength of Rich and Lean Concretes.

		Proportion, broken stone.	Crushing strength, 1 week. Lbs. per sq.in.	Rela-tive.	4 weeks. Lbs. per sq.in.	Rela-tive.
Portland sand-cement	1 to 1½ mortar	3	412	0.77	490	0.66
		4	446	0.83	679	0.92
		4½	536	1.00	741	1.00
	1 to 2 mortar..	4	316	0.61	441	0.60
		5	275	0.53	477	0.64
		6	521	1.00	639	1.00
	1 to 3 mortar..	5	144	0.69	274	0.85
		6	110	0.52	182	0.57
		7	210	1.00	322	1.00
English Portland cement	1 to 2 mortar..	2	494	0.60	565	0.81
		3	611	0.75	555	0.80
		4	819	1.00	613	0.88
		5	581	0.71	680	0.97
		6	500	0.61	698	1.00
	1 to 3 mortar..	3	333	....	205	0.53
		4	...	....	366	0.95
		5	...	....	386	1.00
		6	...	....	357	0.92
German Portland cement	1 to 2 mortar..	4	...	....	626	0.86
		5	...	....	703	0.97
		6	...	....	728	1.00

Transverse Strength.—Table VI. is a summary of 191 tests on concrete bars 30 ins. long and 4 ins. square.* The cement stood 497 lbs. per sq. in. neat at 7 days, and 209 lbs. with 3 parts sand at 4 weeks. In most of the bars the mortar was made of pulverized sandstone, although in some cases river and pit sands were used. The aggregate was generally broken sandstone, but gravel and broken whinstone were also used. "In each case the voids in the 'sand' were filled with cement, and those in the aggregate with mortar."

The results are tabulated in the order of the ratio of the cement to the total sand and aggregate. Notice that the results in the last line are proportionally higher than those in the remainder of the table. This difference is probably due to the fact that the specimens for the first four lines were made with natural sand and stone, while in those for the last line only crushed sandstone was used for both the sand and the aggregate.

TABLE VI.—Showing Modulus of Rupture of Portland Concrete Bars, in Lbs. per Sq. In.

Composition Cement.	Sand.	Aggregate.	Age in weeks when tested. 1	4	8	12	19	26	52
1	2	3	95	145	215	266	301	303	320
1	2½	5	37	144	165	194	268	236	260
1	3	5	..	88	129	176	191	214	214
1	2½	6	..	81	130	156	193	199	212
1	3	7	37	113	154	187	216	243	265

Economic Concrete.—The strength of both broken-stone and gravel concretes are given in Table IV., for both natural and Portland cements at different ages. A study of these results shows that the relative strength of natural and Portland concrete is different at different ages. For example, taking averages for 10 days, the Portland concrete was 6 times as strong as the natural concrete; while at a year the Portland concrete was only 3 times as strong as the natural concrete. At 45 days and also at 6 months, the Portland concrete was 4 times stronger than the natural concrete; and at 3 months 5 times as strong. Taking averages for like dates and compositions, the Portland cement concrete was 3.7 times as strong as natural cement concrete. Since the proportions are the same in both, the relative cost of the two concretes will vary as the relative cost of a barrel of each kind of cement. Hence if the cost of a barrel of Portland cement is more than 3.7 times that of a barrel of natural, the latter is on the average the more economical; but if Portland cement costs less than 3.7 times as much as the natural cement, then the former is on the average the more economical. Of course these relations would be different at different dates.

A TYPE OF HEAVY ELECTRIC SIDEWALK ELEVATOR.

In the description of the elevator equipment of the Ivins Syndicate Building of New York city, given in our issue of April 27, mention was made of two sidewalk hoists. With this issue we are able, through the courtesy of the Sprague Electric Co., to continue the description of this interesting plant by giving the details of these hoists.

Both of these elevators have a 6⅔ × 4-ft. platform, and the same general construction, which can be seen in the accompanying illustrations. One, however, has a carrying capacity of 8,000 lbs., and a lift of 26½ ft., and is intended for lowering safes to the sub-basement, across which they can be rolled to the main freight elevator without interfering with persons entering or leaving the building. The other has a capacity of 4,000 lbs., and lifts from the mezzanine basement to the street level, a distance about half that of the heavier hoist.

The points of interest in this equipment, aside from the general construction and the use of the automatic controlling device for the motors, is the suspension of the platforms from four corner chains and the use of four special corner rack guide rails, and also the use of dogs or safety catches, which are thrown should any one of the lifting chains break.

The general construction of both hoists is shown quite clearly in Fig. 1. The details of the safety catches and the method of their operation are best understood by referring to Fig. 2. In this it will be seen that each of the four lifting chains is anchored to the long end of a right angle bell crank (A), the short arm of which is connected by the links (B) to the levers (L), which are mounted upon what may be termed the "catch-shaft." Adjacent to this shaft is another, the "trip shaft," upon which is a loose grooved pulley (P), a trigger lever (T), and two double-ended levers (S). The latter have thrust rods arranged to swing out the pendulum corner dogs until they engage the rack guide rails and bring the platform to rest.

From one side of the top of the shaft to the center of the bottom extends a rope, which passes under a loose pulley at the side of the platform and makes a quarter turn around the pulley (P). On one side of this pulley are two pawls, held against the shaft by links connected with a coil spring, seen at (K) in Fig. 2. As the elevator moves down the pulley (P) revolves, and there is in consequence a tendency for the pawls to fly out. The distance to which they spread depends upon the speed of descent, and the tension of the spring is so adjusted that when a certain predetermined safe speed is exceeded the pawls spread sufficiently to strike the trip (R). This releases the trigger

*Geo. W. Rafter, in report of the New York State Engineer for 1897, pp. 375-460, particularly Table 4, p. 398.

†Feret, Engineering News, vol. xxvii., p. 311.
*A. F. Bruce, in Proc. of Inst. of C. E. (London), Vol. CXIII., pp. 217-28.

(T) and thus throws all four dogs or safety catches, at the same instant, into the guide racks.

The four corner chains, made of 9-16-in. steel, run up and over suitable sheaves at the side of the sidewalk opening. Each pair, Fig. 1, ends in a common ring to which is attached a drum chain made of 11-16-in. steel. These two heavy chains pass down and are wound on two 15-in. cast-iron

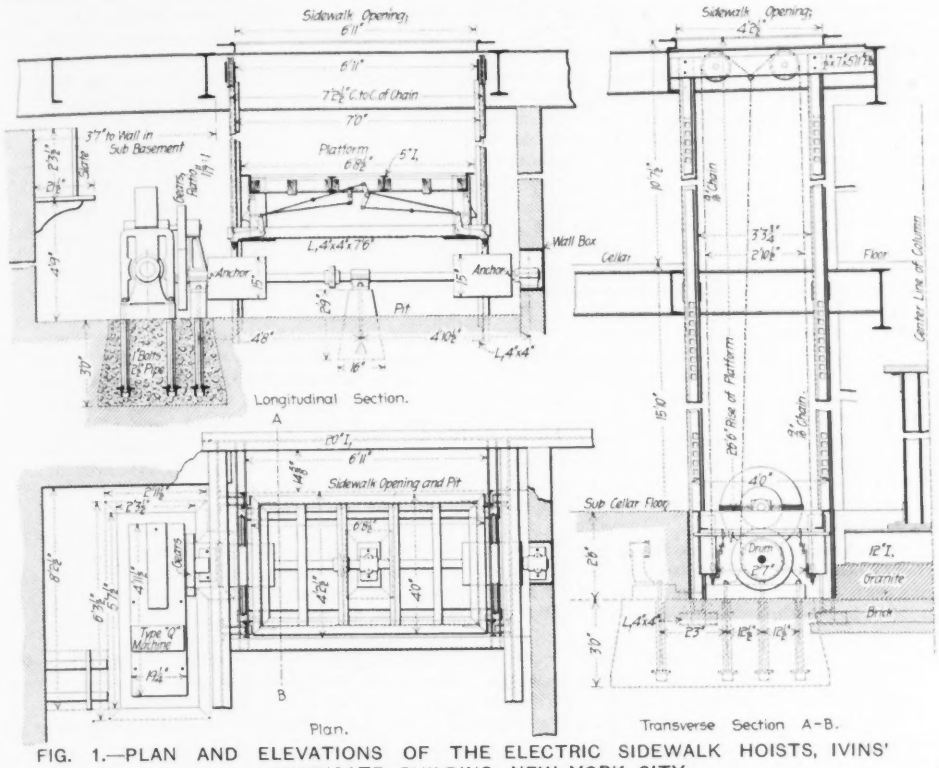


FIG. 1.—PLAN AND ELEVATIONS OF THE ELECTRIC SIDEWALK HOISTS, IVINS' SYNDICATE BUILDING, NEW YORK CITY.
Sprague Electric Co., New York City, Builders.

drums, which are threaded so that the chains do not "climb." The drums are mounted upon a 3-in. steel shaft, which has on one end a large spur gear meshing into another and smaller gear placed above and forming part of the elevator machine proper. This smaller gear, which gives a speed reduction of 1 11-17 to 1, is mounted on the shaft of the worm wheel of a "Type Q" Sprague elevator machine in place of the usual cable drum. This arrangement gives a powerful lift, and the slow speed which is desirable for this class of elevator. The motor is operated by an automatic controller similar in principle to those described in Engineering News of April 27. These controllers are mounted against the wall upon substantial brackets. The motor and controller are covered to keep out dust and dirt, which is an especially necessary precaution, owing to the use of both elevators at times as ash and refuse hoists.

ROCK-SALT IN LOUISIANA.

At the California meeting of the American Institute of Mining Engineers, Mr. A. F. Lucas, of Lafayette, La., presented an interesting paper upon the above subject, of which an abstract is here given.

At the present time four deposits of rock-salt have been found in Louisiana, occupying so-called islands, or elevations of from 80 to 250 ft. above tide, and lying in a N. W. and S. E. line near the shores of Vermillion, Cote Blanche and Atchafalaya bays. These deposits are known by the names of Jefferson, Petite Anse, Grand Cote, Cote Blanche and Belle Isle. These "islands" are surrounded by low marshes; though the last-named is really an island in Achafalaya Bay. Geologically, this series of islands is undoubtedly of Quaternary age, while the salt deposits are of the Tertiary Period, and are supposed to rest on the cretaceous. With the exception of about 2 ft. of rich loam, all the islands are covered with drift sand.

Salt was first discovered in 1862, at Petite Anse, within 20 ft. of the surface, while digging a well; and this deposit was utilized by the Confederate government until the Union forces destroyed the works. They were again worked in 1879, but the company failed, owing to a too costly system of transportation which involved three handlings of the product. It was succeeded by the New Iberia Salt Co., of New York, which built a 10-mile branch to the then Louisiana & Texas Railway, and thus obtained satisfactory transportation. In 1896 salt was discovered on the plantation owned for many years by Mr. Joseph Jefferson, the veteran actor, and used by him as a winter residence.

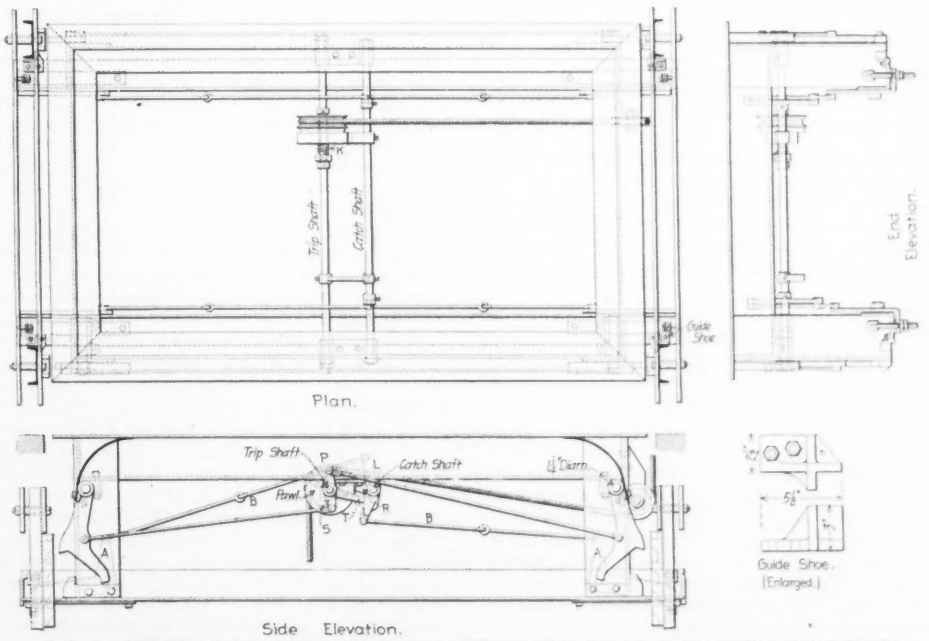


FIG. 2.—DETAILS OF PLATFORMS AND SAFETY CATCHES OF THE SIDEWALK HOISTS.

The salt is found at the depth of 290 ft., but is not yet worked.

The exploration for rock-salt was made by Mr. Lucas with the "jetting" system, starting with a 6-in. pipe and telescoping down to 3-in. or 2-in., and then using a diamond drill when the salt is reached. Notwithstanding repeated attempts, the bottom of the salt deposit has not been found; though, at the Jefferson place, a bore of 2,100 ft. was made, and encountered only solid, pure salt, containing from 98 to 99% sodium chloride. Unlike other salt deposits in the United States, the salt is continuous, without intercalating strata of foreign material.

In the present method of working, the "chamber-and-pillar" system is followed, with the salt excavated by undercutting. The shaft is sunk 250 ft. or more below the apex of the deposit; then stations are opened and an undercut is commenced, 7 ft. high and 75-ft. face. When this has advanced 200 ft., the roof is attacked and blasted down for about 20 ft.; this finally leaves a chamber 75 ft. wide by 200 ft. long and 20 ft. high, and in this the roof is again broken down to a final height of 70 ft. in the center and 60 ft. at the pillars on each side. This final excavation is made by the aid of tripods, made of short ladders, upon which is erected a temporary scaffold for the men and machines. A battery of holes, 10 ft. deep, is drilled near the brow of the chamber and along the whole face, and charged with low explosives; the ladders and scaffolds are then removed and the salt is blasted down. On the pile of this material new scaffolding is erected and the drilling and blasting repeated until the top of the final chamber is reached. Each chamber, of the size described, yields about 50,000 tons of salt; and the pillars left between chambers are 60 ft. thick. When one level is worked out on this plan, the shaft is sunk deeper and another level is opened.

These great vaulted chambers, especially when illuminated by calcium or electric lights, present a very impressive appearance. Two companies are now erecting plants for mining salt. The Gulf Co. will operate on Belle Isle, and the Avery Salt Mining Co., at Petite Anse. The first-named deposit, being adjacent to deep-water transportation, has the best geographical position.

A 100-FT. STACK, 5 ft. in diameter and weighing 50 tons, was recently moved by the Phoenix Iron Co. to a point 15 ft. from its original setting. Mr. H. H. Quimby, Superintendent of the engineering department of the company, was in charge.

THE MARCONI WIRELESS TELEGRAPH is to be used in reporting the International yacht races for the New York "Herald" and Philadelphia "Public Ledger," and these journals say that Prof. Marconi comes to the United States for this purpose. He arrived at New York on the "Aurania" on Sept. 21, accompanied by Mr. Wm. Goodbody, one of the London directors of the Wireless Telegraph Co., and three skilled operators who have been engaged in the experiments in the English Channel. Prof. Marconi said that in the recent British naval manœuvres the cruiser "Juno" and the flagship "Alexandria" were fitted with the necessary apparatus, and as many as 200 messages per day were interchanged between these ships, though at times 80 miles distant from each other, and, of course, entirely out of sight.

THE RAILWAYS OF AFRICA.

The recent public excitement in Europe over the project for a railway to extend the whole length of the African continent, from the Mediterranean to Cape Colony, has aroused some interest in the development of railways in the "Dark Continent," and we, therefore, place before our readers a map showing the principal lines completed, under construction and projected, with some particulars of these lines. The steady growth of railways in Africa and the possibilities of the further development of the export trade of the United States in connection therewith, also makes the matter of more than popular interest. For much of the information plotted on the map and contained in the article, we are indebted to the "Revue Generale des Chemins de Fer."

We have referred to the African-Continental Railway as an "alleged" project, because there seems good reason to believe that even the aggressive Sir Cecil Rhodes does not contemplate the immediate construction of an all-rail line, but merely the construction of railway links between the navigable rivers and lakes and the lines already completed. The present object is to develop the country, rather than to accommodate any existing through traffic, and for this purpose a combination line of communication, comprising railways and internal navigation, will afford all the necessary facilities. It is to be noted that there is no uniformity of gage in Africa, the southern lines being of 3 ft. 6 ins. gage, while those of Egypt are of 4 ft. 8½ ins. and 3 ft. 6 ins. gage, and others are of 24 ins., 30 ins., and meter gage. The popular phrase "Cape to Cairo" is also incorrect, since Cairo is not a port, but is 130 miles from the Mediterranean port of Alexandria, with which it is connected by rail. On the map which accompanies this article we have marked the approximate route of the railway line, which will eventually extend southward along the valley of the Nile to the northern end of Lake Tanganyika. From the southern end the lake there will be either a direct railway to Fort Salisbury and Buluwayo, or a line across to Lake Nyassa, with another line from Lake Nyassa to Fort Salisbury. The total distance by this latter route would be about 6,000 miles. Of the 4,900 miles of railway, about 2,050 are already built, and 1,240 miles undertaken. The route will be approximately as follows:

	Miles.
Railway, Cape Town to Lake Nyassa	1,990
Navigation on Lake Nyassa	310
Railway, Lake Nyassa to Lake Tanganyika	180
Navigation on Lake Tanganyika	400
Railway, Lake Tanganyika to Albert Nyanza	310
Navigation on Albert Nyanza	190
Railway, Albert Nyanza to Khartoum	1,120
Railway, Khartoum to Alexandria	1,500
Total	6,000

By the alternative route, omitting Lake Nyassa, the distance would be about 5,800 miles. The Siberian Railway will be 5,670 miles in length, from St. Petersburg to Port Arthur, while the Canadian Pacific Ry. is 2,906 miles long from Montreal to Vancouver, or 3,387 miles from St. John to Vancouver.

We may now proceed to consider some of the less gigantic schemes for African railway development, which, while they attract less popular attention, are really of much more importance than the spectacular "Cape to Cairo" project.

In the French protectorates of Algeria and Tunis, there are about 2,170 miles of railway, of which 1,830 are in Algeria and 340 in Tunis, while about 560 miles are now under construction in the latter state. In Algeria, light railways or tramways, aggregating about 155 miles, are proposed in the neighborhood of Algiers, and three pioneer lines into the Sahara desert are also proposed. One of these will extend from Algiers to Berrouaghia; the second now reaches from Constantine to Biskra, but will be extended to Ouargla. The third is for an extension of the line from Oran to Ain Sefra as far as Djenienbou-Resz. There are also projects on foot for a railway across the Sahara to connect the French possessions of Algeria with those of Senegal and Guinea, and the interior of Africa. The line to the Niger (in the province of Timbuctoo) would be 1,675 miles long from Ain Sefra, or 1,736 from Blidah; the route from Biskra by Ouargla and Amguid to Lake Tchad would be 2,110 miles in length. Still another project is for a direct line from Gabes to Lake Tchad, 1,860 miles. The French colony of Senegal has a railway from St. Louis to Dakar, 164 miles, but this is not a financial success, on account of its high charges. commerce following the Senegal River, in spite of the bar at its mouth, instead of going to the new port of Dakar. The other railway, from Kayes to Bafoulabe, is part of a scheme to open up the territory between the Senegal and Niger rivers. It took 8 years and $5,000,000 to build the 125 miles from Kayes to Dioubela, and three gages were used, but military expeditions in 1887 and 1892 improved the location and eliminated one gage. The whole line now comprises 82 miles from Kayes to Kale (meter gage), and 18 miles of Decauville portable railway from Kale to Dioubela. A line from St. Louis to Kayes, 500 miles, to connect the railways of the interior and the coast, has been projected, but it is stated that the cost would be prohibitive. Arrangements have been made with the French colony of Soudan for the extension of the line to the Niger. It will cross the Senegal River again and then bifurcate, one line going to Toulimandio, and the other to Bamako, which are the river ports of the lower and upper Niger. The distance from Kayes to Toulimandio will be 335 miles, of which 260 miles remain to be built. Further extensions into the rich and well-populated region of the eastern Soudan are considered probable, as the navigation of the Niger is difficult and dangerous, and does not afford sufficient facilities for transport.

In French Guinea, a line has been proposed from Konakry, the port and capitol, to Bafara and Kouroussa, on the upper Niger. It will be about 310 miles in length, attain an altitude of 2,950 ft., and cost about $5,000,000.

In Sierra Leone, the English have built a line of 30 ins. gage from Freetown to Songotown, about 30 miles, and this is being extended to Rotofunk and the frontier of the French Soudan. It was commeneed in 1895.

On the Ivory Coast, the French have projected three lines: (1) from Grand Lahou up the Bandama valley to the Bogoue territory of the Niger; (2) from Grand Lahou to Grand Bassam and Kong; (3) from Grand Lahou to Bonduku, to get a share of the English traffic from the interior of the Gold Coast region. In this latter colony two railways are being built; (1) extending from the coast at Tarkwa, to develop gold mines; (2) from Akra to Coomassie, this being mainly a military line to aid in the subjugation of the Ashantees. A French firm will also build a line of 24 ins. gage from Kotonou to Abomey, in the Dahomey region, and this will eventually be extended to Carnotville and the Niger. In the colony of Lagos, a railway has been built from the port of Lagos to Abeokuta, whence it is being extended to Ibadan, and it is intended to eventually connect with the railways of the French Soudan.

The Congo Ry. has for its object the opening up of the commerce of the Congo River by giving safe and quick transportation past that part of the river which is impraeticable for navigation, and around which all traffic had to be carried by a portage at enormous expense. This part of the river is between Matadi and Stanley Pool. Above the railway the river and its numerous tributaries afford navigation for about 1,000 miles. The route was explored by a Belgian company in 1887, and work was commenced in 1890. The construction was greatly delayed by the difficulty in obtaining laborers, the hot and unhealthy climate, contagious diseases, and the rocky nature of the country. The first section, from Matadi to Kenge, cost $77,000 per mile. The completed line extends from Matadi to Dolo, on Stanley Pool, a distance of 250 miles, with a six-mile branch from Kinshassa to Leopoldville. Its elevations above sea level are as follows: Matadi, 86 ft.; Col de Zole, 1,574 ft.; Sona Gongo, 2,447 ft.; Tampa, 2,083 ft.; Dolo, 1,063 ft.

The road has a gage of 2 ft. 6 ins., and is laid with 42-lb. steel rails on 104-lb. steel ties, 2.9 ft. c. to c. This track weighs 220 lbs. per yd. The equipment includes 100 locomotives of 5 to 30 tons, 15 passenger cars and 208 freight cars. There are three passenger trains per week and 8 freight trains per day. The journey occupies 20 hours, the passengers stopping at Tumba for the night. An extension of 27 miles from Boma to the Chiloango River is projected, but on a gage of 2 ft.

Other lines are projected to connect navigation on various tributaries of the Congo: (1) between the Lubefa and the Lualaba (Ponthierville-Nyanza); (2) between the Lomami and the Congo-Kamolondo, above the Porte d'Enfer (or Hell-Gate); (3) between the Uelle and the Itimbiri; (4) between the Ubangi (flowing into the Congo) and the Kemo (flowing into the Shari River and Lake Tchad). All these are shown on the map.

The Portugese have for 30 years past projected a transcontinental railway to connect their colony of Angola, on the west, with that of Mozambique on the east. The treaty of 1891, which gave to England the possession of a vast territory separating these two Portugese colonies, has practically put a quietus to this ambitious scheme, but the Belgians are now surveying a line across the Congo Free State to Lake Tanganyika. In 1888 the Portugese Royal Trans-African Railway Co. commenced the construction of the transcontinental line from St. Paul de Loando, and it is now completed as far as Ambaca, 226 miles, passing through a rich plantation country, coffee being largely cultivated. Branches are being built, having an aggregate length of 40 miles. The line will be extended 95 miles to Malange, and eventually to Kasange, on the Kwango River. The cost of the road was about $46,450 per mile, and the track is laid with 40-lb. rails. The railway has reduced the time of travel between St. Paul de Loando and Ambaca from ten days to one day. The Portugese have also projected lines on the east coast from Benguela to Bihe, and from Mossamedes to the plateau of Huila.

The Germans propose a line in their colony of Southwest Africa from Angra-Pequenna to Bethanie, opening up Namaqualand, and they are building a line 310 miles long to open up Damaraland. This latter line will run from the mouth of the Swakop River (in the British settlement of Walfisch Bay) towards Otijumbingue and Windhoek; it will eventually connect with an extension of the Cape Government Railways.

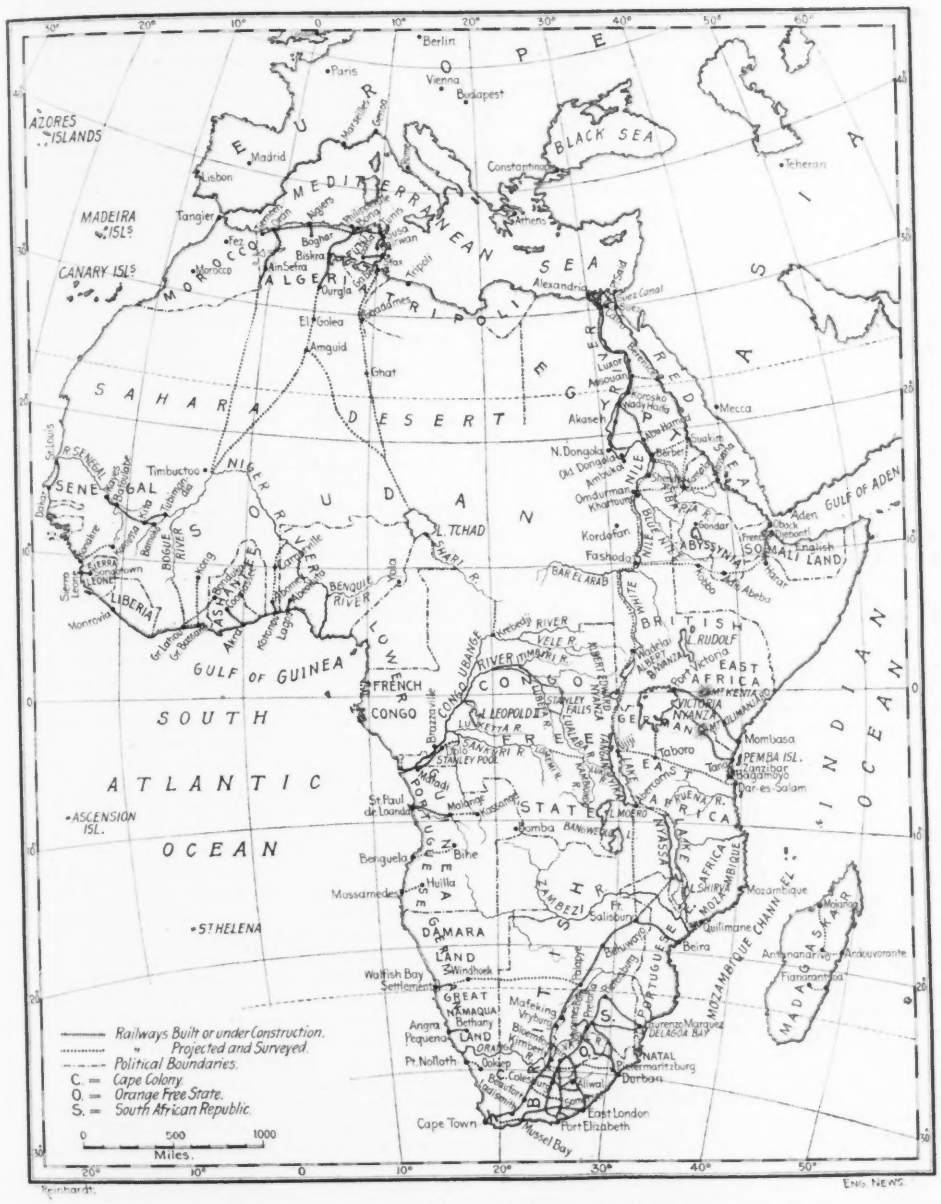
The greatest railway system of Africa is that of Cape Colony (2,495 miles) and its extensions into adjacent states, forming a complete system of about 4,500 miles, all of 3 ft. 6 ins. gage. The railways of Cape Colony comprise three main routes, starting from Cape Town, the principal port for passengers; from Port Elizabeth, the principal port for landing freight; and from East London. The cost of these railways has averaged about $45,150 per mile. These are connected by a number of lateral lines, and a new series of lines is now being built from Mossel Bay to Oudtshoorn and Kliplaat, and from Somerset East to King Williams Town.

Extending from the Cape system is a line which crosses the Orange Free State and reaches Johannesburg and Pretoria, in the Transvaal (or South African Republic). From these latter points there are two railways to the east coast: (1) by the Lourenco Marques & Delagoa Bay Ry. line (to the Portugese province of Lourenco Marques), and (2) by the Natal State Railways to Durban.

The most important line of South Africa, in connection with the north and south transcontinental railway project, is that which extends from Cape Town to Buluwayo, crossing Cape Colony, Bechuanaland and Rhodesia. The British South African Co. built the line from the frontier of Cape Colony to Kimberley in 1889, and to Vryburg in 1890. The Bechuanaland Co. completed the extension from Vryburg to Mafeking, 96 miles, in 1894, and to Buluwayo (587 miles from Mafeking) in October, 1897. The distance from Cape Town to Buluwayo is nearly 1,400 miles, and the journey occupies 90 hours. Some particulars of the South African railways will be found in our issue of July 15, 1897.

The Mafeking and Buluwayo section, 587 miles, is laid with 60-lb. rails on steel ties, as the ants and other insects rapidly destroy all wood-work. The maximum grade is 1.25%. All material had to be brought up from Cape Town, but in spite of all difficulties tracklaying was pushed at the rate

of 1½ to 2 miles per day. The locomotives weigh about 75 tons. The effect of railways upon the commercial development of Africa may be realized when it is stated that the cost of wagon transportation between Mafeking and Buluwayo was $250 per passenger, and $500 per ton of freight, while the cost of railway transportation is about $30 per passenger, and $25 per ton of freight. This line has cost from $15,000 to $20,000 per mile. From Buluwayo it is now being extended to Fort Salisbury, and to two coal fields, 100 and 250 miles north of Buluwayo, the farther point being only



MAP OF THE RAILWAY SYSTEMS OF AFRICA.

150 miles south of the Zambesi River. The railway will eventually be extended to this river (above Victoria Falls), and to Lake Tanganyika. The distance from Buluwayo to Khartoum is about 3,500 miles.

From Fort Salisbury there is a railway of 3 ft. 6 ins. gage to Beira, on the coast. This is an English line, crossing the Portugese territory of Mozambique. It was completed from Fontesville west to Chimoio in 1894, but as the navigation on the Pungwe River was not satisfactory, the road was extended to the seaport of Beira, while the western end was extended to Fort Salisbury by the British South Africa Co. The distance by rail from Fort Salisbury to Beira is 445 miles. Arrangements have already been made for extending the line north from Fort Salisbury to Lake Tanganyika. It had originally a gage of 2 ft., but this has been widened to 3 ft. 6 ins.

The Zambesi River is not available for navigation, and a Portugese company has a concession for a railway 200 miles long, extending from the port of Quilimane to the River Ruo, a small tributary of the Shire River, on the British frontier. From that point, the African Lakes Co., an English corporation, will extend the line 120 miles from Ruo up the Shire River to Impimbi. This will traverse a rich coffee-growing district, and will connect the navigation of Lake Nyassa with the sea.

In the German territory of East Africa there are projects for a line from the coast to the great lakes of the interior. Starting from either Dar-es Salam or Bagamoyo, the route will extend west to Tabora, whence the direct line will continue to Ujiji, on Lake Tanganyika, and a branch will run north to the Victoria Nyanza. This line is to have a gage of 2 ft. 6 ins., and the cost is estimated at $30,000 per mile, but the project appears to have been temporarily abandoned. A little further to the north, a line of 60 miles in length has been commenced by the German East Africa Ry. Co., and is to extend from the port of Tanga to Mohesa, Korogwe and Arasuska (near Mount Kilimanjaro). In 1896 it was completed from Tanga to Mohesa, 25 miles, and very little work has since been done. It is of meter gage, and cost about $23,330 per mile.

In British East Africa, an important line of 650 miles in length is being built across the Uganda district, from the coast to the Victoria Nyanza. Starting from the port of Mombasa, it traverses the desert of Toru for about 100 miles, surmounts the coast range at a pass with a summit elevation of 8,500 ft. (between the peaks of Kenia and Kilimanjaro), and has a terminal at Port Victoria, on Berkeley Bay. The line is of meter gage, and about 206 miles are now completed. It was commenced by the Imperial British East Africa Co., but has been taken over by the British government. It will cost about $13,000 to $14,500 per mile.

Going northward, no railway or railway project is met with until we reach Abyssinia. In 1894, the Negus (or Emperor) Menelik, granted a concession to the Italian Imperial Ethiopian Ry. Co. for a line from Harar north to the French port of Djibouti (in French Somaliland) on the Gulf of Obok, just below the Red Sea. This line will be 281 miles long, of which 30 miles are built. About 35 miles north of Harar, a branch of 250 miles will turn westward to Adis-Abeba, the new capital city. This will eventually be extended to Kobbo or Fashoda, and the White Nile. The line is on the meter gage. Its traffic will be that of the caravan routes, on which the rate of transportation is ten miles per day.

Egypt has an extensive system of railways, especially in the Nile delta, the aggregate length being 1,450 miles. The principal lines are from Cairo to Alexandria, 130 miles; Tantah to Damietta, 70 miles; Callant to Suez, 144 miles. From Cairo a line of standard gage extends along the valley of the Nile, and was completed as far as Luxor in March, 1898. From this point a line of 3 ft. 6 ins. gage continues to Assouan, 6 miles below the first cataract. From this point a line to Berenice, on the Red Sea, is proposed, so that the overland mails from England could be delivered to the steamers at Berenice, instead of Suez. The railway from Wadi-Halfa was built south for 35 miles in 1874, and to Akasheh, 100 miles, in 1884, to enable the Dongola expedition to surmount the second cataract. The line has since been extended to Merowe, below the fourth cataract. The recent line built for Gen. Kitchener's Soudan expedition is one of 250 miles, from Wady Halfa, across the Nubian desert and striking the river again at Abu Hamed. It has already been extended to Berber, and is being continued to the famous desert towns of Khartoum and Omdurman, crossing the Atbara River by the now famous American bridge. From Berber a line to Suakin, 250 miles distant, on the Red Sea, was proposed, and a military railway was at one time commenced but abandoned. This route seems now to have been abandoned in favor of a line extending from Berber to Kassala (ceded to Great Britain by Italy), and thence to Massana or Suakin. The line will also be extended southward along the Blue Nile to Abou-Haraz and the fertile country of Gedaref.

The French island of Reunion has a railway 80 miles in length, parallel with the coast, from St. Pierre to St. Benoit. It was opened in 1882, but the company failed, and the line was taken over by the state in 1897. In the French island of Madagascar, a meter gage railway from the port of Tamatave to the capital city, Antananarivo, 230 miles has been surveyed. The Madagascar Colonial Co. has undertaken to build the line from Antananarivo to the port of Andevorante, and eventually to Tamatave. It will be of meter gage, and will surmount an elevation of 5,200 ft. A railway from Antananarivo west to Majunga, on the Mozambique Channel, is also projected, but the works would be much more difficult than for the line to the east coast. The French Colonization Co., of Madagascar, proposes to build a highway (with or without a railway) from Fianarantsoa to Farahouy Bay, on the east coast. The English island of Mauritius has two railways with nearly 105 miles in operation. They extend from Port Louis to Grand River and Mahetong, with branches to Savanna and Moka.

The total mileage of railways in Africa at the end of 1898, was as follows:

	Miles.
Cape Colony	2,062
Egypt	1,450
Transvaal	1,090
Rhodesia	714
Orange Free State	700
Natal	500
Rest of Africa	3,750
Total	10,866

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ADVERTISING RATES: 20 cents a line. Want notices, special rates, see page XXII. Changes in standing advertisements must be received by Monday morning: new advertisements, Tuesday morning; transient advertisements by Wednesday morning.

Last week's convention of the League of American Municipalities goes far towards giving an affirmative answer to the question we raised a year ago as to the need of another national society of municipal officers. To be sure, the league is as yet only two years old, having been organized at Columbus, O., two years ago. It seemed at the time of the organization that it was a quite unnecessary rival of the American Society of Municipal Improvements, which had then been in the field only two or three years. It still seems a pity that the work of the two organizations could not be combined, thus gaining in strength and reducing by one the large number of engineering and municipal societies, but the two bodies now seem to be quite dissimilar in aims and membership, the league being composed largely of mayors, city clerks and city councilmen, while the other body has comparatively few of these and many city engineers, commissioners of public works and street and sewer superintendents. The papers before the latter body are also more technical in character than those presented to the league, and make little reference to municipal ownership, which is a central feature of the programs of the league. Whatever the final outcome of the league may be, it is certain that the convention, reported elsewhere in this issue, was a great success in the matter of attendance, interest in the sessions and general interchange of views.

By far the strongest feature of the convention was the discussion of municipal ownership, which was, perhaps, the most notable one ever held in this country, both in point of the character of the participants and the ideas brought out. It was gratifying to note that both sides showed a strong desire for fairness and truth, and for the elimination of such questions as can be mutually agreed upon, in order to concentrate the discussion on a few of the most essential points of difference. We shall refer to this matter at a later date.

Two unfortunate features of the meeting were an overcrowded program and frequent deviations from the order of business, compelling some who desired to take part in the discussion of special topics to remain a day longer than they intended, while even then a few went away without an opportunity to express their views. These are faults which most of the older associations are not yet free from, although many of them have shown much improvement in those regards of late

Newspaper reports state that the organization is just completed of the Tripler Liquid Air Co., with a capitalization of $10,000,000, and Mr. Chas. E. Tripler as President. We also learn that litigation has begun in the Patent Office over the respective claims of Mr. Tripler and of Messrs. Ostergren and Burger, of the General Liquid Air & Refrigeration Co. Those who have experimented on the physical properties of liquid air have found that anyone handling it carelessly is likely to be severely burned. Those who experiment with it in a financial way are likely to make the same discovery.

HOW CAN WE MAKE PROSPERITY STAY?

There can hardly be a greater contrast between the industrial condition of the United States at the present time and that which existed five years ago. Then every city had pressing upon it the problem of the unemployed. Now, for the first time in many years, is witnessed a greater demand for skilled labor, in many industries, than can be supplied. Then the seller of goods sought out the buyer, used all the arts at his command to obtain an order, and was frequently compelled to make concessions in price and terms to close the trade. Now, in many lines, is witnessed the rare spectacle of the buyer going to the seller and asking as a favor to have his order executed at some date in the not too remote future.

So we might continue to draw the contrast in many other ways; but it is too plainly evident to every observer to make this necessary. Many of our readers, as we know, have themselves felt the difference in conditions as a direct influence upon their personal welfare; and they and all of us are directly interested in the question, how long is the present era of prosperity likely to last?

That an end to it will sooner or later come is certain. This nation, like every other civilized nation, has had its periods of prosperity before, and they have always been succeeded by periods of financial depression. The present, we may be very sure, will be no exception to the universal rule.

What can be done to prolong the stay of "good times" with us? These seasons of prosperity and of adversity are not caused by any superhuman power. The sunshine and the rain were given as bountifully in 1894 as in 1899. Calamities of storm or of flood, failure of crops or of pestilence, cause hardship in limited localities; but our seasons of financial distress can be traced to no such visitations. Inasmuch, then, as the plunge into hard times and the emergence into days of prosperity are alike due to human agencies, it certainly rests with man, if he be wise enough, to set in motion agencies which shall at least prolong the days of prosperity.

We shall not attempt at this time to enumerate the many causes which operate to bring about or to check business prosperity. Some of them are so important that all men recognize them; others are the subject of political controversy. Our purpose is to point out some of the common and ordinary influences, which can, if properly controlled, operate to prolong the period of prosperity and to lessen the shock of financial disaster when it comes.

In the first place, it is well to reflect that one undoubted cause of the present boom was the expenditure by the Government of some $250,000,000, more or less, in the Spanish War. The purchases by the Government of ships, clothing, food and supplies of all sorts in 1898, coming at a time when manufacturers were already experiencing a revival in trade, gave an enormous stimulus to business of every sort. Compared with the total volume of the country's production, it was indeed a small item; but it was enough, nevertheless, to turn the scale of market prices in the sellers' favor. The law of supply and demand is a natural law of trade; but its actual operation, under modern business conditions, is that a very small margin of supply over demand or of demand over supply is what fixes the price of the entire product in a given industry. The Government demand was not only by reason of its volume, but by reason of its character a most important influence upon the market. The Government did not split hairs concerning prices and terms like the ordinar buyer; it did not make its orders conditional; it did not wait the sellers' convenience to fill them. Its needs were imperative and would brook no delay. In the shipping trade, for example, it absorbed a good share of the shipping on the Atlantic coast, and sent the shipowners hurrying to the builders with orders for new vessels. These in turn placed their contracts for plates for hulls and boilers, and gave the steel mills so much work that other customers found to their surprise that they could no longer have their orders filled immediately on their receipt. So it was, in lesser degree, in other lines.

It is to be particularly noted, however, that the Government orders would have had no such large influence had not the conditions been ripe for a return to prosperity. The hard times of 1893 to 1897 caused a general liquidation of debts. Prices were down to a "hard-pan basis." Manufacturers and traders had learned conservatism during these years, and had learned, moreover, how to conduct their business with greater economy. Had not these conditions existed, no such results could have followed the Government's expenditure as were actually experienced.

It should not be overlooked, furthermore, that in so far as our present prosperity is based on extraordinary expenditures by the Government, it has an unstable foundation. The nation is like a man who borrows a sum of money. While it lasts he may live sumptuously and call himself prosperous; but by and by a day of reckoning comes when the debt must be paid. Creating national prosperity by increasing public debts has been tried many and many a time by other nations, as well as our own. It always works; but financial disaster inevitably follows. The fact that we have increased the national debt by over $400,000,000 since 1891 is not a good omen for future national prosperity.

The tendency of the public in financial matters is always "to go with the crowd." The comparision of the business community to a flock of sheep is an old one. Every man is strongly prone to do what he sees his neighbor doing. This is why in times of great prosperity men incur obligations and enter upon speculations with apparent recklessness, who in times of financial disaster would turn a deaf ear even to meritorious propositions for investment.

We are now in the midst of such a season of business expansion as has not been seen in a long time. Speculation of all sorts is rife. Companies are being floated with millions of dollars of paper capital, and with little save great expectations to show for it. Some of these concerns have bought up some of the abandoned and obsolete factories which failed to survive the competition of 1896 and 1897, and parade a list of such properties as evidence of their solid foundation. Manufacturing enterprises are expanding. Concerns which only a very short time ago were at their wits' end to obtain orders enough to keep them from shutting down, are making large investments to increase their capacity. All these things tend to swell the volume of apparent demand, and to force prices higher and higer until finally the bubble will burst. Banks and financiers refuse further loans; purchasers cancel orders; mills can find no market for their goods, and are shut down; operatives are thrown out of employment and their purchases decrease. Thus does our fair castle of prosperity fall in ruins.

What can be done to postpone this evil day, and to diminish its shock and its intensity when it does come? The almost self-evident answer is that anything at the present time which tends to check the swelling tide of demand, the forcing upward of prices, and the increasing tendency toward debt-incurring and speculation on a gigantic

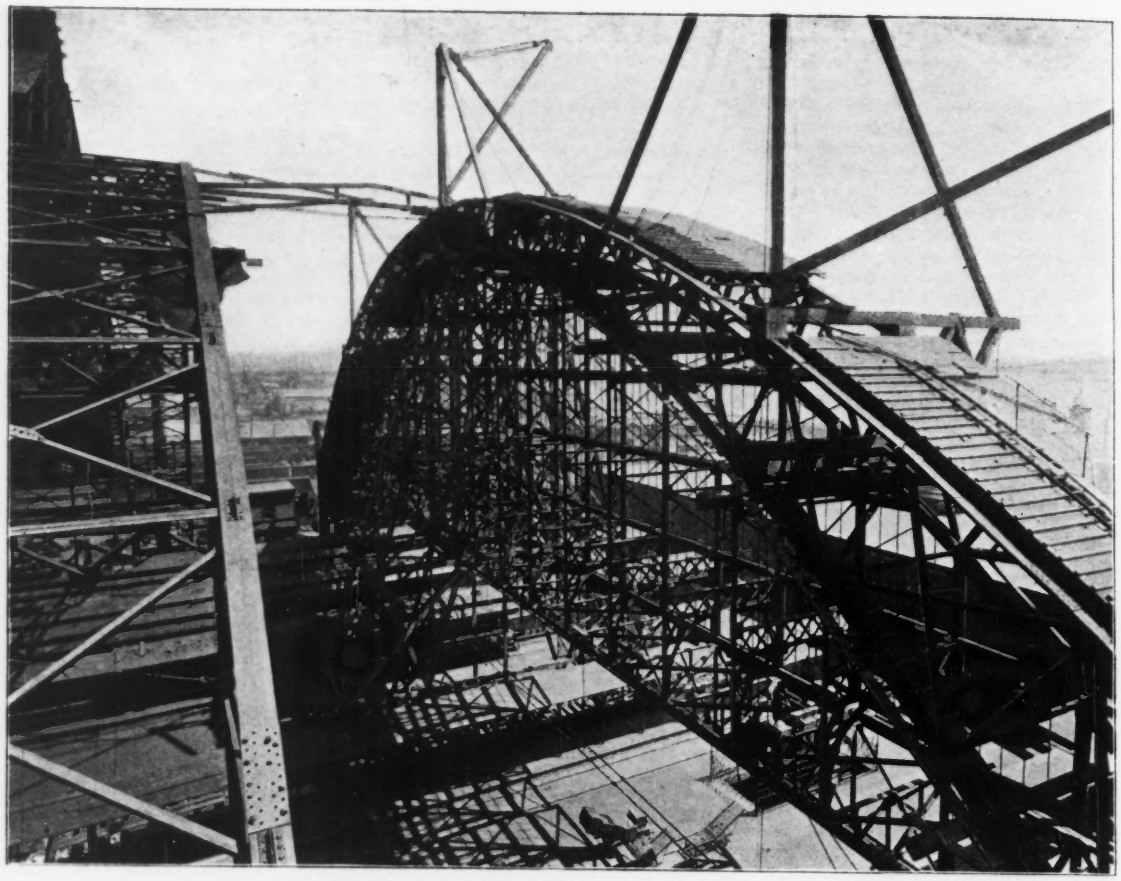


FIG. 5.—VIEW OF GABLE TRUSSES MOVED OUT AND READY TO BE USED AS FALSEWORKS FOR THE ERECTION OF A NEW INTERMEDIATE TRUSS.

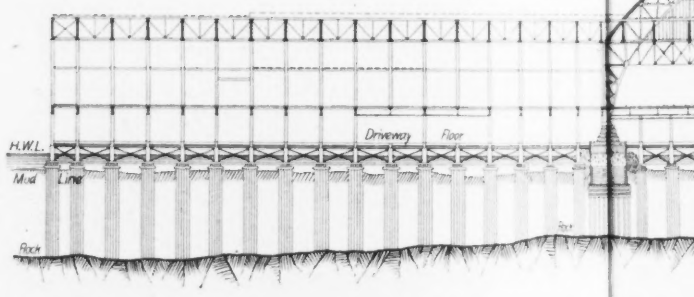


FIG. 3.—SECTIONAL ELEVATION, PARALLEL TO RIVER, SHO

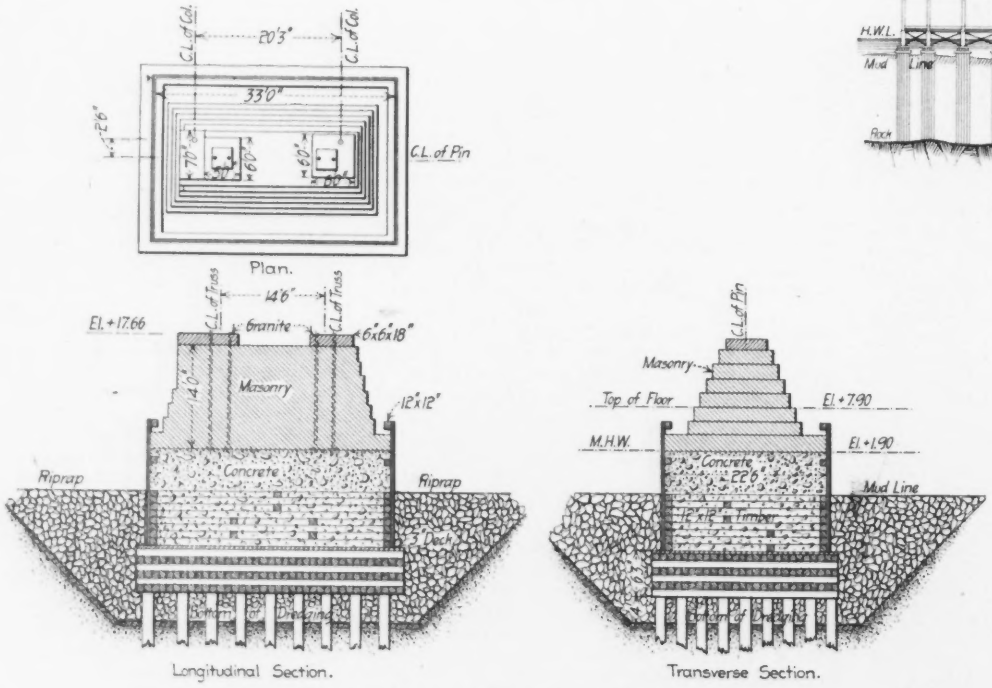


FIG. 2.—FOUNDATION FOR PIERS UNDER MAIN TRUSSES.

NEW PASSENGER TERMINALS OF
PENNSYLVANIA R.R. AT
JERSEY CITY, N. J.

Wm. H. Brown, Chief Engineer.
Louis H. Barker, Principal Asst. Engineer in

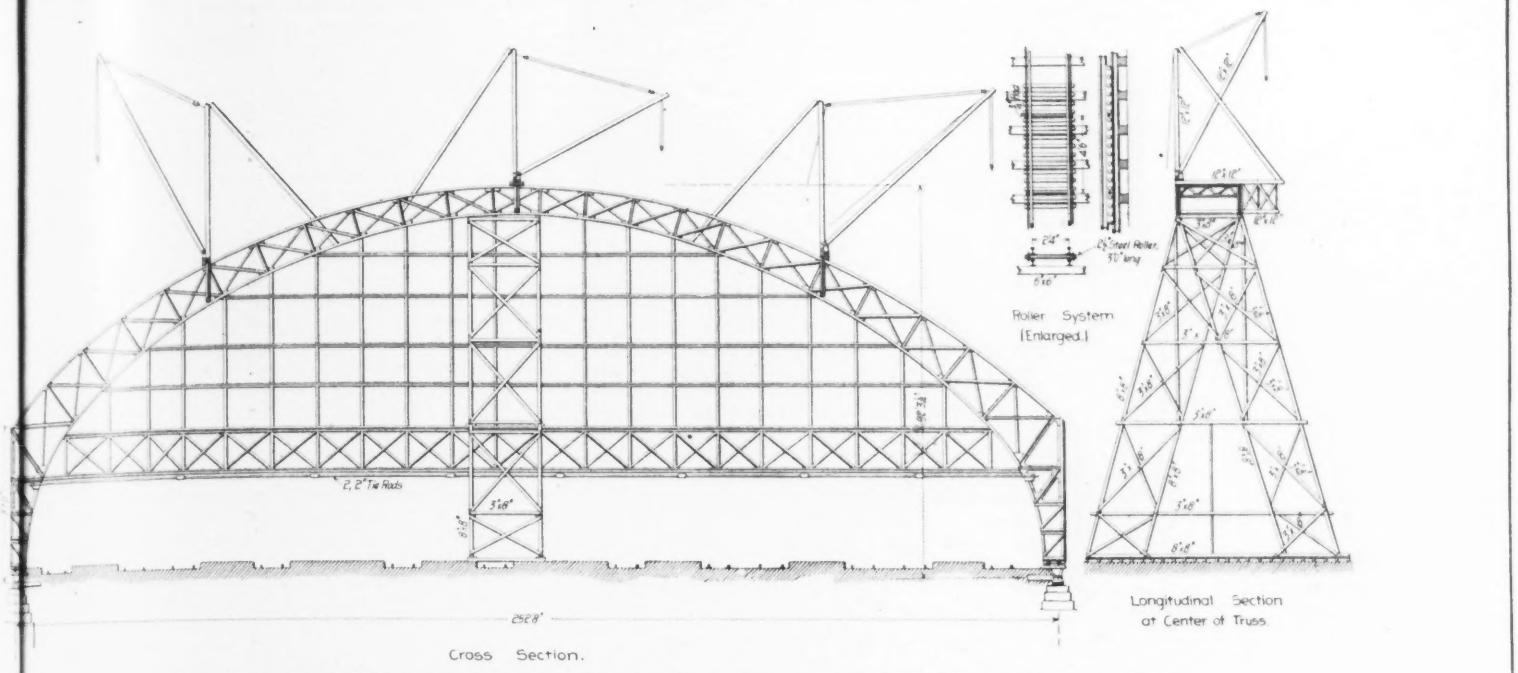
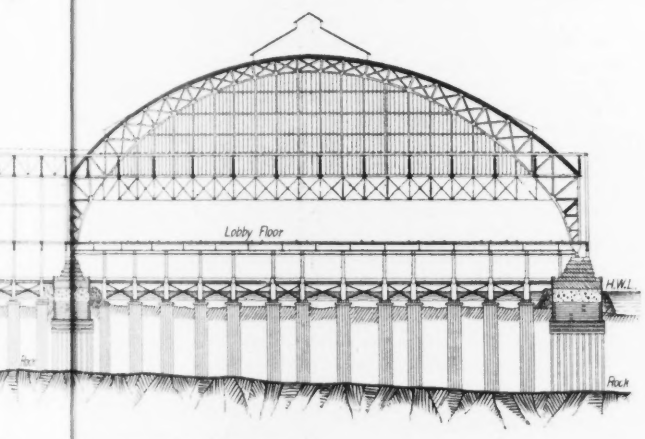


FIG. 4.—ELEVATION OF GABLE TRUSSES WITH CENTRAL STEADYING TOWER AND ERECTING DERRICKS.



EL TO RIVER, SHOWING FRAMING.

RMINALS OF THE
A R.R. AT
Y, N. J.

eer.
sst. Engineer in Charge.

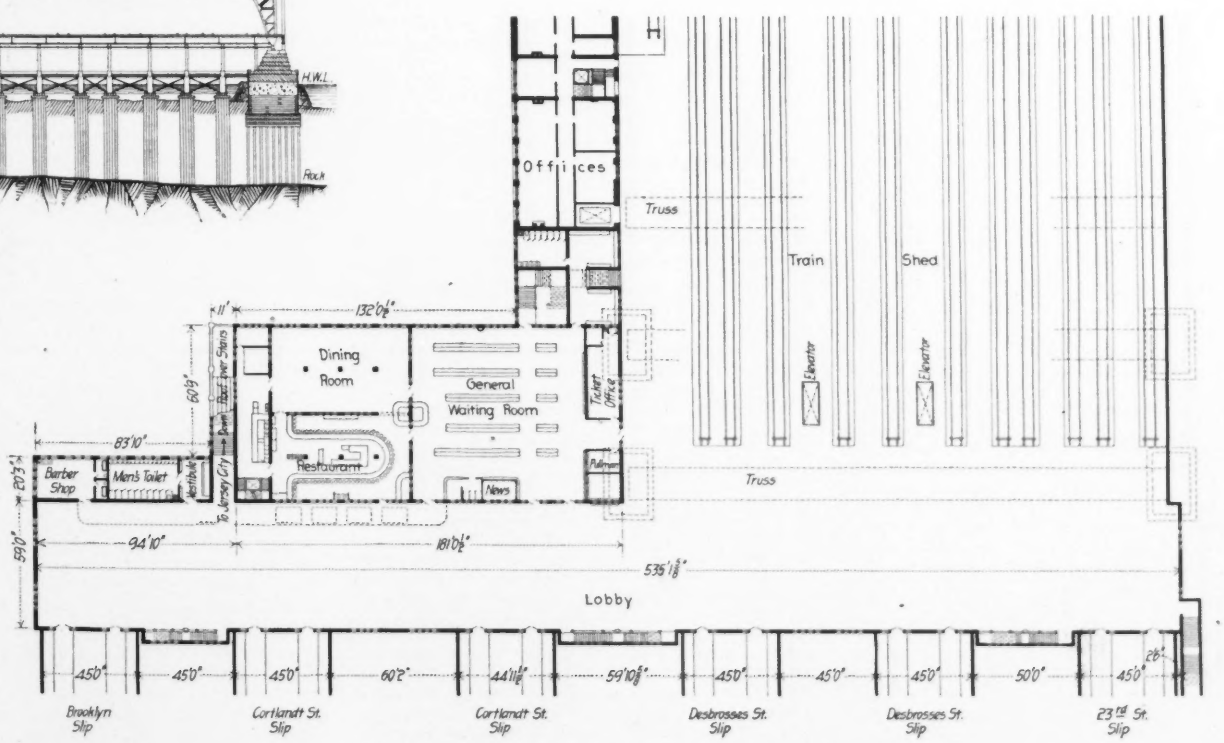


FIG. 1.—PLAN SHOWING ARRANGEMENT OF WAITING-ROOMS, ETC.

scale, will operate to prolong prosperity. Let us illustrate by a concrete example. Here is, let us say, a city which proposes to spend ten million dollars on certain public improvements. These have been a long time in contemplation; but during the hard times the taxpayers have been inclined to oppose such large expenditures. Now, under the general stimulus of prosperity, however, it is proposed to undertake the work. The money is raised by the sale of city bonds, and this volume of demand is added to that which is at the present time operating to raise prices of materials and of labor to a still higher point. Next, suppose that instead of this course the opposite one were taken, and the work were postponed until a future day, when prices have fallen to a more nearly normal level. The taxpayers would then get a much larger return for their money expended. The volume of demand would come at a time when it might be most welcome to fill the order-sheets of mills which were nearing a shut-down, and labor would be employed which would otherwise be idle.

Is it not a fact that our seasons of financial prosperity and adversity are really due to fluctuations in the tide of demand? Do we not need as much to check it in times of prosperity as to stimulate it in times of adversity? Must we not, in fact, do the one in order to do the other?

We wish to emphasize the fact, moreover, that the course which is thus indicated is really a sound financial policy. To go as the crowd goes is as contrary to good business principles as it is to the larger financial interests of the nation. Whoever at the present time erects a building, equips a manufactory, constructs a system of water supply, or does almost any piece of work which can be classed as a permanent investment will receive a smaller return for a given expenditure than at any time for many years. Now is the time when all purchases and investments should be restricted to the lowest possible point. Now is the worst possible time to engage in large investments and speculations, notwithstanding the fact that every one is doing it. It is the best possible time to pay debts and not to incur them.

In the hard times of 1894 a great number of cities throughout the country embarked in public works on a large scale, partly to give a means of support to the army of unemployed, and partly to take advantage of the low prices. This was not only a wise method of giving charity, but it was sound financiering. To give it full effect, however, the converse principle should also be adopted and in times of great prosperity all public work except that absolutely necessary should be set aside and left until a return of hard times and low prices make its undertaking advisable. The city which pays its debts and enlarges its sinking funds in good times, will find its bonds in eager demand when hard times come, when investors who have met losses through their speculations in railroad and industrial stocks compete with each other for safe bond issues.

What is good financiering for cities is also good for railway companies. It is a better time to pay debts than to buy steel rails, or bridges, or rolling stock, except in so far as these may be absolutely necessary for the profitable operation of the road. Every company which pursues this policy is not only saving money for its stockholders, but is helping to prolong good times and diminish the shock of financial disaster when it comes. Its orders, which would now be booked at high prices and with long delays, will be eagerly sought for at some future day, and will serve to keep some mill going that would otherwise stand idle.

And what is good for city and railway and other private corporations is also good for the nation. No one thinks much in these days when all is gold that glitters, and the newspapers make us all familiar with hundred-million-dollar schemes (on paper), of urging economy in the administration of Government affairs. Yet now is the very time when economy is most imperative. All projects for permanent improvements, all public building schemes, all river and harbor work, all expenditure on navy and coast defences, should be given a most searching scrutiny, and expenditure on them should be reduced to the lowest point. Whatever can be postponed should be. The country's trade needs no artificial stimulus; on the contrary, every addition to the volume of demand at the present time stimulates the inflation of prices and brings nearer the inevitable crash. Two years, or five years hence, the Government expenditure for such improvements may be a most valuable means of reviving drooping prosperity and aiding in its restoration.

The way to make the good times stay, then, is simply to hold in reserve a part of the forces which are now pushing the tide of prosperity on toward its flood, that they may be expended later to check the ebb, and leave at least enough water in the harbor that not so many good ships may become stranded.

If the nation, the states, and the cities, and all the great private corporations of conservative management and great financial strength were to adopt the principle we have laid down, who can doubt that our period of prosperity might be long continued. The tendency, as we have already pointed out, is all in the other direction. Public officers and those in charge of the affairs of corporations are affected like other men by the glamour of prosperity and embark in large schemes which they would not consider in times of financial stress. Those who do perceive the folly of such a policy, however, and who work against the tide, may have the satisfaction of knowing that they are working for the interests of those for whom they are trustees, as well as for the promotion of sound and lasting national prosperity.

LETTERS TO THE EDITOR.

A Sinking Fund Formula.

Sir: Having occasion some time ago to work out the annual amount necessary to form a sinking fund for payment for an improvement, the writer found the problem a tedious one, as he was unprovided at the time with short cuts or tables.

To facilitate matters for the future, he worked out (with the aid of the binomial theorem) the following formula, which will be of use to himself, and may prove of some benefit to others who may be called upon to make similar calculations:

Let

S = the sum obtained at the end of a term of years, n, by depositing annually $1.

x = rate of interest allowed on deposits in decimals of a dollar.

n = number of years in which payment is to be made.

Then

$$S = n\left\{1 + \frac{n+1}{2} \cdot x + \frac{n^2}{6} \cdot x^2 + \frac{n^3}{24} \cdot x^3 + \right\}.$$

The results obtained are very approximate and the error inappreciable with ordinary rates of interest, as may be seen by glancing at the following:

Assume 6% as the rate of interest on deposits:

Then

S = by formula in { 5 years $5.980; more correctly $5.975
15 " 24.675; " " 24.672
20 " 38.840; " " 38.99

Since looking into this question the writer has been struck by the want of uniformity in tables relating to sinking funds, as much variation as 5% being noted in one instance.

Yours truly,

W. T. Ashbridge, C. E.

Toronto, Ont., Aug. 31, 1899.

(In this connection we would refer our readers to Table 17, p. 81, of "The Economic Theory of the Location of Railways," by the late Mr. A. M. Wellington. This table gives the value of $1.00 placed at compound interest, at from 3 to 10%, for each year up to 100 years. The formula used is $S = (1 + r)^n$; in which r = rate of interest; n = number of years, and S = amount of $1.00 at compound interest.—Ed.)

Litigation Over Hydraulic Dredging Patents.

Sir: While the "laws delays" are proverbial, especially in patent litigation, there are, it seems, exceptions.

On June 27 last, Mr. John H. Miller, attorney for A. B. Bowers, while in New York city on other business, was informed that the Duluth Dock & Dredge Co., of Duluth, Minnesota, had commenced to build a dredging machine to be used in Duluth Harbor, which was an infringement of the Bowers' patents.

Mr. Miller was not able to give the matter his attention until July 8, on which day he left New York for the West. Making a flying trip to Duluth, he found that the infringing dredge was very nearly completed, and within a week's time would be ready to be put in operation. He immediately set to work, and with the aid of three stenographers operating at the same time, he drafted a voluminous bill of complaint and a mass of affidavits comprising in all over one hundred pages of typewritten matter, thus preparing all the papers for an injunction against the Duluth Dredge & Dock Co. It was then necessary for him to find a judge to sign the injunction, and this was a matter of no little difficulty, as it was vacation time and the Circuit Judges had all gone on their vacations to distant parts of the country. By a liberal use of the wires, however, he finally ascertained that District Judge Lochren would hold a short session of the Circuit Court at St. Paul on Monday morning, July 17. At that time Mr. Miller appeared in court before Judge Lochren at St. Paul, and after submitting the papers to him, the judge entered an order against the Duluth Dredge & Dock Co., requiring them to appear in court on the following Monday, July 24, to show cause why an injunction should not be issued against them. In the meanwhile a preliminary restraining order without bonds was signed enjoining the further building of the dredge.

Armed with these papers, Mr. Miller hurried back to Duluth. The injunction papers were served on July 18, and work on the dredge was thereby stopped. On July 24 the matter was heard before Judge Lochren at St. Paul. After an oral argument the injunction was made permanent without bonds, and the Duluth Dredge & Dock Co. were thereby enjoined from further building the machine.

It will thus be seen that within only 16 days from the time of starting in on the matter, during which he was compelled to travel nearly 1,500 miles, personally inspect the dredging machine on Lake Superior, interview numerous witnesses and prepare legal papers comprising over a hundred pages, and make two appearances in court at St. Paul, Mr. Bowers' attorney succeeded in obtaining an injunction against parties building an infringing machine, which at the time of the injunction was only partially completed.

R. G. Packard.

130 Pearl St., New York city, Aug. 25, 1899.

(Proofs of the above letter were sent by us to the Duluth Dredge & Dock Co., with an invitation to make a reply. No answer has been received from them, however.—Ed.)

The Coefficient of Expansion of Rails.

Sir: I have read with interest the report in your valuable paper of the last annual meeting of the Roadmasters' Association and also your criticism of the report of the committee on miter joints, 60-ft. rails and expansion.

There is no thought in my mind that the committee ever doubted the time-honored rules of the expansion of metals. Rails of different sections to expand the same for any given change in temperature must have the same chemical composition and have the same density—that is, unit volume must weigh the same for the different rails. Also all rails must be subjected to the same temperature a sufficient length of time to have every atom of each rail reach a uniform temperature, then the expansion will be the same. A small rail exposed to a sudden change in temperature will reach the new temperature much sooner than a large rail. Now, for argument's sake, let us suppose that the maximum temperature does not last sufficiently long for the heavy rail to reach an average temperature equal to the average temperature of the smaller rail, then so large an expansion space should not be left for the large as for the smaller rail.

It seems to me that the universal rule of allowing a certain predetermined space between rails when laying new track varying the space with the temperature of the air should be changed so that the space should vary with the variation of the temperature of the rail. The temperature could be ascertained near enough by placing the rail on its side and by means of clay construct a small trough holding sufficient amount of water to immerse a thermometer a sufficient length of time to reach the temperature of the rail.

I think there may be other conditions which should influence the expansion space.

First.—Character of ballast. Whether it absorbs heat or reflects heat.

Second.—Wood or metal ties. It is a well-known fact that rail buried in the ground with only the top surface exposed vary only a slight amount in length compared with the same weight of rail in standard track, owing to the radiation by the web and base flanges of the heat absorbed by the head of the rail. Now, if the web and base flanges will radiate all the heat absorbed in the above case, why will not metal ties radiate a considerable amount of heat from rail wholly exposed.

Third.—Direction of the line of rails. Whether running north and south or east and west; thus varying in the amount of surface exposed to the direct rays of the sun.

Fourth.—Location of rails, whether in cut or on embankment. Rails on a long, high embankment are exposed to the direct rays of the sun much longer than if in a cut or on level ground.

Fifth.—Rails in a sag or on a summit. We all know that with all the care we can take it is impossible to keep from getting iron bound in the sags. Would it not be advisable to leave a large expansion space in sags and put the rails close together on summits?

Respectfully yours,

S. P. Baird,
Assoc. M. Am. Soc. C. E.

Portsmouth, O., Sept. 18, 1899.

(It strikes us that the only safe rule is to fix the

expansion space according to the highest temperature that the rail may reach, and this occurs when it is exposed to the sun. It is true that a heavy rail will take a few minutes longer to become heated throughout than a light rail; but on a hot summer day the rails may be exposed to the sun for many hours, and we can see no possible reason why under such conditions a heavy rail should not expand as much as a light one.—Ed.)

A Reply from Capt. Carter.

Sir: My attention has been called to an editorial in your issue of Sept. 7, entitled "Concerning the Case of Capt. Carter."

Conscious of my innocence and believing that in the end the truth would surely prevail and that my honor would be vindicated, I have submitted in silence for two long years to the false and calumnious attacks of my enemies made in the public press, and I am even now impelled to notice your editorial only because your journal goes to many men of my profession who know nothing of my case, and who might otherwise believe your words to be true, and your denunciation of me deserved. I am informed, moreover, that advance sheets of your editorial were scattered broadcast to the daily press, with the view, doubtless, of eliciting comment adverse to me, and of having the public believe that your review of the case was an honest and an impartial one, based upon the evidence. If, therefore, it should result that your review was not warranted by the evidence, and that your statements and inferences concerning my case are not true, then your action must be denounced by the entire engineering profession as peculiarly base, and you must have forfeited the respect of all honorable men, for even you must admit that a journal such as yours professes to be, can be of no value whatever to an engineer unless it speaks the truth. It therefore becomes my duty to give to you, and your duty to present to your readers, information which may aid them in estimating your alleged impartial review of my case at its just value; and I do this, not because of your personal attack upon me, but because the questions involved in my case are vitally important to every engineer in America. Before proceeding to the case proper I shall correct a few of your collateral misstatements.

You allege that after the official record in my case was sent to the Secretary of War, "the papers were for a long time in the custody of the attorneys for Capt. Carter." This is a sheer falsehood which I challenge you to justify.

You intimate that Mr. MacVeagh "has already submitted three different formal briefs in this case before the President and the Attorney-General." This is another falsehood without a shadow of justification.

You further state concerning Mr. MacVeagh that "when he returns and makes his plea it will then be seen what further pretexts for delay may be found," insinuating that either I or my attorneys have sought pretexts for delay. This is another falsehood equally baseless, which I challenge you to justify.

You allege that "the influence, personal, social and political, which has gone into the defense of this case in Washington, New York and Savannah, has been without precedent," thereby insinuating that the case was sought to be settled otherwise than on its merits. This is another falsehood, for which I challenge you to produce a shadow of justification. My friends have always insisted that if I were guilty I should be punished, but that if not guilty I deserved vindication. This is the only "influence" that has been used.

You further state that you have "followed the course of this remarkable case from the outset" and "from all the study we have given to the evidence, we see no reason whatever to question the correctness and justice of the court-martial's decision."

Let us see how closely you have studied the evidence. The principal and overshadowing charge against me—and the one to which you refer—was that of entering into a conspiracy in 1896 with the contractors doing government work in my district to rob the United States by securing the payment to such contractors of two false and fraudulent checks in July, 1897, one for $230,749.90 and the other for $345,000. It was alleged (1) that I so advertised for proposals and so managed the advertising, giving out of information, receiving of proposals and awarding of bids, as to enable the favored contractors to secure the contracts, and (2) that after the award of the contract I permitted the contractors to use mattresses and stone different in kind and character from the mattresses and stone contracted for; less costly to the contractors, and of less value to the United States. On the trial it was proven by official records, by eminent officers of the Corps of Engineers, and by equally eminent civil engineers, that the specifications for the work were proper and had been approved by the authorities; that the advertisements had been inserted according to law; that information had been fully given; that the sealed proposals had been opened in the presence of the competing bidders, and that the contracts had been awarded to the lowest bidders in accordance with the law, at prices lower than the average prices for similar work elsewhere on the Atlantic and Gulf coasts. It was proven, and not disputed, that the contractors were paid only for the quantities of work actually done under their contracts. The whole question in this case then is the contention that the works were not done according to the contracts. The witnesses in support of that theory were Capt. Gillette, who swore he never saw a brush mattress such as called for by my specifications, whose total experience, such as it was, on mattress work for similar engineering purposes was limited to only 12,000 cu. yds. and 18 months of time, and whose animus and unreliability are graven on the record; Gieseler, who swore that he never saw a mattress under the 1896 contract, and few under any other, who never built one, and who was an office man pure and simple; Twiggs, who never built a mattress, and whose sworn evidence was in direct conflict with his written reports, certified to on honor, and who was impeached by Mr. G. W. Brown, a civil engineer of integrity and experience; Keating, an uneducated laborer, who swore that he had had a total experience of only six or seven weeks with mattress work; Hale, who was directly impeached as to veracity and who swore he did not know the difference between a square yard and a cubic yard, and a man named Cooper, who never built a mattress, who was directly impeached as to veracity, who swore he would do wrong rather than lose his job and whose testimony was in direct conflict with his written reports certified to on honor.

That the work had been done according to contract and the government not defrauded was proven by the sworn testimony, among others, of such men as Mr. George Y. Wisner, Mr. H. C. Ripley, Mr. A. E. Kastl, Members Am. Soc. C. E.; General W. P. Craighill, ex-Chief of Engineers and Past Pres. Am. Soc. C. E.; Major J. H. Willard, Major W. L. Marshall, Major F. A. Mahan, Capt. C. McD. Townsend and Capt. Thos. H. Rees, of the Corps of Engineers.

When you wrote your "fair and impartial review," did you forget to state that the evidence shows that General Craighill swore that "the work done by Capt. Carter in Savannah River and Harbor is one of the most successful operations of which he has any knowledge, either in this or any other country, and that the cost for the results obtained is not unreasonable?

When you wrote your "fair and impartial review," did you forget to state that the evidence shows that Cooper, the chief witness for the prosecution, estimated the actual cost of the mattress work at 71 cts. per sq. yd., and then, later, when requested to do so, estimated the actual cost of the same work at only 9 cts. a sq. yd.?

When you wrote your "fair and impartial review," did you forget to state that the evidence shows that Mr. George Y. Wisner, after a thorough examination of the work, swore that the United States was not only not defrauded, but saved more than $1,000,000 in Savannah Harbor alone, due to the excellent character of the work executed there by me.

Will you now have the fairness to print the following statement of Capt. C. McD. Townsend, of the Corps of Engineers:

I am to-day accepting, under specifications similar to the ones in Captain Carter's contracts, material almost identical with that which went into the Savannah works. My fascines are made of brush with the leaves and twigs remaining on them; they are bound with one strand of tarred rope, commonly known as lath yarn, though the specifications say tarred rope, and their binding is not unreasonably tight. I am putting in a multiple mat whenever it is considered necessary, and am leaving out all the intermediate poles; not the half with which Captain Carter was charged. I have let $40,000 worth of work on 15-day proposals; have sent one specification to bidders, and notified them if they wanted to bid, they could apply for more. I have driven one contractor off the work, forfeiting all sums due to him from the government and have signed letters in La Crosse which were dated Rock Island. This has not been done in any spirit of braggadocio, but has resulted from the regular course of business, and is what I testified I would do before Captain Carter's court martial. It is what one must do if he has the interest of his work at stake, and it is fearful to contemplate that the fiendish ingenuity displayed in his case can group such trivial and innocent matters together in such a manner as to produce the appearance of crime, and that our reputations are at the mercy of any disordered mind that may succeed us.

Will you now have the fairness to print the following statement from Maj. W. L. Marshall, of the Corps of Engineers:

I recognize the fact that if the position of the prosecution in Captain Carter's case is upheld, there is no security to any Engineer and the carrying on of public works will be impossible to anybody subject to military courts.

Will you now have the fairness to print the following statement from Mr. George Y. Wisner, of the American Society of Civil Engineers?

Not one penny was ever lost to the United States, but on the contrary, Captain Carter's skillful conduct of the work at Savannah alone resulted in saving over $1,000,000 to the government. If Captain Carter can be found guilty on such evidence as was adduced at his trial, then any engineer in America can be convicted of any charge whatever from the records of his own office when such records are used by unscrupulous enemies.

Will you now have the fairness to print the following statement from Capt. T. H. Rees, of the Corps of Engineers:

I know that the contracts for Captain Carter's work were awarded to the lowest bidder after due legal advertisement and that the prices were lower than the average prices for similar work elsewhere on the Atlantic and Gulf coasts. I know that his work was done according to contract and that the United States was not defrauded out of one dollar.

Will you now have the fairness to print the following statement from Mr. H. C. Ripley, of the American Society of Civil Engineers:

I was present during the entire trial of Captain Carter, and listened to nearly every word of testimony. I made a critical examination of the works at Savannah and Cumberland Sound, executed by Captain Carter, and from an experience of 20 years on works of a similar nature, I do not hesitate to say that Captain Carter's work will compare favorably with similar work done by other officers of the Corps of Engineers, both as to quality of work and as to the cost to the government. To my mind the prosecution utterly failed to prove the charges, and I believe that a jury of reputable Civil Engineers would have rendered a unanimous verdict of acquittal.

The Hon. Wayne MacVeagh, ex-Attorney-General of the United States, who was not my attorney during the trial, was asked subsequently by a friend of mine to undertake my case. Having been prejudiced against me by the garbled accounts given to the press, he declined unless after an exhaustive examination of the entire record, he should find me absolutely innocent. Mr. MacVeagh's character is well known; he gave weeks of uninterrupted study to the case and then wrote:

A most careful study of the evidence has completely satisfied me that Captain Carter is as innocent a man as I am. It is not only that there is absolutely nothing in the proofs submitted which is not entirely compatible with his innocence, but many facts are proven which are absolutely irreconcilable with his guilt.

Will you now have the fairness to print that and then state your qualifications to judge of the merits of this case?

A further word: That the works under my charge were successfully executed, was admitted under oath by the most unscrupulous and vindictive of my enemies. The work done must therefore have been suited to secure successful results. Similar work has been done elsewhere with varying degrees of success. The evidence shows that my work was executed at a less cost to the government than the average cost of other similar work. If then, I used a mattress to secure successful results which cost the contractor only about one-tenth of what all other similar work has cost, either all the other engineers are fools or they have knowingly permitted a mattress costing about $1 a yard to be used when one costing about 10 cts. a yard would have done fully as well, conclusions doubtless too absurd for even you to entertain.

You state "no honest man would object to have accusations against him, passed upon him by a body of members of his own profession." That fairness I have never had, except by men like General Craighill, Major Marshall, Captain Townsend, Captain Rees, Mr. Wisner, Mr. Ripley, Mr. Kastl, and others, the results of whose investigations have been given. The Board of Engineers first appointed to investigate my work, declined to examine it, but took against me the statements of men who were afterwards proven to be ignorant or untruthful, or both. Moreover, one member of that Board made false statements concerning my actions in leading questions to witnesses, thus directly subverting justice.

I have never shrunk from, but have always courted the most searching inquiry into my works by my brother engineers. So far as I know, no experienced, honest and disinterested engineer, however much prejudiced against my works, has ever examined them without becoming convinced that they were honestly and efficiently executed, and that the government was not and could not have been defrauded out of one dollar.

There has been prepared a book containing an abstract of the charges against me, the entire evidence taken at the trial and the briefs on both sides, which any engineer wishing the truth may have. A perusal of the evidence will show any intelligent man whether or not you have stated the truth in this case. If your errors were made in good faith, you will now be glad to give the truth to your readers, but if the falsehoods you have printed were written knowingly, you will, of course, refuse to print this letter.

O. M. Carter,
Capt., Corps of Engineers, U. S. A.

New York, Sept. 25, 1899.

(It is one of the rules of this journal to keep its columns open for fair presentation of both sides of any question, so far at least as the interests of our readers permit, and we print Captain Carter's letter in full, as received. We think it fair to point out, however, that his letter is a presentation of some of the evidence in his favor, and not an answer to the position taken in our editorial. We wrote, not to present the evidence against or for Capt. Carter, or our own opinions, but to defend the competency of the court martial which tried him to sift the evidence and determine the truth. It is these men on whom the responsibility was laid of hearing in a judicial spirit the whole matter, and the public will inevitably be guided by their decision in its opinions and not by the opinions of Capt. Carter's attorneys or of the witnesses who testified in his favor, or of those who may review the case at Washington, from its

printed record. We do not impugn the honesty of those who testified for Capt. Carter in his trial, as that officer attempts to do for those who testified against him. We simply hold that as the responsibility for judicially weighing the evidence was not theirs, they are more likely to have reached a prejudiced conclusion than are the officers who sat in the court martial.

If time and space permitted, we might answer in detail the various points raised in Captain Carter's letter, and discuss some of the evidence presented against him by the prosecution; but the task of digesting an amount of testimony which required nearly four months for its presentation is so great that for the present, at least, we prefer to print his letter without further comment than that already made.—Ed.)

THE OVERLOADING OF INTERLOCKING MACHINES.*

By C. C. Rosenberg.†

Signal engineers on roads which formerly had the signal work done by some one in connection with other duties have, as a rule, received (among legacies which they would thankfully relinquish if they could) some machines that are overloaded.

Some years ago it was considered good practice to load a lever with about as many switches and bars as could possibly be attached, and occasionally a signal or two was added if it could be done, the object being twofold—economy and speedy operation. It has, however, been fully demonstrated that there was very little, if any, economy in doing this, as a machine that was loaded with about all the lever would admit without straining it, would not give the service it should, as all connections would wear to such an extent in a short time that it needed constant attention and its life would be shortened at least from three to five years.

The lost motion caused by such wear would soon place the plant in the "careful attention" class, so far as safety was concerned. As to its manipulation, any one familiar with the operation of a plant of this kind will agree that an overloaded machine cannot be handled as quickly, as it requires the strength of a robust man to reverse a lever, and, consequently, slower movements are made, whereas, on a machine fairly loaded, the levers can be operated with greater speed and in the end there is less time consumed in setting up a combination. While the first cost for an installation of this kind is considerably less, it must be admitted that the cost of maintenance is considerably more, as foundations and bases become loose, and jaws, cranks and pins soon wear to such an extent as to necessitate renewals, and require constant attention.

At the present time machines are often overloaded when at the beginning there is no intention to do so. Instructions are issued to make a plan for interlocking a certain junction or crossing. The plan is approved, the machine ordered, and after it arrives on the ground it is found desirable to add a cross-over and possibly a siding, and rather than go to the expense of enlarging the machine, it is decided to change the locking and add the additional switches and necessary signals to the levers already provided. This is also true as to existing plants. Frequently the tower or cabin is only large enough to accommodate the machine in use, and possibly there are no spare levers to attach the extra movement. The cost to enlarge is more than the management cars to expend, and the outcome is that the machine is overloaded. It would be well if the signal engineer, in making plans, would impress upon his superior officer the necessity of providing additional spare spaces or levers, so as to meet the above contingencies, as the cost is small compared to having the machine enlarged or overloaded.

THE MANCHURIAN RAILWAY.

An occasional correspondent of the London "Times," writing from Peking, on July 9, gives a very interesting account of his experiences in Mongolia and Manchuria, in two journeys on foot and horseback over about 600 miles of caravan route and railway, built and prospective. His first journey, of about 130 miles, was from Pekin to Tartar Kalgan, or Chang-Kia-Kan, as the Chinese call it; the second was from Niu-Chwang, at the mouth of the Liao River, to Mukden, the old capital of Manchuria, and the sacred city of the present Manchu dynasty of China.

The first is the great caravan route to Siberia and Mongolia, the routes separating at Kalgan. He was surprised at the agricultural wealth of the plains traversed; though it was also evident that under some attention paid to public works, in controlling streams and rivers, great benefits would follow. At Ki-ming, 80 miles from Peking, is a large coal mountain with the sides dotted with surface workings; and long strings of donkeys and country carts were transporting much dust, but also some good lump archracite coal. The writer believes that a railway from Peking would not cost more than $30,000 per mile, inclusive of rolling-stock, and such a road would certainly pay as a transporter of coal alone.

On his second trip, he found the Liao River, a fine, broad, turbid stream, with 17 to 18 ft. of water on the bar at the mouth. Here is one terminus of the Niu-Chwang line of the Chinese Imperial Railway; and three miles higher up is the Russian camp recently acquired for the landing of material for the Russian Manchurian line, or the Chinese Eastern Railway. Here are already accumulated vast stores of railway rails, ties and other material, including the boilers and parts of 20 or more Baldwin locomotives. These engines, and six smaller ones for yard and construction work, by some incomprehensible mistake, have been sent out to a woodless country with fireboxes arranged for burning wood. They are also compound engines; but others coming from the same works are single expansion, and are coal-burners. These engines, many still in the packing cases, have been lying here a long time exposed to the weather. They were originally sent to Niu-Chwang on a ship too deep to cross the bar, and landed at Port Arthur and transhipped from there. Seldom, says the writer, has there been such brutal usage of machinery; bent and broken cases are lying at all angles, imposing severe and injurious strains upon the contents; axles and bright work on cranks have been stripped of their protection and are rusting; axle-boxes are broken; smoke-stacks and spark-arresters are crushed and bent; connecting rods are mixed up with grate-bars, twisted firing tools, etc., and bolts of all kinds are lying about out of touch with the parts they belong to. The railway buildings already up are of a ramshackle type in wood and galvanized iron.

From this camp the line runs east, 13 or 14 miles, to connect, at Ta-shih-chao, with the trunk line running from the north to Port Arthur. The Russian standard gage is 5 ft.; the rails in this section are 35 ft. long and weigh 64 lbs. to the yard, while the ties are a very good and tough Japanese timber, roughly hewn with unsquared ends, and 6 to 9 ins. face; some were almost triangular in section. The writer was informed that the Russians expected to open the line to traffic in September or October, from Port Arthur to Te-ling, 30 or 40 miles north of Mukden; and the whole Siberian road was to be open in about 2½ years. This is a too sanguine estimate, says the correspondent; as he found many gaps in the Port Arthur-Te-ling section, and the coolies were doing poor work and a competent staff of engineers and constructors has still to be organized. At Hai-cheng, Liao-yang and Mukden large affluents of the Liao must be crossed; and in the summer of 1888 these rivers burst their bounds and inundated the whole country side, sweeping away whole villages, and causing a famine the following winter. Another such a wash-out would undoubtedly sweep away many miles of railway. Extensive river-work will be necessary to control these streams; and, meanwhile, the Russian engineers have wisely determined to use temporary wooden bridges only. In fact, the whole line seems temporary. The soil handled is largely that curious, soft, porous "loess" which makes culvert-building a serious matter; as they will have to be stone lined, and provided with extensive stone wings and aprons to prevent under-cutting. Stone, timber and cement is now being accumulated for this protection, but no work has yet been done.

The embankments range from 16 to 18 ft. wide on top; and the line is not ballasted, though there is excellent ballast material in the parallel hills. It seems to be the intention to relay the line after communication is open, and before heavy traffic commences. The alinement is very bad, on the parts laid with rails, both, laterally, from bad work, and vertically, as the result of unequal settlement in the embankment.

The letter describes the people of the neighborhood of Mukden, as tall, sturdy, well-set and independent in bearing—"fine material for the future Russian armies of Manchuria, with which they propose to overrun North China, and, not improbably, Central and Southern China, too." The Rusisans seem to fraternize well with this people; though the presence of the soldiers has caused the women to avoid strangers, which, until lately, was not the case. As the railway approaches Mukden it bends to the west so as to pass at the covenanted distance of 10 miles from the "holy city" and its mausoleums, to the "feng-shui," of which the railway is supposed to be detrimental. But it is the obvious intention of the Russians to later abandon this loop and run close to the city and to the coalfields to the east. This coal is now largely used for cooking and heating the houses. The Chinese officials look upon the building of the railway with holy aversion; the trading class is disposed to welcome it as enlarging trade and improving communications; while the farmers are extremely wrathful, because their farms are taken by the Chinese government—which supplies the right-of-way, without compensation. The government is supposed to pay these farmers for land; but it is not likely that they will receive anything but promises. In several places the villagers attempted to defend their property by force, and a regiment of Russian regulars had to be called in.

*Abstract of a paper read at the meeting of the Railway Signaling Club, in Chicago, Sept. 12.
†Signal Engineer, Lehigh Valley R. R.

BOOK REVIEWS.

A TREATISE ON MASONRY CONSTRUCTION.—By Ira O. Baker, Prof. Civil Engineering, University of Illinois. Ninth edition, revised and partially rewritten. New York: John Wiley & Sons. Cloth; 6×9 ins.; pp. 556; illustrated. $5.

When the first edition of this now well-known work was published, we expressed the opinion that it was the most valuable and complete treatise on masonry ever published in any language. We are entirely safe in making the same statement to-day, ten years later, regarding the revised and partially rewritten ninth edition, which has just been issued. The revision which the book has undergone is not merely a nominal one, as is so often the case with new editions of engineering books, but several of the chapters have been entirely rewritten and considerably lengthened to include new matter which ten years' progress in engineering have brought to the front, and other chapters have been recast and rearranged to a greater or less extent. The entirely new matter includes the chapters on "Lime and Cement," "Sand, Gravel and Broken Stone," and "Mortar and Concrete." Some of the matter of greatest interest in the two chapters last named is abstracted elsewhere in this issue, and will give our readers a fairly good idea of the manner in which the matter on hydraulic cement and concrete work is handled by the author. The book has the same binding and typography as the preceding editions.

PRACTICAL ELECTRICITY; With Questions and Answers.—Edited and published by the Cleveland Armature Works, Cleveland, O. Flexible covers; 4½×6 ins.; pp. 286; 83 cuts; 20 tables. $2.

The scope and character of this manual are well indicated by the following, quoted from the preface:

This book was written especially to assist those who have some practical knowledge of electricity and who wish to learn more of the way in which wiring is calculated and of the simpler and more important parts of dynamo electric machine design. . . . One who studies the text and answers the questions at the end of each chapter should be able to calculate a wiring job for lights or power; to calculate the proper size and amount of wire for a dynamo when he has the dimensions of the machine; to calculate the size and winding for a magnet to give a required pull, etc.

In this modest statement we can heartily concur. This book is one of the very few of its class which succeed in presenting the salient features of applied electricity in such a manner as to be of material service to the ordinary wire-man, dynamo-tender, or engine-man. Abstract principles are fittingly illustrated by familiar facts, and as far as possible are stated in simple, though precise, language. Data and complete tables of physical constants are given for the calculation of electric circuits and machines, and their application is shown by practical examples. We find here none of the loose and erroneous statements which are usually present in books of this kind, and the authors are to be commended for the care and ability they have shown in making a difficult subject more easily accessible. Our only criticism is that the high standard of excellence shown in the text of the book is not adhered to in the mechanical make-up.

THE DESIGN AND CONSTRUCTION OF DAMS, including masonry, earth, rock-fill and timber structures, and the principal types of movable dams. By Edward Wegmann, C. E., M. Am. Soc. C. E., author of "The Water Supply of the City of New York, 1658–1895." Fourth edition, revised and enlarged. New York: John Wiley & Sons. Cloth; 12 × 9¼ ins.; pp. XII + 250; illustrated. $5.00.

This work of Mr. Wegmann, as stated in its title, illustrates and describes the important structures of this type throughout the world, and lays down the principles governing design, so far as science has revealed the law of internal stresses in masses of masonry. This fourth edition is chiefly marked by adding a lengthy chapter

upon movable dams, of which a few have already been built in the United States; in adding further illustrations of dams constructed, and in giving the full specifications for the New Croton dam, now under construction, and the largest structure of this type ever attempted. The manner in which the profile for this monster dam was calculated is also set forth in the Appendix, with a practical example of the application of the equations used.

THE UNIVERSAL DIRECTORY OF RAILWAY OFFICIALS, 1899.—Compiled from official sources by S. Richardson Blundstone, Editor of "The Railway Engineer." London: The Directory Publishing Co., 8 Catharine St., Strand. Cloth; 8½ × 5½ ins.; pp. 530. 10 shillings.

The fifth annual edition of this directory covers a list, up to date of issue, of railway officials in Great Britain, Europe, Asia, Africa, Australasia, North and South America. So far as the English lines are concerned, these records seem to be very full, giving the name, office held and last address of each official, as well as stating the length of line operated, the gage and amount of rolling stock. The same system is carried out in the case of other countries, with the lines alphabetically arranged under great national divisions. In the back is a handy "Personal Index," alphabetically arranged, by which the official position and address of any individual can be found, when the name only is known. Taken altogether, it is a very well printed and useful book of reference to those interested.

APUCU DES CHEMINS DE FER RUSSES DEPUIS L'ORIGINE JUSQU'EN, 1892.—Andre de Gortschakov, Editor. Paul Weissenbruch, 45 rue de Poincon, Brussels. 3 vols.; paper; 8 × 12 ins.; pp. 900; 1 vol.; plates.

This sketch of the Russian railway system from its beginning up to the year 1892 was prepared by the members of the Imperial Technical Society of Russia on the occasion of the fourth session of the International Railway Congress at St. Petersburg, and is now published in the Russian and French languages under the auspices of the Russian Commission to that Congress. As a general resume of the development of the railway system of Russia the work is superior to anything which we have seen in the more familiar foreign languages, and is, of course, far ahead of anything which has been published in English. A notable feature is that the different departments of railway construction, operation and management are treated by Russian railway engineers, who can speak with full knowledge and authority. For anyone desirous of familiarizing themselves with Russian railway practice and having a knowledge of the French language we can, therefore, recommend the book as probably the best which is easily available. Summarized briefly, the first section—there being five sections altogether in the two volumes of text—treats of the general problems of location and construction, including permanent way, track and permanent way structures, stations and buildings; in the second section the motive power and rolling stock are described, and the remaining sections discuss the various phases of transportation, operation, etc. All the typical constructions mentioned in the text are illustrated in the plates which make up volume third of the book.

LIQUID AIR AS A BLASTING AGENT.

Although a reaction has promptly set in against the exaggerated opinions on the prospects of liquid air, in which the press indulged, the difficulties which the application of condensed gases of so low boiling points involves, do not appear to be well understood. Some experiments, conducted by the Vienna Crystal Ice Co., in the presence of representatives of the Austrian Technical Military Committee may, therefore, be of interest. We do not regard the experiments as by any means decisive, since they were certainly not made under favorable circumstances; but they are instructive. The liquid air was obtained from the Linde company in Munich, and was transported in open flasks provided with a Dewar vacuum jacket. The flasks were packed with felt and cotton; over the open neck, which projected through the lid of the wooden case, a cap of felt was loosely fitted. When despatched, the liquid contained a mixture of oxygen and nitrogen in the ratio of 75 : 25. During the 72 hours which elapsed before actual use, the greater part of this time being spent on transport, half of the liquid had evaporated, and the remaining liquid contained 85% of oxygen; nitrogen is more volatile than oxygen. Two kinds of cartridges were made of kieselguhr, mineral oil (solar oil) and the liquid. In the first case, the kieselguhr and oil were mixed in a wooden basin, the liquid added gradually, and the paste ladled into paper cartridges clothed with asbestos. In the second case, the earth and oil were charged into the cartridge, which rested in a double sheet-metal cylinder with a separating layer of felt, and the liquid air gradually poured into the cartridge until the mass was thoroughly impregnated. In both cases the formation of mist and of hoar frost sufficiently indicated how much of the oxygen escaped during the preparation. The cartridges could be handled, but the men did not care to squeeze them in firing the primers and detonators; as a consequence one cartridge missed fire. Holes, 30 ins. deep, were bored in rock. It resulted that these so-called oxylignit cartridges were hardly strong enough, as too much oxygen had evaporated. The cartridges of the second type did not prove so powerful as the others, probably because the lead cases furthered evaporation, especially from the bottom of the cartridge. On the results, Artillery-General-Engineer Hess has commented to the following effect: The preparation of the cartridges is wasteful and dangerous to the eyes, etc., and, owing to the rapid evaporation, it is further impossible to guarantee the strength of the cartridge, even in the roughest way. Kieselguhr and oil seem to be suitable absorbents, and oxylignit an effective blasting agent, though comparative tests have not been made yet. The cartridges must be used within, say, 15 minutes of their preparation. There is no danger, hence, from missing fire. But, on the other hand, it will be difficult to fire many cartridges simultaneously, and, strictly speaking, the cartridges should be made on the spot, and be in a very hard condition. That would scarcely be possible below ground; the spurting liquid might break the glasses of the hot safety lamps, and it remains to be investigated whether the large volumes of oxygen might not lead to spontaneous ignition of marsh gas or coal dust. The evaporating oxygen would, on the other hand, improve the air, and the blasting would not contaminate it. Some of these objections are very serious, especially the unreliability of the power of the cartridge, and the short period during which it remains active. The cartridge cannot, of course, be sealed, nor can the vessels in which the liquid air is transported. For military operations oxylignit would certainly not appear to be suitable. But the whole question is only in its experimental stage, and better methods of making cartridges could probably be devised.—London "Engineering," Sept. 8.

THE NEW PENNSYLVANIA RAILROAD PASSENGER TERMINAL AT JERSEY CITY.

By Edward B. Gumaer.*

(With two-page plate.)

In March, 1898, a fire destroyed the waiting-rooms, ferry passageways, etc., at the eastern passenger terminal of the Pennsylvania R. R., at Jersey City, N. J. Previous to this date this terminal consisted of a single span trainshed, 256 ft. wide and 625 ft. long, covering 12 lines of track. At the river end, and directly between the trains and the ferries, were located the waiting-rooms, restaurant, ticket offices, etc., and to reach the ferries the arriving passengers were compelled to pass through two sets of doors and a waiting-room, and over narrow 60-ft. bridges, spanning the lower deck ferry drive, to a longitudinal passageway, only 14 ft. wide, connecting the different ferries to New York and Brooklyn. As traffic increased the weak points in this arrangement developed themselves, and the officers of the company had been contemplating a change for a considerable time before the fire occurred which compelled the improvement now rapidly nearing completion.

By the new arrangement, shown in Fig. 1, passengers from New York or Brooklyn arrive at the terminal on a level with the track floor; as nearly all of these boats are now arranged to land passengers from the upper deck by means of moveable bridges in the ferry houses. The passenger on landing finds himself at once in a lobby, 30 ft. high, 59 ft. wide and 535 ft. long, running parallel with the river and connecting on one side with the six ferry-slips, and on the other, either directly with the train platforms or with the waiting-rooms, restaurant, etc., as desired. This lobby has in it comfortable seats for the waiting passengers, conveniently located along the east and west walls.

The waiting-room proper is 81 × 98 ft. and 30 ft. high. It is handsomely decorated, and contains ticket offices, ladies room and toilet, telegraph and telephone offices, newsstand and parcel room. Connected with this room are the restaurant and a large dining-room. As will be seen on the diagram, the trainshed is now north of the waiting-room and directly connects with the lobby mentioned, so that either in entering or leaving the trains there is no obstruction between the trains and the ferries. There is, however, an ornamental iron fence, separating the trainshed and the lobby, and provided with gates opposite the ends of all train platforms. Over these gates will be placed the latest device for indicating to the passengers the destination of the train opposite to it, with time of departure, etc.

The buildings themselves have a steel framework; and the floors of the waiting-rooms, restaurant, etc., are made of composition slabs reinforced with wire, after the Metropolitan fireproof system; a layer of cement concrete and tiling completes these floors. The walls, between the steel frames, are composed of expanded metal lathing covered with cement plaster; and the inside walls and ceilings of the lobby will be decorated with ornamental "staff" work, much after the design of the Broad Street Station, in Philadelphia, Pa. The exterior of all the buildings will be sheathed with copper stamped in designs to conform with the interior decoration.

The general extent of the present trainshed plant can be estimated from the following figures:

	Area.
Trainshed, 256 × 777 ft.	198,912 sq. ft.
Lobby, 60 × 535 ft.	32,100 "
Waiting rooms and restaurant, 81 × 192 ft.	15,552 "
Retiring rooms, etc., 44 × 49 ft.	2,156 "
" " " 20 × 84 ft.	1,680 "
Six ferry buildings, 45 × 80 ft. each	21,600 "
Office building, 50 × 160 ft.	8,000 "
Total under cover (about 6⅛ acres)	280,000 sq. ft.

In the new construction about 10,000 lin. ft. of steel girders were used, ranging from 2 ft. to 5 ft. in depth, and the lobby alone is carried on 34 girders of 60 ft. span, each girder weighing about 7½ tons. While every effort has been made to facilitate the egress and ingress of passengers, the size of the station is such that anyone landing from a Brooklyn Annex ferryboat and going to No. 12 track platform, will have to walk about 1,500 ft., or over one-quarter of a mile. The estimated total cost of the improvement is about $700,000, including $25,000 or $30,000 expended in temporary structures, passageways, etc., erected for the handling of traffic during construction, and for guarding as much as possible against inconvenience and danger to passengers. That this portion of the work was well carried out is proved by the fact that not a single serious accident happened either to workmen or passengers during erection.

The roofs on all the buildings are made as flat as possible, so that metal covering may be dispensed with and 5-ply felt, cement and slag roofing substituted. For the roof of the trainshed extension, the sides are so steep that for 50 ft. up each side from the bottom, 14-oz. soft copper, with standing seams, was applied; the remainder of this roof is covered with felt and slag. The original trainshed has three large glass skylights, two on each side and one forming the roof of a 55-ft. span central lantern with ventilating sides; all of these extend the length of the original roof. It was found that during the winter months, or with very heavy rains, it was impossible to prevent the snow or rain from getting through and interfering with the comfort of passengers. As a result of this experience the new portion of the roof was designed without skylights or lantern; and to ventilate the roof 20 36-in. copper ventilators were arranged in five rows of four each. As the gable end was almost wholly glass, this latter afforded sufficient light.

The buildings are all lighted by electricity, the lobby by arc lights and the waiting-rooms, restaurant, etc., by incandescent lights. Steam is used for heating purposes, and both electricity and steam are generated in the company's own plant, located about 1,500 ft. from the center of distribution.

The extension of the old trainshed 125 ft., resulting from the new arrangement of waiting-rooms, etc., required the erection of a similar length of iron supports for twelve tracks and their platforms, and the same length of new roof. To support the latter two pairs of main trusses and four main piers had also to be supplied. The four piers were founded on piles driven to the rock, which is here about 38 ft. below mean high tide. For each pier 81 piles were driven inside a coffer-dam made of 8-in. yellow-pine sheet piling 45 ft. long, with dove-tail splines spiked on the edges. Previous to the erection of this dam the mud had been dredged out to a depth of 24 ft. A steam saw was rigged to cut off the heads of these piles, but on account of the large amount of bracing necessary inside of the dam, it was found to be more economical to pump out the dam and level the piles by hand. These piles were capped by a solid grillage made of six courses of 12 × 12-in. timber, with a 3-in. deck, making a platform 26 × 35 ft. On this platform was then built a crib of eight courses of 12 × 12-in. timber, tied by ten

*Weldon Building, Jersey City, N. J.

12 × 12-in. timbers to keep it from spreading; the outside of this crib was planked with two courses of 3 × 12-in. hemlock, applied diagonally and extending 4 ft. above mean high tide, or 10 ft. above the 3-in. deck mentioned. The box thus formed was 22 ft. 6 ins. wide by 33 ft. long, and this was filled to within 2 ft. of the top with Portland cement concrete, made in the proportion of 1 cement to 3 parts sand and 5 parts of 2-in. broken stone. Bearing plates for four 2-in. anchor bolts, for each pier, were set on top of this concrete and built into the brickwork, which was carried up 14 ft. to receive the granite capstones which were to support the truss pedestals. The material used in the four piers aggregated as follows:

12-in. yellow pine piles	324
Hemlock timber	50,600 ft. B. M.
Yellow pine timber	352,000 ft. B. M.
Hard brick	450,000
Granite	432 cu. ft.
Dredging	3,840 cu. yds.

These four piers were built by contract at a cost of $40,000.

After the piers were completed the mud was dredged out to a depth of 4 ft. below the bottom of the grillage timber, and stepped up at an angle of 45° from an area 6 ft. larger each way than the grillage. This space was then filled up with riprap to the mud line. This riprap was placed at a price per cubic yard, and was not included in the above contract. The foundations for all the remaining work were made of creosoted piles, driven to the rock, cut off at extreme low water mark and capped with two courses of 12 × 12-in. yellow pine. On these caps were placed cast-iron columns, braced both ways by 2-in. tie-rods. Each column was 8 ft. 3 5-16 ins. long, and they were provided with seats for girders of the lower floors and planed tops to receive the steel columns of the buildings.

In extending the old trainshed it was deemed the most economical plan to move the old pair of gable trusses 125 ft. riverward, to their new position, and to fill in between with new work. These gable trusses differ from the intermediary main trusses in that they are provided with vertical and transverse framing for the support of 6,000 sq. ft. of glazing; and they are also stiffened against wind pressure by a special horizontal truss. The two intermediary trusses supplied are duplicates of the old ones of the same type and are proportioned for 30 lbs. of dead load, 17 lbs. of snow and 35 lbs. wind pressure per sq. ft. They are constructed of heavy angles and plates, with riveted connections, and are built in two equal parts, and each bottom end rests on a 5 11-16-in. pin, with a 5-in. pin connecting them at the top. At the top, the rivet connections between the two members have slotted holes for expansion. The pedestals at the foot of the trusses are anchored to the masonry, on the south side, by two 2-in. anchor bolts; on the north side the truss bears on a nest of steel rollers. In the old work the 5 11-16-in. bearing pins are tied together by 12-in. 100-lb. I-beams in full spliced section, running across the shed under the tracks and placed in boxes filled with tar and gravel to prevent corrosion. In the new trusses the lower pins are tied together by 5 × 1-in. eye-bars. In the gable trusses these bottom chords of eye-bars, or beams, are replaced by horizontal riveted tension members, extending across from side to side and about 20 ft. above the trainshed floor-level.

The new intermediate trusses are 14 ft. 6 ins., c. to c., with ten panels of roof rafters 46 ft. 6 ins. and 50 ft. .0½-in. in length, respectively. The roof is made of 3 × 14-in. yellow pine purlins, 16 ft. c. to c., and having the top edge cut to the radius of the roof trusses; on these 1¼-in. tongued-and-grooved yellow pine roofing boards were nailed.

As the gable trusses had to be moved a considerable distance, and presented a very narrow base when the height and span are considered, it was deemed a wise precaution to erect a timber tower under the center of these trusses before it was cut loose from the roof and jacked up from its foundation. This tower was built of 8 × 8-in. posts and 3 × 8-in. ties, with cross bracing. When the gable trusses were moving, this tower was carried by them about 6 ins. clear of the trainshed floor; and when the trusses had been shifted to their new position, the space between the sills and the floor under the tower was wedged up tight, and the tower filled its office of resisting any tendency in the trusses to overturn. At one time during erection, one end of the tower sills was found to be down tight on its bearings, and the other end was lifted about 18 ins. clear of the floor. This was caused by the top of the main arch being temporarily out of plumb towards the west. A pair of triple blocks were rigged up and attached at one end to the top of the trusses and at the other to the trainshed floor; the rope was then led to the drum of a hoisting engine and the trusses were pulled into vertical line and the strain on the tower was relieved.

The gable trusses had a sufficient base to insure stability under ordinary conditions, and with the tower available as an additional base if needed, it was decided to use these trusses as a false works for erecting the two intermediate trusses, while the gable trusses were being moved to their new position. By this arrangement the temporary false works originally employed were avoided and considerably money was saved as well. To support the old roof during the cutting loose of the truss, timber posts were set up between the tracks, and the longitudinals and the old roof were then disconnected and cut clear across the shed.

To provide a roadway for the movement of the gable trusses cribwork was built up on each side of the trainshed and on this was laid two pairs of rails, 28 ins. apart. The inner truss was next reinforced by placing in position a set of two adjustable tie-rods, extending across the trainshed, at a height sufficient to clear the stacks of the engines, and thus tying the vertical ends of the trusses together. The bottom ends of the trusses were disconnected from the pedestals, a little above the level of the shed floor, and the trusses were lifted a few inches by hydraulic jacks with an aggregate capacity of 300 tons at each end; the rails were then slipped under the truss ends and greased. The moving was accomplished by a ten part tackle of 1¼-in. rope, and a large hoisting engine. When the trusses had been hauled forward 3 ft., they were guyed and the sills of the central tower were wedged up. Timbers, 12 × 12 ins., were then bolted horizontally across between the two trusses at every panel point on the lower chord, and these timbers projected out 5 ft. on the west side so as to form a cantilever support for the assembling of the members of the new truss. Each truss weighed about 95,000 lbs., and the maximum weight of any single part was 21,000 lbs.

The new truss members were delivered on cars and hoisted into place by three 10-ton. derricks, with 55-ft. booms, located on top of the gable trusses and operated by two hoisting engines on the floor below. To support each of these derricks, a sill was bolted across the top chords of the two trusses and extended 10 ft. beyond the river truss; this sill was stiffened by two panels of Howe truss outside. This projecting sill held one stiff leg of the derrick and the other stiff leg was set in the plane of the truss and bolted to the outer face. A working platform for the men was provided by leaving the roof boards on the gable-trusses, and planks laid across the transverse braces at the lower chord level commanded the cantilevers.

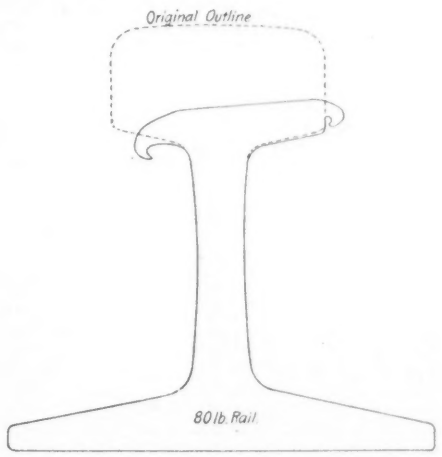
With the first member of the new truss erected and the old roof connected with it, the gable-trusses had to be moved forward again. They were jacked up, and a set of 50 2½-in. steel rollers, 3 ft. long and set 6 ins. apart in a frame, was laid on the two lower rails and an upper pair of inverted rails placed over the nest of rollers. The trusses were let down on this and moved 14½ ft. towards the river, and there again arranged for erecting the second member of the first intermediate truss. When this had been set up and the roof connected, the gable-trusses were again moved forward 43½ ft., at the rate of about 10 ft. per minute, to a position for the first member of the second truss; at the end of the fifth movement of this nature, the gable-trusses were in their final position, the intermediate trusses were built and the roofs connected. Each separate truss was assembled in four days, and the new roof was finished in about 20 days by a gang of 50 men.

The new work at the Jersey City terminal was designed in the Pennsylvania R. R. offices, by Mr. William H. Brown, Chief Engineer, and Mr. W. A. Pratt, Engineer of Bridges; Mr. Louis H. Barker, Principal Assistant Engineer, was in direct charge at Jersey City, with Mr. Martin L. Gardner as his assistant. The architects were Messrs. Furness, Evans & Co., of Philadelphia. The steel work was manufactured by the New Jersey Steel & Iron Co., and Mr. A. Brann was the contractor for erection. The foundations were put in by the Sandford & Sillman Co., of Jersey City, N. J. The original trainshed at this place was fully described and illustrated in our issue of Sept. 26, 1891, at the time of its construction.

RAIL WEAR ON AN ELECTRIC ELEVATED RAILWAY.

The wear of rails under heavy traffic is illustrated to a somewhat remarkable degree by the accompanying section of a worn rail taken out of the track of the Union Elevated Loop Ry., at Chicago, after a service of about eight months, during which period it had carried, approximately, 6,000,000 wheels. This road carries the trains of the Chicago elevated railways, and each train consists of a motor passenger car with two or three trailers, so that only one-third to one-fourth of the wear can be attributed to the heavy motor cars.

The rail was of the section recommended by the rail committee of the American Society of Civil



Worn Curve Rail from the Union Elevated Loop Ry., Chicago.
(One-half Size.)

Engineers, and weighed 80 lbs. per yd. It was of commercial make, with about 0.48% carbon, but these rails are being replaced with others of special make, having about 0.60% carbon. It was on the high side of the curve at Fifth Ave. and Lake St., the curve elongation being 3 ins.

For sections of the rail and particulars of the service, we are indebted to Mr. S. S. Neff, Superintendent of the Union Elevated Loop Ry.

ANNUAL CONVENTION OF THE LEAGUE OF AMERICAN MUNICIPALITIES.

The third annual meeting of the league was held at Syracuse, N. Y., Sept. 19 to 22, inclusive. The convention opened with Mr. Saml. L. Black, ex-Mayor of Columbus, and President of the League, in the chair. The address of welcome was given by Mr. Jas. K. McGuire, Mayor of Syracuse. In regard to the comparison between American and European municipal governments, to the disparagement of the former, the speaker said it should be remembered that our city governments are young. In the county of Onondaga (N. Y.) there was only one white man one hundred years ago, whereas now the city of Syracuse alone has a population of 130,000.

In his annual address President Black stated that questions of municipal government now overshadow those of the state and of the nation. Until 1860 we were a nation of farmers and villagers. This should be remembered in comparing our municipal institutions with those which have been developed for hundreds of years abroad under strong central governments. The time will come when foreign cities will be studying our cities as models of municipal government.

The New Patriotism; a Golden Rule Improvement.

By Saml. M. Jones, Mayor of Toledo, O.

This address was based on the principle that all government should have as its aim the giving of equal oppor-

tunity to each and every individual. Among the remarks that made the greatest impression on the audience were these: Political machines are organized, not to carry on government, but to capture offices for the few. A political leader is a man who is trying to keep up with the people.

Garbage Collection and Disposal.

There were three papers on this topic. The first one was by Mr. J. J. Williams, Mayor of Memphis, Tenn. He favored municipal collection, rather than the contract system, and for final disposal believed cremation far superior to reduction, making some very sweeping general statements, unsupported by examples, to the effect that reduction plants pollute the air for miles around, so that "courts and law-makers have been appealed to, and have, as a rule, given relief to the sufferers by abating the foul, disease-breeding nuisances." The city of Memphis has four crematories, so located as to shorten the haul sufficiently to save in expense of haulage more than the cost of cremation. Whether cost here included interest and depreciation was not stated.

A paper urging the necessity of a more comprehensive and scientific study of refuse disposal was sent by Dr. Wm. C. Creighton Woodward, Health Officer of Washington, D. C. From advance copies furnished to the press the following has been extracted: Although nearly all our large cities have investigated garbage disposal through committees or otherwise, "seldom, if ever, has a city sought some one familiar with the details of the subject and paid him to study the needs of the community and devise for it a scheme for the collection and disposal of garbage." At present "there appears to be no other function of municipal life, in this country at least, so poorly organized as the collection and disposal of refuse, nor any other on which so little accurate information can be obtained." As an illustration of the unsatisfactory condition of hauling refuse in many cities Dr. Woodward gave the following description of the practice in his own city, our national capital:

The removal of refuse from the streets is effected under contract, under the supervision of the department of street and alley cleaning. The material collected is deposited on low lands. Garbage is collected under contract, under the supervision of the health department. It is deposited on waste land along the shores of the Potomac River some miles below the limits of the District of Columbia. When the river is frozen the garbage is burned. Within the past six years such material has been disposed of by reduction and by cremation, and now we have reverted to the more primitive method. There are a few licensed collectors, chiefly for the accommodation of hotels and other like places, who feed to hogs the material which they collect. Dead animals also are collected under contract, under the supervision of the health department. Horses and cows are utilized for their hides and for the manufacture of fertilizers. Some of the smaller dead animals are likewise disposed of, but most of them are removed along with the garbage. Ashes are taken away at the expense of the householder, under the supervision of no one in particular. There is no system of licensing collectors, nor any restriction as to time and manner of removal and transportation. The ashes which are not blown over citizens while being taken out and carried away are deposited on low land. Poor colored men, with poorer wagons and poorest horses, do most of the work. The miscellaneous trash which accumulates about houses, stores, manufactories and offices, such as waste paper, cast-off clothing, broken bottles and crockery, old tin cans, etc., is disposed of at the expense of the occupants in the same manner as ashes. The places of deposit are frequently the sources of nuisance, chiefly by reason of the fires which are lighted and smolder on them. Contents of privies and of cesspools are removed at the expense of the householder as often as necessary. The material removed is carried down the river on scows and deposited in pits on waste land some distance below the city. Manure from stables is removed at the expense of the occupant as often as he thinks desirable. It is used on neighboring farms as a fertilizer. Much of it is carried down the river on scows; the rest is removed in wagons. There are no regulations governing the time or manner of removal or of transportation.

Could a more thoroughly disjointed scheme for the removal of the wastes of the city be devised? None of it except the contents of manure pits and a part of the dead animals saved. Hardly two kinds of refuse collected under the supervision of the same office. There is no system of licensing private collectors of material other than garbage and night-soil. None of them except collectors of garbage and night-soil are under any restrictions as to time and manner of doing their work. No information is available as to the value of the material collected, and, of course, none as to how much of value might be recovered and the best way of doing it. Yet how many cities are better off in respect to these things than is Washington? Some, of course, but probably not many.

What is the result of this lack of organization? That it is grossly extravagant cannot be doubted, but as a part of the expense is borne by numerous householders, and paid out by them from time to time in driblets, the exact measure of extravagance cannot be aacertained. But the citizens suffer the loss just as truly as if the payment were made out of the city treasury. The result from an administrative standpoint is that the city is clean only in spots—the poorer, more overcrowded sections, where cleaning is most needed, are not cleaned—and doing the work is in itself almost as great an annoyance, even if less injurious to health, than leaving it undone. The result from a sanitary standpoint is best illustrated by comparing conditions as they exist with reference to garbage, which is collected at the expense of the city, and night-soil, which is collected at the expense of the householder. As the removal of garbage costs the citizen nothing (for he must pay his taxes whether the garbage be removed or not) he promptly notifies the health department if it remains on his premises longer than it should, so as to secure its removal. As it is removed by a representative of the city, if it be improperly cared for by the householder the defects are promptly discovered and remedied. On the other hand, the removal of night-soil must be paid for in cash by the householder every time it is effected; therefore it appears to be to his interest financially to have it removed as infrequently as possible. As a result those careless of the requirements of law deposit it in public sewers whenever an opportunity presents itself; if that cannot be done, it may be buried in the yard or on some neighboring lot. When privy boxes are full, the machinery of the health department must be put into operation to secure the removal of their contents, thus involving additional expense upon the community by rendering necessary an increased number of inspectors. Defective privies are discovered only upon complaint or in the slow course of routine inspection, and therefore may exist some time before receiving attention. The difference between cleaning the streets, which is done at public expense, and cleaning cellars and back yards, which is done at the expense of the householder, is equally striking. The citizen reports promptly the failure of the contractor to clean the street in front of his residence, because he wants a clean street and it costs him nothing to get it, but even while he is complaining of the condition of the street he is allowing the dirt to accumulate on his own premises because he must pay out dollars and cents to have it removed. And when the nuisance for which he is responsible has become unbearable, or when he has been notified by the health department, he cleans up and the man whom he employs to assist him probably smuggles much of the dirt to some vacant lot not far distant. This illustrates what may be done, and what not infrequently is done. The intelligent law-abiding citizen, in Washington as elsewhere, keeps his property in good sanitary condition, and then suffers from the neglect or wilful wrong-doing of his more ignorant and careless neighbor.

The paper concluded with advocating municipal collection of all refuse and on experimental investigation of refuse disposal, conducted by state governments, in order to save duplication.

The third and last formal paper on refuse disposal was by Mr. H. J. Gondon, of New York, Editor of "City Government." A table was presented showing the methods of collection and disposal in 37 cities, which is reproduced herewith.

The table shows that 5 of the 37 cities have no public provision for garbage collection; that 18 collect through public contractors; 1 through private scavengers; 12 directly by the municipality and 1, New York, both by contractors and the city. For the waste no public provision is made in over half of the cities, while 12 collect by contractors and 4 direct. As to final disposition of garbage, 8 have reduction processes, 6 cremate, 7 dump on land, 3 dump in water, 3 bury and 6 feed to swine. Most of the dry waste is dumped.

Table Showing Methods of Garbage Collection and Disposal in 37 American Cities.

Place.	How collected.		How disposed of.	
	Garbage.	Dry waste.	Garbage.	Dry waste.
Albany, N. Y.	No system.	Privately.	No system.	No system.
Allentown, Pa.	Contract.	Privately.	Buried.	Tipped.
Buffalo, N. Y.	Contract.	Contract.	Reduced.	Tipped.
Cincinnati, O.	B'd city affairs.	Privately.	Reduced.	Tipped.
Cleveland, O.	Contract.	Privately.	Reduced.	Tipped.
Charleston, S. C.	St. Dept.	St. Dept.	Dumped on land.	Tipped.
Cambridge, Mass.	Poor Dept.	Poor Dept.	Fed to swine.	Tipped.
Detroit, Mich.	Contract.	B'd Pub. Wks.	Reduced.	Tipped.
Duluth, Minn.	No system.	Privately.	No system.	No system.
Davenport, Ia.	Contract.	Privately.	Dumped in river.	Tipped.
Erie, Pa.	No system.	Privately.	No system.	No system.
Elizabeth, N. J.	Contract.	Contract.	Dumped on land.	Tipped.
Fall River, Mass.	Contract.	St. Dept.	Fed to swine.	Tipped.
Hartford, Conn.	Contract.	Contract.	Buried.	Tipped.
Kansas City, Mo.	Health Dept.	St. Dept.	Dumped in river.	Tipped.
Louisville, Ky.	St. Dept.	St. Dept.	Dumped on land.	Tipped.
Lincoln, Neb.	No system.	Privately.	No system.	No system.
Lawrence, Mass.	Health Dept.	Health Dept.	Fed to swine.	Tipped.
Milwaukee, Wis.	Health Dept.	B'd Pub. Wks.	Buried.	Tipped.
Minneapolis, Minn.	Contract.	Privately.	Dumped on land.	Tipped.
Memphis, Tenn.	Health Dept.	Health Dept.	Cremated.	Cremated.
Mobile, Ala.	St. Dept.	St. Dept.	Dumped on land.	Tipped.
Manchester, N. H.	St. Dept.	St. Dept.	Dumped on land.	Tipped.
McKeesport, Pa.	Privately.	Privately.	Cremated.	Cremated.
New York, N. Y.	St. Dept. & Cont.	St. Dept. & Cont.	Reduced.	Dumped at sea.
New Haven, Conn.	Privately & Cont.	Privately.	Fed to swine.	Tipped.
New Bedford, Mass.	Contract.	Privately.	Reduced.	Tipped.
Pittsburg, Pa.	Contract.	Privately.	Reduced.	Cremated.
Providence, R. I.	Contract.	Privately.	Fed to swine.	Tipped.
Richmond, Ind.	Health Dept.	St. Dept.	Cremated.	Cremated.
St. Louis, Mo.	Contract.	Privately.	Reduced.	Tipped.
Sioux City, Ia.	Contract.	Privately.	Dumped in river.	Tipped.
Salem, Mass.	Health Dept.	Health Dept.	Fed to swine.	Cremated.
Toledo, O.	Contract.	Privately.	Dumped on land.	Tipped.
Wilmington, Del.	Contract.	Contract.	Cremated.	Tipped.
Wheeling, W. Va.	Contract.	Privately.	Cremated.	Tipped.
Youngstown, O.	No system.	Privately.	Cremated.	Cremated.

The author believed that ashes and dry wastes should be collected by the municipality, as well as garbage, and also that the final disposition of all refuse should be in the hands of the city. Like the author of the first paper, he favored cremation, going so far as to state that "nothing has done so much to retard the progress of sanitary garbage disposal as the invention of the various reduction or utilization processes"; adding that a careful analysis of any garbage reduction contract would show that the process cost more than cremation. This position was supported by arguments of some length, which, however, could hardly be called conclusive, although interesting and worth consideration.

The last part of Mr. Gordon's paper was designed to show the superiority of municipal collection to the contract system, both in efficiency of service and lowness of cost. The tendency of contractors to slight the service of collection was discussed and a number of comparisons between the cost of the two systems, based on official returns, were submitted. In conclusion the author said:

The solution of the whole garbage question is a very simple matter for any city. First, reconcile your minds to the fact that the protection of the public health is more important than the saving of a few dollars. Then familiarize yourself with the history of the contract system as applied to this work in this country and you will come to the conclusion that in order to have this work properly done it is necessary for the city to shoulder its just responsibility and do the work itself. Then employ an honest and competent sanitary engineer to map out the work of collection and estimate its cost. Then turn the work over to the health department, where it properly belongs, together with an appropriation sufficient to cover the engineer's estimate. Finally, don't attempt to make the disposition a commercial enterprise, at the cost of the health of your people.

A large number of mayors and councilmen were scheduled for the discussion of this topic, but only two responded to the call of their names. The first of these, Mr. Conrad Diehl, Mayor of Buffalo, asked the commissioner of public works of that city, Mr. Marcus M. Drake, to speak in his place. Mr. Drake outlined the experience of the city for some years past. It has tried both contract and municipal collection. He preferred the latter. After changing to the contract system, some years ago, on a unit price basis, the amount of garbage and ashes collected rose with astonishing rapidity. When the contract expired lump bids were called for, and the contract was awarded on that basis, for $80,000, to the very contractor who had received $160,000 the previous year on the unit price basis. An interesting experience with the contract for garbage disposal was also narrated. Some years ago the contract for final disposal was let for five years, at $35,000 a year. When the contract expired the old contractors, who were using the Merz reduction system (see Engineering News, Nov. 1, 1894), bid $45,000 a year for the work, claiming that the increase in price was justified by the increase in population and garbage. The lowest bid was only $15,000. A long contest ensued, during which it was urged that the contract should not go to the lowest bidder, since so low a figure would result in financial loss and general trouble. The question being pressed to a decision, the lowest bidder was given the contract, and within three days asked permission, which was finally granted, to assign the contract to the old contractors, who had done the work the past five years for $35,000 a year and had bid $45,000 for the next five years. The work is now being done by the old contractors at $15,000 per year.

Mr. David P. Whealan, a councilman from Richmond, Ind., spoke in favor of municipal collection, and described the crematory which was installed there about three years ago. The crematory, building and grounds cost $8,839, and for the last nine months of its operation consumed 6,947 cu. yds. of garbage at a total cost of $1,380, or 19 cts. per yd.

Mayor Perry, of Grand Rapids, Mich., stated that his city had recently installed a 50-ton Engle cremstory, which burns garbage for $1.26 a ton.

The Special Assessment System for Public Improvements.

The first paper on this topic was by Mr. J. A. Johnson, Mayor of Fargo, N. D. It was mostly of a historical and legal character, reviewing the development of special assessments in various countries, beginning with an English statute of Henry VI., enacted in 1427, and coming down to recent enactments by the American states. Numerous legal definitions and judicial opinions bearing on the subject were cited, all showing that such assessments may be levied, in the discretion of the sovereign power, provided they do not exceed the actual benefit incurred on any given piece of real estate. Of the 45 states in the Union all but five have laws authorizing special assessments. A general act of North Dakota authorizes the assessment of the cost of street improvements and sewers, up to 80% of the total, on abuttors, the balance being met by general taxation.

The second paper on special assessments was by Mr. John B. Weakley, Jr., Mayor of Florence, Ala. The courts of the South have been very slow in recognizing the principle of assessments for benefits. All of the states of the South, after considerable struggle, have at last upheld the principle, except South Carolina, which denies it utterly, being adverse, generally, to municipalities. The legal aspects of the subject were ably reviewed by the speaker. Regarding the proper basis of making assessments, he believed that where the cost of improvements are to be met by abuttors the work should not be carried out if the majority of the frontage objects, unless so decided by a two-thirds vote of the council. Every fair-minded man can see that a well-paved street is used as much by the general public as by abuttors, and therefore the city as a whole should meet a part of the cost, say one-third. If there are railways in the street they might bear one-fourth of the cost, the city at large one-fourth and abuttors one-half. Street intersections might properly be paid for one-half by immediate abuttors and the other half by the abuttors in the corresponding block.

There was comparatively little discussion on the subject proper. A speaker from York, Pa., stated that after trouble in collecting special assessments and a reluctance to foreclose the liens on the property due to unpaid assessments the system was finally abandoned. Paving (brick on concrete) is now paid for by bond issues, which it is intended to redeem in 30 years. This raised a question by another delegate as to how the city would meet the fact that the pavement would have to be renewed before the bonds were redeemed?

Report of Secretary and Treasurer.

The secretary, Mr. B. F. Gilkinson, of New York, reported that the membership, which is by cities instead of individuals, has increased during the past year from 72 to 124 members, now representing a population of 12,500,000. During the year two information bulletins have been issued, in editions of 10,000 each, sent to non-members as well as members. The receipts during the year were $2,670, of which all but $120 has been turned over to the treasurer. The report of the treasurer showed a balance of $18. Unpaid dues amount to $1,340. The secretary recommended that a consulting sanitary engineer be engaged to answer questions submitted to the bureau of information.

Municipal Ownership of Public Service Industries.

By far the most prominent feature of the convention was the discussion of municipal ownership, to which the best part of two days were given. Both sides were ably represented, but the sympathies of nearly every one present, except the speakers on the negative, were overwhelmingly in favor of municipal ownership.

The first address on the municipal ownership program was by Mr. Henry V. Johnson, Mayor of Denver, Colo. After asserting that the question should be discussed from the standpoint of "practical business expediency and economy," the speaker took up the various municipal undertakings in the discussion, one after another. The general prevalence of municipal ownership of water-works throughout foreign countries and the fact that 1,700 of the 3,200 American works in existence in 1897 were under public ownership were cited as evidences of the universal belief in public ownership of this class of city works.

The water-works of Denver, which are owned by a private company, are bonded for $7,000,000, and stocked for as much more, but the plant, on the authority of engineers, could be duplicated for $5,000,000. In a somewhat similar manner the author passed in review lighting, street railway and telephone systems, showing how some or all of these, as he believed, had been eminently successful under municipal ownership. In the matter of telephones it was urged that their use is very much restricted because the private companies claim it is more profitable to have a few subscribers at a high rate than many at a low rate, while a broad municipal policy would result in a much wider extension of this modern convenience. In conclusion Mr. Johnson said:

> What capital is doing for itself, the people of a city can do for themselves in the ownership of their public utilities. The "trusts" are a great object lesson to the people, and as our cities study this lesson they will see how immense savings are made and how the cost of production is made cheaper and cheaper. They will finally understand that water and light and transportation and telephone message service are great human necessities; that they are such necessities that no man or set of men should be allowed to speculate in or to handle for profit; they will learn that they can produce them for themselves cheaper and better than any one else can do for them, and when they do learn this (and they are learning it fast), then will our cities own and control and operate all of these great public industries.

Mr. Gustav Tafel, Mayor of Cincinnati, sent a paper, in which he also made water-works a starting point. He had found, from figures given in "The Manual of American Water-Works," that certain cities under public ownership were being served with water at much lower figures than certain other cities under private ownership, selected with a view of fair comparison. The city of Cincinnati, he said, notwithstanding past bad administration, had one of the lowest water rates in the country. If a city can successfully operate water-works, why not other undertakings as well? Public ownership would go far towards eliminating one of the most baneful influences in municipal life, the use of money by franchise corporations to secure and retain valuable franchises. An indispensable accompaniment of municipal ownership is the merit system, and a greater extension of the principle of home rule.

Mr. J. R. Robinson, Mayor of Colorado Springs, also sent a paper. He favored municipal ownership because he thought it tended toward a higher morality, a greater interest in municipal affairs and an extension of the civil service.

The next paper was by Mr. F. G. Pierce, Mayor of Marshalltown, Ia. That city, with a population of 12,000, has had municipal water-works for 23 years, and a municipal electric street lighting system for 12 years. According to the perdictions of some, the city after so long an experience with municipal ownership, should be bankrupt and "a hotbed of municipal corruption and incompetency." Facts and figures regarding the finances and public improvements of the city showed that such predictions are far from having been the result. The water-works have paid, hitherto, interest, operating expenses, repairs and extensions, besides supplying water free to 191 fire hydrants. The city charges only 3½ cts. per 1,000 gallons for water used for manufacturing purposes. A 3-mill tax has been levied this year for improvements. The rates for dwellings have recently been reduced from $6 to $5 a year, and two faucets instead of one are permitted. The expense of street lighting is met by general taxation. The city tax rate for a few years past, including everything except the school tax, has been 1.5 cts. on the dollar, on an assessed valuation of $1,600,000. There are 109 arc street lamps of 1,100-c. p. each. The total city debt is $71,000 (also excluding the school debt).

Mr. A. B. Foot has said "that all money taken from taxpayers for investment in municipally-owned industries is confiscated." The money paid under private ownership for hydrant rental or street lamps would pay the interest on a municipal plant giving equally good service. The proposition sometimes made that private ownership means the taking of private property for public use without compensation may be met with the statement that public property (such as public streets) should not be taken for private purposes without compensation.

Figures from nine Iowa cities were given by Mr. Pierce to show the effect of municipal ownership on city finances. Four of the cities were the next largest to Marshalltown within the state, and four were the next smaller ones, the ninth was Marshalltown itself. The figures given showed a lower bonded indebtedness and lower rate of taxation in cities having municipal ownership than in those with private ownership.

The cost of street lighting in Marshalltown, under public ownership, was given at $36 per lamp per year (1,200-c. p. arc) and in the eight other cities, with private plants, $89. The lighting plant in Marshalltown is operated in connection with the water-works. It was added to the water works, steam for the new engine being taken from the water-works boilers. The total cost of the electric lighting plant, not including the water-works boilers and building, has been $16,000. In figuring the cost of electric lighting, it was brought out by questions from the audience, the coal bill for two months of the year is taken and also the $25 per month added to the salaries of the three men at the station when the lighting was added. Interest at 5% on the cost of the lighting plant, although there is no indebtedness, and depreciation at 5%, are included in the yearly cost. Coal at Marshalltown costs only $1.25 a ton.

Probably the longest paper against municipal ownership was the one sent in by Mr. Robt. P. Porter. He started in by calling attention to the increasing municipal indebtedness of the country, part of which is due to the craze for aiding steam railroads years ago, and then said:

> An effort is now on foot, in my opinion, fraught with great danger to American municipalities, to remove all constitutional and legislative restrictions on municipal indebtedness when the municipalities wish to purchase these so-called revenue-producing properties. * * * * Citizens who believe in sound government should vigorously oppose all attempts to remove the constitutional limitations on state and municipal indebtedness.

Official English reports on the municipal ownership of gas works "show no special advantages in favor of municipally owned plants." The Massachusetts Gas and Electric Lighting Commission has recently published figures detrimental to municipal ownership.

The city of Philadelphia turned over its gas works to the United Gas Improvement Co., Dec. 1, 1897. From that date until July 1, 1897, the company paid the city $467,628 as a percentage on all collections made by it, under the terms of the lease. If Philadelphia would also turn its water-works over to a private company, the author stated, "the public would be better served and millions saved to the taxpayers."

In place of perpetual franchises reasonable leases should be made to companies.

The personal inquiries of Mr. Porter had led him to believe that when submitted to practical American tests the glowing accounts of municipal street railways abroad are valueless. Municipal ownership in Great Britain has made nothing like the progress reported, while in the matter of water, gas and street lighting, it is a question whether the United Kingdom or the United States is in the lead.

Personal inquiries in London lead to the conclusion that the tramway employees of the London County Council believe themselves the subject of unfair treatment in a variety of ways, including long hours of labor and low wages for substitutes.

Mr. Martin A. Gemunder, of Columbus, O., devoted the first part of his paper to an abstract discussion of the relative cost of service under public and private ownership. His line of argument followed closely that advanced by Mr. A. R. Foote, in one section of his book on "Municipal Ownership of Public Service Industries." In brief, it was that the items entering into cost of service were identical in each case and the items themselves would be identical, except that operating expenses would be higher under municipal than private ownership. Cities should make a profit on their works, in justice to the taxpayers, whose money, it was alleged, is through municipal ownership diverted from private to public use. Excessive profit in the case of private works should be prevented by municipal regulation.

An argument against public ownership advanced by the author was that under it the service was not administered by experienced officers. The civil service, even if extended, would be insufficient, because it does not apply to the higher city officials, and renders it difficult to discharge those who are incompetent. Furthermore, so much red tape is thrown around the letting of municipal contracts that advantage cannot be taken of fluctuations in market price. Clerks and other officers must be paid higher wages under municipal than private ownership, to offset political assessments and uncertain tenure of office. The democratic form of government is "a flat failure when it undertakes to enter the mercantile arena." The permanent public service of Glasgow, or other cities under monarchical government, is a far different thing than under our changeable system. The faults of American municipal book-keeping came in for a share of Mr. Gemunder's criticism. In conclusion, he urged publicity of the accounts of municipal franchise corporations, including sworn statements of receipts and expenditures and the right of municipal examinations of the accounts of these companies.

Mr. Gemunder was interrupted many times during the reading of his paper by questions from the floor and by examples of cheaper service rendered by public as compared with private ownership. Many in the audience simply could not keep still during an abstract discussion of the subject when they were so brimming full of concrete facts, as they believed, showing the excessive cost and other objectionable features of private ownership. In the heat of the argument these impatient ones did not always make it clear whether the lower prices under public ownership were offset by increased taxes, but in several instances this particular point could not be raised. Some of the delegates objected to the statement by Mr. Gemunder and others on his side that municipal reports could not be trusted, urging that it was hardly courteous to make such charges before a body composed of city officials. Mr. Taylor, of Bridgeport, asked if the figures submitted by private companies were any more trustworthy, and if it was not true that they kept two sets of books, in case public statements were required. A delegate from Los Angeles illustrated the feelings of his fellow citizens on the advisability of municipal ownership by stating that they recently voted, 8 to 1, the sum of $2,090,000 for municipal water-works. He thought short-term contracts was one of the reasons why lighting companies charged high figures, and suggested that where the law prevented longer contracts than a year, as in Los Angeles, the city might obtain much more favorable rates by building the wire system and letting the company operate it.

After the agitation created by Mr. Gemunder's paper had subsided, Mr. James B. Cahoon, of Elmira, N. Y., presented "A Business Argument Against Municipal Ownership," which soon raised another tempest. Mr. Cahoon stated that he had had charge of private water, gas, electric light and street railway systems, and is now Vice-President of the National Electric Light Association. He thought the demand for municipal ownership was a "snap judgment" on the part of most people. Where municipalities have, under state laws, the apparent right of municipal ownership and exercise them, they rob capitalists, unless, in case of purchase, they pay for the good will of the business.

Municipal street railways abroad give nothing like the service rendered by private American lines, having 15,000 population per mile of track to our 2,600. No municipal plant has developed anything new, private ones leading in all improvements. No municipal plant has been or can be operated as cheaply as private plants by 10%, largely because there is a lack of incentive to that end.

At this point the audience again gave vent to its feelings and the speaker was forced to yield the floor temporarily (which he did most courteously) to the other side. Someone asked who pocketed the saving due to private incentive. Mr. Cahoon answered that it is the fault of the city if it does not. Mr. McVicar, of Des Moines, told how the operating expenses of the water company of his city were swelled when the reasonableness of the rates charged was in question, by increasing the salary of the president and giving salaries to his relatives, men in his employ, who paid them over to the president.

When Mr. Cahoon was allowed to resume he said that private companies employ their men on the merit system, and there should be a rigid system of public accounting for plants under both private and municipal ownership.

The importance and the great cost of obtaining pure water supplies may sometimes make private ownership of water-works impracticable, but no question of public health applies to the other services under discussion.

An investigation of the Detroit municipal electric lighting plant, made by the president of a Chicago electric company, and published in the Chicago "Economist" for April 8, 15, and 22, 1899, showed that the service, properly accounted for, cost the city more than a private company had offered to do the work for before the plant was built; the increased cost being $38 per lamp in 1896, $36 in 1897 and $29 in 1898. The city reports tell quite another story, however. The reported costs of municipal service generally omit depreciation, insurance and taxes, and sometimes interest charges.

The next paper against municipal ownership was by Mr. M. J. Francisco, of Rutland, Vt. He said the proper function of municipalities is to govern, not to usurp the work of individuals. If competition is unsuccessful, why not have public regulation? There is no analogy between water-works and electric lighting plants. Nature provides water free, ready for distribution. Electrical works require the most delicate machinery, easily getting out of order and liable to be suddenly thrown out of use by accident or soon discarded because out of date.

A large part of Mr. Francisco's paper was devoted to a critical analysis of the figures of cost of municipal electric lighting, and to showing how costs were grossly understated, owing to omitted items. Many of these criticisms appeared to be well grounded.

If true, as claimed, that private companies bribe city officials, can the latter be trusted to handle money? If honest men were elected to office there would be no bribery by corporations. A number of cities were cited as having abandoned municipal ownership.

On Thursday, Mr. Cahoon read a letter from the National Electric Light Association, offering to pay half of the expenses, up to $5,000, of an examination of the books of municipal electric lighting plants, the examination to be made by an expert selected by the President of the National Electric Light Association, and approved by the President of the League of American Municipalities. Mr. Cahoon stated that the electric lighting companies wished to learn whether it was safe for them to continue to invest money in their business. The convention voted to accept the offer, provided the President of the League should appoint an expert to examine the books of private electric lighting companies, the expert to be approved by the President of the National Electric Light Association. This counter proposition met with some opposition from the representatves of the electric light association, who urged that their desire was merely to learn whether or not municipal lighting was a success; but the other side replied that its advocates likewise wished to learn whether private companies were not charging too high rates and putting forward unjustifiable claims in comparing public and private ownership. The amendment was finally agreed to by the representatives of the companies, although they asserted that it was intended to block their proposed investigation, since it was doubtful whether any one had authority to authorize a wholesale examination of private accounts.

The form in which the offer was finally accepted was as follows:

Resolved, That the offer of the National Electric Light Association to pay one-half of the expenses, not to exceed $5,000, to investigate municipal plants, the investigator to be appointed by the said association, be accepted on the following conditions:

First. That the President of this League appoint one investigator and the President of the National Electric Lighting Association another; these two, with any needed assistants, to investigate jointly and report on all points of agreement and of disagreement.

Second. That the investigation extend to the charges for commercial and street lighting, the cost of coal, the wages and hours of labor in private companies whose conditions are as similar as may be to those of the public plants examined. The presidents of the two associations in conference with their expert investigators to select the plants to be examined, both public and private. In case of disagreement on this point half of the public and half of the private plants to be selected by each president.

Later in the session a motion was carried to the effect that the National Electric Light Association be requested to formulate a system of bookkeeping for municipal electric lighting plants.

The formal papers having been read, the general discussion of the subject of municipal ownership was opened by Mr. John MacVicar, Mayor of Des Moines, Ia. He opened by saying that the opponents of municipal ownership were almost invariably directly interested in private companies. He claimed that municipal ownership means lower rates, improved service, higher wages for employees and purer politics. His own experience with municipal officers had not shown them to be as black as they are painted. It takes two parties for bribery, and it is not city officials alone who are approached by private corporations. In Des Moines influential citizens and the press have been enlisted on the side of the corporations by purchases of stock at nominal figures or by absolute gifts of it.

Regarding the proposition for public regulation of rates of private companies, as advocated in Mr. A. R. Foote's recent book, the speaker said that reliance could not be placed on the legislature to authorize such regulation or on the courts to enforce it. Some good had been accomplished in Des Moines, because such legislation existed, but the courts rendered no aid. The gas company finally reduced its rates below $1.75 per 1,000 cu. ft., not because the court decided it must, for the court held that a fair price. The reduction came through the commotion caused by an attempt to bribe a newspaper editor. The editor carried $1,000 in cash, which had been given him to secure his influence for the gas company, to the city council and left it with them, to be delivered to the owner, when claimed. The man who paid the editor the money came to the council for it. The council refused to give it up, on the ground that he was not the owner, but merely an agent, and the State Supreme Court has upheld the action of the council. The agitation, however, led to the reduction of rates.

Mr. MacVicar also took exception to Mr. Foote's plan for determining cost of municipal service. He did not see why a city should figure a profit when making up the basis of charges. It might as well figure contractors' profits in the cost of paving when making out special assessments for work done directly by the city.

At this point Mr. Wm. R. Hill, M. Am. Soc. C. E., read a paper describing the water-works of Syracuse, the poor water service rendered by a company before the city bought the works, and the beneficial results under municipal ownership.

The name of Mr. A. B. Foote, of Washington, D. C., was on the programme to open the general discussion against municipal ownership. He submitted, without reading it, a pamphlet of 98 pages, containing some of his views on the subject, and read a resume of the argument consisting of twelve propositions, which he submitted to the convention for debate, and for reference to a committee for report at the next annual meeting. These propositions, in the main, are presented in Mr. Foote's recent book on "Municipal Public Service Industries," reviewed in our issue of Sept. 21. We will reserve them for future discussion.

Prof. E. W. Bemis, now of New York, spoke next, and in favor of municipal ownership. In answer to Mr. Porter's statements as to the development of municipal ownership abroad, Prof. Bemis said that 45 of 64 county boroughs in England and Wales own their water-works; 21% of the street railway track in England is in 16 municipalities which own their street railways; about 42% of the English electrical lighting plants are owned by the cities and towns in which they are located. Various reports were cited to offset Mr. Porter's assertion that public ownership in England had not been a success. The Philadelphia gas plant, cited by Mr. Porter as a desirable change to private ownership, was deliberated wrecked by the city officials in order that it might be turned over to the company.

As to the propositions of both Mr. Gemunder and Mr. Foote that the taxpayer is deprived of his capital when a city builds a water or lighting plant, Prof. Bemis said that with a proper system of charges the cost of service, including interest on the bonded indebtedness, all other expenses is met by the consumers, so no taxpayer's money is required for capital, and therefore profits need not be included in the cost.

Quotations were introduced by Prof. Bemis from speeches made at meetings of lighting associations in which it was deliberately urged that the newspapers and influential citizens should be kept on the side of the corporations by inducements effective to that end, and that manufacturers should be urged to decline to bid on machinery for proposed municipal plants. Here Prof. Bemis was interrupted by statements that just such refusals had occurred at Columbus, O., and Poughkeepsie, N. J.

Prof. Bemis said he had recently collected fresh figures from 74 public and 132 private lighting plants, which showed the private plants were charging the most per candle-power hour for street lighting. The decrease in electric lighting employees at Detroit, and alleged increase in the work they must do, was shown to be partly due to the substitution of carbons which burned two nights instead of one. As to municipal ownership of water-works in this country, figures from "The Manual of American Water-Works" were cited to show its prevalence, especially in the larger cities.

Is It Better for a City to Do Its Work by Contract, or Day's Work?

By Geo. R. Perry, Mayor of Grand Rapids, Mich.

The author was in favor of the work done directly by the city, urging that under the contract system cheap, imported labor is employed, poor material used and bad work done, the contractor being interested only in making profits. The city is interested in having a higher class of labor employed and in having as good work as possible, and is more likely to get such work if it does it itself. Instances were cited of money being saved under the city system in Minneapolis and Grand Rapids. If there is any profit in the execution of public works, the cities should secure it by doing the work themselves.

Drainage, Sewerage and Water Supply of New Orleans.

By Wm. C. Flower, Mayor.

The important municipal improvements, under the above head, begun or proposed at New Orleans, were described by Mayor Flower. The work is estimated to cost $15,000,000, and includes the construction of a comprehensive sewerage system, the improvement and extension of the drainage system for removing surface and ground water, and the purchase and improvement of the water-works, including under the latter head the construction of sedimentation and filtration works. The drainage pumps, located in seven stations, will be driven by electric power, generated at a central station.

Sewage Disposal Problems.

By G. Everett Hill, of New York City.

This paper was an able, popular presentation of the important subject named. The system of treatment by filtration and forced aeration, introduced by the late Col. Waring, is capable, the author stated, of bringing sewage to a drinking water standard at the rate of 125 gallons per sq. ft. per day, or 5,445,000 per acre. The process requires the use of power to force air through the filters, but (many will be interested to know.—Ed.) the expense will be "inconsiderable, especially if electric power, which needs no engineer, be used." Water waste was noted as an important factor in sewage disposal problems. Forty gallons per capita per day, the author said, "will suffice for extreme luxury in cleanliness—yes, for a veritable ablutionary dissipation."

English Cities at Work.

By Frederic C. Howe, Cleveland, O.

The paper opened with a reference to the high character of the men engaged in public service in England, many of whom are drawn from the students of economics and literature and also from retired military officers. A remarkably high civic spirit is shown in England, and the best men are glad to give their services to the cities. The three forms of activity which most engage English cities at the present time are:

(1) Their relation to quasi-public corporations. * * * (2) The effect toward the improvement of the sanitary condition of their cities as seen in the reclamation of the slums and the erection of model tenements. (3) Their relation to labor, public contracts and the sweating system.

The most notable feature of the English attitude towards quasi-public corporations is that it is one of expediency. A review was given of municipal ownership of street railway lines, with figures designed to show the satisfactory results obtained. Of 600 gas plants in the United Kingdom over 200 are owned by municipalities. From 1883 to 1896 the municipal gas plants increased in number from 148 to 203. The charges for gas supplied by ten municipal plants, ranging in size from 40,000 to 535,000, range from 54 to 78 cts.

The author also reviewed the measures taken to improve the housing of the working classes and also the movement for direct municipal employment and fair wages.

Constitutional Limitations of Municipal Indebtedness in Relation to Public Improvements.

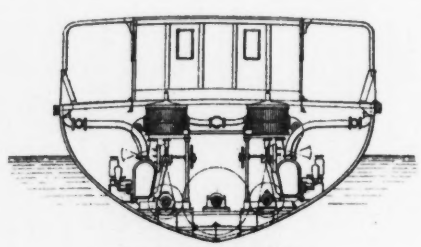
By Chas. W. Tooke, Professor of Law, University of Illinois.

The constitutional limitations placed on municipal indebtedness, which range from 5 to 10% of the assessed valuation, are more restrictive than was anticipated, owing to the fact that property is rarely assessed at anything like its real value. It was supposed, as is shown by the debates in some of the constitutional conventions, that the percentage limitation would be quite flexible, through changes in the assessed valuation, but these changes strongly tend downward, wherever county and state taxes are based on the same assessed valuation, owing to the desire of each municipality to make the state and county taxes as low as possible. This points to the desirability of raising city taxes from one source and county and state taxes from some other source, such as a tax on corporations, as is done in New Jersey and some other states.

Many cities and towns are seriously embarrassed in carrying out public improvements by the limitations under discussion, being unable to issue bonds for much-needed paving, sewers, schools, water-works and other improvements. Two general remedies were suggested in the paper: (1) Exempt from the limitation all indebtedness due to revenue-producing works, like water-works and lighting plants; and (2) remove the limitation. In the former case, bonds of the exempted class should be issued only on a two-thirds vote of the city council and on approval by party vote. If the limitation be entirely removed, a system like that of the English Local Government Board might be adopted, under which all increases in bonded indebtedness could be made only after approval by the board, after a public hearing in the locality concerned. The importance of this whole question is greatly increased by the modern demands for municipal ownership.

General and Miscellaneous Business.

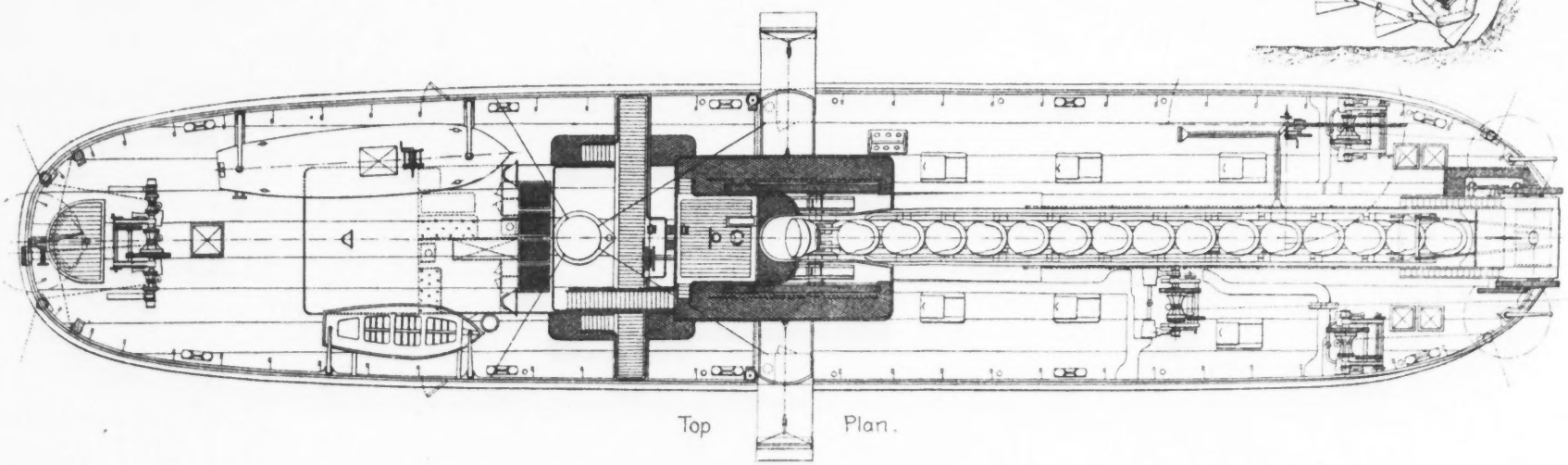
The officers elected for the ensuing year were as follows: President, Henry V. Johnson, Mayor of Denver; Secretary, B. F. Gilkison, New York city; Treasurer, Thos. F. Taylor, of Bridgeport, Conn. Charleston was chosen as the next place of meeting. The constitution was amended so as to admit municipalities of 10,000 population, or less, for $10 a year, and to create a class of associate members, composed of individual officers, where cities do not join. On the constitutional amendments, 48 cities voted, this being the largest number of votes cast on any proposition.



Transverse Section,
Showing Engines.

Longitudinal Section.

0' 5' 10' 20' 30' 40' 50'



Top Plan.

1000 HP. LADDER DREDGE FOR VLADIVOSTOCK HARBOR IMPROVEMENT WORK, SIBERIA.

A. F. Smulders, Rotterdam, Holland, Builders.

CHAS. HART, LITH., 26 VESEY ST., N. Y.