ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

VOL. XLI. No. 13.

TABLE OF CONTENTS.

AN AMERICAN BRIDGE FOR THE SOUDAN has been purchased by the British War Office and has already been shipped by the Pencoyd Iron Works, of Philadelphia, Pa. This bridge is to cross the Athara River, near Khartoum, and will consist of seven spans having an aggregate length of 1,100 ft. The order was placed with the Pencoyd Iron Works by the British War Office less than six weeks ago, the company agreeing to build the structure in seven weeks. This company was given preference over English bridge builders because the latter had stated that it would require seven months to complete the structure. The British War Office was anxious to have the bridge completed before fall in order to facilitate the operations of General Kitchener against the Mahdi.

THE TOTAL VALUE OF IMPORTS AND EXPORTS, into and from the United States, from Oct. 1, 1789, to June 30, 1898, has been compiled by the U. S. Bureau of Statistics. This total is $29,979,961,487 for imports, and $30,952,202,985 for exports; the balance in favor of exports being $972,241,498. Until about 1855, as a rule, we imported more than we exported; only 12 separate years previously to that date showing an excess of imports. In 1860 the exports exceeded imports in value by $37,956,042, but the balance turned the other way—except 1862, 1863 and 1868, until 1874, when exports again exceeded by $57,052,197; and by 1879 this excess had reached $269,733,107. This was high-water mark until 1894, when $278,839,605 was the value of the excess of exports over imports; and in 1887 and 1888 the imports were slightly ahead. From 1894 to 1897 the rate of excess fell until last year, when the exports exceeded imports by $534,626,851; the figures for 1897 being $273,023,355 in favor of exports. In the period 1822-1898 we imported in specie $1,940,150,320; and in the same period we exported $3,400,623,581; showing a balance of $1,460,473,261 exported in specie.

THE AMERICAN OUTPUT OF BESSEMER STEEL ingots in 1898, says the London "Iron and Coal Trades Review," was 6,609,017 tons against 1,759,386 tons for England. The American production of steel rails was 1,955,427 tons, against 751,591 tons for England. The British works fell behind their output for the previous year by 124,769 tons; while the Americans exceeded the 1897 production by 1,333,702 tons, or 20%. The "Review" admits that the serious decline in the British Bessemer rail industry is mainly due to American competition, and America has been especially aggressive in the export of steel rails, having exported nearly 300,000 tons in 1898. It thinks England has lost considerable money by sticking to the established price of £4 12s. 6d. per ton for rails.

STEEL RAILS FOR THE CALEDONIAN RAILWAY, of Scotland are being shipped from Sparrow Point, Md., on the steamship "Kastalia," sailing from Baltimore. This is the first instalment of 500 tons out of an order for 35,000 tons. Two barks are also loading steel rails at Sparrow Point for Melbourne, Australia.

BIDS FOR CONSTRUCTING SETTLING RESERVOIRS and pump mains for the new water-works of Cincinnati will be received on April 25. The reservoirs will hold about 400,000,000 gallons and have a water area of 45 acres. About 12,500 ft. of macadamized roads will be required, 9,000 ft. of sewer pipe drains, 11,000 ft. of 5 and 6-ft. water pipe and 15,000 ft. of smaller pipe. Mr. Aug. Herrmann is President; Mr. G. Bouscaren, M. Am. Soc. C. E., is Chief Engineer, and Mr. Chas. G. Roth is Clerk of the Board of Trustees, "Commissioners of Water-Works." Further particulars regarding this work are given in our advertising columns.

BIDS FOR EXTENSIVE IMPROVEMENTS TO THE Water-Works of Seattle, Wash., will be received until April 12, as stated in detail in our advertising columns last week. The principal items in the work are: Diverting weir on Cedar River, 400-ft. canal and settling basin; a 42-in. pipe line, composed of 6.4 miles of riveted steel and 22 miles of wooden stave pipe; a mile of 30-in. pipe, partly wood and partly steel; 4,000 ft. of 24 and 30-in. wood pipe; 13,200 ft. of 12-in. and 2,600 ft. of 16-in. Kalamein pipe; 3,650 ft. of steel and 1,240 ft. of cast-iron pipe, each 30 ins. in diameter; a 16,000,000 and a 20,000,000-gallon reservoir; a 30 x 60-ft. stand-pipe encased in "Ransome Concrete;" and a 3,000,000-gallon pumping plant. The estimated cost of the work, which is to be let in four sections, is $1,250,000. Mr. R. H. Thompson is City Engineer of Seattle and Mr. Frank Oleson is Secretary of the Board of Public Works.

AN ADDITIONAL WATER SUPPLY FOR BROOKLYN borough will be reported on soon, it is expected, by Mr. Wm. Dalton, Commissioner of Water Supply for New York city. Mr. Dalton believes it will be necessary to go to the mainland for more water. This is due to the prospective heavy future demands of water, which he says will soon equal the available supply on Long Island; and state legislation restricting the extension of the present works into Suffolk Co., or the east end of the island, without permission from the county authorities; and to the recent decision enjoining the city from pumping water from one of its driven-well plants, the possibility that the higher courts may uphold this decision and that then the ruling will be extended to restrain the city from using its entire well plant. One or more companies has been ready for years past to develop a water supply on the mainland to meet the needs of Brooklyn.

A LIMIT ON THE AMOUNT OF FREE WATER supplied to charitable institutions in Washington, D. C., has been established by the District Commissioners. Meters must be set by June 30 and after that date all water in excess of 50 gallons per inmate per day will be charged for at meter rates. A similar plan might be adopted with great benefit in many other cities.

THE MOST SERIOUS RAILWAY ACCIDENT of the week occurred on the Pittsburg, Fort Wayne & Chicago R. R., at Jack's Run, near Pittsburg, Pa., on March 26, and resulted in the death of two men and the probable fatal injury of a third. A passenger train was standing at the place where the accident occurred when a heavy freight extra on the Pennsylvania R. R. ran into its rear end at a speed of 30 miles per hour. The telegraph operator and signal man claim that they signaled the freight to stop but that no attention was paid to the warning.

3,000 LBS. OF SMOKELESS POWDER EXPLODED at the works of the E. I. Dupont Co., at Carney Point, near Wilmington, Del., on March 22. Three men were instantly killed and several others were injured. The first explosion occurred in one of the drying houses from some unknown cause and was followed by several others. The loss to the mill is estimated at $250,000.

THE TYPHOID RECORD in Philadelphia mounts higher and higher, notwithstanding which the Select Council again voted down the filtration loan last Thursday, this time on reconsideration. A total of about 4,500 cases and 450 deaths since Jan. 1 has now been reached. Nearly 100 cases were reported in a single day last week. An appropriation of $37,000 for filters in the public schools has been recommended by Council's Finance Committee. In Newark about 300 cases of typhoid and 25 deaths have been reported thus far in March alone. Camden has also joined the list of fever-stricken cities, with 50 cases from Feb. 15 to March 15, and 61 cases during the subsequent 12 days. The city recently abandoned the Delaware River for a new artesian well plant, but the latter proving deficient some 20 to 25% of the supply has been taken from the river of late.

THE TIMBER DRY-DOCK AT LEAGUE ISLAND, Philadelphia, is reported as leaking and in need of extensive repairs. Signs of weakness at the entrance, tending to jam the caisson-gate, were reported some time ago, and an appropriation of $64,000 is now available for this repair. The new 700-ft. dock, authorized at this place, however, is also to be made of timber; though the naval authorities claim that a concrete dry-dock could be built at a comparatively small additional cost.

THE COURSE IN NAVAL ARCHITECTURE at the Naval Academy at Annapolis, will be discontinued there owing to the failure of Congress to provide for it in the appropriation bill. The Navy Department, in consequence, is again taking up the proposition of last year: to have eight leading cadets at the Academy, assigned to the Construction Corps, take a supplementary course at the Massachusetts Institute of Technology, or at Cornell University. Rear-Admiral Hichborn recommended the first-named institution last year, but prominent naval officers were opposed to the cadets leaving the Academy for instruction. It is now proposed to send cadets to both the Massachusetts and the Cornell schools, as both have courses in naval architecture.

THE BRITISH NAVAL ESTIMATES for the coming year, according to the annual statement of the First Lord of the Admiralty, cover an expenditure of $132,972,500, of which $10,080,000 is for shipbuilding alone. The total force will amount to 110,640 officers and men, including marines and coast guards; with a naval reserve of 25,800. The newest battleships, either launched or nearing completion, have 14,000 tons displacement, on a length of 405 ft.; 19 knot speed with natural draft, and 18,000 I. HP. The armament includes four 12-in. guns in two barbettes; 12 6-in. quick-fire guns in casemates; and 12 12-pdr. and 6 6-pdr. quick-fire in secondary batteries. The barbette armor is 11 ins. thick and the vertical side armor 7 ins. thick and gradually reduced to the bow; the casemates are 6 ins. thick. The new armored cruisers of the "Drake" class, will be 500 ft. long, 71 ft. extreme beam, 26 ft. mean draft and 14,000 tons displacement; 23 knots speed with natural draft and 30,000 I. HP. They will be armed with two 9.2-in. guns in shields, 16 6-in. quick-fire in casemates, 14 12-pdrs. and 3 3-pdrs. There will be 6-in. vertical side armor combined with strong steel decks. The coal bunker capacity is 2,500 tons, and it is expected that 21 knots can be continuously maintained at sea. The battleships have four torpedo tubes, and the cruisers two. The boilers will be of the Belleville type, with economizers.

THE U. S. SAILING-SHIP "CHESAPEAKE," which will be launched at Bath, Me., about June 1, depends wholly on sail power for propulsion, and is especially built for training the naval cadets in those essentials of seamanship which are in danger of being lost in this age of steam. The "Chesapeake" was authorized as a training ship on March 3, 1897, and $250,000 was appropriated for a composite ship propelled by steam and sails; this act was afterwards modified by striking out the word steam and the appropriation was reduced to $125,000. The Bath Iron Works secured the contract for $112,600, and the terms call for her completion by August, 1899. The ship is built of steel with the bottom sheathed with 4 ins. of yellow pine and coppered to 2 ft. 2 ins. above water line. The main-battery includes six 4-in. rapid-fire guns; four 6-pdr. and two 1-pdr. guns. She is full ship rigged, with lower masts of steel, allowing for a spread of 19,975 sq. ft. of sail. Two boilers supply steam to run pumps, and electric distilling and refrigerating plants. The new "Chesapeake" is 175 ft. long, 37 ft. beam, 16½ ft. draft, 81 ft. main mast, 1,175 tons displacement. She will carry 200 men, and every effort is being made to make her the finest type of her class afloat.

THE DELAWARE RIVER 30-FT. CHANNEL, authorized by the last River and Harbor Act, is to be examined and reported upon by the following board of engineer officers: Colonels G. J. Lydecker and C. W. Raymond and Major W. H. Bixby, Corps of Engineers, U. S. A. The act referred to carries an appropriation of $500,000 to begin the work, which is estimated to cost nearly $6,000,000. It can be completed in six years.

THE CAPE COD & NEW YORK CANAL CO. had a hearing, on March 23, before the Committee on Harbors and Public Lands of the Massachusetts Legislature. This company has $6,000,000 capital, and it introduced the engineer of the old canal company, Mr. C. M. Thompson, who testified that the canal would cost $4,000,000 outside of land damages; and financiers and contractors testified to their belief in the canal project and their readiness to perform the work on the plans laid down. The opposition has yet to be heard from.

THE DELAWARE & HUDSON CANAL CO. having announced its intention of discontinuing the use of the canal, now says, through its general counsel, Mr. Wilcox, that it does not propose to build a railway on the abandoned canal line, down the Delaware Valley or to Kingston. The canal company was chartered in 1823 to carry coal, etc., to New York city; but as long ago as 1867 it became evident that coal could be transported cheaper by rail, and the company was authorized so to carry its coal. The canal was run at a loss until the company has now decided to abandon it and wipe the $7,000,000 expended on the canal off of its books. The right to take water from the Delaware, Mongaup and Neversink Rivers is considered of some value. In 1898 the traffic of the canal outside of coal amounted to 263,103 tons of merchandise, 229,200 tons of which was cement; in 1897 the total traffic was 257,545 tons, including 222,758 tons of cement.

sq. ft.
"
"
6 "

5 ins.
3 "
¾ "
1½"
2 "
galls.
tons.

have
ber of
wn at
,509,-
nstru-
next
Great
and
0 and
some
stria,
had
1896.

d by
ght 6
gray
y be
side
card,
the
Place
Mons
tract
made
and
000.
the
ard,
ired
000,
r of
s as
for
t is

the
of
0 0
It
hia
on
ow
est
he
el-
up
00
es.

in
ite
ns,
p-
by
ol-

returned to the office, to be compared with the measurements, to determine if the work has been correctly performed. In cleaning basins in this way, all of the deposit is removed, while none but the solid material has to be carted.

Single horse carts are used, with a carrying capacity of 1 cu. yd. An average day's work for a gang is 20 cu. yds.

The cement carried, mentioned above, is to make good any defect which may be found about the trap or brickwork. Plenty of disinfectant is used when deemed necessary. I approve of the plan of the city owning all carts used, as they can be controlled better, and can be of a uniform size, by which the cleaning of each basin can be regulated, so as to have each cart at the proper place at the proper time, to facilitate the work, so as to get the best results.

Fig. 3.—TRIPOD AND LIFT READY TO MOVE.

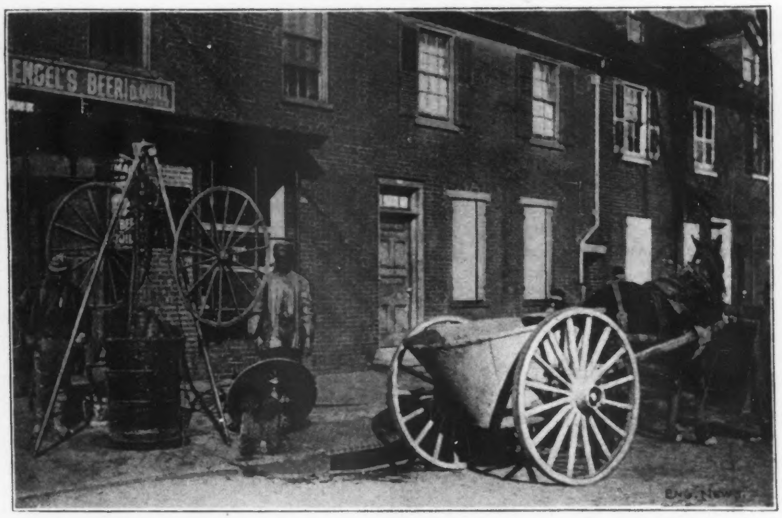


FIG. 4.—CATCH-BUCKET LIFTED READY FOR EMPTYING INTO CART.

APPARATUS FOR CLEANING SEWER CATCH-BASINS AT WILMINGTON, DEL.

For this work, the city owns but four horses, that being all that is necessary for the winter months. When others are required, they are hired by the day with harness and driver. The carts we furnish.

The carts in use, Fig. 6, are made especially for this work. They are steel-bodied, having no tail-boards, and the load line is intended to be 6 ins. below the top of the cart. The extra height is used as slop-boards, to prevent the liquid from being spilled upon the streets, during the trip to the dump.

While speaking of basins, I will state a plan I have successfully used to relieve and lessen the trouble that is liable to occur at low points in streets, where there is no chance for surface relief. By simply using a branch pipe in the basin connection, and using two traps instead of one, I have known of no instance where both traps have become entirely clogged during the same storm. I have several places of this kind that formerly caused much trouble. There has been none since adding the extra trap. One of the style of basins that I favor is what we designate as a spider, or central basin. This is located near the center of the street, with chutes leading to the inlets in the gutters as may be desired. In some instances we have as many as six chutes leading into one basin. In this way there is quite an expense saved, both in construction and maintenance, and it also keeps the men and carts away from the sidewalk during the process of removing deposits.

In these basins there should be placed two traps to allow for the extra work to be performed by the outlet.

During the winter months, most of our trouble comes from ice. The warm air from the sewers is generally sufficient to keep the water in the traps from freezing, but there are places that are exposed in such a way that ice will form to an extent that the trap will become solid.

There is one basin in which I have known the ice to form 18 ins. thick; but these places are rare. Chutes to basins are easily affected and require much attention. For relief of this kind of trouble we have small, light boilers, shown by Fig. 9, in the text, mounted on two wheels in such a way that they can be moved readily by the use of one horse. These boilers furnish steam through ¾-in. hose to be directed to any point that may require the remedy, which is very effectual. The boilers are used in the summer to run pulsometer pumps. The inlets to basins need attention after each heavy snowstorm. This work, with the exception of some extra important places, is not attended to during the first 24 hours after the storm, as that is the time required by law for the public to remove the snow from the sidewalks in front of their estates, and any clear space would be used for the ejected snow. After the 24 hours has passed an open cut is made about 10 ft. wide from the inlet to the center of the street. This the public are inclined to maintain for their own benefit as a passway to cross the street, or to reach the car. This serves our purpose until the gutters can be cleared of snow. There were in use in this city in 1898 a total of 4,026 catchbasins. These were examined 18 times during the year. The total number cleaned in 1898 was 14,522, the deposit removed amounting to 10,607 cu. yds.

Sewers.—The first care of sewers is to see that their condition is maintained to the point where they are most useful for the work intended. This can be obtained by inspection. A general inspection is made and recorded of every manhole to the sewer at least once during the year. Every sewer that is large enough for a man to pass through, from manhole to manhole, is entered, and its condition as to deposits and construction is noted. When sewers are too small for a man to go through, they are examined by the use of reflectors and sunlight; also by candles upon a float pulled through the sewer by rods or lines. (See Fig. 2.) The long wooden float with candles upon it, is used by being pulled through the sewer by the connecting rods, while the small line upon the reel is left trailing behind to serve as a check, or to draw the lights back, as may be desired. The rods are connected together in the manhole and shoved down stream until the next manhole is reached, then the float is attached. It is then pulled through the pipe, allowing the rods to pass on to the next manhole. The best results are obtained by the use of candles. The glazing of each pipe, as the candles pass, forms a reflector which shows each tiny crack, or imperfect joint. The location of any trouble can be readily found by counting the number of joints to the manhole, or by the rods in use. Some of the sewers, the knowledge of which comes with experience, require more attention than others, and must be examined as the occasion requires. For instance: I have one sewer that receives the deposit from a soap factory. The conditions are such that unless prompt attention is given, the liability of a stoppage would be certain.

There are many places in sewers which require special attention. Among these will be found flat grades, curves, changes of grade, and points where side sewers enter the mains. At these places back water will be formed, causing dams. In sewers with flat grades, especially small sewers, the use of pans in the manholes is beneficial, as the material which drops through the ventilation holes of the manhole cover is caught, and prevented from forming a dam in the manhole. The pans are easily taken care of, and will soon pay for themselves. It is well known that water seeks its own level. When this occurs, by a dam in the sewer, the material will settle and deposit.

When the obstruction once is formed it will generally increase, unless care is taken to remove it. Sometimes obstructions will be found in small sewers, that we are unable to guard against, such as come from house-closets and mills.

They are generally caused by some article which can catch against the joint of a pipe. I have had much trouble in the vicinity of sawmills and carpenter shops, due to children poking small sticks through the ventilation holes in the manhole covers. This also occurs near dumping grounds. All sorts of things were poked through the holes, until, as a matter of safety, I have been obliged to have the holes made as small as possible. I had one instance where a man removed a manhole cover and dropped the carcass of a 40-lb. dog into a 12-in. sewer, thinking that there would be no trouble with it. But there was.

It is important that the slightest trouble should be removed at once, and notice of it can only be obtained by constant inspection of places liable to be affected. Care should be taken to thoroughly ventilate sewers at all times. This is helped by the process of flushing.

Flushing of sewers is an important part of maintenance, as a rush of water starts, and carries along many small articles which might accumulate, not only causing obstructions, but allowing decomposition, which means an extra amount of foul air. The flushing of dead ends should be especially attended to. The process used by us is to attach a line of hose to a fire hydrant, place an inverted pail, with a rope attached to the handle, in front of the outlet, then filling the manhole with water to a depth desired, remove the pail and allow the water to escape suddenly through the sewer.

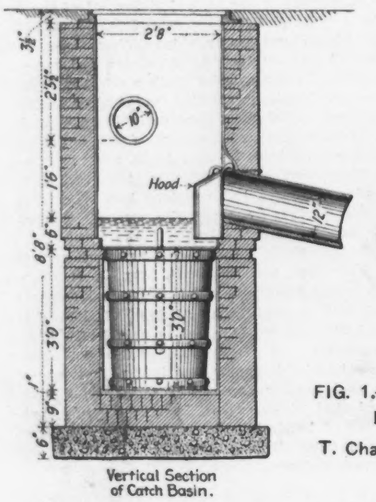
In places that do not have the water facilities equal to this city, other means have to be resorted to. At times we use a wooden ball attached to a line, Fig. 4. This is allowed to float through the sewer, forced by the column of water behind it. The leakage between the sides of the sewer and the ball cuts the sediment that may have collected in the pipe. I find this method excellent, as it does the work without any injury to the joints of the pipes, which is liable to occur if heavy streams of water are directed into the sewer, which should only be done in cases of emergency, and then great care should be taken in the direction of the stream.

SEWER CATCH-BASIN AND CLEANING APPARATUS AT WILMINGTON, DEL.

By T. Chalkley Hatton, M. Am. Soc. C. E.*

Through inquiries from municipal engineers pertaining to street inlets and catch-basins for use in connection with a combined system of sewers, it has occurred to me that perhaps the catch-basin which I designed in 1891 for use in Wilmington, Del., and which was constructed, and has since been a satisfactory and economical experiment, and which is original so far as my knowledge goes, may be of sufficient public interest to warrant a brief description.

In order to insure perfect sanitary conditions in



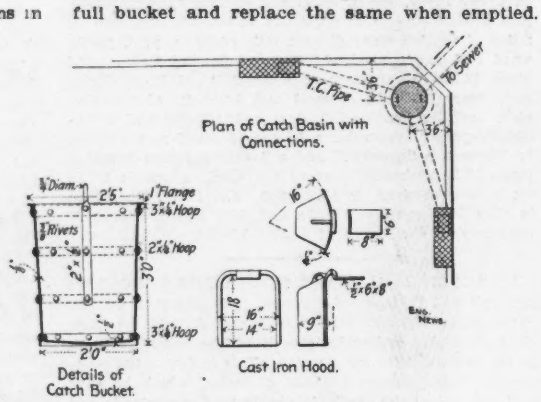


FIG. 1.—PLAN AND DETAILS OF SEWER CATCH BASIN USED AT WILMINGTON, DEL.

T. Chalkley Hatton, M. Am. Soc. C. E., Engineer in Charge of Sewers.

any combined system of sewers, it is, in my opinion, absolutely necessary to prevent the street detritus which is collected by the rains from entering the large-sized sewers. It has often been publicly stated by municipal authorities, who should know better, that the most economical method of disposing of street detritus is by permitting it to flow off through the sewers. No doubt this would be true if we could always be assured of a sufficient rain storm to fill these sewers to such a depth as to carry off, in suspension, all heavy matters; but we cannot. Light rains frequently do not contribute sufficient water to fill the inverts of the sewers to such a depth as to prevent the silting and depositing of heavy matters upon those inverts, and hence an obnoxious decomposition is bound to emanate from these deposits, from whence the term "sewer" suggests to one's senses everything that is most filthy. This need not be if proper sanitary precautions are observed, either by the designing engineer or his employer. One of these necessary precautions is to construct some apparatus for catching the street detritus. It is for the engineer to design something which will not only answer this first purpose, but, in order, as far as possible, to eliminate the difficulties and expense attending the proper maintenance of the apparatus, he must so construct it as to require as little work to clean as possible with as little personal discomfort to those whose duty it is to do the cleaning. Otherwise the apparatus will be allowed to take care of itself, which means a foul cesspool at each street intersection. I think the popular outcry against catch-basins is the outcome of allowing them to take care of themselves; it was, therefore, my object in designing the catch-basin shown in the accompanying cuts to so construct it as to provide for a minimum capacity of material which could be economically handled, without the necessity of pumping out the water, or shoveling out the solid contents, both of which processes require time and obnoxious labor.

Fig. 1 shows the location of the catch-basin and connecting inlets with reference to the curbs and sidewalks, the several details of its size, the dimensions of the galvanized iron catch-bucket, its position when in the basin, and the details of the cast-iron hood for trapping the sewer gases. The hood is lifted from its hanger by an iron hook, from the surface, so as to allow the bucket to be raised out of the basin; at the top of the bucket there is riveted to its outside perimeter an angle iron which fits upon a ledge of bricks projecting around the entire inner surface of the basin; this joint is not necessarily waterproof, but it is dirt-proof.

Fig. 2 shows the apparatus for raising the bucket when full. It is a very simple machine, consisting of a friction pulley, hung upon a cast-iron tripod head, the legs of which are made of 1½-in gas pipe screwed into the head, the whole being mounted upon a pair of light carriage wheels. It can easily be pushed about the streets by one man, and set up over the catch-basin, and the same power can raise the full bucket and replace the same when emptied.

The accompanying photographs, Figs. 3 and 4, show the act of raising the bucket, and the apparatus as it is being pushed along the street.

The catch-basin, with bucket, hood and connections complete, costs $40. Each connecting inlet costs, according to its requisite size, from $25 to $50. The lifting device costs $35. Two men, with horse and cart, can clean 20 catch-basins per day, at a cost of $5.50, or only 27½ cts. per basin; and, besides, the filth is not lying about the streets for several hours, much to the discomfort of weak stomachs. I built the first of these basins in 1891, and up to date there is no appreciable wearing out of the galvanized iron buckets.

*Engineer-in-Charge of Sewers, Wilmington, Del.

MAINTENANCE OF SEWERS AT PROVIDENCE, R. I.

By Allen Aldrich.*

(With full-page plate.)

The following notes on the maintenance of catchbasins and sewers embody some of the results of an experience of 26 years in connection with the sewers of Providence.

Catchbasins.—The care of basins is especially important to the maintenance of sewers, and neglect causes much trouble. Basins are built to collect and prevent such material from entering the sewers as would endanger or prevent the proper work intended for them to perform. If the deposit is allowed to collect in the basin to the point where it can escape through the trap, then comes the additional labor and unnecessary expense of removal from the sewer.

By the use of improper traps, much material is allowed to enter the sewer which should be excluded. For instance: Pieces of shingles, small twigs, sticks, barrel hoops, banana stalks, and many other things which would be liable to strike a pipe joint and become lodged, thereby forming a collector for such objects as get into the sewers through the house connections. This obstruction, unless discovered and removed, will continue to collect debris until the sewer becomes completely clogged. The result can be anticipated according to the location of the difficulty. In some localities cellars would be flooded by sewage, causing anxiety, sickness and expense.

The inlets to basins require attention as well as the outlets. The chutes leading from the gutters to the basins also require prompt attention, or much inconvenience and trouble will result to the public.

Everything that comes should be collected in the basin, as it is built for that purpose and should be made to do its work. This can only be done by the use of a proper trap, which will allow the fluid to pass off and retain solid material and debris, and at the same time prevent the escape of foul air and gases from the sewer, also, by the prompt removal of the deposits from the basins.

I will now describe the method I am using at the present time for the maintenance of basins. A record of each basin is kept and an inspector makes an examination once a month. If deemed necessary, re-examinations are made after heavy rains. The depth of deposit, condition of trap, and general condition of repairs, if any are needed, are noted. This gives the opportunity to direct the work to the best advantage.

A list on a special form is made out and given to the head man. This list contains work enough to keep a gang employed for the day. Duplicates are kept at the office, which enables us to locate any man that may be wanted. A gang consists of two laborers and two carts with drivers. The outfit, as shown in the view, Fig. 6, on the full-page engraving, consists of a ladder, two shovels, one handrope, two hoisting buckets, one bailing bucket, one pair of hip rubber boots, and a small box containing cement, a trowel and a can of disinfectant.

The start for the day's work is made by one cart going to the wash-stand to be cleaned. The second cart, with the men and tools, proceeds to the first location on the list. Upon arrival, one man, by the use of the ladder, goes into the basin and bails the liquid through the trap into the sewer with the ten-quart pail, until nothing but the

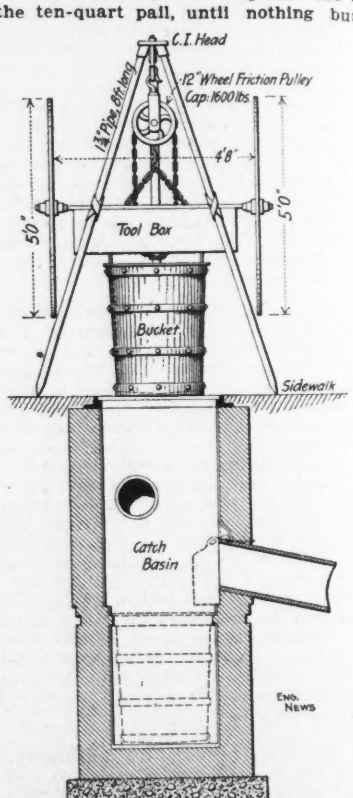


Fig. 2—Section of Catch Basin, with Tripod for Lifting Bucket in Place.

heavy deposit is left to be removed into the carts by the use of handropes and buckets.

By the time the cart is loaded and starts for the dump the second cart has arrived from being washed and is ready for its load, and by the time cart No. 1 has returned from the dump, cart No. 2 is ready to start. The following morning cart No. 2 is the first to leave the yard, giving cart No. 1 an opportunity to wash. By this method the men are at work, and the opportunity given to thoroughly wash a cart every other day. When the deposit is removed from the basin and the sidewalk in the vicinity of the basin has been washed, the head man notes on his list the amount of deposit removed from the basin. He then proceeds to the next location and continues the work in a like manner until the day is done. The list is then

*Superintendent Sewer Maintenance Department.

to strain the joints or break the pipes. When necessity compels me to work from the upper side, I do not allow the blocking of the pipe to obtain pressure, but leave an open pipe, and depend upon the force of the hydrant stream directed upon the object to do the work.

Those who have seen hydraulic mining can readily understand how effectual a well-directed stream of water can be made. Much expense can be saved by prompt attention to small repairs. They should be attended to as soon as discovered, for the action of water is quick and thorough, and many times small defects will lead to serious results.

Steam at a high temperature should not be allowed to escape from buildings direct into the sewer. Vitrified pipe, after heating, expands. In this condition a dash of cold water, which is liable to occur in a sewer at any moment, will cause sudden contraction. The result of this change is that it will seldom fail to break the pipes. In places where tide water gets into the sewers, I have known 6-in. heavy cast-iron pipe to be substituted for the vitrified, with no better results. The same results may be expected at any point of a pipe sewer, where steam and cold water come in contact during a rainstorm. By the admission of steam into the sewer it will escape through the ventilation holes in the manhole covers, which are located in the center of streets directly in the path of horses, that are liable to become frightened. Steam entering a brick sewer does not affect the construction as it does a pipe sewer, but the escape from the manholes is the same. The presence of steam not only increases the expense of labor to be performed in the sewer, but endangers life. It is also impossible to make a correct examination during its presence. Including storm sewers, there were in use in this city in 1898 a total of 173.42 miles of sewer. Of these 10.4 miles were cleaned during the year. The amount of deposit removed from the sewers during 1898 was 831 cu. yds., which, with 10,607 cu. yds. removed from the basins, made a grand total of 11,438 cu. yds.

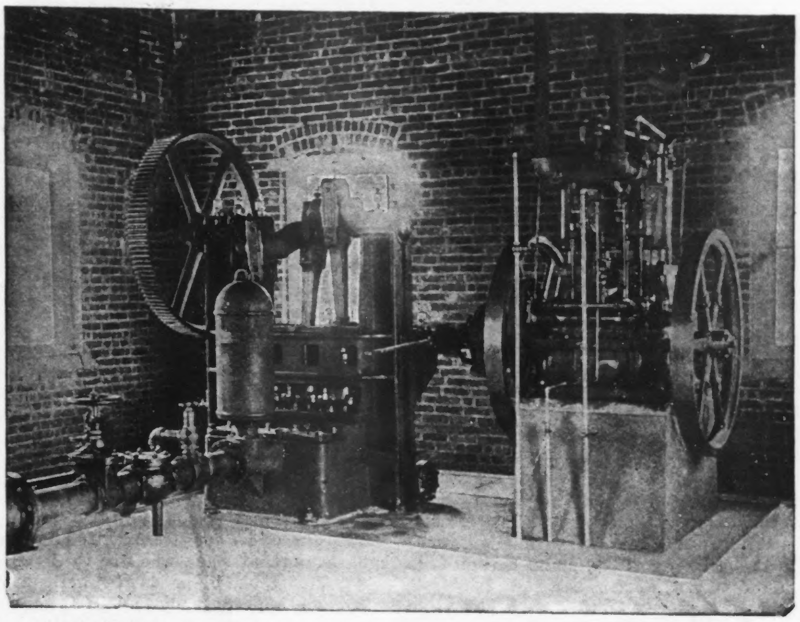
A GASOLINE PUMPING PLANT FOR THE WATER-WORKS OF TOMS RIVER, N. J.

In our issue of April 15, 1897, we spoke of the use of small pumps driven by gasoline engines or electric motors as one of several tendencies in water-works practice. One of the most recent installations of this kind was made last year for the Toms River Water Co., at Toms River, N. J. Mr. Chas. J. Everett, Jr., 253 Broadway, New York city, was constructing engineer for the works, and has kindly given us the following information:

The water supply is taken from three 6-in. pipe wells, sunk to a depth of 35 ft., within 150 ft of the creek known as Toms River. The water is delivered through an 8-in. main into a 50,000-gallon tank, supported on a steel skeleton 80 ft. in height. The depth of water in the tank is read in the pump station by a Shaw mercury column. The normal working pressure is about 60 lbs., but for fire service the tank pipe may be closed and 100 lbs. direct pressure utilized at any of the 36 hydrants distributed over the 3½ miles of pipe—ample water relief valves for the pumps being provided, so that the engines may continue to run at full speed if the hydrants be suddenly closed. This is essential, because if a gas engine be checked in speed by overloading, it will immediately stop, instead of simply slowing down like a steam engine.

The pumps were made by the Goulds Manufacturing Co., of Seneca Falls, N. Y., and were secured through the Sciple Pump & Machine Co., of Philadelphia. The gasoline engine was made by the National Meter Co., of New York city. We are indebted to the courtesy of the Goulds Co. for the cuts of the pumping machinery shown herewith.

Two duplicate units are employed, each consisting of one 8 × 10-in. Goulds triplex geared power pump, direct-connected to a 20-HP. gasoline engine by a friction clutch. By means of a stationary lever altering the tension of the governor spring, the speed of the engines can be varied at will, from 200 to 325 revs. per min. without stopping the machinery. As the pumps are geared 7½ to 1, the revolutions of pump shafts can be varied from 27 to 43, which permits a variation of from 175 to 280 gallons per minute from each pump, since one revolution of an 8 × 10-in. pump displaces 6½ gallons. The plant was designed for a normal capacity of 200 gallons per minute from each unit, the higher speeds being intended for fire service only. The noise attending the use of high-speed gearing is greatly reduced by employing rawhide pinions. The general design of pumps and engines is shown by the accompanying view.



GASOLINE PUMPING ENGINE PLANT FOR THE WATER-WORKS OF TOMS RIVER, N. J.
Chas. J. Everett, Jr., Engineer.

The engines are of the vertical, two-cylinder type, and on account of the shock of explosion being vertical, they run with no perceptible vibration, which is of great advantage when direct-connected machines are used.

The approximate cost of the pumping plant was $4,450, divided as follows: Two 20-HP. gasoline engines, $2,200; two 8 × 10-in. Goulds triplex pumps, $1,750; setting and connections, including clutches, $500. The cost of pumping may be calculated as follows:

Engine consumption of $\frac{1}{8}$-gallon per brake HP. per hour = $1\frac{1}{4}$ cts. Adding $\frac{1}{3}$ for losses (efficiency of pump), $= 1\frac{1}{4} \times 1\frac{1}{3} = 1\frac{2}{3}$ cts. for water HP. 100 galls. per min. 100 ft. high $= 2\frac{1}{2}$ HP., and costs $1\frac{2}{3} \times 2\frac{1}{2} = 4.16$ cts., or 6,000 galls. (per hour) costs 4.16 cts., or 100 galls. 100 ft. high $= \frac{4.16}{60}$ cts. $= 0.07$ ct.

Or, 1 ct. worth of gasoline will pump 1,430 galls. 100 ft. high.

The above estimates are based on gasoline of 74 to 75° Baume., at 10 cts. per gallon.

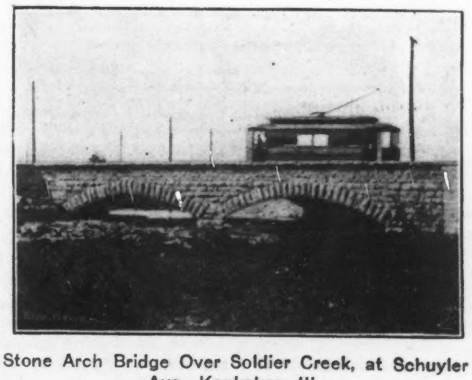
For continuous operation the cost of fuel for a steam plant of the size given above will be less than for a gasoline plant, but in small towns when the pumping is done at intervals, requiring, as at Toms River, only a few hours a day, the gasoline plant will be the more economical, as there will be no waste of fuel in starting and stopping. The gas or gasoline plant also has a very great advantage, when the water storage is small, in that the pumps may be started without delay in case of fire. At the Toms River station, the engines are started by one man turning the flywheel by hand, and in two minutes from the time the engineer reaches the station he can have the first pump in full operation, and the second in an equally short time.

The plant was put in operation about March 1, 1898. Mr. J. H. Williams is President of the company, and Mr. Edw. Snyder is General Superintendent and Pumping Engineer.

A STONE ARCH BRIDGE OF MODERATE COST.

We illustrate herewith a substantial little stone arch bridge recently built at Kankakee, Ill., to carry Schuyler Avenue over a small stream known as Soldier Creek. The structure has two stone arches, on a skew of 60° with the center line of the street, the span being 20 ft. 6 ins. on the square, or 23 ft. 8 ins. measured on the line of the street. The rise is 3 ft. 6 ins., and the radius is 21 ft. 4 ins. on the skew ends and 17 ft. across the arch. The arches are 63 ft. 8 ins. long. They carry a roadway, 42 ft. wide, and two concrete sidewalks, 5 ft. wide, with 6-in. curbs. The spandrel and parapet walls are 18 ins. thick on top, and the parapet is 2 ft. 6 ins. high, finished with a 6-in. coping 22 ins. wide. The ring stones are 2 ft. deep.

The material used is yellow Kankakee limestone, rock-faced, except that the coping is bush-hammered. The stones are laid in mortar composed of 1 part Portland cement to 4 parts sand. The centers were left in place for 60 days after the completion of the work, and there was no settlement when they were struck. The foundations



Stone Arch Bridge Over Soldier Creek, at Schuyler Ave., Kankakee, Ill.
W. K. Woodruff, City Engineer.

are of rock, the springing being only 18 ins. above the rock. The structure was designed by Mr. W. K. Woodruff, City Engineer, to whom we are indebted for photographs and particulars concerning the structure, and built by James Lillie, at a cost of about $2,700. It was completed in July, 1898.

Mr. Woodruff prepared plans for a single concrete arch of 40 ft. span, with a rise of 4 ft., but there was a certain prejudice against the use of this material. It therefore became necessary to use stone, and to make two arches, as it was in-

In the view, Fig. 4, the small ball with the line attached is a copper float which is used to get a line through the sewer for any purpose desired. The section hose on the left is 2-in., 5-ply, with short nozzle. This hose is made heavy and stiff, so that it can be pushed into a 4 or 6-in. pipe to reach any obstruction within a distance of 50 ft. Many times this will save the digging up of streets, or the breaking of concrete, to get at the obstruction. The length of hose, with the connecting rods attached, shows how a line of hose can be forced into a pipe sewer for a distance of 100 ft. The rod with the straps is the one used to attach to the hose nozzle. The nozzles are of different length, to be used as the work may require. The hydrant head has four discharge ports, as shown in the foreground. This gives the advantage of additional lines of hose if desired.

In flushing the main sewer, 2½-in. fire hose, with 1½-in. nozzle, is used, giving a large body of water for washing purposes, and obviating the velocity which a smaller stream would give. In sewers that I have washed in this way for years, I can perceive no injury to the brickwork or cement joints.

Where the sewer is large enough for a man to enter he is always at the nozzle to direct the stream. The dirt is collected at each manhole ahead of the flushing or washing. When possible, we start at the extreme end of all branch sewers and clean to the main, then take the main, leaving everything behind in a clean condition.

Fig. 5 shows a wagon loaded with tools and men, with a hose reel behind, ready to start for the cleaning of a large sewer. Fig. 1 shows a wheeled derrick in use at a manhole.

Sand catchers or sumps should be placed in all main sewers at points along flat grades, as their use is beneficial for the collection of dirt at given points, and, with a little attention, will greatly lessen the work of cleaning sewers. When men can go into the sewer, the work is done in the most satisfactory manner. Most of our work at cleaning is done by the hydraulic process, as it is the most rapid and thorough. The supply of water in Providence is good, and we have the opportunity to use it to its full advantage.

One of the causes of trouble we have to contend with is roots of trees. This nuisance has to be watched and fought. They come where least expected, and, unless their presence is detected, will cause much trouble. To remove them special apparatus is required, shown, among other things, in Fig. 3. We use three steel brushes linked together and drawn through the sewer by a horse or derrick. These cut the fibers and bring them to the manhole to be collected and removed. I have seen no apparatus that removes them as readily as the brush. The cause of this plague is imperfect construction. I find less trouble with sewers of the bell pipe style than the sleeve. It requires less skill and attention to make perfect joints on the bell pipe, therefore the results are better. One of the causes of trouble with pipe sewers is the non-removal of cement at the pipe joints during construction. Another, is improper care in making the house connections. Sometimes, in making the side connection, the proper care is not taken and the connection pipes are allowed to penetrate through into the sewer far enough to make an obstruction. Also, in making the connections, dirt is allowed to get into the sewer, which forms a dam. These things can be obviated with care.

The different small tools used for cleaning sewers and removing the obstructions are shown by Fig. 3.

The two inverted iron buckets are dragged through 12 or 15-in. pipe sewers in places where water is not available or desired. These buckets are sometimes used when the manholes are a long distance apart.

The steel brushes already mentioned are for the removal of roots. The sections are connected by links, which allows the brush to conform to the shape of the sewer, as can be seen by the bent form. It can be readily forced through a curved section of pipes. It is one of the most effectual implements that is used for the removal of fibers, which will get into sewers. The brush as it passes, cuts the roots and brings them to the manhole to be collected and removed.

The canvas drag is used for cleaning sumps where there is a depth of water to contend with. The drag is attached to a long handle, which guides it as it is dragged from one end to the opposite end of the sump.

The two frames, one closed for transportation, the other opened as it stands in the manhole when in use, lead the hauling lines from the sewer to a derrick or horse. If the derrick is used, the lines pass through the frame over pulleys direct to the derrick drum.

If a horse is used, then the articles which are shown between the frames are placed upon the edge of the manhole and the hauling line placed in the guide sheave.

The wooden drags at the right and left of the view are sometimes used in sewers which are not large enough so that wheelbarrows could be used to advantage. These drags, after being loaded, are brought to the manhole by use of derrick or horse.

The small tools shown at the right and left of the frames are used with the connection rods to reach and remove any object that may be located in pipe sewers at a distance from the manhole, and many times they will save the digging up of a street to open a sewer at the affected point.

Grease is also one of the troubles with which we have to contend. It is allowed to escape from houses and restaurants with water used for boiling meats or washing dishes. With hot water it passes through the connection pipe until it reaches the trap, or the tide water, where the contact with cold water chills and congeals the grease, which then adheres to the sides of the pipe, accumulating layer upon layer, until the pipe is completely clogged. The best way to remove this, when available, is by the use of a stream of water. The way to prevent it, is to compel persons using the sewers for such purposes to be provided with large grease traps. The use of lye or potash, employed by many as a remedy, should be discouraged, as these simply solidify instead of removing the obstruction.

The care of sewers is provided for by the use of special tools, adapted and generally constructed to suit the conditions of the places that they are to be used in. I have found that in some cities some of the apparatus used there could not be used to advantage here.

During my experience I have seen and tried many different kinds of apparatus, and there have been but few in which I have not been able to find some good qualities. Machines that have been cast aside have given me ideas that I have worked out to an advantage. The best that there is for this work is what is wanted, and I am willing to adopt anything that will do the work better than those which we now use.

Fig. 8 shows emergency apparatus. These are generally used in case of breaks in sewers. They consist of pumps of various kinds, mounted in such a way that they can be placed in service with but little trouble. The objects suspended on the background are 2½ and 4-in. hydraulic ejectors. These are very useful, as they contain no valves. They are attached by a line of hose to the hydrants, and are capable of a lift of about 25 ft. Gravel, 1 in. in diameter, will readily pass through while the ejector is at work. The capacity of pulsometers is about 100 gallons per minute. That of the centrifugal pumps, 1,200 and 1,500 gallons per minute.

Fig. 10, in the text, shows the portable boilers used in connection with pumps in Fig. 8. During the winter they are of great service in thawing frozen water pipes, or for removing frost from any street surface that might require opening. The boiler on the right has a 4-in. Webber centrifugal pump, with a capacity of 600 gallons per minute. This is very useful when cellars have been flooded; also, if a sewer becomes choked up, as this piece of apparatus can be set at work in 30 minutes.

Fig. 7 illustrates a piece of apparatus that is used to remove sand which settles on the bottom of large sewers. It has just been successfully used in a 102-in. sewer. It is constructed in raft form so that it can be put into a manhole at any point desired. A gate, built to fit the circle of the sewer, is controlled by the use of two hand levers, as shown in the picture. Upon the top of the gate are six large candles, which give all the light required in the sewer. The raft is placed with the end to the right, down stream. A man stands ready with a fork to remove any heavy obstruction which may be found in front of the scraper. By lowering the gate to rest upon the bottom of the sewer, the water rises behind the raft and forces it along down stream, while the escape water from between the sides and under the bottom of the scraper or gate, cuts and starts the deposit, which can be forced ahead of the raft, until the manhole is reached. The heavy material can then be removed, and the raft will force the remainder to the next manhole, and so on to the desired point.

The sewer in Allens Ave., a 102-in. circular, has been cleaned in this way for a distance of 6,400 ft. The amount of deposit removed was 60 cu. yds. The cost of forcing the dirt to the manholes was $25. The depth of water in the sewer ranged from 18 to 24 ins. The deposit was in spots, and varied from 3 to 12 ins. deep. The raft was in use four days. The trip was experimental, it being the first time that the raft was used. At times the dirt would accumulate ahead of the scraper to a depth of 18 ins., but at no time did the scraper fail to move it along.

One of the most successful ways of removing obstructions from pipe sewers is to force a line of hose into the sewer until the obstruction is reached, then pull it back about 2 ft.; then by turning the water on suddenly the obstruction is removed without injury to the pipes.

It is bad policy to try to force obstructions from the upper side, as any additional pressure is liable

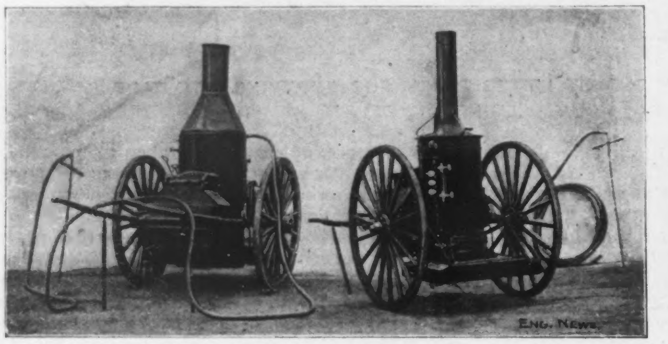


FIG. 9.—SMALL PORTABLE BOILERS.

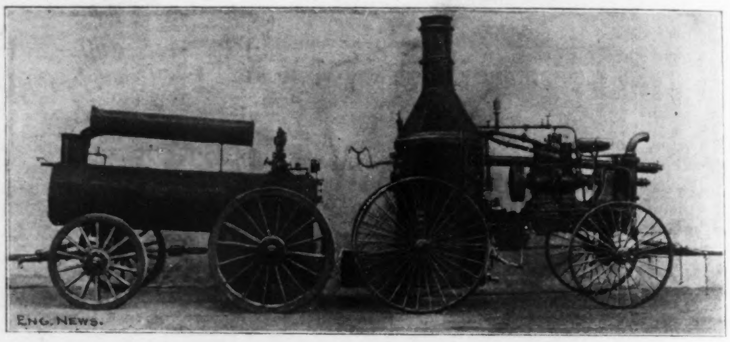


FIG. 10.—PORTABLE BOILERS FOR EMERGENCY USE.

being painted green, with a white forked stripe and a fish-tailed end. The Hall signals are of the well-known disk or banjo type. The electric train-staff system is operated on only one block. The staff machines at St. Joseph and Bee Creek Junction have 19 absolute staffs, one permissive staff and six tablets, so that 26 trains can be sent through in one direction before another returns in the opposite direction, provided, of course, that all the staffs and tablets are at one end of the block to begin with.

It may be interesting to note that this railway

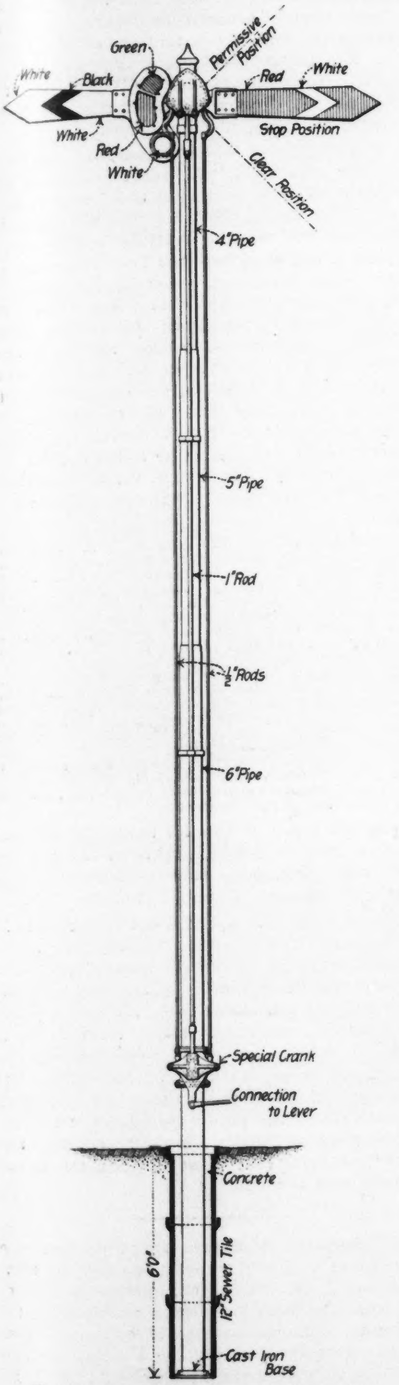


Fig. 2.—Three-Position Block Signal. J. P. Coleman, Union Switch & Signal Co., Inventor.

system, with 4550 miles of road, has about 34 interlocking plants at junctions and crossings.

Each block signal, as shown in Fig. 2, is mounted on an iron pole built up of three lengths of 4-in., 5-in. and 6-in. pipe, put together with swaged and shrunk joints. The poles resemble those used for electric railways, and were first used for signaling purposes by Mr. H. D. Miles, Signal Engineer of the Michigan Central R. R. The pole is about 34 ft. long over all, set 6 ft. in the ground, and having the pivots of the blades about 25 ft. 8 ins. above the ground. The post has a cast-iron base, and that portion which is embedded in the ground is surrounded by three lengths of 12-in. sewer pipe, the space between the post and pipe being filled in with concrete, as shown. Iron posts of similar construction are used for the distant signals. Bracket posts are used at some block stations, in order to give a better view of the signals, as shown at Mazon and Toluca, on Fig. 1.

A three-position semaphore is used for the telegraph block signals, which allows of permissive blocking under certain restrictions, as noted further on. The horizontal position (with a red light) indicates "track blocked, stop;" when the arm is lowered at an angle of 45° (and a white light is shown), it indicates "track clear"; when the arm is inclined upward at an angle of 45° (and a green light is shown), it indicates "caution, proceed under control." The two arms (for trains in opposite directions) are carried by a cap casting secured to the top of the post by set-screws. Each arm is connected by three rods to a special form of bell-crank, sliding in bearings and placed near the foot of the post. The arm is operated by the center rod, which is 1 in. in diameter. In moving, the arm revolves upon the end of one or another of the ½-in. side rods as a fulcrum. This arrangement is shown by the diagram, Fig. 3. With the arm at the normal position, indicating "stop," the operating rod is pushed up to cause it to take the "track clear" position, the arm revolving upon the top of the rod nearest the end of the arm. To show the "caution" signal, the operating rod is also pushed up, but the arm then revolves upon the top of the rod nearest to the spectacle casting. With this arrangement when the arm is set for the "clear" or "caution" position, it will return to the normal "stop" position in the event of a connection breaking, the preponderance of weight being in the spectacle in the former case and in the arm in the latter case. This form of signal is the invention of Mr. J. P. Coleman, of the Union Switch & Signal Co.

At most of the block stations the signals are operated by short levers moving in notched sectors bolted to the table in the operator's office, as shown in Fig. 4. Ordinarily there are horizontal leads from the levers, as shown in the lever to the right, but in some cases a vertical lead is necessary, for which purpose a tail lever is used, as shown at the left. Where distant signals are used, however, the home and distant signals are all operated by the ordinary style of long levers, with sectors bolted to an oak foundation beneath the floor.

The permissive system is only used on single track, and for freight traffic which is so heavy that it cannot well be handled in any other way. In a few instances, however, where the blocks are long and on ascending grades, a passenger train may be allowed to follow a freight train. It is never used to allow a freight train or a second passenger train to enter a block section already occupied by a passenger train. Where signals of the two-position type are installed, the train is stopped by a "stop" signal and the operator then issues a permissive or "caution" card for the second train entering the block. This is practically the same plan as that used on the Erie R. R. when the block system was first adopted on that line, but eventually it was found practicable to apply the absolute block to freight as well as to passenger traffic, as noted in our issue of Jan. 9, 1896. On that road the Mozier three-position signal is used to some extent.

The rules provide that when an operator receives notice of a westbound train, and has no orders for that train, he must notify the next operator to the west, ascertaining if the block is clear and the "stop" signal displayed, and arrange for the latter operator to hold all eastbound trains. He will then admit the train into the block. For eastbound trains, the operator must ascertain that the block east of him is clear, and that he has no unexecuted orders to block eastbound trains. As soon as a train enters the block the operator must report it to the operator in advance; and when it has passed 300 ft. within the block (and he has seen the markers on the rear car) he must put his signal at the "stop" position again and then report to the operator in the rear that the train is clear of the block.

Two rules which appear to call for some comment are those establishing a clearance limit each way from the block signal as follows:

16. A clear block signal indicates that the block is clear to a point 1,000 ft. before reaching the next home block signal.

41. A train finding a block signal displayed at "stop," must stop before reaching it. Where trains are required to stop to do work or to allow opposing trains on passing tracks to depart, or to take water and coal, they may pass the home block signal displayed at "stop," but not to exceed a distance of 1,000 ft. without receiving a clearance card.

In regard to this point, Mr. H. U. Mudge, General Superintendent, informs us that this latter rule was adopted in place of the rule used by a number of roads, which provides that a clear signal gives the train a clear track only to the outside switch of the next station. This seemed to him too indefinite, as the outside switches at some of the stations on this road are fully a mile from the block signals. It is hoped that in time the signals will be so arranged that it will not be necessary for trains to pass them in order to clear sidings or to do work.

The fittings for the three-position signals, including castings, arms, table levers and connections, were furnished by the Union Switch & Signal Co., of Swissvale, Pa., and the pipe poles by the Pennsylvania Tube Works. The lamps for all signals were furnished by the Adams & Westlake Co., of Chicago, the type used being its Bessemer steel semaphore lamps, which are so designed that one standard frame will accommodate two full-sized lenses, one full-sized lens and one back light, or one full-sized lens and one blind back. The staff system be-

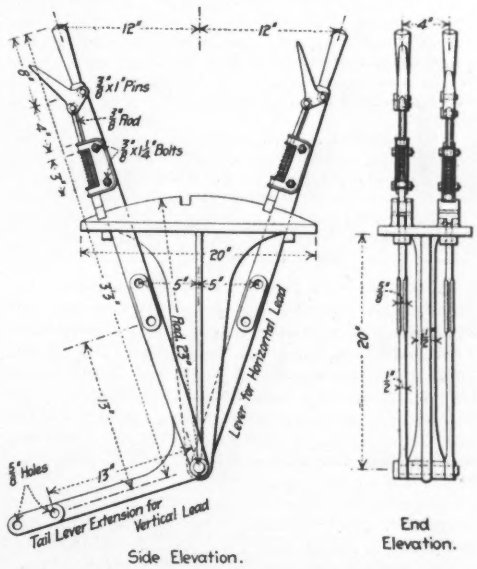


Fig. 4.—Table Lever Machine for Three-Position Block Signals; A., T. & S. F. Ry.

tween Bee Creek and St. Joseph was furnished by the National Switch & Signal Co. (now consolidated with the Union Switch & Signal Co).

The machines and the greater part of the ground work of all interlocking plants erected by the A., T. & S. F. Ry. in 1898, were furnished by the Union Switch & Signal Co., the pipe and wire carriers by the Detroit Pipe & Wire Carrier Co., and the home and distant signals, concrete pipe-carrier foundations, and some of the ground works were built at the Topeka shops of the A., T. & S. F. Ry.

Since January, 1898, the railway company has installed all of its own signal work, including interlocking plant, telegraph and other block signals, highway crossing signals, and the staff system. All installations are made as permanent as possible. The signal poles, of whatever description, are of iron, pipe-carrier foundations of concrete with iron tops, and cast iron crank and compensator foundations are of the National Switch & Signal Co.'s pattern, set in concrete.

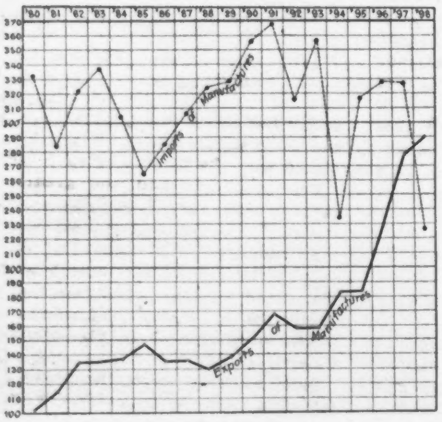
For the drawings, rules, and other information made use of in this article, we are indebted to Mr. H. U. Mudge, General Superintendent, and Mr. J. S. Hobson, Signal Engineer, of the Atchison, Topeka & Santa Fe Ry.

advisable to raise the grade of the roadway sufficiently to allow of a large stone arch.

This new masonry structure replaces an unsightly old bridge consisting of wooden stringers resting on rough stone abutments and trestle bents. The erection of so substantial and ornamental a masonry bridge in a city of small size is exceedingly creditable. It may be well to point out, however, that the presence of a rock foundation at small depth combined with small flood volume in the stream was especially favorable to the use of the masonry arch.

THE FOREIGN TRADE OF THE UNITED STATES SINCE 1880.

We reproduce herewith an interesting diagram which appears in a recent number of the "Monthly Summary of Commerce and Finance," issued by the Bureau of Statistics of the Treasury Department, and showing in a striking manner the surprisingly rapid growth in the exports of American manufactures which has taken place within the last five years. The figures given are in each case for the fiscal year ending on June 30. For the current fiscal year the exports of manufactured goods up to the end of January (seven months), amounted to $182,336,507. If the same rate is kept up for the remaining five months, the total for the present year will be $312,576,000. It is not unlikely, however, that advancing prices may operate to reduce the amount of exports during the rest of the present fiscal year.



Import and Exports of Manufactured Goods by the United States, 1880-1898.

In studying the diagram, it should be borne in mind that it is based on values and not quantities, so that any general rise or fall in prices which has occurred should be taken into consideration. Thus, since a general fall in prices has occurred since 1894, it is safe to say that the increase in the volume of goods sent abroad is even greater than the lines of the diagram indicate for recent years.

Turning to the line representing imports, it appears probable that the great drop from 1893 to 1894 was due to the decreased consumption of imported luxuries owing to the hard times. The drop from 1897 to 1898, on the other hand, can have been due to no such cause. It appears probable that a part, at least, was due to the displacement of foreign goods by goods of American production, although imports made in 1897 in advance of the enactment of the Dingley tariff bill account for most of the difference between the two years.

THE SAN BLAS INTEROCEANIC CANAL project has recently been brought to light again by the efforts of Mr. N. W. Bliss, a Chicago lawyer. He claims that a practicable route exists for a sea-level canal, 27¾ miles in length, with a tunnel 7.67 miles long through the Cordilleras. His idea is that since thousands of miles of tunnels have been built for railways, mines and canals, and since tunnels have been projected to connect England with France and Ireland, therefore a tunnel large enough for ocean vessels does not form an objection to this route. The character of the material, and the possible effects of earthquakes appear not to have been considered, and the fact that certain tunnels of ordinary size have been built and projected is a poor basis upon which to advocate a tunnel of huge dimensions under very uncertain conditions. In an issue of March 14, 1895, we gave particulars of a Darien tunnel route, projected by the late Mr. F. M. Kelley, with a total length of 28½ miles and a tunnel 88 x 112 ft., 11,880 ft. long, with about 1,000 ft. of rock above the tunnel. The estimate of cost was $48,000,000, of which $11,000,000 was for the tunnel, with an additional $5,000,000 for lining, or $53,000,000 in all. Beyond the canal would be considerable work on river channels, the total distance from ocean to ocean being about 94 miles. The San Blas route now revived by Mr. Bliss was discussed in our columns 20 years ago, at which time the seven-mile tunnel was to be 70 x 118 ft. or 100 x 168 ft. The estimate then was $136,000,000, including $89,000,000 for the tunnel (Eng. News, Sept. 13 and Oct. 25, 1879).

BLOCK SIGNALING ON THE ATCHISON, TOPEKA & SANTA FE RAILWAY.

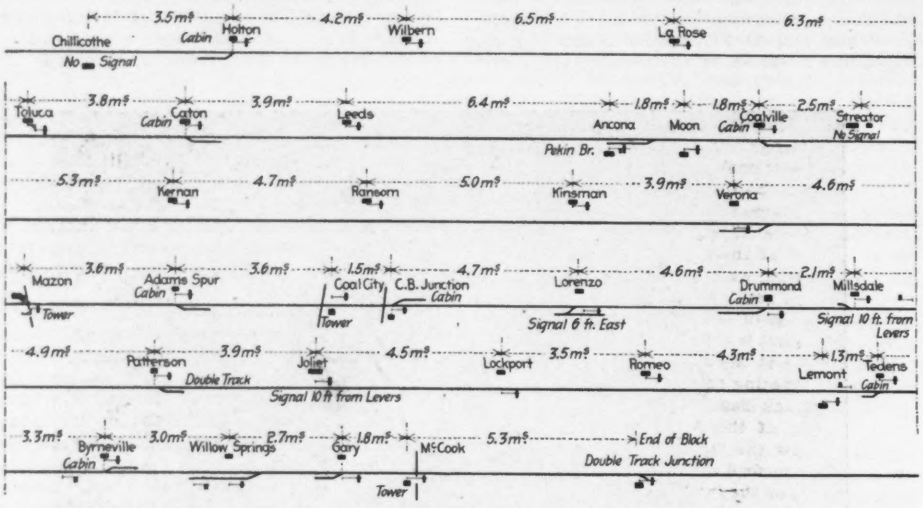


FIG. 1.—PART PLAN OF BLOCK SIGNAL EQUIPMENT ON THE ATCHISON, TOPEKA & SANTA FE RY. (CHICAGO DIVISION).

When the block system first began to be introduced in this country, many railway men considered that it would meet with little favor outside of a few double-track trunk lines in the eastern states, for the reason that the cost of the plant and the difficulty of operating traffic under this system on single track would make the system practically inapplicable for the great mileage of single track on Western roads. As a matter of fact, however, the facilities which the block system affords for the safe and prompt handling of heavy traffic, have led to its somewhat extensive adoption on Western railways.

A notable example of this is afforded by the Atchison, Topeka & Santa Fe Ry., which, according to information furnished us by Mr. H. U. Mudge, General Superintendent, has now about 940 miles of its line (or 20% of its total length) operated on the block system. Of this length, 916 miles are operated under telegraph block signals (45 miles of which are double track), 7¾ miles under the electric train-staff system, and 16¼ miles under automatic block signals, The telegraph block system has been in use nearly eighteen months on about 300 miles of the line west of Kansas City, and the balance of the equipment was put in during 1898. The system is distributed as follows:

	Miles.	Installed.
Telegraph Block.		
Chicago to Kansas City	458	1898.
Holliday to Newton (via Topeka)	190	1897.
Holliday to Emporia Jnctn. (via Ottawa)	99	1897.
Winfield to Purcell, Ind. Ter.	167	1898-9.
South Leavenworth and Soldiers' Home.	2	1898.
Total telegraph block	916	
Automatic Electric Block.		
Kansas City to Holliday (Hall signals)	13	1897.
Winfield to Purcell Junction*	1	1898.
Raton Tunnel (Hall signals)	1	1892.
Florence Yard (Hall signals)	1	1898-9.
Pueblo Yard (Union disk signals)	0¼	1898.
Total automatic block	16¼	
Staff System.		
St. Joseph & Bee Creek Junction	7¾	1898.
Total block system	940	

*(Union electric semaphores.)

The arrangement of blocks and signals is as follows:

Telegraph Block.

Location.	No. of blocks.	Signals, Double-arm home.	Signals, Distant.
Chicago to Kansas City	98	93	16*
Winfield to Purcell	30	27	6*
Holliday to Newton	34	32	7†
Holliday to Emporia Junct'n	23	22	6‡
South Leavenworth and Soldiers' Home	1	2	0
Total	186	176	35

Automatic Electric Block.

Location.	No. of blocks.	Signals, Home.	Signals, Distant.
Kansas City to Holliday	25	25	23
Winfield to Winfield Junct'n	1	2	0§
Raton Tunnel	1	2	0§
Florence Yard	1	1	0§
Pueblo Yard	1	2	0§
Total	29	32	23

*Three-position home signals.
†Two-position home signals.
‡Originally two-position, now being converted to three-position.
§All controlled by continuous rail-circuit.

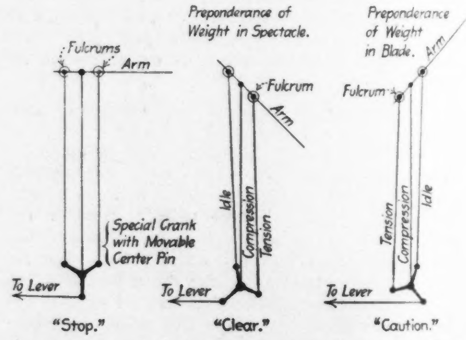


Fig. 3.—Diagram Showing Operation of Three-Position Block Signal.

Fig. 1 is a diagram plan of part of the Chicago Division, equipped with the telegraph block system, showing the arrangement of home and distant signals. It will be noted that in some cases the former are mounted on bracket posts.

The length of the block sections is from two to eight miles, the average being five miles. At night, however, some of the smaller stations are closed, increasing the maximum length of block to about ten miles.

The block signals, Fig. 2, are quite independent of and distinctive from the signals at interlocking plants. They have pointed ends, and are painted the usual colors, but with a forked white stripe on the red face of the blade and a forked black stripe on the white back of the blade. The distant signals are put up where any obstruction interferes with the view of the home signals, and are similar to those used at interlocking plants,

ENGINEERING NEWS AND AMERICAN RAILWAY JOURNAL.

Entered at the New York Post-Office as Second-Class Matter.
Published every Thursday
at St. Paul Building, 220 Broadway, New York, by
THE ENGINEERING NEWS PUBLISHING COMPANY

GEO. H. FROST, - - - - - - - - - PRESIDENT.
D. McN. STAUFFER, - - - - - - VICE-PRESIDENT.
CHARLES WHITING BAKER, SECRETARY AND MANAGING EDITOR.
F. P. BURT, - - - TREASURER AND BUSINESS MANAGER.

WM. KENT, E. E. R. TRATMAN, M. N. BAKER, CHAS. S. HILL, J. J. SWANN, } ASSOCIATE EDITORS.

A. B. GILBERT, - - - - - - - ASSISTANT MANAGER.

CHAS. W. REINHARDT, - - - - - CHIEF DRAFTSMAN.

ALFRED E. KORNFELD, New York,
F. A. PECKHAM, Chicago,
S. B. READ, Boston,
C. F. WALKER, Cleveland, } ADVERTISING REPRESENTATIVES.

PUBLICATION OFFICE, 220 BROADWAY, NEW YORK.
CHICAGO OFFICE, 1636 MONADNOCK BLOCK.
BOSTON OFFICE, 299 DEVONSHIRE ST.
CLEVELAND OFFICE, OSBORN BUILDING.
LONDON OFFICE, EFFINGHAM HOUSE, 1 ARUNDEL ST., STRAND.

SUBSCRIPTION RATES: United States, Canada and Mexico, One Year, $5.00; *6 months,* $2.50; *2 months,* $1.00. *To all other countries in the Postal Union: Regular Edition, One Year,* $7.60 (31 *shillings*); *Thin Paper Edition, One Year,* $6.31 (26 *shillings*). *SINGLE COPIES of any number in current year,* 15 *cents.*

In ordering changes of mailing addresses, state BOTH old and new addresses; notice of change should reach us by Tuesday to be effective for the issue of the current week. The number on the address label of each paper indicates when subscription expires, the last figure indicating the year and the one or two preceding figures the week of that year; for instance, the number 329 *means that subscription is paid to the* 32*d week* (*that is the issue of Aug.* 10) *of the year* 1899; *the change of these figures is the only receipt sent, unless by special request.*

ADVERTISING RATES: 20 *cents per line. Want notices, special rates, see page XIX. Rates for standing advertisements sent on request. Changes in standing advertisements must be received by Monday morning; new advertisements, Tuesday morning; transient advertisements by Wednesday morning.*

In our issue of Dec. 29 last, we expressed the opinion that the sole hope for the successful construction and operation of the New York Rapid Transit Underground Ry. was in some plan of cooperation between the city and the Metropolitan Street Ry. Co. As recorded in detail elsewhere in this issue, that company has now made a formal and definite offer to the Rapid Transit Commission, stating the terms under which it will construct and operate the road.

We have carefully examined the terms of this offer, and they appear to be generally fair in every respect save one—the granting by the city of a perpetual franchise for the road. The Metropolitan officers have declared that this is an essential feature of their proposition, and two prominent members of the Rapid Transit Commission have expressed the opinion that it will be necessary to grant this perpetual franchise if private capital is to undertake the construction of the road.

We dissent absolutely and emphatically from this proposition. It is possible to provide a limit to the life of the franchise of 40 or 50 years and make it sufficiently attractive to private capital, and an equally sound business proposition.

Under the offer of the Metropolitan company, a construction company is to be formed which will build and equip the entire road and lease it in perpetuity to the Metropolitan Co. for 5% on the cost of construction. This 5% interest charge becomes, then, a perpetual charge upon the income of the road; and no provision whatever is made for a sinking fund to pay off the bonds which the construction company will issue to raise funds for the construction of the road.

Now what we would propose is that the operating company shall pay, in addition to the rental, 1% per annum of the cost of the road and equipment, this sum to be either accumulated to form a sinking fund from which the bonds will be paid off at maturity, or else used each year to pay off a certain proportion of the bonds until they are all taken up. If the former alternative be taken, and interest is allowed at 4% on the sinking fund accumulation, it will amount to the entire cost of the road in only 40 years. Then when these bonds are paid off, let the construction company disappear and the road become the property of the city, which doubtless would continue to lease it for operation to the Metropolitan company or its successors under such terms and conditions as might be equitable at that time.

Forty or fifty years is a very long time in the life of a man. The keen financiers who control the Metropolitan company are not looking ahead for that length of time for the profits from constructing and operating the Rapid Transit road. They expect to make, and doubtless will make, great profits from the franchise, and they can make them with equal facility if a limit of a half century is set to the life of the franchise, and if some small part of the earnings which this franchise enables them to make are set apart to pay for the road, so that it can become the property of the city at the time of the franchise's expiration.

The Metropolitan company's 5% bonds are now quoted at a figure which makes it quite certain that it could sell at par 4% bonds for the building of the underground road, guaranteed by itself. This being the case, the rental to the construction company ought to be no higher than 4%, and the 1% additional provided for in its own offer would constitute the sinking fund payment which we have above outlined.

The Metropolitan company can abundantly afford to make this concession. It will receive the most valuable franchise in the possession of the city of New York. It will pay therefor only 5% of its gross receipts, no matter how large these may be, and it does not have to make this payment or to pay any taxes whatever until the railway for which the franchise is given is established so that it pays its operating expenses and fixed charges, and—under the plan we have proposed above—the sinking fund charges on the cost of the road as well, which even under its own plan it must meet in some manner.

In addition, its future as the corporation which is eventually to control all forms of passenger street railways throughout the extent of Greater New York will be by the securing of this franchise absolutely determined. The men who control this great corporation will certainly reap a rich harvest during their lifetime; and they should at least be willing, if the city grants them this most valuable privilege, to let it revert to the city again at the end of a half century.

We have said that forty or fifty years is a long period in the life of a man; but it is not long in the life of a city or a state. Not a few American cities which were wise enough to set a limit of 25 to 50 years to the duration of the franchises which they granted to private corporations for the use of their streets have already reaped great benefits in the renewal of these franchises. Other cities are looking forward to similar benefits a few years hence, when franchises which they have granted will expire. No wiser provision is contained in the charter of Greater New York than that which sets a limit of 25 years to the life of all franchises hereafter granted. It is very likely necessary to give a longer life than this to the Rapid Transit franchise; but surely a half century is long enough. What moral right have those now living to bind all succeeding generations? Forever and ever and ever is a very long time!

We sincerely hope that the Rapid Transit Commission may be able to secure from the Metropolitan officials some such modification of their otherwise equitable and well considered offer as has been here suggested.

The retirement of Mr. Geo. H. Benzenberg, M. Am. Soc. C. E., from the office of City Engineer of Milwaukee, Wis., which is announced in our column of personals this week, merits some further mention than do the general run of changes of city engineers which we commonly have to note in that column. Mr. Benzenberg has held the office of City Engineer in Milwaukee for a quarter of a century, a period of continuous service in one position which is almost or quite unparalleled in the records of City Engineers in the United States. Furthermore, by his administration of his office and his participation in the public affairs of his community, he has caused the office to be recognized and to possess a voice in the control of the city's public works, such as is the case in few American cities. In accomplishing this he has often had to meet both political opposition and criticism of his professional work by other engineers; but a strong personal self-confidence, backed by good common sense, the full courage of his convictions, and the strength of will and personal grit to fight for them to the last, have usually brought his department out the winner in the end. It is these successful battles which Mr. Benzenberg has waged against personal and political opponents of his policy, that have given to his office its responsible and important position in the city government.

A case in point which illustrates excellently what has just been said was Mr. Benzenberg's successful work in purifying the foul Milwaukee River. The crying need for this work was unquestioned; but the City Engineer's proposals for carrying it out were objected to as uncertain and costly; local engineers, generally, declared his plans impracticable; and finally the experts employed refused to lend them their endorsement. Throughout all this opposition Mr. Benzenberg persistently defended the plans he had laid down; and ultimately he obtained the authority and the money to carry them out. The conditions which the work had to meet and the success with which it was done were described as follows by Mr. Don J. Whittemore, M. Am. Soc. C. E., in discussing it before the International Engineering Congress of 1893:

> Along several miles of the river many of the best and most expensive mercantile and other establishments are located, covering the ground between the shore and the adjacent streets completely. Into the river was flowing 60 per cent. of the sewers of a city of 200,000 population, and of course the river was foul. This is a mild term. It was so filthy from noxious and nauseating exhalations that I venture to say that Chicago River would be termed clean in comparison. A person could not pass over it without having a feeling of nausea. Occupants of the buildings were made ill. Removals from its banks were contemplated by many and real estate in its proximity depreciated in value. While the people universally demanded a remedy, a majority had little faith in the plan proposed. I, myself, had grave doubts of its success. What was the result? Within one day after starting the flushing the nuisance was completely abated. It is not often that an engineer's work is to be heartily appreciated within 24 hours of its completion.

There is a lesson in this for those who will learn it, and it may be found repeated in all the work of the City Engineer's office of Milwaukee since its present occupant assumed charge.

In conclusion, it is worth while to note that Mr. Benzenberg's quarter of a century's service as City Engineer has covered almost the entire period of greatest growth of the city in wealth and standing, and practically the entire scheme of its public works has taken form under his hands. It is not often that an engineer can point to an equal record of work accomplished in the service of a single American city and retire in the full strength of the public confidence without regard to political beliefs. Mr. Benzenberg's right to the "good long rest" which he proposes to take, has been well earned.

The Association of Engineering Societies, which was organized in 1881, chiefly through the efforts of the late A. M. Wellington, appears to have entered upon the most prosperous period it has thus far known. The Association as originally organized had as members only the Boston, St. Louis, Cleveland and Western societies. At the beginning of the present year the Association includes 13 different societies, as follows: Boston, Montana, Detroit, Cleveland, St. Paul, Pacific Coast, Minneapolis, Denver, Buffalo, St. Louis, Virginia, Louisiana and Cincinnati. The combined membership of the associated societies is now about 1,500. The financial condition of the Association has greatly improved during the past few years. The assessment for the "Journal" is now only $2 per annum; and we learn that during the present year this will very likely be reduced by a dividend of $1 per member to reduce the surplus in the treasury. An engineering association which declares a dividend is a novelty worth especial notice.

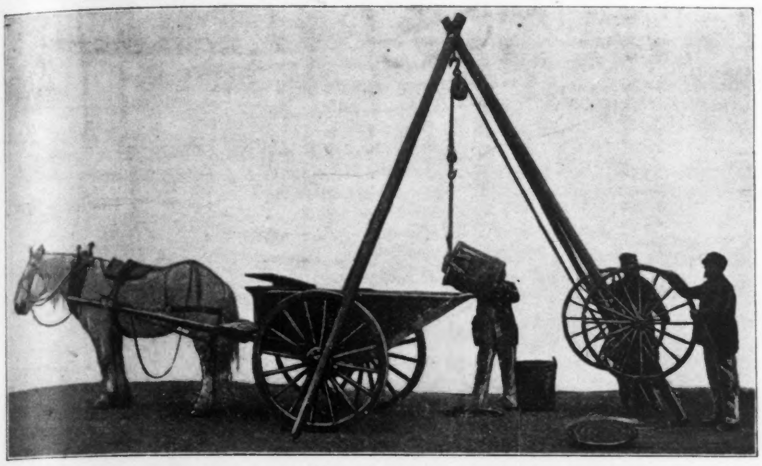


FIG. 1.—WHEEL DERRICK AND CART.

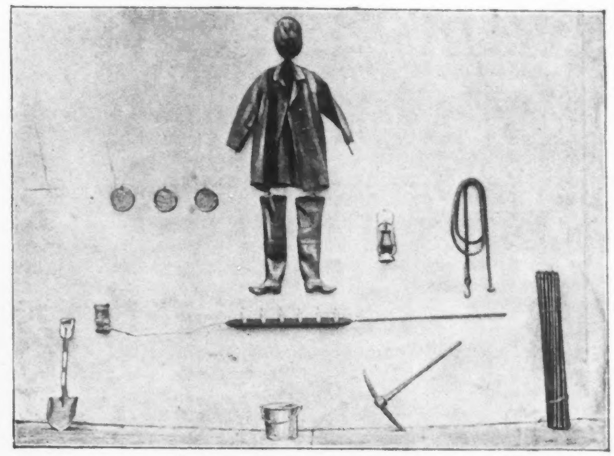


FIG. 2.—OUTFIT FOR EXAMINING INTERIORS.

FIG. 3.—TOOLS FOR REMOVING OBSTRUCTIONS.

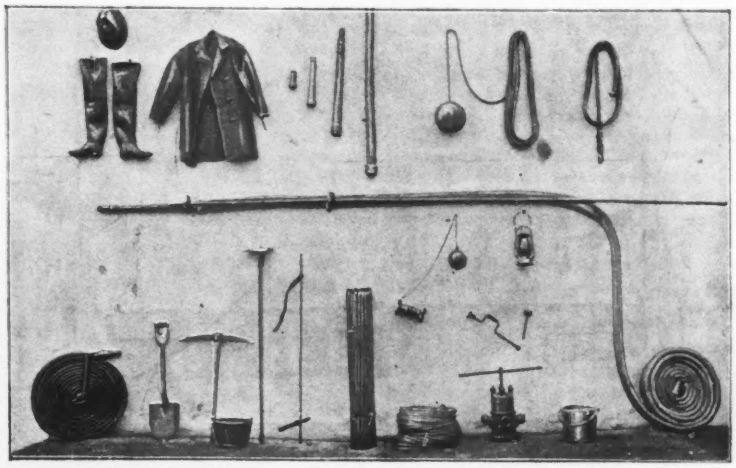


FIG. 4.—FLUSHING IMPLEMENTS FOR SMALL SEWERS.

FIG. 5.—OUTFIT FOR LARGE SEWERS.

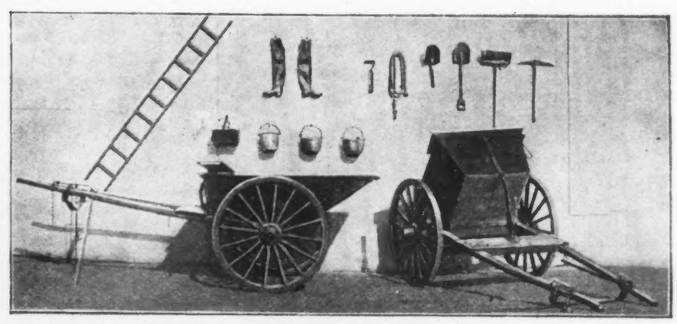


FIG. 6.—CARTS AND TOOLS FOR CLEANING BASINS.

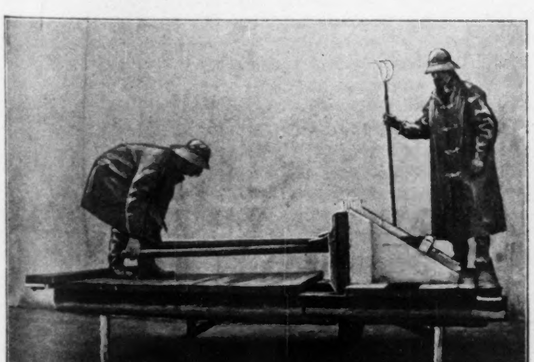


FIG. 7.—SCRAPER FOR LARGE SEWERS.

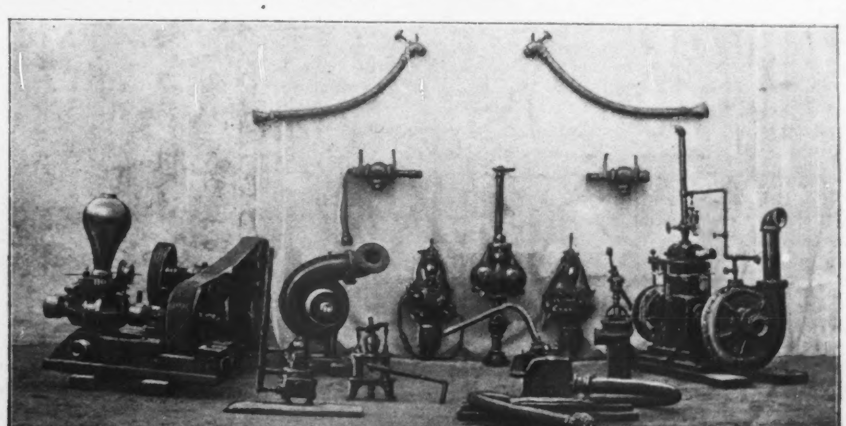


FIG. 8.—EMERGENCY APPARATUS.

APPLIANCES USED IN THE MAINTENANCE OF SEWERS AT PROVIDENCE, R. I.

Allen Aldrich, Superintendent of Maintenance.

Mar

The o
cers an
transpo
sponder
calls fo
isolated
incomp
master
it is th
petuate
cently
or with
averag
of his
conditi
of a cl
the he
the fin
in com
the ca
dations
to trav
valesce
averag
cargo
in the
it is th
experie
materi
should
where
of exp
to the
mand
The sh
for the
be no
the pa
Army
rise to
handli
and d
sorely
to wh
ence
bad w
letter
or tw
for ef
gainir
of su
gover
servic

A NEW

The
ment
ment,
in the
upon
tute
we a
from
area,
civic
The
Wor
main
polit
impo
Boar
matt
Shav
were
gove
The
of m
boar
to t
nici
Lon
vest
Boa
Cou
ers
dire
Fo
don
tion
mil

The outrageous treatment of United States officers and soldiers traveling on the U. S. Army transport "Port Victor," as described by a correspondent in Porto Rico, elsewhere in this issue, calls for some severe comment. If it were an isolated case it might be charged to individual incompetence on the part of the Army Quartermaster nominally in charge; but, unfortunately, it is the direct outcome of a vicious system perpetuated by Department red-tape. Until very recently the Army had nothing to do with the sea, or with transport by ships; and as a result the average Army Quartermaster is utterly ignorant of his duties and responsibilities under the new conditions, and is practically under the control of a civilian sea captain who has no interest in the health and comfort of his passengers, or in the final disposal of his cargo. In fact, no one is in competent and responsible charge; and, as in the case of the "Port Victor," decent accommodations are not provided for the passengers forced to travel on the vessel under official orders; convalescent soldiers are treated much worse than average steerage passengers, and a perishable cargo is allowed to be carried about until it rots in the hold of the ship. The remedy is plain; and it is the one applied by all nations that have had experience in the transport of troops and war material by sea. This whole transport service should be transferred to the Navy Department, where it belongs. It would then be in the hands of experts; under the charge of men accustomed to the handling of ships and competent to command those in sea charge of the transport vessel. The ships themselves would be properly fitted out for the service to be performed, and there would be no neglect or delay due to sheer ignorance on the part of those nominally in command. The Army control of transports in the late war gave rise to all manner of insubordination, delays in handling troops and materials and to absolute and dangerous failures to supply material when sorely needed. But the Army tenaciously sticks to what it calls its right, in spite of this experience and the usages of other nations; and the bad work goes on, as is plainly evident from the letter referred to. In the course of a generation or two, Army Quartermasters may fit themselves for efficient service at sea, but while they are gaining this experience there will be an interval of suffering for the men and of damage to the government material conveyed by the transport service.

A NEW PROPOSAL FOR MUNICIPAL CO-OPERATION IN THE GOVERNMENT OF LONDON.

The bill for the reorganization of the government of London, recently introduced in Parliament, recognizes some of the principles laid down in the editorial discussion, in our issue of Feb. 16, upon "Municipal Co-operation a Possible Substitute for Consolidation." The main point to which we again refer is the separation of local affairs from those common to the whole metropolitan area, to the end that local self-government and civic pride may be preserved and encouraged.

The creation of the Metropolitan Board of Works in 1855 made possible the provision of a main sewerage and drainage system for metropolitan London and the establishment of other important joint works. The jurisdiction of the Board extended over 101 parishes; but to simplify matters, 78 of the smaller of these, according to Shaw's "Municipal Government in Great Britain," were formed into 15 districts. The parishes were governed by vestries and the districts by boards. The Metropolitan Board of Works was composed of members chosen by the several districts and boards. Its functions were limited almost wholly to the works under its charge, such other municipal powers as existed, outside the city of London proper, being vested in the respective vestries and boards. In 1889 the Metropolitan Board of Works was succeeded by the London County Council, to which greatly increased powers were granted and its members were elected directly by popular vote.

For many years the further unification of London has been the dream of many. The jurisdiction of the County Council covers about 120 sq. miles, but this area still includes 40 to 50 separate local governing bodies. With the single exception of the old city of London, which includes an area of little over a square mile, there is not, properly speaking, a city in the district. The parishes and districts exercise certain municipal functions, but have no mayors, the vestries and boards being presided over by chairmen.

The Royal Commission of 1894, whose report was noted in our issue of Feb. 16, proposed to raise some of the more important parishes (19 in all) to the dignity of cities and to consolidate the remainder of the parishes to form as many cities as seemed wise. These new cities, with the old city of London, it proposed to then unite (by co-operation, not consolidation) to form one grand new city of London, with a council and Lord Mayor. In other words, it proposed to raise the vestries and districts to the rank of cities and at the same time increase the dignity and power of the county of London by giving it the title so long reserved to itself by the little area called the city of London. Nothing ever came of the proposal, however.

The measure now before Parliament omits the feature of consolidation into one great city; takes away from rather than increases the powers of the London County Council and follows one of the main ideas of 1894 by providing for some 20 to 30 municipal boroughs, or cities, with greater powers than was proposed by the Royal Commission of 1894. Twelve of the present parishes, two of the district areas and a combination of ten parishes are suggested as suitable for municipal boroughs. These 15 boroughs have an aggregate population of 2,665,000 and a ratable value (amount paid for rent) of over $100,000,000. Twelve of them were included in the 19 proposed cities of 1894. Besides the City of London, the remaining area includes over 30 parishes and districts, with a population of about 2,200,000 and a ratable value of some $65,000,000. Some of these would be formed into boroughs as they stand and others joined together for that purpose. The formation of these additional boroughs, above 15, would be left to commissioners appointed by a committee of the Privy Council, but

> every other borough shall, unless for special reasons stated in a report, which shall be laid before Parliament, have either a ratable value exceeding £500,000, or a population between 100,000 and 400,000.

These boroughs would have a mayor and a council composed of not over 72 members. The reduction in the number of councilors seems to be one of the most popular features of the bill. In contrast, the proposed borough of Poplar now has three parish vestries and one district board, with 84, 84, 108 and 60 members, respectively, making a total of 336.

Of the two chief adverse criticisms of the bill it is hard to say which is the stronger, the failure to make any reforms in the government of the old city of London or the weakening instead of materially strengthening the London County Council. Directly, the County Council is not much weakened, but some of its powers are immediately transferred to the boroughs and others may be, provided: (1) The Council and some one borough so agree; (2) other boroughs apply for like transference; and (3) when a given power of the London County Council has been turned over to half the boroughs the Council, in turn, may apply for an order transefrring this power to the remaining boroughs. In each of the three cases the approval of the Local Government Board of England is essential to the transfer.

It is a cause of regret to many that the bill makes no provision for assessments for benefits, or the placing of the cost of part or the whole of street and other improvements upon the property adjoining, the value of which is so greatly increased thereby. The need of authority of this kind has long been felt in London. Of late, the County Council has needed such powers more than once, to aid it in carrying out projects for street widenings and other work which in the aggregate would cost millions, and so materially increase the tax-rates. In this country many of our cities would find their hands tied completely if the practice of paying for local improvements by assessments upon abutting property-owners were to be stopped. Whole cities are provided with improved pavements and sewerage systems in that way, as most of our readers know. But in London, real estate not only escapes such assessments, but all taxes, in many cases the taxes being assessed on tenants, in proportion to the rents they are paying. Who pays the taxes finally, landlord or tenant, is a question we will not discuss.* The landlords seem to be very well contented to have their tenants settle with the tax gatherer, and more than contented to have this settlement include the cost of all street and similar improvements, as well. That is to say, they strenuously oppose assessments for benefits.

That the adoption of this plan would be advantageous to the metropolis and its component parts, there can be no doubt. Local improvements would then meet with no opposition from tax-payers in other districts, while the cost of larger works could be divided between abutting property-owners and the several sub-municipalities directly affected, whether these were two or composed the whole metropolitan area. In some cases a triple division could be made between abutting property, the sub-municipalities in which the improvement was located, and the whole metropolis. Such a plan is often pursued in America, where a city is divided into local improvement districts.

It is quite possible that assessments for benefits might be opposed by another class than the landlords, and for quite a different reason. The extremists among the advocates for consolidation rather than municipal co-operation object to the present bill that it perpetuates and even aggravates the present distinctions between the rich and poor quarters of the metropolis. They would prefer to see one strong, central administration for all London, with a uniform tax rate, in order that the wealth of the old city, Westminster and other sections, might contribute to the regeneration of East London and like quarters. From this standpoint benefit assessments might be objected to on first thought, but reflection will show that they are advantageous whether London remains many distinct cities or one consolidated municipality. With benefit assessments, the cost of local improvements would fall first of all upon the landlords, instead of as now, on the tenants, and if the cost eventually fell on the tenants, the chances are that it would be distributed over a longer period than under the yearly rates plan, and thus would be easier to bear.

We said above that the metropolis at present embraces some 40 to 50 governing bodies. This by no means tells the whole story, for there are wheels within wheels here in such numbers as to make one dizzy, as the following quotation from "The Municipal Journal and London," formerly and still popularly called "London," clearly indicates:

> There are at present 42 local government areas in London, and within many of these there are numerous minor authorities. Everyone will be glad to get rid of the schedule B vestries, 44 in number, and to sweep away the whole batch of petty parochial authorities, which includes 57 boards of overseers, 20 boards of directors, governors or trustees of the board, 14 burial boards, 19 library commissions, 13 bath and washhouses commissions, two market boards, and other authorities, including even such an archaic body as a Board of Paving Commissioners. All of these authorities have officials and spend money; some of them are self-elected; none of them are thoroughly representative.

This is local confusion, rather than local self-government. It is not so much the number of governing bodies, or certainly the number of areas, that is objectionable, as the diverse origin and powers of these many sections, once separate hamlets and towns well outside London, but brought into it through centuries of growth. The present areas are so disproportionate in size as to seem to make new lines almost a necessity. One has a population of only 11,000. There are 13 with less than 50,000 inhabitants each, while the average for the 42 areas is over 100,000. A score or so of municipalities, in place of double the number, would give ample scope for self-government, and at the same time afford an opportunity to wipe out numerous anachronisms and impediments to municipal progress.

For 45 years two forces have been struggling against each other in metropolitan London: One for actual consolidation into an immense city, and the other for the retention of local autonomy on the part of scores of minor districts. Each force

*Those interested in the subject are referred to Seligman's "Shifting and Incidence of Taxation," and other works of like import.

has partly gained and partly lost. The Metropolitan Board of Works and the County Council mark the progress of the struggle for unification, the results of which have been chiefly limited to what we, in our previous discussion, termed municipal co-operation. On the other hand, numerous local vestries and boards still retain their power, although the number has been greatly reduced. The old city of London, too, has been very successful in holding its own, and is but little molested in the present bill, although threatened with strong rivals, notably the proposed city of Westminster, comprising about one-seventh the ratable value of the county of London, or fully as much as the old city.

The success of the bill is problematical. Some such bill, Mr. Shaw says in his book, has been introduced about once in five years for half a century. The others, or some of them, have aimed to humble the rich and powerful old city; and its influence has contributed largely to their failure. It was expected that the new bill would strike harder at the County Council than it does. The county and the city having been let pretty well alone, and there being a prospect of 25 full-fledged municipalities, comparable in power with the other important English cities, in place of over 40 parishes and districts of rather nondescript character, this measure may succeed. The consolidation of some of the minor districts, and the addition of new powers, seems to be a step in the right direction, but it is only a step towards the desired goal. There can be no true municipal unity, for London or any other great city, without full recognition of the necessity of diversity; in other words, without a proper differentiation of the functions of the metropolis and of its component parts. Such a differentiation the bill leaves largely to the future. Perhaps this was necessary if the bill is to succeed, for several more definite bills have failed in the past, and numerous interviews in the most recent numbers of "London" indicate that there is still a great diversity of feeling regarding the proper division of powers between the great city and its lesser districts.

LETTERS TO THE EDITOR.

The Spread of Fire in a Wooden Building.

Sir: The logic of the case leads to similar conclusions. To-day my attention is called to your "treatise" on the Windsor Hotel fire in your paper of March 23. I enclose my treatise in the "Boston Herald" of March 24.

Yours very truly,
Edward Atkinson.

Boston, Mass., March 25, 1899.

(We reprint the following extracts from an interview with Mr. Atkinson in the paper above referred to.—Ed.)

The facts appear to be that the fire began in one of the lower stories; that heavy smoke appeared from the upper stories before the fire had declared itself below; that there was a long interval between the appearance of the smoke from the roof or upper windows and the alarm below. These facts are entirely consistent with the theory that I am presenting to you, and with the facts in other similar fires.

A smouldering fire may occur in the basement. It may smoulder for a long time in an out of the way place, making a hole through the side partition, thus gaining a draft into the cellular structure which extends throughout the building.

From such slow combustion gases are generated of an inflammable or explosive kind. These gases will escape in the form of smoke at the highest point to which the hollow spaces extend, connecting hollow floor with hollow walls and hollow roofs. There will be nothing but gas appearing as smoke for a long time, until it may happen that the spaces in floors and partitions become pervaded with gas at an explosive point.

This gives a vent somewhere, letting in a strong current of air. The instant that occurs the gases will be expanded by the oxygen, and the fire will break out at many points in the building at the same time.

Cylinder Ratios for Compound Engines.

Sir: I do not doubt that Mr. Ball and myself are in entire agreement as to the indisputable advantage of permitting terminal "drop" in the high-pressure cylinder of those compound engines having high cylinder ratios; and I also think that he does hold the view that "the triple expansion engine is no more economical than these compound engines of large cylinder ratios," because the very next sentence in his letter following the quotation shows that he does. "The triple expansion engine" is certainly not the kind of engine he has in mind as superior to my compounds, but quite a different kind of three-cylinder compound engine. He would have a third cylinder as much smaller than my high-pressure cylinders as they are smaller than their low-pressure cylinders, and I understand he would also desire a corresponding increase in the boiler pressure—let us say, from 160 to 250 lbs., or even to a still higher point. If I understand his discussion correctly, I should put his view—which is my own view—this way: The high ratio compounds are as economical as ordinary triple expansion engines, but could be improved by the addition of a third cylinder five or more times as small as the former high-pressure cylinder, working with a boiler pressure much higher than is now customary with ordinary triple expansion engines. Of course, if this additional cylinder would deliver its exhaust steam to the former high-pressure cylinder with no less a pressure than 160 lbs., all the work done in the new cylinder would be pure gain.

From a practical point of view, however, I doubt the expediency of attempting to carry so high a boiler pressure. The tendency of the day is rather to employ less than 160 lbs., in view of the stress on piping and feed-water accessories. Superheating is also looming up on the horizon as a substitute for such very high pressures.

George I. Rockwood.

Worcester, Mass., March 18, 1899.

Notes by Rail from Los Angeles to Topeka.

Sir: The alarming scarcity of water for irrigation in Southern California during the present season has directed attention to the carrying out of schemes for water storage which have lain dormant for years. The rainfall at Los Angeles up to March 10 was less than 3 ins., whereas it should reach 15 to 20 ins. The fruit trees along the line of the Santa Fe Ry. show up very badly, the leaves on the citrus trees being curled up and turning yellow. The famous Bear Valley reservoir is practically empty; there being only a small pond of water near the base of the dam.

After crossing the range of mountains through El Cajon pass, the railway follows the Mojave River for some distance, in which there is a large flow of water which is practically unused. At Victor, the upper narrows of the river, the canyon has a width of only 150 ft. at the bottom, while at a height of 150 ft. above, the walls are only 360 ft. apart. Inasmuch as bed rock can be reached at about 52 ft. below the surface, this would seem to be a natural site for a dam. One built to a height of 145 ft. would contain about 70,000 cu. yds. of masonry, and would form a reservoir with an area of 7,718 acres, an average depth of 50.5 ft. and a capacity of 390,000 acre-feet. The tributary drainage area would be about 1,250 square miles in extent, and about 200,000 acres of lands could be irrigated, lying between the Santa Fe Pacific and the Southern California railways. Should the dam be built, about 5.5 miles of the last-named line of the Santa Fe system would have to be rebuilt at a higher elevation.

The site of the dam is only 37 miles from Barstow, the junction point of the two lines, up to which point the locomotives use oil fuel. The burner in use by the Santa Fe has proved a great success, and it is proposed to apply it to the locomotives running east to the Needles. On the other hand the burner in use on the Southern Pacific did not prove satisfactory, and they have returned to the use of coal.

Barstow is the junction where cars are changed for the noted mining camps of Randsburg and Johannesburg, and the crowd waiting for trains is very cosmopolitan, including Chinese and soldiers returned from the Philippines. Daggett, the next station, is the location of the once famous "Calico" mines, so named on account of the vivid and varied hues of the mountains, but they are not in operation. Here are also extensive borax mines, which are reached by a diminutive railroad—the Borate & Daggett Ry.—about 12 miles in length.

The track of the Santa Fe Pacific is being put in excellent condition. Many new ties are in place, of Arizona pine and creosoted, with an apparently small percentage of creosote, at the company's plant at Bellemont. New rails have been laid on Wolhaupter tie-plates of a size large enough for the pine ties, but on some of the lines farther west, where they have been used on redwood, they could be advantageously increased in size at least 25%.

The wooden bridges are either already replaced with steel or else abutments and piers are building to receive new spans. Many of the low crossings, where but little waterway is needed, have a number of short spans of girders, but just east of Winslow the crossing of the Little Colorado, while low, must provide for a large flow, and three spans of about 170 ft. each are being provided for by building low brownstone piers. Borings were made to rock near the site of each pier, and also at some distance back, by an outfit belonging to the company's water supply department, and the rock profile was then determined. It was at such a depth, however, that piles were driven and the piers were started on timber grillages below scour line. The brownstone is obtained from numerous quarries along the line, the best one and the one which produces the most uniform colored stone being east of Winslow, near Penzance. This stone is used for the stations at Ash Fork and at several other points, as well as for some of the stone dams which are being built to form reservoirs in which to store water for use on the line of the railway. One at Seligman is 58 ft. high, of cut stone masonry.

The water supply department has been putting in numerous pumping plants for pumping water from some distance off the road to the stations. Water is pumped to Winslow from a point 6 miles distant. The pipe line runs up grade for half the distance, and is an 8-in. steel pressure pipe. From the summit down to the station, cast-iron pipe is used. Coal is used for fuel, being hauled to the pumping station, but this is very expensive, and the plan is contemplated of establishing a small power station on the line of the railway, and transmitting power to the pumping station by electricity or compressed air.

The tunnel, about 300 ft. long, in Johnson's canyon, near Fairview, which was on fire about a year ago, has been retimbered, cribbing being used to a height of 12 ft. in some places to support the roof, and the whole was then sheeted over tight with corrugated galvanized iron, this lining being to prevent further danger from fire.

There is considerable timber still standing along the line of the railway, some of it being large enough to use for ties, but the best timber is some distance from the road. The mills at Williams, Ariz., have a logging road nearly 15 miles long to reach good timber, which is said to extend over 100 miles toward the south.

Gallup, N. M., is the center of a considerable coal mining district, the coal being shipped as far west as Los Angeles. The coal is slow to ignite, but burns up rapidly and leaves a light ash like that from a wood fire.

The great quantities of old rails stored at various points along the road are suggestive of the enormous tonnage which there is in the whole country to be reworked by the steel mills.

Large cast-iron pipe was seen in quantity at various points and distributed along the road for use at the various small drainage openings under the track.

Soon after going through the tunnel in Raton pass, at an elevation of 7,622 ft. above sea-level, Trinidad, Colo., is reached, where are located extensive coal mines, which produce an excellent coking coal. Many ovens are in operation, and the product is shipped to Pueblo to be used at the steel plant. The coal measures are not found in the carboniferous strata as in the east, but in the Laramie group of the Upper Cretaceous. Most of the seams are nearly level and the system of working them the same in general as in eastern mines. The area of this field is nearly 1,300 sq. miles, of which nearly 500 sq. miles are accessible, with an estimated tonnage of nearly 4,500,000,000 tons. The seams which are now being worked average about 5 ft. in thickness. In Las Animas and Huerfano counties, there are about 25 large mines, employing in the neighborhood of 3,000 men, and producing over 1,750,000 tons per annum, or nearly half the coal mined in Colorado.

Pueblo is the location of the steel works of the Colorado Fuel & Iron Co., the only ones in the world, according to Andrew Carnegie, with which Pittsburg cannot compete. The plant was begun in 1880 by the Colorado Coal & Iron Co., which built one blast furnace, a Bessemer department, a rail mill, nail plate mill, nail mill, foundry and machine shop. The first cast was made from the furnace in the fall of 1881, and the first rails were rolled in the spring of 1882. Prior to 1885 the mills of Denver and at Ogden were bought and moved to Pueblo. In 1889 No. 2 furnace was blown in, and in 1892 a third was placed in operation. The works now employ, when in full operation, 2,500 men. The production for 1898 was over 117,000 tons, of which over 82,000 tons was of rails and nearly 22,000 tons merchant iron. Coke is obtained from 1,028 ovens owned by the company, limestone only seven miles from the works and ore from the Calumet and Orient mines. The company owns a large body of ore near Ashcroft, and has a lease on mines at Hartville, Wyo. The manganese comes from a 33% Leadville ore.

The iron ores of Colorado are hematites, magnetites and limonites. The first-named is not an important factor in the production, the second is found in large quantities, but as the limonite can be worked to so much better advantage, it is practically the only source of supply. The principal mine is the Orient, at Villagrove, in Saguache county. The ore has a high percentage of moisture, is low in phosphorus, easily mined and easy to reduce.

An interesting piece of work is in progress on the Rio Grande Ry. between Cuchara Junction and Alamosa, the rebuilding of about 25 miles of the line over Veta Pass. The old line has grades of 4.5%, very sharp curves, many of which were uncompensated, and was very expensive to maintain and operate, although it was the best line that could be made with the money available at the time it was built. The new line crosses the divide by a pass about 150 ft. lower, has no grades of more than 3%, has light curvature with compensation and is at the greatest distance about three miles from the old one. The old buildings, stations and the like, have been photographed and will be torn down in sections and re-erected on the new line. The bridging will be of timber, the trestles having bents of New Mexico pine, which can be obtained at $8.50 per M., and stringers of Oregon pine of 20-ft. span, the latter costing about $22 per M. on the line.

The heaviest engine at present in use on the Rio Grande R. R. is of the ten-wheel type, weighing 124.3 tons in working order and with tender loaded, the heaviest load on a pair of drivers being 39,585 lbs. It was guaranteed to haul a train of six cars weighing 240 net tons from Denver to Pueblo, a distance of 120 miles, in 2 hours and 45 minutes net, and has come up to the guarantee.

The new bridges of the road are being built for a load of two 156-ton engines, followed by 4,000 lbs. per lin. ft.

The line of the Santa Fe between Denver and Pueblo is being put into the same high condition as the main line, stone arch culverts and fills being substituted for trestles.

Along the line through Kansas, one is impressed with the increase of windmill plants for irrigation. One good-sized earth reservoir was seen which had three high-class windmills near by to fill it.

East of Newton, stone outcrops are frequent, and crusher plants have been built and much of the line is now ballasted with broken stone, making a roadbed equal in many respects to the Pennsylvania. The work of double-tracking this division is also in progress. The stone is also quarried extensively for building purposes, and has been used for the elegant stone station at Emporia. F.

Topeka, Kan., March 20, 1899.

Engineering Features of San Juan, Porto Rico.

Sir: Afer six days in the hold of the government transport "Port Victor" the city and harbor of San Juan, Porto Rico, was the most beautiful sight upon which my eyes had rested in many a day. I had heard something of the inadequacy of the San Juan hotels, but to myself and my

Plaza at San Juan, Porto Rico, Showing Slag-brick Paving in Foreground, with Plaza Covered with Concrete.

companions the beds were of down and the table that of the Waldorf-Astoria. While this has nothing to do with the engineering progress of the island, it seems only proper to here register a brief statement of my impressions of the Army transport service; and it is to be hoped that all of the vessels in this service are not as ill-fitted for their purposes as is the "Port Victor," and that some of them are in charge of sailing masters and Army quartermasters who know more of their business, have more humanity and realize better the requirements of the soldiers committed to their charge. It is only fair to state that nothing said against it is in the least overdrawn in the light of what was encountered on this particular vessel.

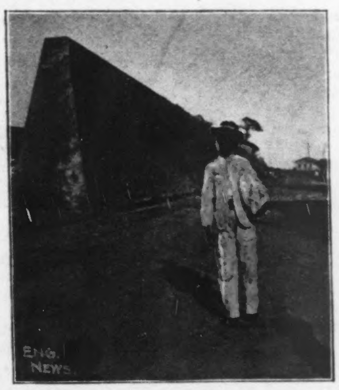
The "Port Victor" was originally an Australian cold-storage boat, full of refrigerating apparatus. With first-cabin accommodations for eight people in four staterooms, passage was furnished by the quartermaster's department for 26 first-cabin passengers. The two-thirds left out of the cabins were given cots in the hold over the refrigerating plant, among bags and barrels of putrid potatoes, which had made two journeys to and from Porto Rico without being unloaded. The thermometer was near zero on the day of leaving New York, and there was one single army blanket furnished each passenger, and no mattresses. As there was no heat whatever—except that from the refrigerating apparatus!—the lack of comfort, not to mention the dangers of pneumonia, may be imagined. The cabin accommodated 16 people at table, and there were more than double this number, including ship's officers, to be seated; there were no cabin attendants, and the cots, with their single blankets, had to be cared for by the passengers; nor were there facilities for washing, one basin only being provided between all who were not in staterooms. These vessels are intended primarily to transport troops, and the soldiers fared even worse than did the cabin passengers. They were mostly men in the regular service, who had been invalided home and were returning as convalescents. These men had hammocks furnished them, with but one blanket each, in a part of the ship which was open to the skies, the hatches having been removed. Their quarters were not heated, and the thermometer registered zero, or thereabouts, on leaving New York, and it did not reach a bearable temperature until the third day out.

I have been here a week now, in the course of which time I have made the best of my opportunities to discover the kind and character of the engineering works in progress. The result may be summed up by stating that I have been most agreeably surprised to observe that the Spaniards have done far more than they have been credited with in the way of good engineering, wherever it was necessary to add to their comfort or meet the needs of a military occupation. On the other hand, practically nothing has been done by them for the development of the resources of the island. The people have been ground down by over-taxation and by laws and restrictions, the object of which has been to obtain from them the most work and revenue with the least aid from the government; they have been left alone to work out their own salvation in the matter of such public improvements as highways, railways, etc.

This letter will be devoted to a statement of the general character of the engineering work in progress in and about the city of San Juan, and especially to a statement of the condition of the paving of near-by roads and the sanitation and water supply, as personally inspected, or as reported upon by the Port Rican officials and our own military engineers. To-morrow I expect to start out on a journey to the eastward over the mountains toward Humacao, and after a couple of days to return and make the journey to Ponce over the main military road. I hope, therefore, to later tell you something of the water supply and sanitation of the cities passed through, as well as of the condition of the country roads and bridges, and the water resources and the topography of the country itself.

Under the Spanish regime, the "Obres Publicos," or Department of Public Works, the head of which was a member of the Insular Cabinet, had full charge of all public works, and these included not only the maintenance of highways, bridges and other structures in the interior, but also the supervision of the city water supplies, especially in the city of San Juan. Under the military government established by the Americans, these works were for some time carried on by a similar department in charge of a Porto Rican. Now, however, this official has been replaced by Major Josiah Pierce, Jr., a Volunteer Engineer officer on the staff of General Henry. At present there are in Porto Rico but two engineer officers of the Army, Major Pierce and Major Root; and the latter officer is charged chiefly with the engineering work about the city of San Juan, including the harbor improvements. As a result, it will be seen that it is not only impossible for the Americans to make new surveys or examinations, or to undertake any new engineering work upon the island, but is scarcely possible for those in charge to properly superintend work commenced by the Spaniards, and which is now being continued by the Porto Ricans under the nominal supervision of our engineer officers. These two officers have their entire time occupied in examining and reporting upon such projects as may be suggested by various military officials, and they are necessarily unable, by reason of a lack of assistants, or even of trained draftsmen or surveyors, to go much beyond the perfunctory stage of a report.

San Juan harbor is as beautiful and as safe a land-locked harbor as could be desired for vessels drawing less than 25 ft. of water. The city of San Juan is on an island separated from the mainland by a narrow stream, but 60 to 100 ft. in width, and spanned by several substantial bridges. This island and Palo Seco Point, on the Bayamon side, and Cabras Island, between the two but a little further out to sea, thoroughly protect the harbor, which is thus entirely land locked. The bar between Cabras and the point of San Juan at Morro Castle is a very difficult one to cross and the channel is tortuous for a large vessel. This channel is said to be dredged to a depth of 30 ft., and dredges are now at work deepening and widening it. The transport "Berlin"

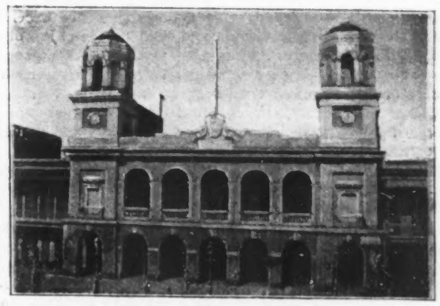


Portion of Old City Wall, San Juan, Porto Rico.

(the old Inman liner), which draws 27 ft., touched the bar, however, on her last trip, and the weather was not especially rough when she crossed. The portion of the harbor in which vessels drawing over 20 ft. of water can anchor is so restricted that comparatively few can find anchorage at one time.

On the ocean side the city is protected by a massive sea wall of masonry extending well around to opposite the cemetery, a little to the east of Morro Castle. East of this the city is protected by coral reefs and cliffs, about 50 ft. in height, above which the city wall of masonry rises. The city wall and fortifications extend around on the inner side of the harbor, entirely enclosing the city with the exception of Puntilla Point. From Puntilla eastward the shore of the inner harbor is faced by a mole or sea wall, adjacent to which the depth of water is sufficient for vessels drawing 25 ft. to tie up to the mole and unload at the warehouses on the shore. The facilities therefore for handling cargo are comparatively good in kind, but so limited in quantity that not over half a dozen vessels are now able to lie at the mole at one time, others being required to load and unload by lighters while lying in the harbor. The old city wall cuts across the city at the eastern end of the main defenses at San Cristobal, near the railroad station; while beyond the bridges which span the stream separating San Juan from the mainland is a masonry wall extending the width of the point and thus doubly protecting the city from the land side. This massive wall is picturesque in the extreme; it is of heavy masonry, about 5 ft. in width at the base and 2 ft. at the top, and 12 to 15 ft. in height.

The streets of San Juan are all well paved with bricks, of the size of our standard American paving brick, imported from England. They are of hydraulic pressed furnace slag, and for uniformity of shape, as well as for durability, they appear to be even superior to the best of our paving bricks. The public plazas and other open spaces, however, are generally not paved with these bricks, as the heavier traffic does not pass over them; but they are covered with a good surface of concrete not unlike our granolithic pavement. The main plaza is kept at all times scrupulously clean, as are the sidewalks



Municipal Building, San Juan, Porto Rico.

and the streets in every part of the town. Concerts are given twice in every week in this plaza, either by the native military band, or by that of one of the American regiments stationed here. The plaza of Christopher Columbus is also cleanly and well paved. Facing this latter is the Custom House, while facing the main plaza are the Municipal buildings, the post office and some of the principal business houses.

During the time of Spanish occupancy the streets of San Juan are said to have been kept comparatively clean, but not nearly so clean as they are now. There is a well organized force of street cleaners, under the Superintendent of Public Works, engaged all the time in hand-sweeping the streets, much as Broadway is swept, and they manage to keep it much cleaner than is the latter. The sidewalks are surfaced by smooth concrete and are separated from the roadways by substantial curbstones, while the surface of the street is well rounded and the gutters are ample and substantial. As San Juan is built upon a hill nearly 200 ft. in height, the grades of its streets are good, in places even too steep; and as the rainfall is abundant and frequent it aids in washing the streets and keeping the gutters clean.

Garbage and similar solid refuse is collected daily by garbage carts not unlike our own, and is carried away and deposited at the end of the bay where it can do no damage. There is no underground sewerage system in the city. All rainfall and surface drainage runs off in the open gutters, but no house drainage is discharged into these and therefore they are not offensive. Cleanly as is the exterior aspect of the city, and clean and inviting as are the fronts and entrances of the houses, San Juan is not as sanitary nor as clean a city as it appears to be. Like all Spanish-American cities, its filth is hidden, and is placed where it can do the most harm. No provision is made for sanitary removal of liquid house refuse or fecal matter. All of the buildings are constructed in the form of a hollow square, as elsewhere in Spanish-America, but the houses are higher than usual, rarely being less than two stories in height and often three stories. In the center court is a cesspool, dug well below the surface of the ground, and a fresh water cistern for collecting such rain water for the uses of the house as may run off the roofs. This center court is a pest-hole of vile odors and the breeding place of disease germs. Much of the liquid refuse and garbage is thrown carelessly into this, instead of into the garbage barrel, and is allowed to putrefy until such time as it may be convenient for the house servants to sweep it into a barrel for removal, or into the cesspool. Not only does the liquid refuse, as that which comes from the kitchen in cooking and from various lavatories in washing, run into the cesspool, but also that which comes from the water closets. There is a tank on the top of many of the houses into which water is pumped, and this supplies a head of water for flushing the plumbing, which is discharged, however, not into sewers, but into the cesspool in the courtyard. Many houses, especially the hotels and the residences of the wealthier classes, are provided with excellent plumbing and often with bath tubs. Everything about the living apartments that meets the eye is cleanly and as it should be, excepting the water closets and middens, which are offensive in the extreme. One has but to leave the front rooms—the only ones which an American should ever risk occupying—and turn to the back rooms, or those opening on the courts, to be greeted with the odors which emanate therefrom. In much the larger proportion of the houses in San Juan, however, there is no modern system of plumbing, and the excreta is discharged into middens, which are supposed to be cleaned out at proper intervals. This, however, is but rarely done, and is often neglected for such periods of time that not only do they fill up, but so also do the stacks which lead from them to the second and third floor closets, thus making the portions of the houses in which they are placed unbearably odoriferous and proportionately pestilential. Even when these middens are cleaned there are no facilities for entering the house and removing the material from the rear, but the men have to come through the main entry of the building into the center court and carry the material through the rooms of the lower floor of the houses.

Surveys have been made and plans prepared for the construction of a proper sewerage system for the city of San Juan, and there is no serious difficulty connected with the construction of such a system. An abundant water supply will soon be provided; the slopes are excellent, and the only difficulty connected with the handling of the sewage is its proper discharge into the ocean at such a point as will insure its being carried away from the harbor, or its chemical treatment or filtration. San Juan, which is a comparatively healthy city, must not be turned into a pest-hole such as are Havana and Santiago de Cuba, by discharging the refuse of the city into its land-locked harbor, whence it will have no natural means of egress, depositing a deep coating of mud and slime over the harbor bottom.

At present the city of San Juan is supplied with water exclusively by the rainfall collected in cisterns from roofs. These are in a few cases constructed of masonry founded on the surface of the ground and standing a few feet above it in the courtyards. In a majority of cases, however, they are but wells or cisterns in the courts, their tops being level with the surface of the ground. As a rule this supply from rainfall is ample for most domestic purposes, and as it is frequently replenished by the rains which occur almost daily throughout the year, it is comparatively fresh. It may therefore be stated that in general this supply is wholesome, provided it be filtered, as is generally the case; though such water cannot be safely used in a tropical climate and in midsummer without being previously boiled. This general remark, however, applies only to such water as is collected and retained in tanks of masonry which rest above the level of the ground surface. As already stated, the majority of these cisterns are placed below the surface of the ground, and therefore lack aeration, but, above all, are immediately fouled by drainage from the neighboring cesspools, as well as from the streets and from the surfaces of the courtyards. Such a water supply is evidently not only unwholesome, but it is dangerous in the extreme.

The water supply now provided San Juan is not only unwholesome in quality, but it is decidedly inadequate in quantity. There is no water for fire purposes other than can be pumped from the nearby bay; nor is there sufficient for flushing house drains, watering streets and flushing sewers, though the latter functions are fairly well performed by the frequent downpours. A new supply of water for the city of San Juan is, however, about to be provided. The construction of this was started after several years of survey, and is approaching completion under the direction of a competent Spanish engineer. The supply is good and its introduction into the city is modern in every appointment. About five or six miles from the city the Rio Piedras has across it a dam, in which a short canal heads and carries the discharge of the river into two settling reservoirs. Each of these basins has sufficient capacity to hold 1½ days' supply for the present population of the city, and the minimum discharge of the river is about double the water supply now required, while its maximum discharge is ample to supply all the requirements of a city of much greater size, if storage capacity were provided.

From the two settling reservoirs the water is carried in a masonry channel directly into three filter beds, two of which are sufficient to handle a day's supply for the city, thus leaving the other for rest and cleaning. From the filter beds the water runs directly into the pumping well, which has a volume equal to one-half the daily city consumption. Here is erected a duplicate pumping plant, containing modern engines, each capable of pumping 35 gallons per head of the present population in 12 hours. From the pump well the pumps force the water 110 ft. in height, whence it flows through mains, only a portion of which are yet laid, to a distributing reservoir on the highest hill in the city. This reservoir has a capacity of about twice the daily consumption. The pumps, however, also serve a separate system of mains, and can supply the city directly without pumping into the distributing reservoir; and if necessary they may even pump directly around the filter beds without permitting the water to pass through these. But a small portion of the city service system has yet been constructed. Major Pierce, who has investigated the progress made in this city supply, has reported that $35,000 will be required to complete the whole system, and as he has favorably recommended the expenditure of this sum, this gravity supply is likely soon to be pushed to completion.

Aside from the harbor work, the masonry mole of the harbor front, the new city water supply and the street and garbage systems, there is nothing of engineering interest about the city of San Juan, with the exception of a substantial old masonry highway bridge and a modern iron railway bridge, which respectively carry the military road and the railway across the narrow channel which separates the island from the mainland. H. M. W.

San Juan, Porto Rico, Jan. 10, 1899.

(The Major Pierce referred to by our correspondent has recently been honorably discharged from the Volunteer service, thus leaving only Maj. Root to represent the Engineer Corps of the Army in Porto Rico.—Ed.)

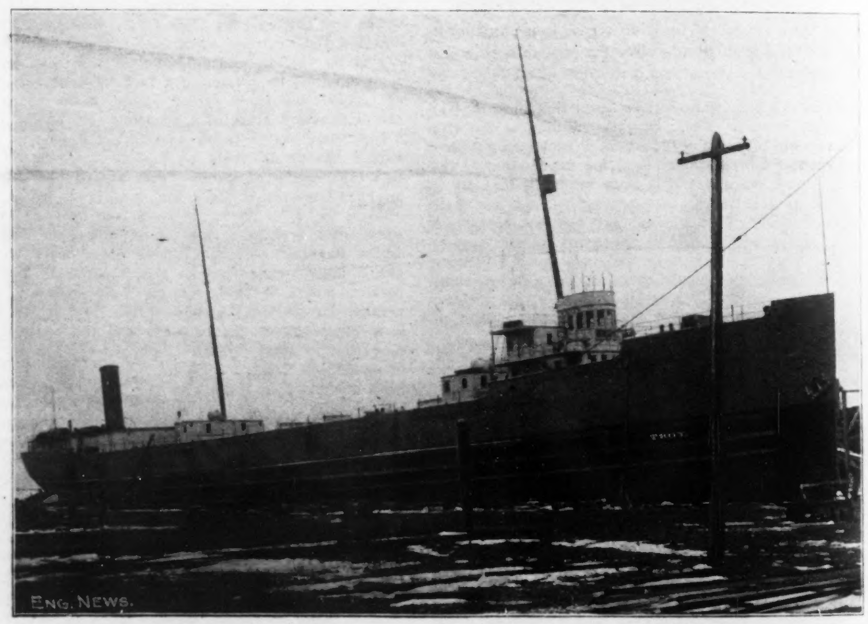
Notes and Queries.

The map of the northwestern portion of South America, on page 180 of our last issue, had a scale of miles attached which by an error was made of one-half the correct size.

THE LAKE FREIGHT STEAMER "TROY."

Within recent years there has been a marked increase in size and an improvement in the construction of the steamers on the Great Lakes, not only for those employed in the coal and ore traffic, but also those for general freight traffic. A good example of the modern lake freight steamer is the "Troy," which was built in 1898 for the Western Transit Co., of Buffalo, N. Y., operating what is known as the New York Central & Hudson River R. R. Lake Line. The steamer runs regularly between Buffalo and Duluth. Many of our readers who attended the convention of the American Society of Civil Engineers at Detroit, last summer, will remember seeing the hull of the vessel at the Wyandotte shipyards, and the engines at the Detroit engine shops. The ship and its engines were built by the Detroit Dry-Dock Co., of Detroit, Mich., and the accompanying view represents the steamer laid up for the winter at Detroit. The general dimensions are as follows:

Length on keel	380 ft. 6 ins.
Length over all	402 " 6 "
Beam, molded	45 " 6 "
Depth, molded	28 " 0 "
Height between decks, molded	9 " 8 "
Mean draft	17 " 6 "
Cargo capacity on net draft	5,100 net tons.
Engine cylinders, diameters	19, 27½, 40 and 58 ins.
Engine cylinders, stroke	42 "
Boilers (3 Scotch marine), diameter	11 ft. 0 "
" length	11 " 6 "
" pressure	210 lbs.
Total heating surface	4,617.6 sq. ft.
Total grate surface	102.4 "
Ratio heating surface to grate surface	45 to 1.04



LAKE FREIGHT STEAMER "TROY"; WESTERN TRANSIT CO. (N. Y. C. & H. R. R. R. LAKE LINE.) Detroit Dry Dock Co., Builders.

The steamer is designed for both package and coarse freight. The hull is of steel, with framing of channel construction, and the cargo hold is divided into 5 compartments by screen bulkheads. It is double-decked for the entire length, and has a top-gallant forecastle, an orlop deck forward and aft, and water ballast in ten compartments 5 ft. deep, of about 2,000 tons capacity. There are eleven hatches on each deck, and seven watertight gangways between decks. The decks and deck houses are of steel, the latter being elaborately finished inside with hardwood.

A line of hoisting shaft runs from the collision bulkhead at the bow to the bulkhead forward of the boiler room. This has two hoisting drums at each hatch, and a single drum at each of the two forward gangways, the latter being used for skidding freight up the gang planks, on account of the height due to the sheer of the hull. The vessel is equipped with all the latest appliances for handling all kinds of freight, both package and bulk. It is also fitted with electric lights throughout, electric signal lights and a search light. The rig consists of two steel pole masts, the foremast being fitted with a "crow's nest" for the lookout. Two stockless anchors are placed at the bow, and a third is at the stern, the latter arrangement being peculiar to lake steamers.

The engine and boilers are placed at the extreme afterpart of the vessel. The engine is of the four-cylinder, four-crank, quadruple-expansion type, having cylinders 19, 27½, 40 and 58 ins. diameter, and 42 ins. stroke. The high-pressure cylinder is placed forward and the first intermediate cylinder aft. The larger cylinders, with their heavier reciprocating parts, are in the middle, for the sake of a better balancing effect. The high-pressure and first intermediate cylinders are fitted with piston valves, while the second intermediate and low-pressure cylinders have double ported slide valves, all operated by means of the ordinary link-motion, and each being independently adjustable. The steam chests of the two latter cylinders are placed at the side, so as to reduce the length of the engine, the valves being worked by rocker arms. The framing consists of four columns on the back side (supporting the slipper guides), and five at the front, thus making the engine very open and accessible.

The main shaft is supported in five journals, and is 12¼ ins. diameter, with crank pins 12¼ ins.

diameter and 10 ins. long. The outboard shaft is 12½ ins. diameter. The propeller is of the sectional type, 14 ft. diameter and 16 ft. pitch. The air pump is 33 x 14 ins., with a trunk 18 ins. diameter, and the two feed pumps have cylinders 4 x 12½ ins. The air pump, feed, bilge and cooler pumps are all worked from the crosshead of the low-pressure cylinder by means o. a lever and connections.

The auxiliary machinery includes one duplex feed pump, 9 x 5 x 10 ins.; one duplex fire pump, 10 x 6 x 10 ins, and two duplex ballast pumps, 10 x 16 x 12 ins. A double vertical engine, with cylinder 12 x 12 ins., drives the hoisting shaft, and there are two steam winches on the upper deck, two steam windlasses, and two steam capstans, one forward and one aft. The steam steering engine is of the Detroit Dry-Dock Co.'s make, and has two cylinders, 7 x 7 ins. The two dynamos are driven by direct-connected engines.

There are three Scotch marine boilers, 11 ft. diameter and 11 ft. 6 ins. long, built for a working pressure of 210 lbs. Each boiler has two corrugated furnaces, 39 ins. inside diameter, and 226 tubes 2¾ ins. outside diameter. The total heating surface is 4,617 sq. ft., and the total grate area 102.375 ft., giving a ratio of about 45 to 1.04. Forced draft on the Howden hot-draft system is supplied to the furnaces by a fan 66 ins. diameter and 34 ins. wide, the air heater having a heating surface of 1,360 sq. ft. The uptakes lead to a single smokestack 7 ft. in diameter.

The contract required that the ship should carry a cargo of 5,050 net tons on a mean draft of 17 ft. 6 ins., with a coal consumption per hour of 2,650 lbs., and at a speed of 13 miles per hour. On the first trial trip the results given below were obtained. This trial was made under the supervision of Mr. Hugh Wilson, Chief Engineer of the Western Transit Co., who reported that the engines worked very smoothly and without any tendency to cause vibration of the ship.

Load	5,075 net tons.
Draft, mean	17 ft. 6 ins.
Speed, per hour	13.16 miles
Coal consumption, per hour	2,541 lbs.
Coal consumption, per HP. per hour	1.5"
Horse-power of engine	1,691 HP.

For information respecting this vessel we are indebted to the Detroit Dry-Dock Co., of Detroit, Mich., and to Mr. G. L. Douglas, Vice-President and General Manager of the Western Transit Co., of Buffalo, N. Y. Mr. Douglas also informs us that his company has placed an order with the Union Dry-Dock Co., of Buffalo, N. Y., for a steamer of the same length and depth as the "Troy," but with 4½ ft. more beam, and some minor changes. This vessel is expected to have a cargo capacity of 700 tons more than the "Troy."

NOTES FROM THE ENGINEERING SCHOOLS.

University of Illinois.—It is announced that a course of Railway Engineering will be established at this University, and that work in it may be begun in September next. Considerable work has already been done by the Department of Mechanical Engineering in this direction, and the supervision of the work will still remain with Prof. L. P. Breckenridge of the Mechanical Engineering Department. The course of study as laid out follows the same lines as that of the regular course in Mechanical Engineering for the first three years. During the senior year specialization begins both in the designing room and the laboratory. The course as outlined leads along the lines of work of the Departments of Motive Power and Machinery.

The dynamometer car owned by this department and the P. & E. Div. of the C., C., C. & St. Louis Ry. was illustrated in Engineering News of Nov. 24, 1898. The apparatus in this car will enable the department to make road tests of locomotives, tests of train resistance and air brake, and to inspect track for gage, alinement, surface, and elevation of curves.

The completion of the new shops of the C., C., C. & St. L. Ry. at Urbana, will furnish opportunities to the students to inspect the construction and repair of rolling stock.

Stevens Institute of Technology.—The present activity in all lines of business is having its effect upon the Institute and its graduates. During a single week President Morton has received five letters from prominent manufacturing concerns asking that he recommend Stevens graduates to them for positions. The lowest salary offered was $1,200 a year. No unemployed graduates were available for the positions, and it was necessary to recommend men who are at present employed but who were seeking to better themselves. The fund which is being raised by the Alumni Association of Stevens for the purpose of erecting an additional building for the Institute has been greatly increased by the sale of 1,000 shares of Texas Pacific stock, donated to the fund by President Morton. These shares were purchased by him about four years ago, for $10,000, and when the fund was started he donated the shares to it. Since the stock market has begun to boom, the stock has gradually risen, and recently it was decided to sell it. The sale netted a little over $24,000, and the fund is therefore enriched by that amount. About $20,000 in cash had already been paid into the fund by the alumni. The executive committee of the Alumni Association is working hard to bring the fund up to $50,000, and it is believed that in a very short time the work of enlarging the Institute will be well under way.

PROPOSALS FOR THE NEW YORK HARBOR IMprovement authorized by the recent act of Congress will be received on March 24 and 26, the former date being for the proposals for dredging the East Channel at the entrance to New York Harbor and the latter date for the improvements in the Bay Ridge and Red Hook channels. It is proposed to make the Bay Ridge and Red Hook channels 40 ft. deep at mean low water and 1,200 ft. wide from the 40-ft. curve opposite and below 95th St., South Brooklyn, up along the South Brooklyn shore and the Erie Basin bulkhead, to the 40-ft. curve in Buttermilk Channel, south of Governor's Island. Bay Ridge Channel has been recently dredged 26 ft. deep and 800 ft. wide, and Red Hook Channel 26 ft. deep and 400 ft. wide. The present depths in the area to be dredged range from 10 to 40 ft. at mean low water, averaging about 26 ft. The mean rise of tide is 4.6 ft. The amount of dredging necessary to complete the above described work will not exceed 16,400,000 cu. yds., measured in place. So far as is known the material to be excavated is as follows: Below 50th St., Brooklyn, mainly mud or soft sand. Above 50th St., mud or soft sand to a depth of 15 to 25 ft. at mean low water, overlying sand. At the upper end of the work some clay, gravel and bowlders may be encountered. The excavated material will be removed by the contractor; the average distance to the place of deposit in deep water in the ocean will be about 21 miles. The amount of money now available for payments for excavation under the contract is $90,000. The contractor must begin work of excavation within 30 days from the date of approval of the contract, and must continue work thereafter without suspension until the funds available for payment are exhausted.

The channel known as East Channel, at the entrance to New York Harbor, is to be made 2,000 ft. wide and 40 ft. deep at mean low water throughout its entire length between the Main Channel and the sea, where the present depths generally range from 16 to 40 ft. The amount of excavation necessary to complete the above described work will not exceed 39,020,000 cu. yds. measured in place. The mean rise of tide is 4.6 ft. So far as is known the material to be excavated is mainly sand in the outer or seaward part of the channel and mud in the inner part, with small but varying proportions of fine gravel, shells and clay. The average distance to place of deposit in deep water in the ocean will be about eight miles. The amount of money now available for payments for excavation under the contract is $950,000. The contractor must begin work of excavation within twelve (12) months from the date of approval of the contract.

The rate of progress required for the East Channel work is for the first year 400,000 cu. yds. per month for eight months, and for each succeeding year 1,200,000 cu. yds. per month for eight months. All excavation is to be paid for by scow measurement.

THE PROJECTED TRANSANDINE RAILWAYS, to connect Chili and the Argentine Republic, are to be reported upon by a new commission just appointed by the Chilian Minister of Public Works. The members are to examine the separate projects submitted by a technical commission. The Valparaiso "Times" has little faith in the outcome of the work of this commission; and regards the appointment as "manana" in disguise. The "Times" says that what is needed is the adoption of a more liberal policy toward foreign capital; and if this had prevailed, it says, the Transandine Railway would have been finished years ago.

A 620-FT. TOWER is proposed for the summit of Mount Royal, at Montreal, Canada, to take the place of the old wooden observatory. The mountain is about 750 ft. high, so that the top of the tower would be 1,370 ft. above the level of the St. Lawrence. It is to be built by the La Pointe Tower Co., to the designs of Mr. Francis La Pointe, of Montreal and Chicago.

A BASCULE BRIDGE will probably be built across the Lachine canal, at Atwater St., Montreal, to connect Montreal with the towns of St. Henry, St. Cunegonde, St. Paul and Verdun. The plans prepared by Mr. Francis La Pointe, of Chicago, Ill., have been approved by the local authorities and the engineer of the canal, and are now before the Dominion Government for approval. The bridge will be 220 ft. long, including the approaches, with a clear span of 100 ft. and a headway of 8 ft. It will be 46 ft. wide, with two roadways, two street railway tracks and two sidewalks. Each bascule or leaf rolls back on a curved heel, and is operated by steel cables attached to the top chord, the cables being wound on a drum driven by a 50-HP. motor. Hand gear will also be fitted, the bridge being opened or closed in 10 seconds by the motors, or in 5 minutes by hand. The cost is estimated at about $84,000.

TELEGRAPHING WITHOUT WIRES with the Marconi system has been successfully accomplished between England and France. Press reports state that the stations are at South Foreland, county of Kent, England, and Boulogne, France, about 32 miles apart. This is the greatest distance over which telegraphic messages have been sent without wires and the experiment affords very satisfactory evidence of the practical value of the system. Elsewhere in this issue is given a full description of the apparatus and acounts of some of the experiments leading up to this recent test.

THE STRICKLER TUNNEL, which is being driven through Pike's Peak to draw a water supply from lakes on the opposite side of the mountain for the city of Colorado Springs, Colo., has for some time been the source of trouble between the contractors and the city authorities. The contract was awarded to Messrs. Wilson & Jackson of Chicago, Ill., in December, 1895, and the project was described and illustrated in our issue of Aug. 27, 1896. At about 1,650 ft. from the east end a slide was encountered, and after several months had been spent in an endeavor to drive the tunnel through, a detour of 357.6 ft. was made, on the recommendation of Mr. Goff, of Aspen, Colo., who was appointed by the mayor to investigate the matter. For this detour and for laying dry the west end of the tunnel (so that work could be prosecuted from both ends), the city allowed the contractors an extra sum of $11,800. These and other delays prevented the completion of the work within the contract time, but the city recognized that the reasons for the delay were valid, and on Sept. 8, 1898, an ordinance was passed providing for the completion of the work in 15 months, or by Dec. 8, 1899. Work has progressed steadily since then and is still in progress, about 75% of the tunnel, which will be 6,441.5 ft. long, having been driven. The city has paid the warrants until November, 1898, when the city clerk refused to countersign certain warrants which had been ordered by the mayor and approved by the council. It was claimed that there was a doubt as to the validity of the original contract, although it was approved by the guarantee company which gave surety upon the contractors' bond. When the city clerk thus held back payment on the warrant, the city employed a firm of lawyers to make an inquiry. Its report was to the following effect: (1) the contract is valid and is still in force; (2) the bills for the concrete lining of the tunnel are binding obligations, and warrants therefor may be lawfully issued against the special fund for the construction of waterworks and the enlargement of the waterworks system of the city; (3) the city clerk cannot lawfully refuse to countersign warrants in settlement of bills allowed by the city council under the contract for the construction of the Strickler tunnel, or orders for the concreting of the same, providing that such warrants are drawn against the fund created by the ordinance of April 6, 1896, so long as there is an available balance of that fund to meet such warrants. In spite of this opinion, however, the city clerk has persisted in his refusal to countersign the warrants, still claiming that the contractors' claims were not a legal charge against the city and that they should be charged to the extra sum of $11,800, already advanced. On March 6, however, he declared that he would prepare the warrants for the bills ordered by the council to be paid, amounting to $7,375, on the ground that as the council (which represents the citizens) has not supported him, he has no other course. There has been much dispute over the concrete lining of the tunnel, the newspapers alleging that it was unnecessary, although the city engineers have reported to the council that it is absolutely necessary. At any rate, the contractor was ordered to line the west end, and as much of the east end as the city engineer should direct. He therefore had 1,100 barrels of cement taken up the mountain on the rack railway, the freight charges on which were very high. The excavated material was used for making the concrete. After the order had been partially complied with it was revoked, but as it would not have paid to bring the cement down again it was left on the mountain. Part of the tunnel has also been made of larger dimensions than was originally intended, in order to allow more room for timbering. The west end of the tunnel is now filled with water, and there is a probability that the matter may be taken into the courts, involving more delay and expense. Mr. Jackson, of the Geo. W. Jackson Construction Co., informs us that of the 6,250 ft. of tunnel originally contracted for, he has completed 4,800 ft., leaving 1,450 ft. yet to be driven. From the nature of the granite now encountered, and from the present rate of daily progress, he expects to complete the work by October.

A NEW FORM OF SLATE PICKER for use in coal breakers was recently given a trial at the breaker of the State Line & Sullivan R. R. Co., at Bernice, Pa. The device is the invention of J. H. Roberts, of Bernice, and consists of a series of disks mounted upon a shaft set at right angles to the supply chute, and provided with directing plates, the arrangement being such that the pieces of slate are turned upon edge and fall through a grating, over which the coal passes.

RESTRICTIONS ON THE HEIGHT OF BUILDINGS near the State House, in Boston, are proposed, and hearings have been held on a petition for an act to that end. The height limit seems to be 100 or 125 ft., and the distance limit about 1,000 ft., but no definite figures are before us. The design is to prevent the State House from being shut in by sky-scrapers on the three sides not fronting on the Boston Common.

A MONOPOLY OF MONAZITE SAND in Brazil has been secured from the Brazilian government by an American named John Gordon. This privilege gives him the exclusive right to all the Monazite sand from the lands of the state in the districts of Aecoboco and Porto Sequro. For this $4.87 per ton, in addition to taxes, amounting to 27¼% of the value of the sand must be paid. This sand is worth about $389 per ton and contains the following rare elements: Thorium, 1.5 to 3%; yttrium, 1 to 3%; cerium, 62 to 70%; aluminum, 3%; iron 2.5 to 5%; lanthanium, 2.5%. On account of the high percentage of thorium it is in greater demand than other sands. The deposit is the richest and largest ever discovered.

A VISIT TO THE GENERAL ELECTRIC WORKS AT SCHENECTADY, N. Y.

A party made up of 15 representatives of prominent engineering journals visited Schenectady, N. Y., on March 24, in response to a special invitation extended by the General Electric Co., to examine its works at that place. The chief object of the trip was to inspect the new foundry and to witness the casting of a 20-ton hub for one of the huge generators for the new power station of the Metropolitan Street Ry., of New York city. Advantage was, however, taken of the opportunity to inspect several other departments of this great manufacturing establishment.

The party left New York at 8.30 a. m. and arrived at the works in Schenectady in time to partake of a luncheon which was served in the large office building of the company. Interest in the excellent repast was doubled when it was learned that every dish had been cooked by electricity, and at the end of the meal the visitors felt sufficiently at home to examine the kitchen and see how it was done.

After the meal, the entire party, under the guidance of several of the officials of the company, walked through the large machine shop, testing room, shipping department and the new machine shop, not yet finished, on the way to the foundry, which was the principal object of the pilgrimage. In the testing room one of the synchronous motors, taking three-phase current directly from the Mechanicsville transmission line at 10,000 volts, was an object of considerable interest.

The party was finally corralled in the foundry building after some difficulty owing to the many interesting sights in the various shops passed through. In a later issue we hope to describe this building and its many novel features in detail, but for the present it is sufficient to say that the foundry department, which is used only for gray iron casting, is exceedingly well equipped.

A run was next made with an experimental car on the track which extends along the bank of the Erie Canal. This track, which is about 7,000 ft. long, is owned by the company, and is used for testing new types of motors, controllers, brakes, and, in fact, all railway experimental apparatus. The car used was equipped with electric brakes, the operation of which was illustrated by a series of stops and starts.

Returning to the office, another luncheon was enjoyed, after which the party returned to Schenectady and disbanded, thus ending a very pleasant and instructive day.

AN OFFER TO BUILD THE NEW YORK RAPID TRANSIT RY.

The Metropolitan Street Ry. Co. of New York city has made a formal offer to build and operate the New York Rapid Transit Ry. under the following plan:

1. A construction company will be organized, which will undertake to build with private capital the underground road, on substantially the route and plans adopted by the Commission. The section between the southern terminus and the northern end of Manhattan Island is to be begun within 3 months and completed within 36 months from the time the franchise is granted. As soon as the net earnings from the operation of this first section are sufficient to pay 5% on the actual cost of construction and equipment, work will begin on all the remaining lines and they will be completed within 24 months.

2. The construction company will lease the road for operation to the Metropolitan Street Ry. Co. "in perpetuity," or for a term practically equivalent thereto, for a rental to the construction company of 5% on the actual cost of construction and equipment.

3. Fares on the lines to be as follows: Single fares on local trains, 5 cts. Fares for a journey on both local underground and on surface cars, 8 cts. Fares on express trains, 10 cts., including right to transfers on local underground or surface lines.

4. Track connections to be made between surface and underground lines at various points, so that the same cars can make continuous trips on both surface and underground roads, and special traffic arrangements to be made with steam railways entering the Grand Central station.

5. Express train schedules to be at least 20 miles an hour below 96th St., and at least 30 miles an hour for at least two miles below 42d St.

6. A third track to be built on both the eastern and western branches above 96th St., so that express trains can be run up in the evening and down in the morning.

7. The company is to be allowed to provide space for wires, pipes, electric conduits, etc., in the tunnel and to receive the rentals for their use.

8. The city to receive as its compensation for the franchise granted, an annual rental equal to 5% of the gross receipts; but this rental is to be abated if the net earnings, after paying the rental to the construction company fixed above, are not sufficient to meet it. Further, no taxes are to be assessed upon the real estate or personal property of the company until its earnings are sufficient to pay the 5% on its cost above specified.

We have commented on the above offer in our editorial columns.

WIRELESS TELEGRAPHY.*

By G. Marconi.

"Wireless Telegraphy," or telegraphy through space without connecting wires, is a subject which has attracted considerable attention within recent years. Without attempting to discuss the theory of the system with which I have carried out so many experiments, I hope to put before you some exact information of what has been done in this interesting field during the past year, and some exact data as to means employed to obtain these results. Much has been published on this subject, I must say, with varying accuracy, so that a brief description of the apparatus employed in experiments along the line of the practical application of wireless telegraphy will be in order.

Transmitter.—When long distances are to be bridged over and it is not necessary that the signals should be sent in one definite direction, a transmitter (d d), shown in Fig. 1, is employed, in which two small spheres connected to the terminals of the secondary winding of an induction coil (c) are connected, one to earth (E) and the other to a vertical conductor (w), called the aerial conductor. Should it be necessary to direct a beam of rays in one given direction, an arrangement similar to a Righi oscillator is placed in the focal line of a suitable cylindrical parabolic reflector (f), Fig. 2. The transmitter works as follows: When the key (b) is pressed, the battery current (a) is allowed to actuate the spark coil (c) which charges the spheres of the Righi oscillator or the vertical wire (w) which discharges through the spark gap. This discharge is an oscillating one, and the system of spheres (e e) and insulated conductor becomes a radiator of electrical waves. It is easy to understand how, by pressing the key for long or short intervals, it is possible to emit a long or short succession of waves, which, when they influence the receiver, reproduce on it a long or short effect according to their duration, in this way reproducing the Morse or other signals transmitted from the sending station.

Receiver.—One of the principal parts of the receiver is the sensitive tube or coherer or radio-conductor. The only form of coherer which appears to be trustworthy and reliable for long-distance work is shown in Fig. 3. It consists of a small glass tube, four centimeters long, into which two metal pole pieces (j) (t) are tightly fitted. They are separated from each other by a small gap, which is partly filled with a mixture of nickel and silver filings. This coherer forms part of a circuit containing the local cell (g), and a sensitive telegraph relay (n) actuating another circuit, which circuit works a trembler (p) or decoherer and a recording instrument (h). (q) (s) (m) (v) are shunt coils across the instrument terminals to adjust the current. In its normal condition the resistance of the filings in the tube (T) is infinite, or at least very great, but when the filings are influenced by electric waves or surgings, cohesion instantly takes place, and the tube becomes a comparatively good conductor, its resistance falling to between 100 and 500 ohms. This allows the current from the local cell (g) to actuate the relay (n). One end of the tube is connected to earth and the other to a vertical conductor similar to that of the transmitter, Fig. 1, or, if a reflector similar to that of the transmitter, Fig. 2 is used, a short strip of copper is connected to each end of the tube. The length of these strips of copper must

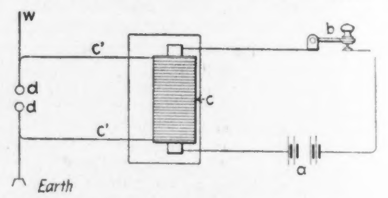


Fig. 1.—Ordinary Transmitter for Propagating Waves in All Directions.

be carefully determined, as good results cannot be obtained unless they happen to be of the proper length, which will cause them to be in tune or syntony with the transmitted oscillations. All the electromagnetic apparatus in the receiver is shunted by non-inductive resistances in such a manner that there may be no sparking at contacts and no sudden perturbations or jerks caused by the local battery current near the coherer. The relay tapper and telegraphic instrument, if not properly shunted, produce disturbing effects. Small choking coils (k, k) are introduced between the coherer and the relay. They compel the oscillating current due to the electric waves to traverse the coherer rather than waste its energy in the alternative path afforded by the relay. The oscillations induced on the short strips of copper, or the aerial conductor (w) by the radiation from the transmitter affect the sensitive tube. This effect consists in a great increase of its conductivity by causing the metal particles between the coherer terminals to come into closer mechanical contact, thus completing the circuit and allowing the current from the cell (g) to actuate the relay (n). The relay in its turn causes a larger battery (r) to pass a current through the tapper or interrupter (p) and also through the electromagnets of the recording instrument (h). The tapper or trembler is so adjusted as to rapidly tap the tube and shake the filings in it and thus break the circuit by restoring it to its normal high-resistance condition when the waves from the transmitter die out. The practical result is that the receiver is actuated for a time equal to that during which the key is pressed at the transmitting station. For each signal, however short, the action of the relay starts the tapper and the tapper by its action interrupts the relay. The armature of the Morse recording instrument being rather heavy, and possessing a comparatively large inertia, cannot follow the very rapid vibrations of the tongue of the relay, but remains down all the time during which the rapidly-intermittent action of the receiver lasts. In this way the armature of the inker gives a practically exact reproduction of the movements of the key at the transmitting end, dashes coming out as dashes and dots as dots.

Much has been said and written about coherers being very unreliable and untrustworthy in their action. This

*Abstract of a paper read before the Institute of Electrical Engineers of London, Eng., and printed in the "Electrician" for March 10, 1899.

has not been in any way my experience. Provided a coherer is properly constructed and used on a suitable receiver, it is just as certain in its action as any other electrical apparatus, such as an electromagnet or incandescent lamp. I have coherers which were made three years ago, that are now quite as good if not better than they were at that time, and we have had tubes working for months in most important installations without ever giving trouble. At the installation erected at the South Foreland Lighthouse, which is working to the East Goodwin Lightship, the coherer was mounted on the receiver when first started in December of last year, and has done its work in a most satisfactory manner ever since. When carrying out some experiments in Italy in 1895, I was using an oscillator having one pole earthed and the other connected to an insulated capacity, the receiver also earthed and connected to a similar capacity. The capacities were in this case cubes of tinned iron of 30 cm. side, and when these were placed on the top of a pole 2 meters high, signals could be obtained at 30 meters from the transmitter. With the same cubes on poles 4 meters high, signals were obtained at 100 meters, and with the same cubes at a height of 8 meters, other conditions being

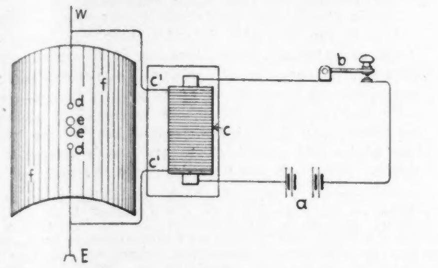


Fig. 2.—Transmitter Provided with Reflector for Directing Waves.

equal, Morse signals were easily obtained at 400 meters. With larger cubes of 100 cm. side, fixed at a height of 8 meters, reliable signals could be obtained at 2,400 meters all round, equal to about one mile and a half. These results seemed to point out that a system of transmitter and receiver designed according to the lines on Fig. 1, i. e., a radiator of the Hertzian type, having one pole earthed and the other connected to a vertical, or almost vertical, conductor, or to a lofty capacity area, and a resonator consisting of a suitable receiver having similarly one terminal connected to earth and the other to an insulated vertical conductor, constitute a system of transmitter and receiver capable of giving effects at far greater distances than the ordinary systems of Hertzian radiators and resonators. The results I have referred to also show that the distance at which signals could be obtained varied approximately with the square of the distance of the capacities from earth, or perhaps with the square of the length of the vertical conductors. This law has since been verified by a careful series of experiments and found correct, and has furnished us with a sure and safe means of calculating what length the vertical wire should be in order to obtain results at a given distance. It has been found that with parity of other conditions a vertical wire 20 ft. long at the transmitter and receiver is sufficient for communicating one mile, 40 ft. at each end for four miles, and 80 ft. for 16 miles, and so on. An installation is now working over a distance of 18 miles with a vertical wire 80 ft. high at each installation station. Such laws are applicable only when apparatus properly constructed is employed.

With all other forms of Hertzian transmitters and receivers I find it to be quite impossible to obtain any results if a hill, mountain, or large metallic object intervenes in any way between the two stations. When the vertical wire system is employed it becomes easy to telegraph between positions screened from each other by hill or by the curvature of the earth. In such cases it seems to be a marked advantage if the aerial conductor is thick, or if a capacity area is placed at the top of it. I am rather doubtful as to the correct explanation that can be given to this effect as there can be very little doubt as to the complete opacity to electric waves of a hill three miles thick or say several miles of sea water. A way out of the difficulty may be arrived at if we suppose that the electrical oscillations are transmitted to the earth by the earth wire (E) of the transmitter and travel in all directions along the surface of the earth till they reach the earth wire of the reacting instrument, and by traveling up this wire to the coherer thus bringing about its action. It is well, also, to note that a horizontal wire, even if supported at a considerable height from the earth, seems to be of little or no practical utility in increasing the range of signals. If a vertical wire 30 ft. long is employed at both stations and to the top of this is added a horizontal length of 300 ft. the distance obtained is greater with the vertical wire alone than if both were employed. These results show that with this system it is not sufficient to use a horizontal radiating or collecting wire as such a wire would be of no utility for long distance signaling.

I believe that the exceedingly marked advance made by the adoption of the vertical conductor is due to the fact that the plane of polarization of the rays radiated is vertical, and that therefore they are not absorbed by the surface of the earth, which acts as a receiving conductor placed horizontally. As the maximum effect is obtainable when the conductors of the transmitter and receiver are parallel, this makes it necessary to have a vertical conductor connected to one pole of the coherer.

It is possible, as has been shown by Hertz, to reflect the waves radiated from the oscillator in one definite direction only. This can be done by using convenient reflectors, similar to those used for projectors, but preferably, for economical reasons, made of copper or zinc, instead of silver amalgam or silver. Except when very small radiators of the Righi or Lebedew type are employed, it is desirable to use cylindrical parabolic reflectors, and it is with reflectors such as I here exhibit that the trials to which I am alluding have been carried out. The advantages obtainable by their use are obvious.

In any other system intended for the transmission of telegraphic signals by means of electric waves through space, the waves have been allowed to radiate in all directions, and would affect all suitable receivers within a certain radius, which, of course, is dependent upon the power of the radiator or transmitter and on the sensitiveness of the resonator or receiver. It is, however, possible by means of syntonizing arrangements, to prevent, to a certain extent, messages affecting instruments or receivers for which they are not intended, and therefore to select any receiver by altering the wave length of the transmitter. By means of reflectors it is possible to project the waves in one almost parallel beam which will not affect any receiver placed out of its line of propagation, whether the said receiver is or is not in tune or syntony with the oscillation transmitted. This would enable several forts, or hill-tops, or islands, to communicate with each other without any fear of the enemy tapping or interfering with the signals, for if the forts are on small heights the beam of rays would pass above the positions which might be occupied by the enemy. An illustration of the possibility of directing these waves can be shown by the action of the receiver, which in this case rings a bell only when the radiator in the reflector is directed towards it. These results are much more marked in an open space than in a lecture theatre, as the walls, gilt hangings, etc., tend to reflect the rays in all directions and may alter the results.

In experiments carried out over a distance of 1¾ miles, it has been noticed that only a very small movement of the transmitting reflector was sufficient to stop the signals at the receiving end, which could be only obtained within a latitude of 50 ft. to the right or left of what was believed to be the center of the beam of reflected radiations. There exists a most important case to which the reflector system is applicable, namely, to enable ships to be warned by light-houses, light-vessels, or other ships, not only of their proximity to danger, but also of the direction from which the warning comes. If we imagine that A is a light-house provided with a transmitter of electric waves, constantly giving a series of intermittent

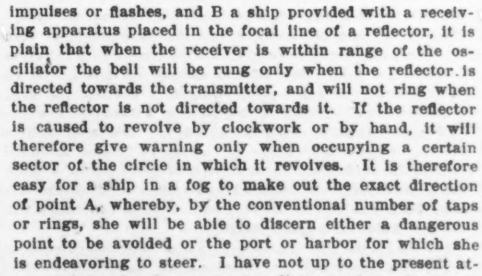


Fig. 3.—Complete Receiver Capable of Receiving from All Directions.

impulses or flashes, and B a ship provided with a receiving apparatus placed in the focal line of a reflector, it is plain that when the receiver is within range of the oscillator the bell will be rung only when the reflector is directed towards the transmitter, and will not ring when the reflector is not directed towards it. If the reflector is caused to revolve by clockwork or by hand, it will therefore give warning only when occupying a certain sector of the circle in which it revolves. It is therefore easy for a ship in a fog to make out the exact direction of point A, whereby, by the conventional number of taps or rings, she will be able to discern either a dangerous point to be avoided or the port or harbor for which she is endeavoring to steer. I have not up to the present attempted to signal any greater distance than about two miles with reflectors, but I am of opinion that across clear space it will be quite possible to obtain satisfactory results at far greater distances, especially if the reflectors are accurately made any larger than those I have used. It was by means of reflectors that the results were obtained over 1¾ miles mentioned by Mr. Preece at the British Association meeting of 1896.

A station at Alum Bay, Isle of Wight, and another at Bournemouth, the distance between them being 14½ miles, were erected at the beginning of last year, in order to test the practicability of the system under all conditions of weather, and also to afford an opportunity of proving that "Wireless Telegraphy" was not a myth but a working reality. The installation at Alum Bay is in the Needles Hotel, and the Bournemouth station (which has lately been transferred to the Haven Hotel, Poole, thereby increasing the distance to 18 miles), was at Madeira House, South Cliff. At each station a pole 120 ft. high was used, which supported the aerial conductor, usually a stranded conductor of 7/20 copper wire insulated with rubber and tape. A 10-in. induction coil is used at each station, worked by a battery of 100 Obach cells "M" size, the current taken by the coil being at 14 volts from 6 to 9 amperes. The spark discharge takes place between two small spheres about 1 in. in diameter, this form of transmitter having been found more simple and more effective than the Righi oscillator, previously used. The length of spark is adjusted to about 1 centimeter, this, being a much shorter spark than the coil can give, allows a good margin over for any irregularity that might be caused by the break. No care is ever taken to polish the spheres (d d) at the place where the spark occurs, as the results seem decidedly better with dull spheres than with polished ones. The first tests were made between the Isle of Wight and a steamer, the height of the mast on the boat being about 60 ft. Readable signals were obtained up to a distance of 18 miles from Alum Bay. It has apparently been thought that weather or varying conditions of atmospheric electricity may interfere with or stop the signals transmitted by this system, but experience of over 14 months of continual everyday work has shown that there is no kind of weather which can stop or seriously interfere with the working of such an intsallation.

Since transferring the Bournemouth station to the Haven Hotel, Poole, thereby increasing the distance to 18 miles, experiments and tests have been carried out daily between the two stations, and it has been found that a height of 80 ft. for the vertical wire at each end is sufficient. An average of fully 1,000 words are daily transmitted each way. In the spring of last year Lord Kelvin inspected our station at Alum Bay, and he was kind enough to express himself as highly pleased with what he saw. He sent several telegrams to his friends, including Mr. Preece and Sir George Stokes, and insisted in paying 1s. royalty on each message, wishing in this way to show his appreciation of what was done, and to illustrate its fitness at that time for commercial use. We are now working at experinemts directed towards still further reducing the height necessary for a given distance. In May of last year Lloyds desired to have an illustration of the possibility of signalling between Ballycastle and Rathlin Island, in the north of Ireland. My assistants, Mr. Kemp and the late Mr. Glanville, installed the instruments at Ballycastle and at Rathlin Island. The distance between the two positions is 7½ miles, of which about four are overland and the remainder across the sea, a high cliff also intervening between the two positions. At Ballycastle a pole 70 ft. high was used to support the wire, and at Rathlin a vertical conductor was supported by the light-house 80 ft. high. Signalling was found quite possible between the two points, but it was thought desirable to bring the height of the pole at Ballycastle to 100 ft., as the proximity of the light-house to the wire at Rathlin seemed to diminish the effectiveness of that station. At Rathlin we found that the light-house keepers were not long in learning how to work the instruments, and, after the sad accident which happened to Mr. Glanville, that installation was worked by them alone, there being no expert on the island at the time. Following this, in July, we were requested by a Dublin paper, the "Daily Express," to report from the high seas the results and incidents of the Kingston Regatta. In order to do this a land station, using a pole 110 ft. high, was erected at Kingston. A steamer, the "Flying Huntress," was chartered to follow the racing yachts, the instruments being placed in the cabin. The height of the vertical wire attainable by the mast was 75 ft. A telephone was fixed from the land station at Kingston to the "Express" office in Dublin, and as the messages came from the ship they were telephoned to Dublin, and published in succeeding editions of the evening papers. The relative positions of the various yachts were thus wirelessly signalled while the races were in progress, sometimes over a distance of 10 miles, and were published long before the yachts had returned to harbor. During the several days the system was in use between the tug and the land station, over 700 messages were sent and received, none requiring to be repeated. On trying longer distances it was found that with a height of 80 ft. on the ship and the same height as already stated on land, it was possible to communicate up to a distance of 25 miles, and it is worthy of note in this case that the curvature of the earth intervened very considerably at such a distance between the two positions.

Immediately after finishing at Kingston a wireless telegraph system was installed between the Royal yacht "Osborne" and Osborne House, Isle of Wight. The working of this installation afforded an opportunity of more thoroughly studying the effect of intervening hills. In this installation induction coils capable of giving a 10-in. spark were used at both stations. The height of the pole supporting the vertical conductor was 100 ft. at Osborne

House. On the Royal yacht "Osborne" the top of the conductor was secured to the main mast at a height of 83 ft. from the deck, the conductor being very near one of the funnels, and in the proximity of a great number of wire stays. The vertical conductor consisted of a 7/20 stranded wire at each station. The Royal yacht was moored in Cowes Bay at a distance of 1¾ miles from Osborne House, the two positions not being in sight of each other, the hills behind East Cowes intervening. This circumstance would have rendered direct signalling between the two positions impossible by means of any flag, semaphore, or heliograph system. Constant and uninterrupted communication was maintained between the Royal yacht and Osborne House during the 16 days the system was in use, no hitch whatever occurring. 150 messages were sent, being chiefly private communications between the Queen and the Prince. Many of these messages contained over 150 words, and the average speed of transmission was about 15 words per minute.

Telegrams were sent when the yacht was at a distance of about 7 or 8 miles from Osborne. On Aug. 12 the "Osborne" steamed to the Needles, and communication was kept up with Osborne House until off Newton Bay, a distance of 7 miles, the two positions being completely screened from each other (even to the tops of the masts) by the hills lying between. At the same position we found it quite possible to speak with the station at Alum Bay, although Headon Hill, Golden Hill, and over 5 miles of land lay directly between. The positions were 8½ miles apart. Headon Hill was 45 ft. higher than the top of the conductor at Alum Bay station, and 314 ft. higher than the vertical wire on the "Osborne." The yacht on the same trip proceeded till about 3 miles past the Needles, communication having been maintained during the whole trip. At another time the yacht went on a cruise round Bembridge and Sandown, communication being maintained with Osborne House, although more than 8 miles of land lay between the two positions.

In December of last year it was thought desirable to demonstrate that the system was quite practical and available for enabling telegraphic communication to be established and maintained between lightships and the shore. This is a matter of much importance, as all other systems tried so far have failed, and the cables, by which some three or four ships are sometimes connected, are exceedingly expensive, and require special moorings and fittings, which are troublesome to maintain and liable to break in storms.

The officials of Trinity House offered us the opportunity of demonstrating to them the utility of the system between the South Foreland Lighthouse and one of several lightships—the "East Goodwin"—which is just 12 miles from the South Foreland Lighthouse, was selected. The apparatus was taken on board in an open boat, and rigged up in one afternoon. The installation started working from the very first without the slightest difficulty. The system has continued to work admirably through all storms, which during this year has been remarkable for their continuance and severity. On one occasion, in January, during a big gale, a very heavy sea struck the ship, carrying part of her bulwarks away. The report of this mishap was promptly telegraphed to the Superintendent of Trinity House, with all details of the damage sustained. The height of the wire on board the ship is 80 ft., the mast being for 60 ft. of its length of iron, and the remainder of wood. The aerial wire is led down among a great number of metal stays and chains, which do not appear to have any detrimental effect on the strength of the signals. The instruments are placed in the aft-cabin, and the aerial wire comes through the framework of a skylight, from which it is insulated by means of a rubber pipe. As usual, a 10-in. coil is used, worked by a battery of dry cells, the current taken being about 6 to 8 amperes at 14 volts. Various members of the crew learned in two days how to send and receive, and, in fact, how to run the station, and owing to the assistant on board not being as good a sailor as the instruments have proved to be, nearly all the messages during very bad weather are sent and received by these men, who, previous to installing the instruments on the ship, had probably scarcely heard of wireless telegraphy, and were certainly unacquainted with even the rudiments of electricity. It is remarkable that wireless telegraphy, which had been considered by some as rather uncertain, or that might work one day and not the next, has proved in this case to be more reliable, even under such unfavorable conditions, than the ordinary land wires. The instruments at the South Foreland Lighthouse are similar to those used on the ship, but as some long-distance tests from the South Foreland to the Coast of France are contemplated, the height of the pole is much greater than would be necessary for the lightship installation. It was found that 80 ft. of height is quite sufficient for speaking to the ship, but the height available on the ship and on shore would be ample even if the distance to which messages had to be sent were more than double what it is at present. Service messages are constantly passing between the ship and the lighthouse, and the officials of Trinity House have been good enough to give expression of their entire satisfaction with the result of this installation. The men on board send numerous messages almost daily on their own private affairs; and this naturally tends to make their isolated life less irksome.

For some time efforts have been made to establish wireless communication between England and France across the Channel, but the promised official consent of the French government has only just been received. Otherwise this communication would have been established long ago. The positions for the stations chosen were situated at Folkestone and Boulogne, the distance between them being 32 miles. These positions are preferable to Calais and Dover, as the latter are only separated by a distance of about 20 miles, which is only slightly more than we are doing every day at Poole and Alum Bay, and as that distance is so easy, we would naturally prefer further tests to be made at much greater distances. Permission was asked to erect a station at Cherbourg, the corresponding station to be at the Isle of Wight, but the French authorities stated that they would prefer us to have our station in that country in some other position on the north coast.

The system has been in use in the Italian Navy for more than a year, but I am not at liberty to give many details of what is done there. Various installations have been erected and are working along the coast, two of these being at Spezia. Distances of 19 miles have been bridged over in communicating with war vessels, although 10 miles have been found quite sufficient for the ordinary fleet requirements. Other installations are now contemplated in this country for commercial and military purposes, and I am confident that in a few months many more wireless telegraph stations will be established both here and abroad.

BOOK REVIEWS.

THE TRANSITION CURVE, BY OFFSETS AND BY DEFLECTION ANGLES.—By C. L. Crandall, C. E., M. Am. Soc. C. E., Professor of Railway Engineering, Cornell University. Second edition, revised and enlarged. New York: John Wiley & Sons. Leather flap; 6¼ × 4¼ ins.; pp. 99. $1.50.

In this work the methods laid down aim at the direct increase of curvature with the distance, resulting in true transition curves; and with large central angles, the rules hold good for both the offset and the deflection methods. The former method, from its extreme simplicity, is applicable during location and the bulk of the construction; and the deflection method, with transit and chain, is employed in the more accurate work on the finished roadbed, or for track-laying. Increased flexibility in alinement and resulting economy of construction and operation, in any but the most easy country, are the chief arguments for the use of these curves. In this edition Table I., referring to offsets and other transition curve data, has been extended to circular curves of short radii; and Table III. has been supplemented by a table of actual deflections in degrees and minutes for a large range of transition curves. A five-place table of sines, cosines, tangents and cotangents has also been added.

ANNUAIRE POUR L'AN 1899.—Publié par le Bureau des Longitudes. Avec des Notices Scientifiques. Paris: Gauthier-Villars, publishers. Paper; 6 × 3¾ ins.; pp. 638, with appendix. 1.50 francs.

This annual has been published by the French government since 1795, in accordance with a decree of the National Convention of that year. Its contents include a calendar for the year, with very full astronomical information; weights and measures; interest tables; geographical and statistical notes; the legal hour and mortality tables. The scientific notes referred to cover magnetic charts of France, tables of densities and elasticity of solids, and tables relating to heat, acoustics, optics and electricity, atomic weights and thermochemistry. The text accompanying these tables describes their use, and in itself constitutes a concise treatise on the various heads considered. Barometric measurements and reductions; variations of temperature; density of the earth; refraction; tides; comets expected and the movements of stars for the year, are among some of the more detailed items treated. A large part of the annual is devoted to recording, for the towns and villages of France, the area, population and density of population, geographic position and the magnetic elements of each. The geographical position of the large cities of the world is also included. It may be said that the many tables given cover a wide range of materials experimented upon and authorities consulted than any we have seen. This is especially true in the tables of atomic weights.

THE TESTING OF MATERIALS OF CONSTRUCTION.—A Text-Book for the Engineering Laboratory and a Collection of the Results of Experiments. By William Cawthorne Unwin, F. R. S., M. Inst. C. E., Second edition. Longmans, Green & Co., London, New York and Bombay. Cloth; 8vo.; pp. 455; 188 illustrations; $6.

The first edition of this work was published ten years ago. The present edition contains much additional information to that given in the first edition, including descriptions of newer machines and apparatus, and additions to the collections of the results of testing.

The first three chapters, covering about 100 pages, treat of the mechanical properties of bodies acted on by stresses; plasticity and hardness of materials; and stress-strain diagrams. The next five chapters, 140 pages, discuss apparatus for testing and for recording results, and the procedure in ordinary testing. Then follow chapters on elastic constants for metals, 11 pages; cast-iron, 14 pages; iron and steel, 55 pages; copper, copper alloys, and miscellaneous tests of metals, 17 pages; experiments on repetition of stress, and endurance tests, 30 pages; timber, 19 pages; stone and brick, 28 pages; and limes and cements, 36 pages. The leading feature of the book is its illustrated descriptions of apparatus used in testing laboratories and its discussion of procedure in testing, and we know of no other book in which these subjects are treated so extensively. The other subjects named above are treated more briefly than they are in many American text-books. We note that the strength, elastic limit, etc., in all the tables in the book, are given in tons of 2,240 lbs. per sq. in., and they have to be multiplied by 2,240 to reduce them to lbs. per sq. in., in which all tests in this country are recorded.

MACHINE DESIGN.—Part II. Form, Strength and Proportions of Parts. By Forrest R. Jones, M. Am. Soc. M. E., Professor of Machine Design in the University of Wisconsin. New York: John Wiley & Sons; London: Chapman & Hall, Ltd. Cloth; 8vo.; pp. 353; $3.

Part I. of this work, issued a year ago, was a small book of only 155 pages, treating of Kinematics of Machinery. The present volume is devoted to form, strength and proportions of parts. It is not apparent why the two books should not be combined in one, for in some parts of machines, toothed gearing, for instance, the kinematics and the form are closely related to each other. We quote the following from the preface:

> The matter presented on the following pages is confined to such subjects as the designer must deal with daily. Equations and formulas are put into such a form as to afford a ready means of application to problems under consideration. Numerical examples and data from practice illustrating principles are introduced wherever it seems that a clear understanding can be brought about in this way. The data thus presented have been gathered from numerous sources during the last fifteen years. Whenever possible the results of practice or experiments as presented by some engineer or experimnter which fairly well represent the general experience along their lines are given in preference to abstract statements. This is believed to be the most satisfactory method, since it affords a means of studying all the facts incidental to the particular case, in addition to furnishing information fully as well as abstract statements.

The subjects treated in the several chapters and the space given to each subject are: Bearings and lubrication, 74 pages; spur and friction gears, 37 pages; belts and ropes for power transmission, 38 pages; screws for power transmission, 16 pages; screw gearing, 15 pages; screw fastenings, 20 pages; machine keys, pins, forced and shrinkage fits, 15 pages; axles, shafting and positive shaft couplings, 19 pages; friction couplings and brakes, 8 pages; flywheels and pulleys, 30 pages; cylinders, tubing, pipes and pipe couplings, 13 pages; riveted joints, 29 pages; frames of punching, shearing and riveting machines, 16 pages; selection of materials, 6 pages.

The book is unique for a work of its kind in giving numerous illustrations and working drawings representing recent actual practice in American shops. The style of the author is in general clear and simple, and he uses no more mathematics than is necessary. The book is a welcome addition to the scanty American literature on the subject, and for the many good things that are in it we are glad to commend it to our readers. We have some faults to find with it, however. It devotes six pages of valuable space to a mathematical demonstration that Schiele's anti-friction curve is the only theoretically correct outline for a step or pivot bearing, and omits all reference to the discussion in the "American Machinist" a few years ago, by eminent writers, which showed that practically if not theoretically it was not a good form of bearing at all. In the chapter on riveted joints no mention is made of the excess strength of perforated plates, which was clearly shown many years ago by the Research Committee of the British Institution of Mechanical Engineers to have an important influence on the correct design of a joint. The engravings are in general on a far larger scale than are necessary, occupying space which should be given to type, and in some cases, as from page 184 to 196 inclusive, are so large as to detract from the appearance of the page. The size of the cuts is no doubt due to their being made by the wax process. They would have been much neater and fully as clear if they had been made by photo-engraving from well-executed drawings. Another defect of the book, which may be corrected in later editions, is its lack of completeness. Many important branches of the subject are entirely omitted, such as strength of flat and of stayed surfaces, chains and chain gearing, piston rods, connecting rods, balancing rotating masses, etc. We hope that Prof. Jones will consider this first edition to be only a beginning to a much more complete work into which it will grow in a few years. There is room for an American book on machine design based on Rankine, Reuleaux and Unwin for its fundamental and mathematical treatment, and on modern American practice for its details of construction. It would necessarily be three times as large as the work now before us, and we think that Prof. Jones is well qualified to write it.

EN

AMI

RECE
have be
at the
on an
cago e
Works,
McMyr
Buffalo
tained
1,000
engine
Wis.,
Univer
000 ft

A G
built
in the
Strong
of th
sheep
veget
200,0

TR
of de
S. K
chine
rate
coun
mou
whee
comp
and
tire
necte
sing
driv
box

P
the
gine
"Jo
for
Aug
a t
pav
40.
squ
rem
blo
are
sq.
lev
str
56
bl
bl
Pi
st
st
or
10
su
cl
is