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TABLE OF CONTENTS.

ELECTRIC MOTOR CARS are gradually being introduced on the South Side Elevated Ry. (Alley Line), at Chicago, to replace the steam locomotives which have hitherto been used. Experiments have been in progress for a long while, and some of the cars are now in service, the trains consisting of four or five cars. The Sprague system is used, in which each car has its own electrical equipment, but all controlled from the front car. This is the last line to make the change to electric traction, and when its engines are taken off there will be no steam locomotives on any of the Chicago elevated railways. On the other lines trains of three and four cars are run, but the speed is by no means equal to that of the steam trains on the South Side line.

MUNICIPAL OWNERSHIP OF STREET RAILWAY tracks in Cleveland is recommended for consideration in the recent annual message of Mr. Robt. E. M'Kisson, Mayor of Cleveland. If the tracks were so owned and then leased to the highest bidder the Mayor states that

> the franchise of the city of Cleveland, instead of bringing $6,600 by way of car licenses as now, would undoubtedly yield over a million dollars annually, to say nothing of the advantages of lower fares and the marked reduction in the general tax rate which this income would allow.

During the past year the Mayor and others have been instrumental in securing a repeal of a statute under which the street railway franchises of the city would have been extended 50 years. In Cincinnati the street railway companies secured the benefit of the law before its repeal.

THE NEW EXPRESS LOCOMOTIVES of the Chicago, Indianapolis & Louisville Ry. have some specially interesting features in their design, and the engine of this class which hauled the special train of the Western Railway Club between Chicago and Lafayette, on April 19, attracted considerable attention. The boiler has no cylindrical course, the conical throat sheet reaching from the extended wagon-top to the smokebox. The boiler is set high along the axles, and its cab floor and firing door are about 2 ft. above the top of the tender frame. To facilitate firing, therefore, the floor of the coal space is made level with the cab floor, the tank extending below the coal space. The engines are fitted with truck brakes, and it would seem to be high time that these brakes were fitted to a large number of express engines. The cab is of polished mahogany, and is unusually roomy. The New York brake pump, the hollow crank pins, the automatic bell ringer and the broad, well-protected steps to the tender deck also came in for their share of the attention. The engines are of the eight-wheel type, with cylinders 18½ × 26 ins., and driving wheels 6 ft. diameter. The weight is 121,800 lbs., of which 79,000 lbs. are on the driving wheels. The engines were built last year by the Brooks Locomotive Works, of Dunkirk, N. Y., and one of them has a record of 9.1 miles (between Owasco and Deer Creek) in 6 minutes, or at the rate of 91 miles per hour.

A NEW TRANSCONTINENTAL RAILWAY across Canada is being discussed. The proposed line would commnece at Quebec, running generally parallel to the Canadian Pacific Ry. on the northern edge of the fertile belt, and terminate at Port Simpson, on the Pacific, about 450 miles north of Vancouver. The latter point is said to possess the finest harbor on the Pacific north of San Francisco, and under the influence of the Japan current, the climate is mild and the harbor would be open all the year around. The route would be laid straight from Quebec to the north end of Lake Winnipeg, and then slightly south to Prince Albert, where it would meet the northerly extension of the Canadian Pacific branch from Regina. The Rocky Mountains would be crossed near the source of the Peace River, at an elevation of 2,400 ft., and the line would then descend the valley of the Skeena to the Pacific. The breadth of the strip enclosed between the line and the Canadian Pacific would vary from 150 to 500 miles, and the length of the line, from Quebec to Port Simpson, would be 2,400 miles. The existing Montreal-Vancouver line is 2,521 miles long. Dr. Robert Bell, of the Geological Survey of Canada, estimates that in this region, south of Hudson's Bay, there are 25,000,000 acres of fertile land suitable for settlement, but now inaccessible on account of the lack of railways.

CHANGING A TUNNEL TO AN OPEN CUT will be a feature of the work for double-tracking the Chartiers branch of the Pittsburg, Cincinnati, Chicago & St. Louis Ry. The tunnel is nearly 400 ft. long, and the cut will have a maximum depth of about 130 ft., with flat slopes in clay ground. The methods employed in opening up a tunnel on the Caledonian Ry., of Scotland, and the shield used in removing the brick, were described and illustrated in our issue of April 21, 1892.

THE DISTRIBUTION OF TRAFFIC in France, over railways, rivers and canals and main highways, for the total internal freight traffic, is placed at 69, 22 and 9%, respectively. The total length of French railways is 21,300 miles; that of navigable ways is 7,600 miles, and the main highways of the country aggregate 24,600 miles in length.

THE COST OF BRIDGE RENEWALS and the substitution of permanent for temporary structures on the Lake Erie & Western R. R., from Jan. 1, 1887, to Jan. 1, 1898, has averaged $19.16 per ft. for 39,512 ft. of work. Most of the costly structures have been built, and this rate is higher than future work will probably cost, the average rate for which is estimated at $17 per ft. of permanent work. These figures are taken from the "characteristic" report on the property of this road, prepared by Mr. W. F. Goltra, Chief Clerk to the Chief Engineer. By referring to an extract from Mr. Goltra's former report, in our issue of Aug. 6, 1896, this work has cost $18.96 per ft., and it was then estimated that future work would cost only $15 per ft. The diagrams accompanying the report show that during 1895 a very considerable amount of work was done in building bridges and filling in banks. In 1896 less work of this kind was done, and in 1897 it was almost at a standstill.

THE REPLACING OF A 117-FT. RAILWAY BRIDGE span was accomplished in 1½ hours on April 24 in the work of reconstructing two spans of the eight-span viaduct of the Pittsburg, Ft. Wayne & Chicago Ry., near Temperanceville, Pa. Practically the same method was adopted as was employed in replacing the Pennsylvania R. R. bridge over the Schuylkill River, near Girard Ave., Philadelphia, Pa., which was fully described in Engineering News, Oct. 21, 1897. A falsework was erected on each side of the old span, and on one of these the new span was erected. The old span was then slid sideways onto the unoccupied falsework and the new span simultaneously slid onto the bridge seats. The work was done by the Edge Moor Bridge Works, of Edge Moor, Del., under the immediate supervision of Mr. W. B. Fortune, of that company, and Mr. W. C. Cushing, Engineer Maintenance of Way, Pittsburg, Ft. Wayne & Chicago Ry.

A BRIDGE ACROSS THE MERSEY, at Liverpool, is being considered by the Chamber of Commerce of that city. It would be a suspension bridge, 150 ft. above high water, with a central span of 2,000 ft., and two side spans of 1,000 ft. each. The estimated cost is $12,500,000.

THE BRIDGE OF BOATS, over the Indus River at Khushalgarh, India, was established in 1876, and is only used between Sept. 15 and June 15, being removed for the flood months. The length of the bridge is 1,000 ft., and it is made up of seven boats, each 62 ft. long, and 18 boats each 48 ft. long, with planked roadway. The Indus at this point is 81 ft. deep, below the zero gage; and the highest flood on record rose 55½ ft. above zero.

THE MOST SERIOUS RAILWAY ACCIDENT of the week occurred on the New York Central & Hudson River R. R., at Fairport, N. Y., on April 21. A westbound freight ran into the rear of another freight train, which was standing at a water station. Three men were killed and one injured.

A LARGE TRANSFORMER EXPLODED on April 19 at the works of the Wagner Electric Manufacturing Co., St. Louis, Mo. The transformer was one of the oil insulated type for high tension work undergoing a test. It is understood that one of the inner connections gave out, causing arcing, which ignited the oil. No casualties are reported.

A POWDER MILL located at Santa Cruz, Cal., blew up on April 26, killing several men and wounding others. The mill was at work on a government contract, manufacturing smokeless and brown pneumatic powder. Four explosions followed and the Naval Reserve was called out to guard the works and prevent the spread of the fire to the magazines.

TELEPHOTES OR A SYSTEM OF SIGNALS for communication between ships, or between land and vessels, will be installed at Boston, New York, Fortress Monroe, Key West and San Francisco. The device consists of incandescent lamps arranged in a vertical row, mounted on a mast and controlled by a keyboard in such a manner that signals can be transmitted by causing the lights to flash in various combinations. At the places named electric light plants are already in operation. It is also reported that the inventor of the system, Mr. C. V. Boughton, will construct a number of small plants, including the signal lamps, a small generator, and gasoline engine, and that many other harbors and stations along the coast will be equipped with these small outfits.

A PORTABLE X-RAY APPARATUS intended for use in war has just been completed by Prof. Reginald A. Fessenden of the Western University of Pennsylvania. It is stated that the new machine will be about as large as a Webster's dictionary and will weigh only 25 lbs. It will be operated by a small gasoline motor or gas turbine which will not weigh more than 25 lbs. The electric generator used is said to be the smallest ever made for practical purposes, yet the outfit will enable surgeons to see clear through the body. It is intended to have these instruments in the various field hospitals.

THE WHITEHEAD TORPEDO, of which we may hear frequently in the next few weeks, is 16 ft. 5 ins. long, 17.7 ins. greatest diameter, and weighs, ready for service, 1,160 lbs. It carries 220 lbs. of wet gun cotton at a speed of about 28 knots per hour, and at that speed it has a range of about 850 yds. This torpedo is built of steel and is propelled by two two-bladed screws, revolving in opposite directions on the same axis, to neutralize the rolling tendency of the torpedo. The screws are operated by a three-cylinder engine driven by air compressed to 1,350 lbs. per sq. in.; and an intricate apparatus, called the Obry gear, is used to automatically keep the torpedo pointed straight during the run. This Obry gear is essentially a gyroscope controlling the valves of the steering engine, which operates two rigidly connected vertical rudders.

THE HOLLAND SUBMARINE TORPEDO BOAT made another very successful test on April 20. She made four dives of about one mile each, running with 14, 13, 15 and 18 ft. of water above her in the several tests. She was under absolute control at all times and her automatic steering apparatus worked admirably, keeping her steadily at the desired depth below the surface. She fired a dummy Whitehead torpedo and also used one of her above-water guns. One marked feature of the test was that though she came to the surface several times, at the distance of two miles and in the somewhat rough water, she was invisible even to those closely watching for her reappearance. The operation was conducted in Raritan Bay, in an average depth of 30 ft. of water. The naval board, which has been watching the tests of the "Holland," does not recommend her purchase at the price asked, $175,000, though this action is strenuously advocated by Assistant Secretary of the Navy Roosevelt. Mr. Holland, on his part, claimed that the board declined to risk their lives in the craft, so that they might more closely watch its movements; and he finally offered to go to Havana, enter the harbor and throw dynamite projectiles into Morro Castle; provided, the government would purchase upon the accomplishment of this feat. He also says that he is offered $100,000 for the craft by French agents, with delivery at New York. The matter is now being discussed at Washington; and the only apparent objection to the proposition of Mr. Holland lies in the determination of the authorities to content themselves, for the present, with a peaceful blockade of Cuban ports. The "Holland" is really unfinished, the engine provided having only 45 HP., while the boat is designed for one of 150 HP., and could carry a larger one still. This may explain the action of the naval board.

THE JAPANESE MERCHANT MARINE, says "Indian and Eastern Engineer," has increased since the Chinese-Japanese war from 160,000 to 400,000 tons of steam shipping. Lines are now organized sailing from the chief ports of Japan to China, India, Europe, America and Australia. This growth follows a change from an agricultural to a manufacturing nation. In 1872 Japan only exported manufactured articles to the value of $500,000; in 1896 exports of this class amounted to $45,000,000, or 40% of her total exports.

STEEL ARCH HIGHWAY BRIDGE OVER FALL CREEK ITHACA, N. Y.

We illustrate herewith two views and a number of detail drawings of a steel arch highway bridge built across the gorge of Fall Creek, at Ithaca, N. Y., to connect the grounds of Cornell University with an adjacent tract of land owned by Messrs. E. G. and C. E. Wyckoff, who propose to lay it out into residence sites for Professors' houses. The bridge has a span of 169 ft. 11 29-32 ins. c. to c. of end pins, and consists of two plate girder arch ribs braced together by cross-frames and a triangular lateral system, and carrying vertical latticed posts, which uphold the floor system. Fig. 1 is a general view of the bridge and gorge; Fig. 2 is an end view from the bank at a point below the floor showing the girders and posts and their systems of bracing; Fig. 3 is a detail of one of the plate girder ribs near the skewbacks, and Fig. 4 shows the skewback shoes themselves.

These illustrations give a sufficiently clear understanding of the arch construction. The floor system is simple, consisting of plate girder floor beams at each post which carry I-beam stringers, on which the plank flooring is laid. The roadway is 24 ft. wide in the clear, and is flanked on each side by a 5-ft. sidewalk. These sidewalks consist of plank flooring laid on I-beam stringers which are supported by latticed bracket continuations of the main floor beams. Fig. 2 shows the hand railing construction clearly. The bridge is also provided with stringers carried on angle brackets riveted to the floor beams, which are intended to support an electric street railway track, should it ever be desirable to construct such a track across the bridge.

As the south bank of the gorge is somewhat higher than the north, it was necessary to place the floor of the bridge on a grade, which was accomplish by using different lengths of vertical posts. In the erection of the work a falsework was built up complete from the bottom of the creek to the top of the bridge, the distance being about 120 ft. at the center of the bridge. In order to facilitate erection, sections of the arch were assembled at the shop and the splices reamed.

The abutments proper were built from the native stone, with shoe stones 4 ft × 4 ft. × 18 ins. from the Cobleskill quarries. These stones were not acurately set in place until the falsework was built up to the level of the pockets, after which the distance across the stream was ascertained by means of wire and a steel tape. The pockets had been so accurately cut, however, that it was found necessary only to bolster up the stones by a thin layer of Portland cement. The removing of the rock was a somewhat difficult operation, owing to the fact that on account of exposure to the weather the stones were by far too soft to retain the blast successfully.

The entire work was under the supervision of M. E. A. Landon, Chief Engineer, and Mr. H. G. Dimon, Consulting Engineer of the Groton Bridge & Manufacturing Co., of Groton, N. Y., the contractors. Mr. K. P. Crandall was Engineer and Inspector for the Messrs. Wyckoff.


Fig. 1.—General View Looking Down Gorge.

Fig. 2.—End View Showing Arch Ribs and Bracing.

STEEL ARCH HIGHWAY BRIDGE OVER FALL CREEK GORGE, ITHACA, N. Y.
Groton Bridge & Mfg. Co., Groton, N. Y., Contractors.

TIMBER SUITABLE FOR STRUCTURES IN NICARAGUA AND COSTA RICA.

By J. Francis Le Baron, M. Am. Soc. C. E.*

The following notes on the timber suitable for purposes of construction are gathered from personal observation during a residence of over two years in Nicaragua, on survey and construction of the Nicaragua Ship Canal, and from the writings of Spanish authors on this subject. Many woods useful in the arts and in medicine, or for the fruit produced, are omitted, as not bearing directly upon the subject.

The density of forest growth in the valley of the San Juan and its affluents is remarkable; trees of many varieties grow to an enormous size; and on the flooded lands the larger trees are usually upheld by great triangular buttresses reaching 10 or 12 ft. up the trunk. Between the trees is an almost impenetrable mass of undergrowth, and about the trees are entwined innumerable creepers, extending to the tops and sometimes attaining a diameter of 8 ins. or more. Viewed from above, the tops of trees in this forest present an almost uniform surface; and the many sharp undulations in the ground, rising and falling 60 to 75 ft., are not indicated at all. These forests are too damp to burn, and the trees are never blown down, except on the river banks, as the mass of foliage is too dense for the wind to affect, but they fall suddenly when they have lived their allotted time.

On the Pacific slope the forests are less dense than on the Atlantic side, and the undergrowth is not so thick, and glades occur among the trees. The trees of Nicaragua, Costa Rica, British and Spanish Honduras, Guatemala, Salvador and the United States of Colombia are all much alike. In the zone of greatest rainfall, the wood often contains so much sap that it cracks and warps on exposure to the sun to an extent that makes it unsuitable for timber. But even these trees, if cut and piled loosely under a shed for six months, or if hewn and then soaked in water for six months, will make good and serviceable timber. The same result will follow girdling when the sap is down.

The termites, or white ants, are very destructive to wood construction in Nicaragua, as they often eat out the entire inside of posts and beams, leaving only a thin outer shell. There are some kind of native woods, however, that they will not eat.

In the following notes the relative abundance, hardness and durability, are estimated on a scale of 1 to 10, the higher figure being the maximum. The diameter is measured breast high, or above the buttresses, when these occur. The "length" of trunk is that part available for lumber, either to or above the first limbs; the "height" is the total height of the tree and branches; the "durability" is that of seasoned timber. The English, Nicaraguan or Spanish, and the Latin names are given when known. Of the 166 varieties of timber noted in the two countries only these are here mentioned which are suitable for timber, or cabinet purposes.

Red Cedar; Cedro colorado, Cedrel or Cedron. (Cedrela odorata.) This belongs to the same family as the mahogany, and there are 17 varieties, known by special names. It is found on the river banks, with a length of 60 to 80 ft.; diameter, 2 to 3 ft. It floats in water when dry and a relative abundance is 5. It is much used for boards and canoe-making, and is very durable in water.

Male Cedar; Cedro macho. Length 80 ft.; diameter 5 ft.; splits hard; floats green; lasts from 10 to 20 years.

Thorny Cedar; Pochote, Cedro Espinado; (Pochira Bombax?) Abundance 10; length 60 ft. and more; diameter 9 ft. A good wood, found on the Atlantic side, on the hills and river banks; it is used for boats, boards and posts. Posts of this timber will take root and grow when used in fences. It bears a cotton ball that is used for textile purposes and for mattresses.

Manwood, Iron Wood; Corteza negro; Palo de hierro; (Tecoma sideroxylum.) Abundance 8 in the West, 1 in East; length 16 to 24 ft.; diameter 4 to 9 ins. Hard to cut and split; sinks when green, but floats when dry; grows on the hills and river banks. It is used for bridge and house timber, posts, railway ties, etc. It is tough and very heavy. There are three varieties of this timber. Resembles bornbeam, Cospinus americana.

Yellow Manwood; Corteza amarillo. Abundance 6 East, 8 West; length 18 ft.; diameter 5 ins. Grows in same localities as above and has the same characteristics and is used for similar purposes. Sinks when dry.

Medlar Tree; Nispero or Itaiba. (Hymaenaea combaril L.) (Mespilus germani) and (M. americana). Abundance, 6; length, 100 ft.; diameter, 5 ft. There are four varieties, known as N. blanco; N. amarillo; N. negro and N. colorado. Grows on the hills and river banks; is very strong, hard and heavy; sinks when green. It is used for bridge and house tim-

*Jacksonville, Fla.

ber; is large and straight; very durable and lasts indefinitely in water. It is a valuable timber, as good as mahogany for some purposes, and bears one of the best fruits of the country. It should be introduced into South Florida. Wood resembles red oak, but is stronger and more durable.

Black Wood; Madera negro, Madre de cacao; (Glirieidia maculata; Kunth.) (Erythrino umbrosa.) (E. velutina.) Abundance 1 East, 8 West; length 20 ft.; diameter 3 ft.; height 40 to 50 ft. A fine hard wood for house framing and cabinet work; largely used for ties on the Grenada-Corinto Railway. It is also used for bridges, but is crooked. In the ground it is said to last for 100 years. It is used as a shade tree in cacao plantations. Wood may be likened to Lignum vitae.

Wild Almond, Break Axe; Almendro, Ibo or Quebrada hacha; (Terminalia cattapa.) Abundance 8; length 80 ft.; height 125 ft.; diameter 1 to 6 ft.; durability 10; hardness 10. Grows on river bank and hills; sinks green, but floats dry. It could be used for bridge timber, planks, docks, etc. It never splits or rots, except after a long time; it is hard as iron and resists nails. The grain of the wood is intertwined, and it is almost impossible to cut it with an axe. In clearing the canal right of way, these trees were sawn down by a crosscut saw and then blown up with dynamite. It is probably the same as the Quebrada negro, of the Argentine Republic, "Axemaster" of Berlize, and El Rey de los Palos, Paraguay. Wood more nearly resembles Live Oak than any other, but is harder, stronger, more difficult to split and more durable.

Tabcon; Tabacon. Abundance 8 East; length 35 ft.; height 50 ft.; diameter 9 to 14 ins.; durability 8. Grows on high lands; sinks when green; splits very hard; last 8 to 10 years in the ground. It is used for house posts, and for tanning.

Mary's Milk Tree; Leche Maria, or Leche cuajo. (Varriga negro?). Abundance 7 East; length 18 to 20 ft.; height 50 ft.; diameter 1 to 3 ft.; durability 5. Grows on high lands and in swamps; sinks when green; splits hard. The heart-wood is very good and is used for posts, sills and plates; lasts 5 years under cover.

Red Tree; Arbol colorado, Coloradito. Abundance 3; length 20 ft.; height 40 ft.; diameter 12 to 16 ins. It floats when green; splits hard; is used for girders. Grows on high lands.

Toasted Leaf; Hoja tostada. Abundance 8 East, length 50 ft.; height 80 ft.; diameter 18 to 20 ins Grows on high and low lands; sinks when green; used for boards, etc.

Marui. Abundance 3; durability 10; length 70 ft.; diameter 2 ft. Grows on high lands; is used for house posts and lasts underground for 10 years.

Chocomico. Abundance 8 East; length 50 ft; height 115 ft.; diameter 12 to 18 ins. Grows plentifully on high lands; sinks when green; splits hard; is used for girders, and lasts 10 to 15 years.

Matasano. (Casimiroa edulis.) Abundance 8; durability 5; length 50 ft.; height 80 ft.; diameter 15 to 18 ins. Grows on high lands; sinks when green; splits hard; is used for house posts, and lasts underground 5 to 6 years. It grows wild and is also cultivated, and bears an edible fruit.

Papaya Almendro. Abundance 8 East; durability 10; length 50 ft.; diameter 50 to 60 ins. Grows on high and low lands; sinks when green; splits hard; used for posts and boards, and lasts underground for 20 or 30 years. This is not the pawpaw, or Spanish papaya, which is a soft, valueless wood.

Sapodillo, Naseberry; Sapotillo, Espanel. Sapote, or Limonero rojo; (Achras sapota L.). Abundance 6 East; length 12 ft.; diameter 4 ft. Grows on hills on East side and is cultivated on the West. Sinks when green; splits hard; has many limbs; said to be proof against teredo, and furnishes a well-known fruit. Stephens reports finding a door-lintel of this wood, in perfect preservation, in the ruins of Palenque; he says it must have been placed there before the Spanish Conquest, or over 300 years ago. It is hard and difficult to work, but makes handsome furniture, and is much used for house framing. Wood somewhat resembles elm in texture, but is much harder.

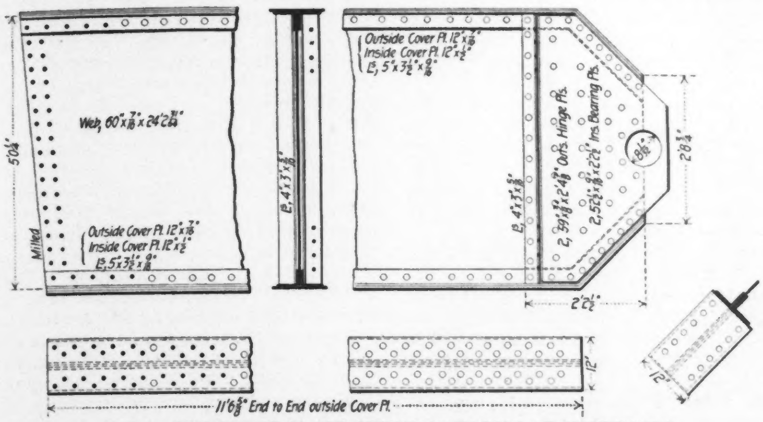


FIG 3.—DETAILS OF PLATE GIRDER ARCH RIBS AT SKEWBACKS.

Guava; Guavo, Goyava, six varieties. Abundance 3 East, 8 West; length to first limb 8 ft.; diameter 18 ins. Grows on river banks; has a straight trunk; hardwood; splits hard and is fibrous. Used for cabinet and household work, and the fruit is eaten green in tropics, and from it is made the well-known guava jelly. Wood somewhat resembles beech.

Male Guava; Guavo macho. Abundance 8; length 16 ft.; diameter 3 ft. It resembles the wild Almond, or Ibo, and bears no fruit.

Tamarind; Tamarindo; (Tamarindus occidentalis). Abundance 2 East; length 40 ft.; diameter 4 ft.; height 80 to 100 ft. Grows on the hills and in valleys; is a strong, hard, fine wood, used for boat building, wheels and carpenter work. It is cultivated in the interior and fruit is used for medicinal purposes and as material for a cooling drink.

Guayacan; four varieties. (Lignum vitae.) Abundance 1; length 18 ft.; diameter 14 ins. Grows on the hills; is hard, straight and fine-grained, very durable; is used for making pulleys, canes, beams and cabinet work. It is exclusively used for ties on the Panama Railway, at a cost of $1.20 each in Colombian silver. Imperishable under water.

Ebony; Ebano Americano. Three varieties similar to the Guayacan and put to the same uses.

Cotton Tree, White Wood; Ceiba; (Bombax ceibal.) Abundance 8; length 50 ft.; diameter 6 to 8 ft. Grows on river banks; is straight; wood soft and used for boards and barrels. Grows in U. S.

Gunacaste comun; (Enterolobium cyclocarpus.) Abundance 1 West; length 50 ft; diameter 4 ft Grows on Pacific slope; used for boat-making and for excellent boards. Sometimes grows to enormous dimensions; the large quantity of gum contained would make good varnish. Two varieties.

Acacia; Jenisero; (Pithecolombium saman). Abundance 1 East; length 30 to 90 ft.; diameter 9 to 15 ft.; many limbed; and is more plentiful on West side. Is a variety between cedar and mahogany; is an excellent wood for wagon wheels, cabinet work and all manner of construction. It floats dry. Grows on the hills.

Cativo; Cautibo colorado. Length 100 ft.; diameter 5 ft. Floats green or dry; wood soft and red; used for house and bridge timber. The C. blanco is similar to the above; but the wood is white and harder, and somewhat resembles white pine. Both grow on river banks.

Alligato Tree; Lagarto and Lagartillo; two varieties. Grows on Atlantic slope. Abundance 1; length 12 ft.; diameter 18 ins. Floats green; splits hard; wood resembles Guava; used for heavy construction.

Coal Wood, or Coyote; Guiliquiste, Guachipelin, Palo do carbon, etc. Abundance 3 West; diameter 4 ft. Floats dry; a very strong yellow wood with many limbs; used for house sills, bridge stringers and railway ties. Very durable in the ground.

Jicaro del Monte, Catabacero; (Crescentia alota, or C. acuminata). Abundance 6 West; length 12 ft.; diameter 2 ft. A strong wood; floats when dry; used for boat's gunwales.

Junzopote negro. Sunsapote; (Mangifira domestica), or Achias jimenia. Abundance 8; length 24 ft.; diameter 8 ins. Floats dry; red in color; used for bridge and house timber and railway ties; bears an edible fruit. Grows on hills. It resembles Canveadeaival wood that grows on East slope. Splits hard.

Laurel; (Laurus nobilis); 9 varieties. Abundance 2 East, but very plentiful in interior; length 24 ft.; diameter 5 ins. A very good, straight wood; floats dry; used for bridge timber, piles and furniture and carriage making.

Gavilan; Gabilan colorado; (Mimosa arborea). Abundance 8; length 16 ft.; diameter 4 ft. A good wood but splits hard; the heart-wood used for ties and general construction; resembles the Acacia Grows in swamps and on river banks.

Black Thorn; Espina negro; E. blanco; E. amarillo. Grows on East side; used in construction and cabinet work; floats dry.

Lead Wood; Palo de plomo. Abundance 4 East; length 80 ft.; diameter 2 to 4 ft. Straight and tall; floats dry. Grows on river banks; wood resembles maple.

Camitos (Crysophylum oliviformis); five varieties. Abundance 8 East; length 100 ft.; diameter 4 to 5 ft. Wood red; brash and resinous; used for bridge piles. Different from Caimita of U. S. of Colombia, which is hard, close-grained and very heavy. Floats dry.

Strawberry Tree; Madrono negro, M. amarillo. Abundance 8 East; length 16 ft.; diameter 18 ins A fine-grained wood without fiber, resembling box-wood. Crooked; floats dry; used for railway ties and general construction; good for lathe work.

Guasimo; four varieties. (Guasuma ulmifolia.) Abundance 8 East; length 16 ft.; diameter 5 ft. Floats dry; used in carpentry.

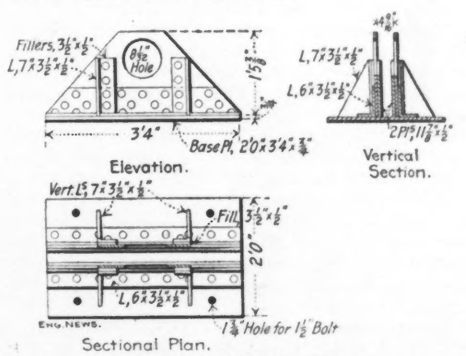


Fig. 4.—Details of Skewback Shoes.

Grape Tree; Uva or Huva. Abundance 8 East; length 20 ft.; diameter 14 ins. A good wood, splits hard; sinks dry; used in house building.

Snake Wood; Culebra. Grows on East side; heavy and splits rather easily; floats dry; used in carpentry and cabinet work, and as a dye-wood.

Tolodo. Length 18 ft.; diameter 3 ft. Grows on East side; floats green or dry; splits hard; makes good lumber and fine fire wood.

Seven Skins; Siete pelejos, S. cueros. Abundance 1 East; length 16 ft.; diameter 2 ft. Floats green; cuts like cheese, but splits hard; not used. Grows on river banks.

Match Tree; Foforito. Abundance 1 East; length 12 ft.; diameter 12 ins. Sinks green; wood fibrous and splits hard; resembles Sapote in appearance; no uses known. Grows on river banks and islands.

Guapinol, Copinal, Alganobo; (Hymenea Courbaril.) (Family Leguminosa.) Abundance 1 East;

length 25 ft.; diameter 4 ft. A beautiful, solid and hard wood; used for boards, beams, wheels and cabinet work; color reddish, with very compact fiber. Bears a nutritious fruit and furnishes a gum equal to Ceylon copal.

Red Oak, White Oak; Encina; Roble; (Quercus robur; Tecoma Mexicana); four varieties. Length 16 ft.; diameter 3 ft.; grows on elevated land in the West. A strong, heavy wood; used for planks, wagons and barrels, and for dyeing and tanning.

Red and White Mangrove; Mangle colorado and M. blanco. (Laguncuiria racemosa.) Abundance 6 East and West; length 25 ft.; diameter 20 to 36 ins.; height 30 to 50 ft. Grows in the salt water on both coasts; strong and heavy wood; used for shoe pegs, also for posts, planks and cabinet work, and for shipbuilding and wharves; for the latter purpose it has no equal. The Red Mangrove sometimes grows to a height of 60 to 80 ft.; the white, or light yellow, to 80 ft., and the black Mangrove grows 50 ft. high. The bark is rich in tannin and dye, and is largely exported to Europe. It grows abundantly in Florida. Has medicinal uses.

Quebracho; and Q. colorado. Abundance 1, in Chinendega; length 28 ft.; diameter 3 ft. This is a strong, heavy wood; used for posts and cabinet work.

Mahogany; Caoba; Caobano; C. Con; (Swietenia mahogani). Grows in Department of Zelaya and near Leon; none in San Juan Valley. Abundant in Zelaya 8; Leon 1; length 25 ft.; diameter 3 ft. Well known in character and use. It costs about $40 to $50 per 1,000 ft., B. M., to cut and square mahogany and get it to the seaboard.

Mulberry; Mora, Moran, (Rebus ideous and Morus tinctoria); six varieties. Abundance 5 West; none on East; length 20 to 30 ft.; diameter 4 to 6 ft. A heavy, yellow, strong and very fine and durable wood; as good a dye as Brazil wood; used in house building, cabinet work and for railway ties. Bears an edible berry; is cultivated. Grows on the hills and high plains.

Gamvacho. Abundance 2 East; length 24 ft.; diameter 5 ft. Floats dry; is straight and many limbed.

Granadier; Granadillo. Abundance 4 West; none East; length 50 ft.; height 80 ft.; diameter 6 to 24 ins. Wood hard and takes a fine polish; used for canes and cabinet work.

Ronron; R. veteado. Abundance 6 West; length 30 ft.; diameter 4 ft. Used for cabinet and other construction.

Male Brazil Wood; Brazil Macho. A heavy wood that makes excellent railway ties.

Nance; Nanzite colorado; (Malphighia punicifolia.) Abundance 8 West; length 20 ft.; diameter 2 ft. A heavy, strong wood, used for building; bark useful for tanning and dyeing; bears a small edible fruit.

Cuban Pine; (Pinus Cubensis.) Grows in Zelaya, on Prinzapulka River, in a strip 50 by 20 miles; also in Segovia and on the higher lands up to 2,500 ft. elevation; none in San Juan Valley, but the most abundant tree in Florida. Length 40 ft.; diameter 18 to 20 ins.; height 60 to 80 ft. A hard, heavy and durable timber. Floats green and dry. Is the Long-leaved Pine; (Pinus palustris); or Ocote.

Icaco; (Chrysobolanus icaco.) Abundance 6 East and West; length 5 ft.; diameter 12 ins. Grows in the sea; bears an edible fruit; brought originally from Senagal. A fine and durable wood; but small and with many limbs.

Papaturo; P. blanco; P. negro. Abundance 5 West; length 16 ft.; diameter 3 ft. Wood soft; crooked; makes a good fence.

Little Cheese Tree; Quisillo. Abundance 10 East and West; length 10 ft.; diameter 12 ins. No known use.

Monkey Tree; Jacote mico, etc.; (Spondias myrobotanus L.); five varieties. Grows in San Juan Valley. A very strong yellow wood. Abundance West 7. Floats dry; splits hard. Bark fiber used for matting, baskets, rope, etc. Length 12 ft.; diam. 12 ins.

Copaiba, Camivar; (Copaifera officinalis.) Abundant in San Juan Valley, and grows to a height of 50 to 60 ft. Wood strong, reddish in color. Much used for inlaid work, being repellant to insects. Used as a dye and in medicine.

Liquid Amber; Liquidambas; (Liquidambar macrophylla, etc.) Grows in San Juan Valley and on West Side to a height of 60 ft. The wood has an agreeable odor and is used in making vases, cups, etc., and has the property of preserving organic substances. Its balsam is well-known for medicinal purposes and perfumery.

Peruvian Balsam; Balsamo del Salvador, etc. (Myroxilon Pereizal, etc.) Grows near Salvador and in San Juan Valley. Abundance 4; height 35 to 65 ft. Wood reddish-ochre; compact fiber; suitable for cabinet work; perfumed. The tree is said to live 100 years. Used for medicine and perfumery.

Rubber Tree; Palo de Hule, Cautchu; (Castilloa elastica.) Abundance 8 East, 2 West; length 30 ft.; height 60 to 65 ft.; diameter 2 to 3 ft. Wood light, soft, and of no use, but each tree yields from 3 to 6 lbs. of rubber sap as a crop, and 100 lbs. of this sap yields 36 lbs. of pure gum.

Milk Tree; Cow Tree; Palo de leche; (Galactodenidrum utile). Grows on moist land in the East; length 70 ft.; diameter 40 ins. Floats green; splits hard; wood white and fibrous and not used. It yields an abundant milky sap, which when boiled is used by the natives in their coffee; the wax from it makes excellent candles.

Melon Tree; Calabash, Jicaro, Tigulate, Temante, or Palo de Melon; (Cresentia cujete.) Plentiful on West side; used for ships knees and cabinet work; wood durable in ground. The wood resembles the Madrono, and the hard gourd which it bears is much used by the natives for drinking vessels.

Other trees, valuable for structural purposes, fruit, dyes or medicines might be included, did space permit any lengthy description. Among these might be mentioned the following: The Little Coffee Tree, wild, and not bearing the coffee of commerce; the Jovo, Cinnamon, Vegetable Wax and Vegetable Suet trees; the Rosewood, Copal, Logwood, Peruvian Bark, Gutta Percha, Pepper Tree, Dragon's Blood, False Brazil wood, Sandal wood and Bamboo; Cocoanut, Coyol, Royal Palm, Cohune, Pijiballe and other varieties of palms. There are still about 29 other trees valuable for timber, but not so well known, or so common; and in some cases these are, too, useful for their fruit, or for dyes and medicinal products, to be available as lumber.

THE TIMBERS OF NEW SOUTH WALES.

In the tenth issue of "The Wealth and Progress of New South Wales," for 1896-7, the Government Statistican, Mr. T. A. Coghlan, presents a brief review of the timber products of the colony, which is here abstracted for the general interest it possesses.

The characteristic of the trees of New South Wales, and of all the Australian colonies, is a dull, evergreen foliage which alters little with the changes of the seasons. The forests are generally open and the trees met with are chiefly species of Eucalyptus, Angophora and other genera of the order Myrtaceae, with the eucalypti predominating. The trees are usually straight and cylindrical in the trunk, with the first branches at a considerable distance from the ground when the tree is full grown. The finest specimens, and those yielding the most valuable timber, are found on ridges and hill sides, usually too rough and stony for cultivation. A list of the best known varieties of commercially valuable trees is given as follows:

Flooded Gum (Eucalyptus rostrata). This tree grows, along streams, to a height of 100 ft. Its wood is most useful for heavy work, and for structures liable to attack by white ants.

Apple-tree (Angophora subvelutina). This tree also grows along the streams; has more spread than the majority of the indigenous trees, and the wood is strong, heavy and durable. The tree is widely distributed over the colony. On the ridges and mountain sides other varieties of trees predominate. The Box reaches a height of 180 ft. and diameter of 6 ft. and its timber is chiefly used for firewood, for which purpose it has no equal. The Bastard Box is supposed to be a cross between the Box and Grey Gum, and is widely distributed; but the quality of the timber varies greatly with the locality. Some varieties are only surpassed among hardwoods by the Ironbark.

Ironbark (Eucalyptus leucoxylon and E. paniculata).) A tree of moderate size, usually 60 to 80 ft. high when full grown; though the White Ironbark attains a height of 150 ft. The timber is heavy; remarkable for its great strength, which is nearly twice that of the best oak in fine specimens. The wood is extensively used for wharves, bridges and housework.

Blue Gum (E. globulus. This is one of the finest of the eucalyptus family. It attains a good height and is sometimes 7 ft. in diameter. The timber is in great demand owing to its comparative lightness, and easy working qualities.

Spotted Gum (E. maculata), grows in the coast districts, on generally poor soil. It attains a height of 100 to 150 ft., but the quality of the wood varies greatly; when good it is considered specially adapted for ship-building.

Stringy bark (E. eugenioides), has a peculiar fibrous bark, and grows chiefly on northern table lands. It is a large tree, and its wood is of great and general utility. The bark is much used for roofing, and also as a paper-making material.

The Messmate (E. obliqua), also called Stringy bark, is one of the largest trees in Australia, frequently being over 250 ft. high. The bark is used for roofing and would make excellent paper.

Bloodwood (E. corymbosa), is a large tree, growing in the coast districts. The timber is generally used for fencing and for railway ties.

Grey Gum (E. tereticornis) grows to a height of 150 ft. and is extensively distributed over the coast districts. The timber is hardly inferior to Ironbark; and some varieties produce a wood of remarkable beauty and great durability.

Tallow-wood (E. microcorys) is a very large tree extensively found in the forests north of Sydney. The wood is more easily worked than most of the hardwoods; it has great strength and durability and is employed for floors and building purposes, and for decks of ships.

The Mountain Ash, or White-top (E. virgata) is found both on the coast and the hills. The timber is in demand for cooper-work and rough carpentry. The tree grows to a height of about 150 ft.

Turpentine Tree (Syncarpia laurifolia) sometimes reaches a height of 200 ft. and diameter of 6 ft. The timber is largely used for piling and other work in sea-water, as it resists the attack of the teredo better than any other wood in the colony.

Red and White Cedar (Cedrela australis and Melia composita). These trees were once abundant in the northern forests; but few of the full-grown trees are now met with, except on the high ridges. The Red Cedar is a magnificant tree, often attaining a height of 150 ft. and a girth of 30 ft. The timber is very valuable; being light, easily worked, durable, splendidly grained and well adapted for furniture and cabinet-work. The White Cedar is about 80 ft. high and 3 ft. in diameter, and the wood is soft and easily worked, but is deficient in tensile strength and durability.

The Silky Oak (Grevillea Hilliana, G. robusta) grows to a height of about 80 ft., under favorable circumstances, and the wood is very suitable for cabinet-work.

The Tulip Tree (Harpullia pendula) is a tall tree, with beautifully marked wood of various shades and susceptible of a high polish.

The Ash, or Pigeonberry Tree, sometimes grows to a height of 130 ft. with a diameter of 5 ft. The timber is light and tough, and in good demand.

The Colonial Pine (Araucaria Cunninghamii) is one of the finest trees of Australia; sometimes reaching a height of 200 ft. and a diameter of 4 ft. The timber is white in color, easily worked, cheaper than any imported pine, and is largely used.

The Native Beech (Gmelina Leichardtii), reaches a height of 150 ft. Its timber is in great demand as it neither shrinks nor warps when exposed. In color the wood is white, or silvery, with a fine, close grain.

The specific gravity and resistance to breaking of various timbers of New South Wales is given in a table. In regard to this table, it should be mentioned that the tests were made with picked specimens, so that the results are perhaps considerably higher than would be obtained in actual practice. The modulus of rupture is eighteen times the load required to break a bar 1 in. square, supported at two points 1 ft. apart and loaded in the middle between the points of support, or

$$S = \frac{3\,W\,l}{2\,b\,d^2},$$

when W = load applied at middle; b = breadth; d = depth; l = length of beam and S = coefficient of rupture, or breaking stress per square inch:

Timhers of New South Wales.	Specific gravity.	Resistance to breaking, or modulus of rupture = S, lbs. per sq. in.
Spotted Gum	.995	13,300
Grey Gum	.917	13,100
Flooded Gum	1.178	14,800
Red Gum	.995	6,900
Woolly butt	1.022	12,700
Black butt	1.067	13,700
White Ironbark	1.177	16,900
Grey Ironbark	1.182	17,900
Red Ironbark	1.224	16,300
Forest Oak	1.208	15,500
Turpentine	1.109	11,700
Stringy bark	1.141	13,900
Black wood	1.129	10,300
Tallow Wood	1.233	15,200
Australian teak	1.006	14,400
Mahogany	1.201	14,500
Forest mahogany	1.156	13,800
Swamp Mahogany	1.216	12,100
White Beech	1.008	15,600
Mountain Ash	1.065	11,500
Rosewood	1.189	10,600
Pine	.868	8,800
Greenheart	1.001	22,000
Oak—British	.69 to 99	11,800
" Dantzic	.69 to 99	8,700
" American	.99	10,600
Ash, European	.753	13,000
Birch, European	.711	11,700
Beech, European	.690	10,500
Mahogany, Honduras	.56	11,500
Teak, Indian	.66 to .88	15,500

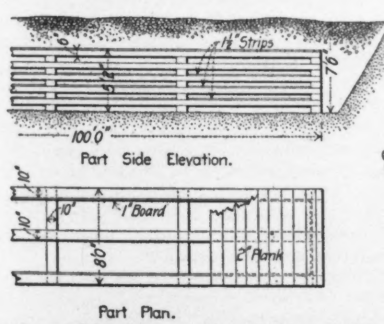
FILTER CRIBS IN THE ALLEGHENY RIVER, NEAR PITTSBURG, PA.

In our issue of May 10, 1894, we described several filter cribs built in the Allegheny River by water companies supplying places near Pittsburg. A number of other cribs in the same locality have been brought to our attention in the past four years and are described briefly below. The main object of these cribs is to remove matter carried in suspension by the river.

Sharpsburg, Pa.

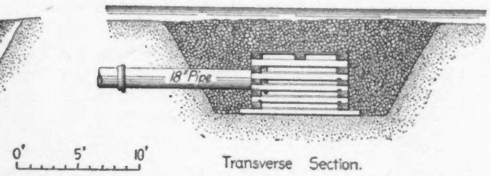
The water-works here were built by the borough in 1886. We are informed that until 1893 the supply was pumped from the river channel directly to the mains, without any attempt to remove the large amount of sediment carried by the river at times. In 1893 plans for a filter crib were made by Mr. Jacob Schinneller, of Pittsburg, and soon afterwards the crib was built. A partial plan and longitudinal section, and also a cross section, of the crib are shown herewith. The dimensions of the crib over all are 8 × 100 ft., × 5 ft. 2 ins. high. The top of the crib is 2½ ft. below the bed of the river, but the crib is made water-tight to a line about 5 ft. beneath the river bed. Below this level the water enters the crib through spaces left at the sides and ends, as shown in the illustrations, and also through the natural material at the bottom. The crib is built of hemlock, the timbers being held together by lag bolts ¾ ins. sq.

The trench in which the crib is placed was dug with pick and shovel, the river being too low at the time to float a dredge. The trench was kept free from water by means of a centrifugal pump. The cost of the crib, by contract, was $2,400, including excavating, back-filling and about 150 ft. of 18-in. pipe.



Part Side Elevation.

Part Plan.



Transverse Section.

FILTER CRIB IN THE ALLEGHENY RIVER AT SHARPSBURG, PA.

The crib is located outside the lower end of an island, about one-half mile below the intake of the Pittsburg water-works, at the other side of the river. The 18-in. intake pipe is about 800 ft. in length, extending from the crib to the pump-well, from which water is delivered directly to the consumers. Mr. Schinneller states that the water is clear at all times. The pumping plant consists of two 1,500,000-gallon Gordon & Maxwell pumps. One of the pumps is in continual service; the other is worked only during fires, when water is pumped directly from the crib. During extreme low stages of the river there is only about 8 ins. of water over the gravel covering the crib. The gravel around the crib can be back-flushed through a 4-in. pipe connected with the discharge side of the pumps. We are indebted to Mr. Schinneller for the above information. The population of Sharpsburg in 1890 was 4,898.

Borough Works, Millvale, Pa.

We are also indebted to Mr. Schinneller for notes regarding a filter crib built for the borough of Millvale (Bennett P. O.). This borough is located on the north bank of the Allegheny River, opposite the city of Pittsburg, and adjoining the city of Allegheny. It has two water-works plants, each drawing water from the Allegheny River. The municipal works were built in 1893-4, with Mr. Schineller as engineer, and Chandley Bros., of Beaver Falls, as contractors. Two cribs have been built for the borough, the first one having become disabled, as stated below. We cannot do better than to quote Mr. Schinneller's description of these cribs, sent at our request, as follows:

The first crib constructed filled with gravel during a flood in the latter part of May, 1893. It was 60 ft. long, 10 ft. wide and 4½ ft. high, and located in the middle of the river, about 500 ft. from the pumping station and below the center pier of the 43d St. bridge, connecting Pittsburg with the borough. The up-stream end of the crib was about 50 ft. below the pier. The influent pipe is cast-iron, flexible joint, 16 ins. inside diameter, and entered the crib in the side about 20 ft. from up-stream end. The stringers and cross-ties were 6 × 8 ins., and the cover was of 2-in. plank, all hemlock, and constructed the same as the Sharpsburg crib (see above). There was about 2 ft. of gravel on top of the cover, which was tight, and when river was at its lowest stage there was about 13 ft. of water over the gravel.

After the crib filled with gravel we concluded to construct a new crib and locate it about 70 ft. nearer the pumping station and away from the pier. The crib is 100 ft. long, 14 ft. wide and 4½ ft. deep, including the cover. The cover is 4 ins. thick and 24 ft. wide, extending 5 ft. over the body of the crib all around, so as to prevent the gravel from coming in contact with the body of the crib. The cover at the outer edge on the sides is spiked to 6 × 8-in. timbers. All lumber used is hemlock. There is 3 ft. of gravel over the cover, and 8½ ft. of water above the gravel. The influent pipe enters in through the cover, having an elbow at the end, and projects down into the crib about 3 ft.

On submitting the above description to Mr. John Wallace, Superintendent of the borough water-works at Millvale, he has sent us the following:

The first crib constructed did not fill up, but was washed away, and the influent pipe filled with sand. The second crib was constructed by the Borough of Millvale, under the superintendence of Mr. James T. Dickey and myself, Mr. Dickey being chairman of the water-works committee and I being superintendent of the works. The crib is there now and in good shape. All the rest of statement as to construction is correct.

In placing the second crib different means were used from those employed on the first crib. Stone was placed all around the crib and on top of it to a depth of 12 ft. It was then covered with 2 ft. of gravel. We have now the best of filters, barring none in the state, as the quality of the water derived from the same will prove to any one wishing to investigate the matter.

The water is lifted to a 420,000-gallon tank by means of two pumps, having a combined capacity of 4,000,000 gallons. The average daily consumption in 1896 was about 650,000 gallons.

Private Crib, Borough of Millvale.

The Bennett Water Co. built works here in 1890-1, with Jas. H. Harlow & Co., of Pittsburg, Pa., as engineers. This crib is 16 × 100 ft. by 4 ft. deep. Water is pumped to an elevated tank having a capacity of 280,000 gallons. No further information is available. The population of the borough of Millvale in 1890 was 3,809.

Purification Effected by the Filter Crib of the Pennsylvania Water Co, of Wilkinsburg.

The Pennsylvania Water Co. supplies the 37th ward of Pittsburg (formerly Brushton); the boroughs of Wilkinsburg, Edgewood and Rankin; and the townships of Sterrett, Braddock, Penn and Wilkins.

The population supplied is not given, but the average daily pumpage in 1895-6 was 990,000 gallons, and the maximum 1,750,000 gallons. The works were built in 1889-90, with Jas. H. Harlow & Co., of Pittsburg, as engineers. Mr. W. A. Alexander, of Wilkinsburg, is superintendent of the company. The supply was originally taken directly from the river, being pumped, as now, to a reservoir. In the fall of 1896 the company put in a filter crib, with Messrs. Harlow as engineers. No description of the crib is at hand, except that it does not differ materially in design from others built after the plans of the same firm, illustrated in our issue of May 10, 1894.

The engineers inform us that from the first of February to the last of September, 1897, a total of 29 bacterial examinations were made to determine the removal effected by the crib. The results show an average for the 29 analyses of 3,542 bacteria in the water directly from the river, and 266 in that from the crib, or a removal of 92.5%. Eight sets of samples examined in August and September, 1897, gave the following results:

	Water from— River.	Water from— Pump after passing crib.	Per cent. removed.
Aug. 4	200	71	64.5
" 10	450	35	99.2
" 17	9,910	86	99.1
" 25	1,980	168	91.5
Sept. 7	23,835	237	99.0
" 14	6,175	173	97.3
" 21	6,355	137	97.8
" 28	10,560	352	97.7
Average	7,433	157	98.2

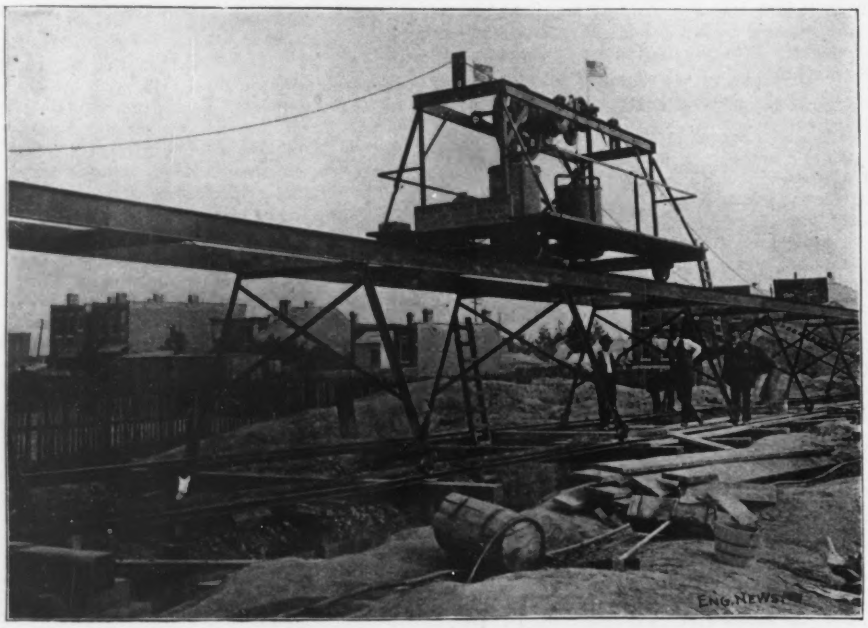
The engineers also state that independent bacterial examinations made by another party during July and August show about the same results as those just given. In addition, the same independent party made a series of chemical analyses. These showed a change in the water, as affected by the crib, from more or less turbidity to clearness; an increase in alkalinity and nitrites; sometimes an increase and sometimes a decrease in total solids, loss on ignition, chlorine and free ammonia; and generally a decrease in sulphuric acid, iron, albuminoid ammonia and nitrates. The highest total solids in the crude water was 44.8 parts per 100,000, the corresponding sample of water after passing the crib showing 14.0 parts. Generally the total solids in the crude water was not over 15 parts per 100,000. The average amount of chlorine in the water was not far from 2 parts per 100,000, but this was largely due to salt from oil wells. The deaths from typhoid fever in Wilkinsburg the year after the crib was put in operation, as compared with those for the previous year, and as compared with deaths from the same cause in both years in surrounding localities supplied with unfiltered water, indicate that the effect of the filters upon the public health has been beneficial.

A NEW TRENCH MACHINE.

We illustrate herewith a new trench machine for use in the excavation of sewer and other trenches in city streets which has been put on the market by the Potter Mfg. Co., of Indianapolis.

Most of our readers are now familiar, we presume, with the general operation of trench machines; but for the benefit of any who are not we may explain that in all machines of this class the dirt is excavated from the trench and hoisted in buckets, which are then carried to the rear of the machine and dumped over the completed sewer, water pipe, or whatever may be built in the trench. Thus the dirt is handled but once, and obstruction of the streets by dirt piled in them is avoided. The advantage in this respect is so great, that, in specifications for street work it is common now to specify that trench machines shall be used. Such a specification involves no additional cost to the city, since a contractor saves so much in labor by the use of the machines that he cannot afford not to use them on trenches of any considerable width or depth.

The machine illustrated herewith is of the steel trestle type, as shown by the engraving; and differs from other machines of this type chiefly in the apparatus upon the car. The upper horizontal frame of this carries three cross-shafts. The middle shaft carries a brake drum, the bull wheel for the traveling rope, and two drums for the separate hoisting ropes. Each of the other shafts carries a grooved wheel for a hoisting rope. A pulley at each end of the frame supports the traveling rope. This is a steel cable, which starts from the upper



VIEW OF THE POTTER TRENCH MACHINE.
Potter Mfg. Co., Indianapolis, Ind., Makers.

drum of the hoisting engine, passes along the trestle and over the traveler, around a tail-block pulley or sheave at the rear end of the trestle, and returns again to the traveler and passes round the bull wheel, to which it is attached. The other cable starts from the lower drum of the engine, and goes directly to an eye or ring in the front of the frame of the traveler. This latter cable holds the traveler stationary while the buckets are being raised or lowered, and pulls it forward again after the buckets have been dumped.

The buckets are raised and lowered by winding or unwinding the main cable on the bull-wheel, which, being attached to the same shaft as the drum, causes the bucket cables to wind or unwind on their drums. The machine is operated by the engineman in obedience to signals given by the man on the traveler. Ordinarily two buckets are handled at a time. The buckets are of steel, with a capacity of ½, ⅔ or 1 cu. yd. capacity.

The buckets used are either ordinary buckets with drop-bottoms, or a special drop-bottom bucket designed by the Potter Co., and illustrated herewith. The operation of this bucket will be apparent from the drawing. It is claimed that it will open and close automatically. A rope may be attached to tip it at any desired point. These buckets are made with a capacity of ½-ton to 8 tons.

A WATER POWER PLANT ON THE JORDAN RIVER, UTAH.

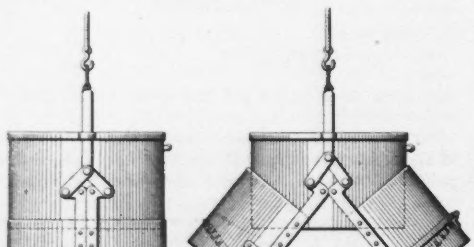
By W. P. Hardesty.*

An important water and electrical power plant is now under construction on the Jordan River, along the Rio Grande Western Ry., at a point 22 miles south of Salt Lake City. The Jordan River is the outlet of Utah Lake, and where it passes through the "Jordan Narrows" it has considerable fall, affording a good opportunity for the development of water power. Last summer a company was organized to utilize this, and within the past three months great progress has been made toward construction of a plant.

There are several large irrigation canals taken out of the river within the "Narrows," and the right to use one of these—the Utah and Salt Lake Canal—was purchased. The water for the power plant is thus conveyed from the head of the river's rapid fall to the lower end, where the power plant is located.

The canal runs through a very rough country, and no pains have been spared in its enlargement to meet the demands of the power plant to have all construction as substantial as possible. The old canal has been widened and deepened to four times its former capacity, and will now carry 600 cu. ft. per sec.

It has a fall of 1 ft. per mile, a bottom width of from 26 ft. to 36 ft., and carries 7 ft. depth of water. Three flumes will be constructed, of which the shorter one, of 200 ft., is now finished; the two longer ones, of 825 ft. and 1,200 ft., respectively, and which are cut-offs from the old canal line, will be built soon, the water for the present going around through its old channel. These flumes are 26 ft. wide, and carry 8 ft. of water. Opposite the site for the power plant a



Drop-Bottom Bucket for Trench Excavation.
Potter Mfg. Co., Indianapolis, Ind., Makers.

very strong system of gates is put in the canal, and a concrete masonry forebay is being built. From this, four lines of 72-in. sheet steel pipe will lead down to the power house, a distance of 300 ft.

The wheel-pit of the power house is 13 ft. × 82 ft. inside, the power house being 26 × 82 ft. There will be four 700-HP. McCormick turbines in two pairs.

Each turbine has two discharge or draft tubes, on account of having at times to discharge water at two different levels. The longer tubes discharge into the wheel-pit, from which a tail race leads direct to the Jordan River. The shorter tubes discharge inside the power house into tail races which lead to two other irrigation canals, one on each side of the river, and about 20 ft. higher than the same. During the irrigation season a full supply will have to be returned to each of these to compensate for the taking out of the water above their head-gates. Two different heads, one of 54 ft. and one of 74 ft., can thus be used on any turbine, according to necessity.

There will be four 500-K-W., three-phase, 300 revs. per min. generators, one direct connected to each turbine. The Westinghouse system of electrical machinery will be used throughout. The pressure pipes, turbines and other hydraulic machinery is being supplied by the S. Morgan Smith Co., of York, Pa. For the marketing of the electrical power, transmission lines will be built to Bingham, 12 miles distant, an important silver and lead mining camp, and to the Mercur gold mining camp, 21 miles distant.

At the present time the canal (except the two longer flumes) is finished; the very heavy excavations for pressure pipes, the wheel-pit and the power house are completed; the pipe and connections and the casings for the turbines are on the ground. The power house, of heavy concrete and brick masonry, will shortly be started, and it is expected to begin delivering power to Bingham and Mercur as early as June 15, the final surveys having been made and the poles distributed.

The name of the power company is the Salt Lake City Water & Electrical Power Co., with office at Salt Lake City. Mr. Allan G. Lampson is president, and Mr. R. M. Jones (the engineer who built the Big Cottonwood Power Co.'s plant), is chief engineer.

*Room 612, Progress Building, Salt Lake City, Utah.

A NEW SOLAR TRANSIT.

Several years ago the Ohio Society of Surveyors and Civil Engineers appointed a committee to test the accuracy of the indications of solar transits, with the purpose of removing, if possible, the apparent objection to their more extended use in land surveys. This committee obtained solar instruments of all the more prominent makers, excepting one only, and commenced a series of extended tests. The general conclusions of the committee as published in the Proceedings of the Society, were as follows: "That solar instruments as constructed might, with careful handling, be relied upon to work within an arc of two minutes; providing, however, that a known and accurately established meridian could be had on which first to test them." The committee became satisfied that the chief difficulty lay in the inability of ordinary surveyors to adjust the instruments accurately; and it also found that the chief objection of the profession to the use of solar transits arose from the fact that these additional adjustments are absolutely necessary and are very difficult to make, and that their maintenance was a matter of some uncertainty.

From the experience thus gained, Mr. J. B. Davis, of Cleveland, a member of the committee, began experimenting in the direction of eliminating these difficulties; and the final result was the new solar transit here described, which is now manufactured by Ulmer & Hoff, instrument makers, of Cleveland, Ohio.

In this instrument the transit telescope is used for solar work, thus obtaining greater accuracy by using a larger telescope. By the method of setting the reflector, the necessity for special solar adjustments is removed. The telescope has a fixed object end, and is so placed centrally that the line of collimation is adjusted on a fixed point by revolving the telescope in its sleeve. The reflector revolves with the telescope; and as the line of collimation represents the polar axis, this reflector is in proper relative position each time a solar observation is made, and without a separate solar adjustment.

The cross-hair ring, at the eye-piece end of the telescope, is provided with the usual vertical and horizontal transit hairs; but it has in addition two horizontal solar hairs, placed equidistant from the central hair. In this ring, the vertical hair is adjusted by the usual method of reversal, and the horizontal hairs can be adjusted by the revolution of the telescope in its sleeve, as is done with the Wye level. The needle and time graduations on the rim of the sleeve act jointly as a finder, to bring the image of the sun within the field of view.

The operation of this instrument is thus described by Mr. Davis for the two purposes noted:

To Dip Telescope to Known Latitude.

1. With the usual transit adjustments accurately made, carefully place the transit axis vertical by means of plate levels and telescope level, and with horizontal limb of transit registering zero (at zero as a convenience in reading the angle) sight a target to line and level.

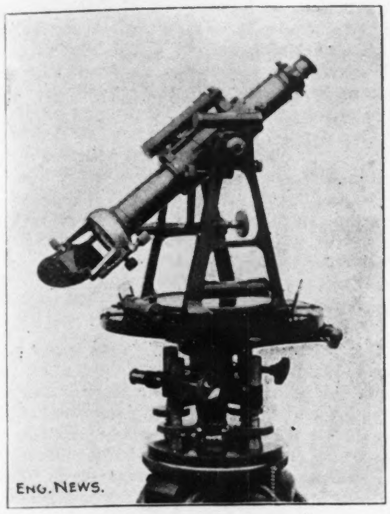


Fig. 1.—A New Solar Transit. Invented by J. B. Davis, C. E. Made by Ulmer & Hoff, Cleveland, O.

2. Set off on the transit limb an angle equal to the latitude of the place of observation, and with the telescope still horizontal, bring the image of the target center into the line of collimation of transit (see Fig. 2).

3. Return the telescope to zero reading on limb, it will then again point to the target center; loosen the set screw, which passes through an arm of telescope axis and engages the telescope, and rotate the telescope 90°, securing it in this position; dip telescope until the target center appears in the line of collimation, and bring the bubble of axis level to a central position (see Fig. 3). The telescope is now dipped to the required latitude angle, and the axis level enables the operator at any time to quickly and accurately determine the latitude position of telescope.

To Determine the Latitude by Instrument.

1. Place reflector at proper angles (as in instructions for finding the meridian which are given in Solar Pamphlet) to reflect the sun's image, when at noon declination, into the optical axis of telescope.

2. Having now set the reflector in its proper relative position to the line of collimation, rotate the telescope 90° in its sleeve, and secure it by set screw before referred to.

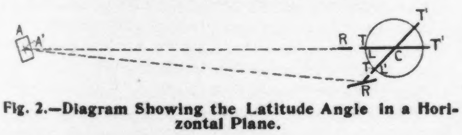


Fig. 2.—Diagram Showing the Latitude Angle in a Horizontal Plane.

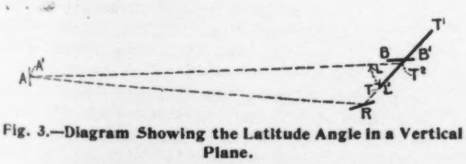


Fig. 3.—Diagram Showing the Latitude Angle in a Vertical Plane.

A—Target.
A'—Target center.
C—Transit center.
T-T'—Telescope.
R—Reflector.
L-L'—Latitude angle.
A'-C-R—Arc in a horizontal plane.
T²—Telescope axis.
B-B'—Telescope axis level.
A'-T²-R—Arc in a vertical plane.

3. Dip telescope and follow sun until it has attained its greatest altitude, and then set latitude or axis level in a horizontal position, in order that the telescope may be returned to the proper latitude position when desired.

4. To read latitude angle from transit limb, return the telescope to zero reading of limb and throw the image of target center into line of collimation. Now place telescope in a horizontal plane, and move it horizontally until target center is again seen in line of collimation, when read off the latitude from transit circle.

It will be observed that in this construction, the operation of dipping the telescope to the latitude of the place is a prior, instead of a subsequent operation to that of placing the reflector at its proper declination position for a meridian observation. This is so because, in determining the meridian, the declination position of the reflector must remain undisturbed until the observation is completed. And as the reflector is used in the combination for setting the telescope to latitude position, the transverse axis level becomes essential, as a means of re-establishing the latitude position of the telescope after the reflector is set to its declination position.

The operation of determining the true meridian with this instrument and the setting of the reflector, are the same as described in the "Solar Pamphlet," issued, in 1897, by Messrs. Ulmer & Hoff; with the exception of the operation of setting off and determining the latitude of the place, described above.

It will be noted that the usual vertical arc has been eliminated, with all its mechanical and operative objections. The result is a much greater simplicity of construction and greater accuracy in operation are also claimed. When more than one meridian observation is to be taken in the same latitude, the ease and rapidity of observations is materially increased.

In answer to a query regarding the necessity of having an assistant to set the target for use with this transit, Mr. Davis writes as follows: The setting of the target is as simple as the sighting of the target in leveling, and it requires no more time. It is this target-sighting method, together with the rotating telescope, that makes it possible to eliminate all solar adjustments. If circumstances require it, the target can be sighted within 12 ft. of the instrument; and it is difficult to conceive of any condition of rough country that would interfere with the use of the J. B. Davis transit that would not apply with equal force to any other transit.

With regard to measuring a vertical angle on the horizontal limb, Mr. Davis says that this method was not intended to take the place of a vertical arc in general practice, but only to replace the latitude arc in a solar transit. For practical reasons the method of setting off a vertical angle is not applicable for latitudes much lower than 20°; but this is a much lower latitude than any within the boundaries of the United States. Vertical arcs, and especially segmental ones, are very liable to error.

RAPID TRANSIT IN PARIS.

The Metropolitan Railway of Paris is to be commenced at once, in accordance with a decree passed on April 1, which also authorized a loan of $33,000,000 for that purpose. It is hoped that some of the divisions of the line may be open for the Exposition of 1900. The chief features of the project are electric traction, comparatively narrow cars, the construction of the roadway by the City of Paris and equipment and operation by a leasing company. The width of gage adopted is 4 ft. 8¾ ins., and the cars will be 7 ft. 10¼ ins. wide from out to out.

The route includes six distinct lines, which with branches have a total length of about 34.3 miles. These main lines are as follows: Porte de Vincennes to Porte Dauphine, traversing Paris from East to West; circular line on the old exterior boulevards; line completing the two first to the North, from Porte Maillot to Menilmontant; a North and South line across the city, from Porte de Clignancourt to Porte d'Orleans; line connecting the Boulevard de Strasbourg with the bridge of Austerlitz; line uniting the Vincennes Road with the Place d'Italie. The estimated total cost of the construction of these lines, without equipment, is $30,000,000; the balance of the capital authorized is for works of art and administration.

The leasing party is the General Traction Co. of Paris, associated with the Creusot Co. To provide for the payment of the capital in 75 years, at 3.33%, requires an annual revenue of $1,100,000. To secure this the city will receive from the leasing company a rental based upon a tax of one cent on each second-class ticket, either single or return, and two cents on each first-class ticket. This will require an annual passenger traffic of 110,000,000 people over the whole line, or about 3,213,000 per mile. This is not considered unreasonable, as the Auteuil line now annually transports nearly twice that number. The General Traction Co. will receive no subvention, nor guarantee of interest, and the price of tickets is fixed in advance, as follows: Three cents for a second-class ticket and five cents for first-class; with return second-class tickets at four cents, good until 9 a. m. With 125,000,000 passengers, and running expenses placed at 50%, the company figures that, after paying rental, there would be left about $625,000, or enough to pay the interest on its capital. When the passenger traffic exceeds 140,000,000 the company will have to pay a supplemental rent of .02 cent per passenger; and above 150,000,000 .04 cent per passenger up to 190,000,000. Above this figure the rental will remain fixed at 1.1 cents for second-class, and 2.1 cents for each first-class ticket.

The city reserves to itself the right of a maximum consumption of eight years in the building of the first three lines, and a further time of five years for the completion of the other three lines. This, however, is simply a precautionary measure, as it is intended to push the lines to completion as speedily as possible. The duration of the concession is 35 years; but the City of Paris reserves the right to acquire the line in 1910, and at the expiration of the concession the electrical installation becomes the property of the city without further payment.

The trains will be operated in sections of four cars each, with 50 places in each car; and it is required that not less than 16 nor more than 32 trains be run, each way, per hour. The speed is to be 22.3 miles per hour; or, including stops, 13 miles per hour. The stations provided number 123. Besides the lines established by the law of April 1, the Municipal Council proposes two other lines, not yet definitely located; these would be—from the Palais Royal to the Place du Danube, and from D'Auteuil to the Opera, by way of Grenelle. All work will be conducted by the ordinary technical staff of the City of Paris, which will be augmented as required, and for this special purpose an increase in pay is provided for. By the advice of the State Department and at the request of the Minister of Public Works, Parliament refused to sanction the control of working conditions imposing upon the leasing party by the Municipal Council. These conditions would have fixed, for the laboring force, a minimum of wages and a maximum of working hours; and it was ruled that these conditions were contrary to public policy and covered regulations that could only be fixed by a general law, applicable to every one.

THE INSTITUTE FOR THE HOME STUDY OF ENGINEERING and the Correspondence School of Technology, both of Cleveland, O., have consolidated under the name of the former. Prof. E. P. Roberts, of the Correspondence School, is technical director; Mr. F. D. Leslie is business director, and Mr. J. H. Norton secretary and treasurer. Both of these gentlemen have been connected with the Institute since its foundation. These schools were the first to give electrical courses by correspondence. The Institute for Home Study of Engineering confined its efforts to electrical and mechanical work, while the Correspondence School of Technology had courses in electrical, mechanical, civil, bridge and hydraulic engineering. All of these courses will be carried on by the consolidated institution, the engineers and instructors who have been connected with both continuing their connection. The new catalogue of the school announces a step in the direction of throwing off the character of privacy and entering the field of public institutions. The school is now partially under the control of an Advisory Board not financially interested and is so constituted that only a very moderate dividend can be declared to stockholders out of the earnings, the remainder being used for extension and improvement of the school's facilities. The members of the Advisory Board are: Mr. C. W. Wason, President of the Electric Club, of Cleveland; Prof. E. L. Harris, Principal of the Central High School, of Cleveland; Prof. Perry Hobb, Professor of Chemistry in the Cleveland Medical College, and Mr. Samuel Scovil, Vice-President and General Manager of the Cleveland Illuminating Co. Prof. Arthur L. Rice, of Pratt Institute, Brooklyn, is the representative of the school for New York and vicinity.

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To most people of sober minds and conservative ideas it seems difficult to realize that our country has undertaken a war with a European nation, with all that that implies. The matters of international politics which have led up to the war it is not the province of this journal to discuss. We only join with all good citizens in expressing regret that the beneficent purposes of the United States toward Cuba were not carried into effect through diplomacy and without a resort to that barbarous method of settling international disputes which still, despite our advanced civilization, remains the court of last resort.

The nation, through its authorized representatives, however, has decided that the circumstances justify it in resorting to arms to enforce its demands; and every good citizen, no matter how strenuous an advocate of peace he may be, must urgently desire to see so large a measure of damage inflicted upon the enemy at an early day that he will be compelled to treat for peace. This is the real object of modern warfare when pursued by an enlightened and civilized nation, to disable so much of the enemy's machinery of warfare, his ships, forts and armies, as will destroy his power to do harm, and to do this with the least possible destruction of life and property.

As for the probable course of the war, where the scene of the principal operations will be laid, what its probable duration may be, and to what extent the United States may suffer—questions that are in every one's mind, we shall attempt no predictions, for in these matters the wisest can offer nothing but conjectures. Of course, the ultimate outcome of the war cannot be doubtful since the contest is between a wealthy and powerful nation on the one hand, and a weak and bankrupt nation, with less than one-fourth the population of its opponent, on the other.

At present, and very properly, the Government's attention is given much more largely to defensive than offensive measures; and its promptness in completing the defenses of the principal Atlantic ports, and in providing a large fleet of auxiliary merchant vessels for scout, patrol and picket duty deserves the highest praise. With Spain's coaling stations on this side of the Atlantic in our possession, any offensive movements on her part must be conducted from a base of operations on the other side of the Atlantic, and her great disadvantage in this is evident.

The steps already taken toward increasing the army are apparently on a scale sufficient for any operations that now seem likely to be undertaken; but thus far the feeling seems to have been that there was little use in providing for an increase of the Navy, since the war would probably be over long before any vessels now undertaken would be ready to take a part in it. We sincerely hope that this may prove to be the case; but inasmuch as we are almost as badly handicapped as Spain herself in any attempt to wage war against the enemy on his own coasts, we ought at least to set about strengthening our Navy in its notably weak places, and if the vessels are not needed for the present emergency after all, so much the better. They will be additions to the Navy which ought to be made in any event. First on the list should be placed torpedo-boats. Compared with any other modern naval power, the United States is exceedingly deficient in these vessels. They cost but a small sum; they can be built in a few months, and our shipyards on the Lakes could readily turn them out, cutting them in two to pass through the Erie Canal. A fleet of at least 25 of these vessels would be none too many to correspond with the present strength of our Navy in other vessels. The torpedo-boat destroyers, as they are called, are another type of vessel on which other naval powers set the highest value, but of which we possess not a single example. With a speed of 30 knots or more, this class of vessels can escape from any vessel their superior in armament, and in foreign navies they are considered absolutely essential for the protection of fleets from torpedo-boat attacks. While destroyers require longer to construct and are more expensive than torpedo boats, it is beyond question that the United States should have a considerable number in its Navy and their construction ought to be undertaken at once.

The third class of vessels that ought to be put under way is the fast armored cruiser, similar to the "New York" and "Brooklyn," with armor enough to protect against all but large-caliber projectiles, armament of 8-in. guns and smaller and a speed of at least 20 knots that will enable her to escape from a heavily-armored battle-ship and to pursue and overtake any vessel for which she is a match. If we are to be obliged to attack Spain on her own shores to compel her to make peace, we cannot lay the keels of more vessels of this class too soon.

The very rapid increase, by purchase, of the number of vessels in the U. S. Navy has compelled the formation of a corps of volunteer officers to man the new ships; with the relative rank and pay of officers of the regular navy, but with commisions terminating at the will of the Secretary of the Navy. Boards to examine applicants for positions in the line, steam engineering, pay and medical corps have been appointed by the government, and these boards are now actively at work selecting from the candidates already before them the men best fitted for the service required. In our issue of March 24, in commenting upon the new Naval Personnel Bill, in connection with the prospects of war, which then existed, some reference was made to the civilian graduates of technical schools seeking appointment in the steam engineering corps of the Navy, and the chances they had under the terms of the bill referred to. An actual state of war and an urgent call for officers from civil life have radically changed the conditions then existing; and in response to requests for information we here give, from an official source, the method to be followed by those seeking service in the Volunteer Steam Engineering Corps of the U. S. Navy.

By the courtesy of Passed Assistant Engineer Walter M. McFarland, U. S. N., of the Bureau of Steam Engineering in the Navy Department, we are enabled to say that anyone desirous of entering this branch of the service must first make a formal application to the Bureau of Steam Engineering, at Washington; and accompany his application by a brief statement of age, state of health, technical training and actual experience in the handling of marine engines. These applications will be placed upon record; and as occasion demands the Chief of the Bureau will select from the list such men as seem best fitted for service; notify them of the selection, and issue to them permits, or orders, to report for examination, at Philadelphia, Pa. The applicant will first have to pass before a medical board, and will then be called before a board made up of engineer officers of the U. S. Navy. The technical examination will generally follow the lines laid down by the U. S. Inspectors of Steam Vessels, for the examination of applicants for the positions of chief and assistant engineers on ocean steamships. If successful, the candidate will then be recommended for such grade as his actual training and experience may justify. Acting commissions will be issued by the Secretary of the Navy to accepted men, as follows: Chief Engineer, with the relative grade of Lieutenant, U. S. N.; Passed Assistant Engineers, with the relative grade of Lieutenant, or Lieutenant, Junior Grade; and Assistant Engineers, with the relative grade of Ensign in the U. S. Navy. The annual pay for these grades, for the first five years in service, is $2,400, $1,800 and $1,200, respectively; with one ration additional, worth about $108 per year more. As before mentioned, these acting commissions will continue in force during the pleasure of the Secretary of the Navy; but while they are in force the holder is, for all essential purposes, an officer of the Navy of the United States, with full authority as such.

Our remarks of March 24 were based upon the recommendation then made by Congress, that, instead of adding to the engineering staff by the appointment of 109 junior engineer officers, it would be wiser to enlist about 100 men of the machinist class, ranking as warrant officers, and of long experience in the actual care, repair and handling of marine engines and boilers. The belief was then expressed that this would be a safer course for the Navy then in existence, than the employment of young men, of, perhaps, far superior technical training, but of less actual value in an emergency; and young men, fitted for this employment, were warned of the social difference in rank between a warrant officer and a commissioned officer in the U. S. Navy. While there is now an urgent call for enlisted men qualified to act as machinists, electricians, etc., on board of warships, the decision of the government to make use of volunteer officers opens the door to the services of the graduates of the technical school who possess the necessary experience and qualifications. About 500 applications are now on file at Washington for positions in the line, steam engineering, pay and medical corps of the Navy. From this list the Chief of the Bureau of Steam Engineering has already ordered a number to Philadelphia for examination; and these latter applications include seven graduates from the Naval Academy, now in civil life, some professors of steam engineering at leading technical schools and engineers of experience on fast merchant steamers. From present indications, at least 200 volunteer officers of line and staff rank will be needed for the present emergency, and the best of these men will stand a very good chance of being permanently retained in the regular Navy, after the war is over.

It might be well to add, for general information, that applicants for service in the machinist class of assistants to the steam engineers, here referred to, must possess the following qualifications: Their enlistment is for a term of three years; they must be in sound physical condition; not less than 21 nor more than 35 years old; be able to write legibly and have some acquaintance with arithmetic; be machinists by trade, and be familiar with the parts and uses of marine engines and boilers, and be thoroughly trained in the use of tools. They will be rated as follows, according to experience: Second Class Machinists are those who fill the above conditions, but have no experience with marine engines; pay, $40 per month and one ration. First Class Machinists are those who have had at least one year's experience at sea with marine engines; pay, $50 per month and one ration. Chief Machinists must already hold a permanent appointment as such, and they will have charge of engine-room watches; the pay is $70 per month and one ration. Enlistments for the position of electrician on board of warships are also provided for, upon similar lines as to age, health and technical qualifications. There are three grades of electricians, ranging in pay from $35 to $50 per month, according to experience and usefulness. Applications for these positions are made at the several government navy yards.

In discussing the equipment of freight cars with air brakes in this journal some years ago, we suggested that when the number of air-brake cars became sufficiently numerous, it might be well to adopt the plan of equipping some cars with an air pipe and hose merely, so that air brake cars could be distributed through the train and save the trouble of sorting them out and bunching them next the engine. On many classes of freight trains it is often inconvenient to bunch the air brake cars, arranging all the cars in station order or division order being much more desirable. On several Western railways this matter of equipping old cars with the train pipe alone is being taken up. At a recent meeting of the Western Railway Club, Mr. G. W. Rhodes, of the Chicago, Burlington & Quincy R. R., stated that the equipment of a thousand cars in this manner was under consideration on that road. It will be remembered that the Federal Safety Appliance law, the operation of which has been postponed by the Interstate Commerce Commission to Jan. 1, 1900, requires that every train shall have at least enough air brake cars to enable its speed to be controlled without hand brakes. What proportion is necessary to do this, is left to the railways to determine; and it is evident that the proportion would be quite different on the steep grades of some of the transcontinental roads and on the railways in the prairie states. On these latter roads, and on the average railway throughout the country, it is probable that trains can be safely operated when one-fourth to one-third the cars are air-braked.

There are thousands of old freight cars in service on which their owners will hesitate to expend the cost of the air brake equipment. Most of these cars will be used in the local service, and by equipping them with train pipes, such air-braked cars as are in the train can be put wherever they happen to come. The objection which will doubtless be raised against this plan is that the emergency application of the brake is likely to be interfered with if four or five cars fitted with piping alone should happen to come together. On the other hand, the present tendency in handling air brakes is to confine the use of the emergency application to actual emergencies. With the brake intelligently handled, it should be possible to stop a train as smoothly with the service application when the air brake cars are scattered through the train as when they are bunched at the head. As for the emergency application, when it becomes necessary to throw this on suddenly, we apprehend that the shocks will be less severe with the air brake cars scattered through the train than with all of them bunched next the locomotive.

THE MAKING OF AN INDEX.

What constitutes a good index? This question is raised by a correspondent in a letter which we publish in this issue, and it merits a careful answer. If, moreover, we may judge from the indexes of many engineering treatises a discussion of the principles of indexing may be of service to a good many of the writers of such books, and of especial value to those who have to read and refer to them. It is a mistake to assume that the subject is too simple a one to demand study. There are few other tasks in the routine of book-making which demand more thoughtful care in order to secure even moderately good results. If this were more generally understood by scientific writers, there would be fewer occasions for such criticisms as the one for which our correspondent elsewhere takes us to task.

We may, we think, assume without argument, as a point on which all engineers will agree, that a good index is a very necessary adjunct of any technical book, and especially of any designed as a work of reference. We can pass this phase of the question, therefore, and turn our study at once to the original query, what constitutes a good index? According to the definition given by the Century Dictionary, an index is: "A detailed alphabetic (or, rarely, classified) list or table of topics, names of persons, places, etc., treated or mentioned in a book or a series of books, pointing out their exact positions in the volume." In the original Latin the word index meant a discoverer, informer, indicator, or that which points out, hence, particularly, the index finger. It is, perhaps, the main fault of the definition just quoted that it does not emphasize a little more the distinctive office of indicator or pointer-out, which the index to a book occupies. A better definition in this respect would be the following: An index is an alphabetic list of catch words or key words of the topics, persons, places, etc., mentioned in a book, with numerical references to the exact positions of these topics, names, places, etc., in its pages.

Neither of these definitions, as a matter of fact, expresses fully the exact nature of a good book index. Nearly all topics are divided into subtopics, and these are often divided again into minor topics. In the best form of indexes only the key words of the main topics are arranged alphabetically with respect to the index as a whole, those of each sub-topic being arranged under its proper main topic in alphabetical sequence in respect to themselves alone. This subdivision of alphabetic lists may be extended to any degree which the nature of the topics makes desirable. In other words, the element of classification as well as that of alphabetic arrangement enters into the selection of the key words, which with their proper modifying and qualifying words, and page references, constitute an index. The selection of distinctive key words, their proper classification, and finally their alphabetic arrangement are what distinguish the index proper from a detailed table of contents.

Keeping alphabetic arrangement and classification in mind, the first duty of an indexer, having before him a number of topics, reference to which is desirable, is to select for each of those topics a key word which a person wishing to refer to that particular topic is most likely to think of and seek. This is evidently in many cases purely a matter of judgment, and it is the difficulty of judging exactly what word another person will think of in any particular case which makes necessary cross indexing and cross reference. By cross indexing is meant the indexing of the same topic under two or more possible key words. Cross referencing is a similar process, but one of a somewhat different nature. Rather broadly defined, a cross reference is a parenthetical expression following a key word which refers the reader to another key word where the topic is fully indexed, or where additional or closely-allied information is to be found. As examples of both cross indexing and cross reference will be given further on, we shall not analyze these processes further here.

Although the selection of proper key words is not a process which rules alone can direct, it is evident from what has been said that there are certain general principles governing this work which the indexer should always strive to follow. To illustrate these rules we will review some of the headings to which our correspondent refers in his letter in another column. His first analysis is the following:

> Although "assumed uplift for draw spans" is not under "draw spans," we find it under "uplift," which is the fundamental idea in the item.

It may be noted here in explanation that draw-spans is used by the author of "De Pontibus" to mean swing spans alone, and not as a generic term for movable or opening bridges in general. The propriety of this usage is very doubtful. It is quite true that draw bridge is not a very good generic term for opening bridges, but it has become established by general usage and should be maintained until some better term is offered. Therefore, the prevailing choice of engineers, we think, would be to use draw spans as a name for the class under which come swing spans, bascule spans, vertical lift spans, etc., as types. This would, of course, entirely alter the position of the topic quoted in the index.

Retaining the special meaning of draw spans chosen by the author, however, there are two very important reasons to our mind why this topic should be indexed under the key word "draw spans." First, "uplift" in its special meaning here is peculiar to draw spans alone, and as a reader would have draw spans only in mind, and never fixed spans, lift spans or bascule spans, when seeking information respecting uplift, "draw spans" seems at least as desirable a key word as "uplift." Second, "uplift" is a sub-topic of the main topic "draw spans," and, like all other subtopics of the same main topic, should be included as a sub-topic under the key word of the main topic in the index.

The full force of this last reason will be seen if we assume that a person wishes to look up all that the able author of "De Pontibus" has to say concerning draw spans. His natural course would be to look under "draw spans" in the index and consult every reference he found there, and, not finding uplift, he would miss this important topic altogether unless he were familiar enough with the subject to notice the omission and curious enough to institute a search elsewhere. Such a search obviously entails labor which might have been rendered unnecessary by a little thoughtfulness on the part of the indexer; but worse than this, it endangers the entire missing of an important topic by a thoughtless or uninstructed reader.

Undoubtedly, "uplift" is also a possible key word for this topic and one which under certain circumstances might be thought of by a reader rather than "draw spans." It is advisable, therefore, to cross index the topic under "uplift," unless it should happen to be divided into several sub-topics, when the key word "uplift" should be made merely a cross reference to "draw spans," under which would be found, for the reasons just given, a full detailed index of uplift and all of its sub-topics. In such a case it will be seen that a cross reference saves space by avoiding a lengthy repetition. Were there no sub-topics under uplift to be repeated, then cross reference, instead of cross indexing would be a fault because it would necessitate the reader making another search to find nothing additional but the page number, which might just as well have been given him at once.

In the preceding analysis of the topic noted by our correspondent we have adopted the nomenclature used in the book whose index he defends. As already stated, we think this nomenclature to be in error and it may be of benefit to point out just how we should index this topic to suit the nomenclature preferred by us, particularly as it will afford an opportunity to illustrate another use of the cross reference. Making draw bridge the generic term for opening bridges of all kinds, then swing bridges, bascule bridges, etc., are simply types of draw bridges. Under "draw bridges" then we should index those topics which applied to opening bridges in general; for instance, conditions which determine the type of draw bridge to be chosen, legal restrictions governing the width of clear opening required of draw bridges over navigable waters, etc. Last, we should cross reference the key word thus, "draw bridges (see swing bridges, bascule bridges, vertical lift bridges, etc.)" Under "swing bridges" we should index all the topics belonging to that type of bridge alone, and also cross reference it thus, "swing bridges (see also draw bridges)." Uplift would then be indexed under "swing bridges" and cross indexed under "uplift." Exactly the same method would be followed with bascule bridges, vertical lift bridges, etc.

It has been made clear, we think, by the foregoing that the "fundamental idea" of a topic (as our correspondent calls it), considering that topic by itself alone, is not always a criterion by which to select the key word under which to index it. Instead, the thought should be first of the classification under which the topic properly comes, and second, what position in this classification the topic occupies; that is, whether it belongs to the main topic, or is a part of a sub-topic under a general main topic. The reason for this will be seen if we remember that ideas cannot be alphabetized. Only words are susceptible to this form of arrangement. Hence the position of any particular idea in an alphabetic list is determined by the sequence of words employed to express the idea; one arrangement of words may place it near the beginning of the alphabet while another will place it toward the end, and the reader has nothing upon which to base his judgment as to where it will be found.

If, however, we first classify the ideas we wish to make reference to into main and subclasses proceeding from the general to the particular we finally limit the field in which the idea may be located so that it can be found easily and certainly.

Turning now to the last example mentioned by our correspondent, he says:

> "Character of flange-sections for plate girders" is not under "plate girders," but it is under "sections for compression flanges of plate girders." Here, again, the main idea is "section of flanges" and not "plate girders."

The topic should be indexed under the key word "plate girders" for exactly the same reason that was given above for indexing uplift under "draw spans." A cross reference or cross indexing might be neglected altogether without any great harm, but in case one is deemed desirable the whole word "flange-section" should be used as the key word, as neither "flange" nor "section" expresses the thought any more than "plate" or "girder" taken by itself expresses the thought expressed by "plate girder." It may also be noted here in answer to our correspondent's first sentence in the paragraph in which this example is stated that we find altogether nine other topics with the key word "sections" in the index of "De Pontibus" and in none of them is it the proper key word to use.

Before passing from these examples finally we wish to call attention to the absolute uselessness of selecting such words as "assumed," "best," "character," etc., as key words. In the first case the topic to be indexed is the proper amount of uplift to be assumed and adopted in designing draw spans. We might then with equal propriety select "proper uplift for draw spans" or "adopted uplift for draw spans," or "amount of uplift for draw spans," instead of "assumed uplift for draw spans," and there is no reason to suppose that a reader using the index would not be as likely to look for one as for another. Similarly, instead of "character of flange section, etc," one might choose with equal propriety "nature of flange section," "make up of flange section," "composition of flange section," "design of flange section," either of which would express the topic indexed quite as accurately as "character of flange section."

Still, again, the index contains four references under "best." Besides "best kinds of metal paint," already alluded to, we have "best lengths of tape-lines," "best method of letting bridges," "best sections for columns," "best span-length for bridges," and "best span-lengths for trestles." But will a reader be likely to look under the head of 'best" for these topics any more than he would under "best" for a hundred other matters of which Mr. Waddell has treated in this book, where a best kind of material or best design, method or workmanship has been pointed out.

Further, it is a cardinal rule of good indexing that if a key word is used at all then every possible reference under that head should be included. If, for example, "plate girder" is used as a key word at all, then the reader has a right to expect that everything regarding plate girders which the author has to say will be included in some form under that head.

Another mistake which our correspondent makes in common with many others is that of assuming that mere length of volume constitutes a merit in an index, when, as a matter of fact, it is one of the most important things to be avoided. An index is essentially a device to save the reader time; and every unnecessary item is a flaw, because it adds to the bulk of the index and in some degree makes it less convenient for use. It is a redundant member which does not possess even the merit which such members sometimes do in a bridge, of enhancing its appearance. An index which takes up only 4 per cent. of the total pages of a book may be far superior to one which occupies 9 per cent. of the total number of pages. By carrying this particular comparison of our correspondent's a little further than he does in his letter we can illustrate this point and several others in addition.

A hasty estimate shows that Trautwine's pocket-book in 33 pages indexes about 4,600 items, while "De Pontibus" in 31 pages indexes 1,500 items. If the indexer of "De Pontibus" had had the same number of items to index as did the indexer of Trautwine's pocket-book his index would have occupied 90 pages, or, to reverse the case, Trautwine's indexer would have put the 1,500 items of "De Pontibus" into ten pages of index. There cannot be much doubt, it seems to us, as to which of these indexes in either case would be the most convenient. This saving of space in Trautwine's pocket-book is accomplished; (1) By using a smaller type; (2) by using two columns of index to each page, and (3) by the far greater discrimination shown in the selection of key words, in classification, and in workmanship in general.

This brings us to still another important consideration in the construction of an index, namely, its typographical make up. In the first place a much smaller type, providing it is clear, may be used in the index than would be allowable in the text proper of the book, and unless the page of the book is very small it is almost always possible nearly to double the number of items per page by arranging the index in double columns. The arrangement of the key words of the main topics alphabetically in respect to the index as a whole, and, also, the alphabetic arrangement of the key word of each sub-topic under the key word of its superior topic has already been mentioned. The relative dependence of the various key words is best indicated by indenting the subordinate key words and employing capital initial letters for the main key words and lower case initials for the subordinate key words.

For the sake of making clear our discussion of this subject, and at the same time answering our correspondent's letter, we have used the index of Mr. Waddell's book to illustrate the various principles which we have endeavored here to set forth; but most of the defects which we have explained are far from being peculiar to this book. It is the exception to find an index in an engineering treatise which bears on its face evidence that its author was acquainted with the principles of correct indexing; nor is this at all a thing to be wondered at. That a man who is absorbed in professional work and studies should be unfamiliar with the technicalities of index making is entirely natural. Nevertheless, in these days of the multiplication of technical literature the responsibility on authors and publishers of providing complete and convenient indexes to all works of reference cannot be denied, and the lack of it furnishes proper ground for criticism.

Our criticism is tempered, however, with the knowledge that the defect to which we have called attention is due to inadvertence rather than to carelessness or neglect on the part of the author; and that he is deserving of the thanks of the profession for the valuable contribution which he has made to its literature.

If this necessarily brief discussion shall serve to make clearer to authors of technical works the true principles that should govern their indexing, and to the readers of such books the methods to be pursued in making use of an index, our object will have been accomplished.

LETTERS TO THE EDITOR.

Specifications for Portland Cement, Philadelphia Department of Public Works.

Sir: In the issue of Engineering News for April 7 there appears a table, "Showing the Principal Features of Specifications for Portland Cement, etc.," in which is given the requirements of the Department of Public Works of this city. The requirements given are those for the year 1896 only and not those for the year 1897. I enclose herewith a copy of the standard specifications of this city, and a diagram showing the average yearly tests and the corresponding increase in the requirements since the year 1892. You will observe that the specifications for the year 1897 are considerably higher than those given in the table in the Engineering News.

Yours truly,
Richard L. Humphrey,
In charge of Testing Laboratory.

City Hall, Philadelphia, Pa., April 12, 1898.

(The diagram which our correspondent incloses was published in a slightly different form in our issue of May 7, 1896. As compared with the figures given in the table published in our issue of April 7, 1898, the later specifications mentioned by our correspondent have the following different requirements:

Age.	Tensile strength. Lbs. per sq in.
Neat cement:	
24 hrs., in water after hard set	175
7 days, 1 day in air, 6 days in water	500
28 " 1 " " 27 " "	600
Mortar, 1 cement, 3 sand:	
7 days, 1 day in air, 6 days in water	170
28 " 1 " " 27 " "	240

As we have stated before, these requirements of the Philadelphia Department of Public Works are unusually high.—Ed.)

Steel Tank Grain Elevators.

Sir: Regarding the very interesting description of the "Great Northern Elevator," at Buffalo, in your issue of April 7, I would say that while you were probably correct in describing this elevator as a new style of construction in elevators, yet the essential principles were long ago utilized, barring the steel column framework and hopper hemispherical bottoms. In confirmation of this statement, I will give a short description of the "Washington Avenue Elevator" of the Girard Point Storage Co., located on the Delaware River, at the foot of Washington Avenue, Philadelphia, Pa.: This structure was started in 1859, and completed about 1863, being put in service in 1866. The elevator has a capacity of about 375,000 bushels and was considered at the time of its construction a mammoth structure.

Structural Features.—The skeleton of the building is of cast-iron columns in the external walls, with brick paneling between. It has a trussed roof carried on the sidewalls independent of the interior columns. The grain tanks are 88 in number; of wrought iron, varying from 5-16-in. to ⅛-in. and built up in courses about 2 ft. wide. These tanks are 11 ft. in diameter and 48 ft. deep. They are flat bottomed, which necessitates some shovelling in cleaning out the bins, but in some of them wooden hopper-shaped bottoms have been introduced to avoid this difficulty. The tanks are supported on a floor system of cast-iron girders, resting on cast-iron columns, which extend only to the bottom of the tanks, which are about 15 ft. from the yard level.

It is interesting to note in this connection, that although located close to the water and subject to locomotive gases, the cast and wrought iron in this structure is in excellent condition, after about 37 years of service. The ironwork has been painted on an average of once in seven years. The interior of tanks not at all.

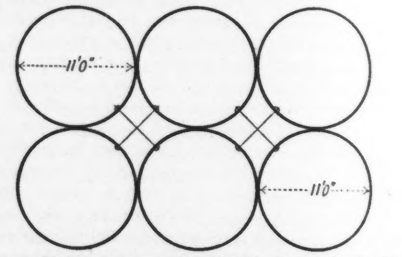


Diagram Showing Arrangement of Tanks in the Washington Ave. Grain Elevator, Philadelphia, Pa., Built in 1863.

From the sketch it will be noted that the tanks are tied together with rods. The purpose of this is to utilize the space between the tanks for storage, which is done successfully. It will thus be seen that in this respect the Washington Avenue Elevator presents a point in simplicity of construction and economy of space in advance of the Great Northern Elevator. The tanks are also tied together at the tangent points by bolts and cast-iron fillers.

Movement of Grain in Tanks.—I read in your issue with much pleasure the article by Mr. Toltz on the "Movement and Pressure of Grain." I wish to call attention to a practical point that is probably known to most elevator men, but perhaps may be news to the engineering public:

When the hopper or drop-bottom shutter in a bin is opened for the exit of grain, a movement takes place much like the action of water. A funnel-shaped cone extends up through the grain and this central movement is so strong and extends to such a height that in one case, of which I have knowledge, it proved fatal to a workman on top of the bin, sucking him in at a distance of nearly 50 ft. from the bottom. The cutting action of grain in running over metal surfaces is remarkable. I have seen wrought iron plate of ⅛-in. thickness, with grain running at an angle of 40°, cut like a sieve.

Relative Merits of Steel and Wood.—As to the relative merits of steel and wood in elevator construction, I wish to say that steel possesses other advantages besides the most prominent one of, immunity from fire, that you mentioned. Insurance costs are much less naturally, in a steel elevator. Grain is subject to various diseases. These are the result of micro growths and fermentation. The wood in or around grain is a germinating habitat for such organisms. The heating of grain, caused by these growths, is a serious feature. It has been proved by experience that steel or iron is much safer in this respect than wood. As to heating in one tank causing trouble in adjacent tanks or in bins between tanks, I would say that at the Washington Avenue Elevator a case occurred of a bad lot of grain that went pretty far in fermentation in one of the bins between tanks, but this caused no trouble in the adjacent tanks. If wood must be used around grain it would seem that experience has demonstrated yellow pine to be less objectionable on the ground of micro growths than other woods.

I wish to say in conclusion that there is another elevator of the Washington Avenue type near Kelsey's Stores, Brooklyn, N. Y.

Yours truly,

G. W. Chance, C. E.

14 So. Broad St., Philadelphia, Pa., Apr. 20, 1898.

(In reference to the paper on "Lateral and Vertical Stresses in Grain Bins," to which our correspondent refers above, we are requested by Mr. Max Toltz to state that he neglected to mention that it was translated from an article published in "Centralblatt der Bauverwaltung, in 1896. Mr. Toltz also calls attention to the following typographical errors which appeared in his translation: In line 18 from the top of the first column "$P_1 F_4$" should read $P_1 F$, and in line 8 from the bottom of the second column "ρ," should read ρ_1 —Ed.)

Table of Coefficients for Designing Bridge Portals.

Sir: In the article on "Table of Coefficients for Designing Bridge Portals," sent you by Mr. C. S. Davis, Engineer Massillon Bridge Co., which appeared in Engineering News for Feb. 10, there would appear to be an error in the expression for the direct thrust in the main strut of the portal, which is presumably stated for the sections of the strut suffering a maximum thrust, viz., the end sections. The expression given for the thrust, $\frac{P}{2}$, is correct for the middle section of the strut, but for the windward section, i. e., between the windward end of the strut and the point of attachment of the knee-brace, the thrust is not $\frac{P}{2}$, but is

$$= -P - \frac{P}{2}\left(\frac{l-b}{b}\right)$$

which, with the dimensions of l and b ordinarily used where this type of portal is adopted, would give five or six times the thrust for which the article directs the strut to be proportioned. The shear in the plane of the portal, while correctly given for the middle section of the portal strut, should have the value

$$+ P\frac{1}{a}\left(½ - \frac{a}{w}\right)$$

in the windward and the leeward sections of the strut, and these values will exceed the shear in the middle sections when a is less than $\frac{W}{4}$.

If, as is apparently assumed, the web is not designed to carry any of the direct thrust nor bending-moment stresses, and if the bracket connection with the strut is so designed as to distribute its stress to both flanges of the portal strut, the stresses in the two flanges will always be widely different and for all probable values of $\frac{a}{W}$ will be opposite in sign, i. e., the strut will in reality be a girder, the two ends suffering bending moments of opposite signs. This being the case it does not appear that the formula for the area of both flanges, as given in the article mentioned, will be sufficient for the determination of the flange areas. This will be evident from an examination of the expressions for the flange stresses under the assumption mentioned above. These expressions are as follows, tension being indicated by the plus sign and compression by the minus sign:

Windward section, leeward end of section—

Upper flange: $P\left[-\frac{1}{2} - \left(\frac{l-b}{4b}\right) - \frac{l}{d}\left(\frac{1}{2} - \frac{a}{w}\right)\right]$

Lower flange: $P\left[-\frac{1}{2} - \left(\frac{l-h}{4b}\right) + \frac{l}{d}\left(\frac{1}{2} - \frac{a}{w}\right)\right]$

Middle section, windward end of section—

Upper flange: $P\left[-\frac{1}{4} - \frac{l}{d}\left(\frac{1}{2} - \frac{a}{w}\right)\right]$

Lower flange: $P\left[-\frac{1}{4} + \frac{l}{d}\left(\frac{1}{2} - \frac{a}{w}\right)\right]$

Middle section, leeward end of section—

Upper flange: $P\left[-\frac{1}{4} + \frac{l}{d}\left(\frac{1}{2} - \frac{a}{w}\right)\right]$

Lower flange: $P\left[-\frac{1}{4} - \frac{l}{d}\left(\frac{1}{2} - \frac{a}{w}\right)\right]$

Leeward section, windward end of section—

Upper flange: $P\left[+\left(\frac{l-b}{4h}\right) + \frac{l}{d}\left(\frac{1}{2} - \frac{a}{w}\right)\right]$

Lower flange: $P\left[+\left(\frac{l-b}{4b}\right) - \frac{l}{d}\left(\frac{1}{2} - \frac{a}{w}\right)\right]$

The notation here is the same as that used by Mr. Davis, with the addition of d = depth of girder between centers of gravity of flanges.

As an example of the widely different stresses which the flanges are subject to, in a portal of general average dimensions, the following results are derived from the above expressions for a portal in which l = 20 ft.; W = 12 ft.; a = 4 ft.; h = 5 ft., and d = 15 ins.:

	Sections. Windward. Windward.	Windward. Leeward.	Middle. Windwrd	Middle. Leew'rd.	Leeward. Windwrd	Leeward. Leeward.
Upper...	$-1¼$ P	$-3^{11}/_{12}$ P	$-2^{11}/_{12}$ P	$+2^{5}/_{12}$ P	$+3^{5}/_{12}$ P	$+¾$ P
Lower..	$-1¼$ P	$+1^{5}/_{12}$ P	$+2^{5}/_{12}$ P	$-2^{11}/_{12}$P	$-1^{11}/_{12}$ P	$+¾$ P

Respectfully yours,

Olin H. Landreth.

Union College, Schenectady, N. Y., Feb. 14, 1898.

(We referred the above letter to Mr. Davis, who sends us the following reply.—Ed.)

Sir: I have your letter of the 19th inst., together with the communication from Professor Landreth, and in reply would say, that I have checked his formulæ and found them correct. The expressions I gave for shear and thrust were not intended to represent maximums in either case, but only the shear and thrust for the center section of the portal, where they give true values under the conditions assumed, viz.: that the wind load is divided equally between the end posts of the bridge and that the lower ends of the posts are considered round ends.

A large portion of the portals put on highway bridges in this country do not have their sizes figured. They are built like others that have gone before or are designed by guess. A very small portion have their sizes determined by correct methods. This may be accounted for by the fact that no simple method of determining the sizes correctly has been generally known. I have attempted to give a formula that will be easy to handle and with the set of coefficients given is not very intricate.

Quite often the space between the bracket, post and portal is filled in with a solid plate, or lattice like the main portion of the portal. In cases of this kind the weak point is at the point of attachment of the bracket to the portal. Sometimes brackets are used merely for ornamentation, and in such cases they should not be counted upon to carry any strain. With a little caution I believe the formula given can be used with perfect safety. In fact it gives larger sizes than are ordinarily used.

In regard to the inequality of the stresses in the two flanges of the portal would say that I have used a formula commonly used for proportioning beams or girders that are subject to direct thrust as well as to bending. The advantage of this is that it is not necessary to determine the stresses in the flanges.

While Professor Landreth's method is correct for finding the stresses, he gives us no guide to tell what material to use after the stresses are determined.

Yours truly,

C. S. Davis.

Toledo, O., Feb. 26, 1898.

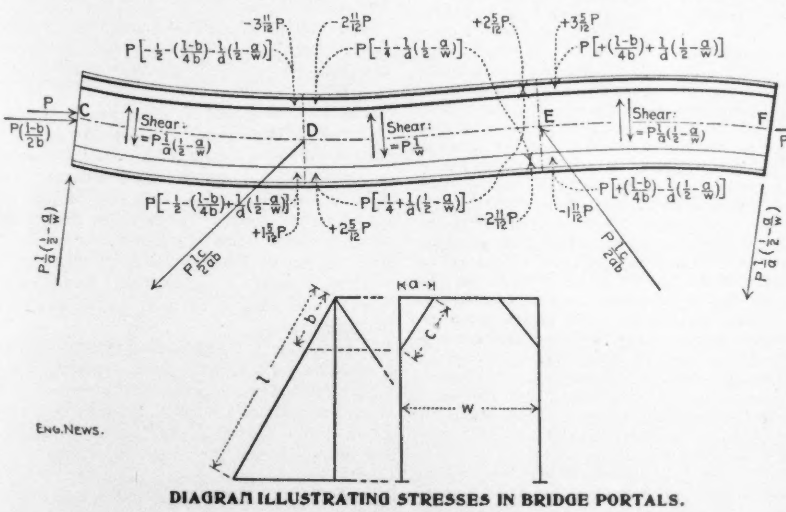


DIAGRAM ILLUSTRATING STRESSES IN BRIDGE PORTALS.

Concerning Ogee-Faced Dams.

Sir: Your issue of April 14 contains an article "On the shape and effect of a stream of water flowing over a dam having an ogee downstream face," signed Clemens Herschel, hydraulic engineer. The article contains a misstatement relative to the Holyoke dam. The dam that the Holyoke Water Power Co. is now building was not designed by Mr. Herschel. The plans for the dam were not based upon any of his preliminary studies for such work and do not resemble them, excepting that all ogee-faced dams have what might be termed a family resemblance.

In 1867 I designed two stone dams for the A. & W. Sprague Manufacturing Co., to be built across the Shetucket River in Connecticut, which were almost precisely similar in section to the Holyoke dam. The particular profile was adopted in order that the water flowing over the dam should run as smoothly as possible and be carried beyond the foot of the dam, so that the backlash, as engineers term it, might be lessened and its destructive effects exerted upon the river bottom below the apron of the dam and not directly at its foot.

When I, as the hydraulic engineer of our company, was called upon to construct the dam across the Connecticut River, I had in mind my former plans and adopted a similar profile, believing it well adapted to the purpose. I do not claim much originality for the designs, though they were not copied from any plan by Mr. Herschel. He surely cannot claim a patent for an ogee section, for dams of that form were built before Mr. Herschel was born. The curve of the upper portion of the Holyoke dam is a parabola, that being the curve that water naturally takes in falling. The parabolic curve was merged into a cycloid, the curve of quickest descent and consequently the smoothest.

I have never seen Mr. Herschel's latest design for the Holyoke dam and cannot express any opinion as to its merits, but if, as he wrote to the directors of our company, he can build a stable and enduring dam across the Connecticut River of the same height as the one I am constructing, half a million dollars cheaper than I am doing, I am sorry that he has not had the opportunity to do so, for I should look upon it as the greatest wonder of the age.

Yours truly,

Edward S. Waters,

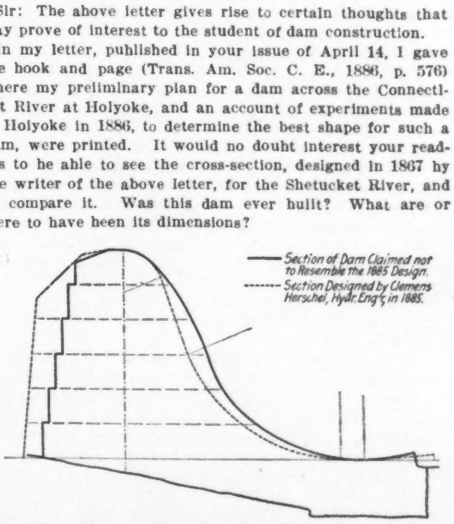
Treasurer and Hydraulic Engr. Holyoke Water Power Co.

Holyoke, Mass., April 18, 1898.

(We submitted a proof of the above letter to Mr. Herschel, who sends us the following reply.—Ed.)

Sir: The above letter gives rise to certain thoughts that may prove of interest to the student of dam construction.

In my letter, published in your issue of April 14, I gave the book and page (Trans. Am. Soc. C. E., 1886, p. 576) where my preliminary plan for a dam across the Connecticut River at Holyoke, and an account of experiments made at Holyoke in 1886, to determine the best shape for such a dam, were printed. It would no doubt interest your readers to be able to see the cross-section, designed in 1867 by the writer of the above letter, for the Shetucket River, and to compare it. Was this dam ever built? What are or were to have been its dimensions?



Cross-Sections of Dam across the Connecticut River at Holyoke, Mass.

A comparison of the cross-section of the dam commenced at Holyoke in 1885, with the cross-section which I designed for a dam at the same place in 1885, shows no valuable or material difference between the two. The outlines of the two are given on the drawing herewith shown, and in making the comparison I have used the section given in the contract and specifications for the work. I leave your readers to judge for themselves whether some other plan was not also "had in mind" when the then hydraulic engineer of the company adopted in 1895 a profile now described as similar to the 1867 designs only. Indeed, I know that my plan was also had in mind, for besides having the use of plans, model, etc., left by me at Holyoke, when I resigned my position there, the then hydraulic engineer had especially sent for, and had studied, the Am. Soc. C. E. paper above referred to, in 1887, or 1888.

The student of dam building would also like to have a reference to a dam 30 ft. high built of ogee section anywhere the wide-world over before 1842, the date before which, as claimed by your correspondent, such dams were common. I know of none. The Croton dam, half-built about 1848, and cobbled up several years later, is not such a case. Its history and cross-section is given in my paper, above referred to.

Of course it is easy to say now that there was nothing new about this design of mine in 1885; but from the amount of adverse criticism and the abuse it then met with, even in influential quarters, one would not have thought so. The experiments referred to in the 1886 paper disposed of most of that; the remainder I endeavored to dispose of in my two letters to Engineering News, Nov. 10, 1892, and April 14, 1898.

I would have made no reply whatever to the above communication, except for the charge that I wrote "the directors of the Holyoke Water Power Company, etc." This is personal and sufficiently untrue, or half true, to make a correction advisable. As will appear, I wrote a private letter, as a stockholder, to a gentleman, who was and is a director, before the work was let, but just as soon as I had heard that the dam was to be built. If I had neglected to do this, I would have considered myself remiss in both my duties and privileges.

This is the letter, omitting only the gentleman's name:

Nov. 26, 1894.

Dear Sir: Referring to our conversation of some months since, I beg to say that I heard to-day that the Holyoke Water Power Co. are intending soon to call for bids on a stone dam at Holyoke. I also learn that this dam is either modeled after the design I made for a stone dam in 1885, or is to be built according to that design.

I intended to have come to the annual meeting this year, as I expected the matter of building the new dam would be laid before the meeting; as I understand was done. But I was prevented by being obliged to attend court that day.

You being one of the parties largest in interest in the company, I am writing this to you to say, that I want to disclaim any endorsement of, or recommendation of, this or any other such stone dam for Holyoke at this time. I do not wish it to be inferred hereafter, because I designed this dam in 1885, when making my first studies of the case, that I recommended it to be built at that time, since, or in 1894. I think, on the contrary, that more than $500,000 could be saved, rather than build it; and this is a sum well worth saving.

Yours very truly,
(Signed) Clemens Herschel.

Now that I have been reminded of the fact of a letter having been written, and have read it, I think it was a very proper letter to write, only that I now believe that I did not then estimate the possible saving nearly high enough.

I do not consider saving this amount of expenditure in the construction of the new dam "the greatest wonder of the age," or as great, as it was to save the old wooden dam from destruction for the last 13 years, or to add twice the estimated cost of the new dam to the value of the property of the company by the introduction of a proper system of water measurements. It only requires the "know how" and a little executive ability. Truly yours,

Clemens Herschel, Hydraulic Engineer.

2 Wall St., New York city, April 22, 1898.

"De Pontibus."

Sir: I have read with surprise in your issue of March 31 your review of Mr. Waddell's "De Pontibus," for it seems to me that the impression your article will give to those who have not seen the book will be rather unfavorable. As I am acquainted with every paragraph in the book from beginning to end, having checked the entire manuscript, besides preparing all the tables, and making many special computations, I feel competent to form a correct opinion of the true value of the work to a bridge designer; and as Mr. Waddell cannot well take any notice of your criticisms himself, I am going to take the liberty, on my own responsibility, of answering a few of your comments and pointing out the scope and usefulness of the book in question.

In my opinion, the treatise is a true "pocket-book" for bridge designers, because it contains in condensed form a great mass of valuable information, including specifications for all kinds of bridges, and many tables and curves of loading to facilitate the making of computations. No one who has not used the work in actual practice can form an adequate opinion of its efficiency and usefulness. The specifications are the most thorough, systematic and comprehensive that I have ever seen, and they cover the entire ground of designing and construction, down to the smallest details, for railway, highway and combined bridges of all types, and can be used also for steel buildings by assuming the coefficient of impact to be zero.

The specifications are so thorough and systematic that if several designers were to work independently on any design, with the general outline and loadings the same, their results would be practically the same down to the smallest details, thus eliminating from the designing, to the greatest possible extent, the effect of "personal equation."

From the time I took charge of Mr. Waddell's office until the specifications given in "De Pontibus" were written, this "personal equation" of the members of the office was always evident to a very large extent, although we used, as far as they would apply, the best specifications available. The consequence was that when the results of an accumulation of data were compiled, great irregularities were found, which prevented satisfactory comparisons of the results of our work. For years Mr. Waddell has had in contemplation the writing of specifications for railway bridges similar in completeness to those he wrote, some ten years ago, for highway bridges, but he had been prevented mainly on account of the amount of personal work that he had to do in connection with his large practice. It was upon my urgent solicitation that Mr. Waddell prepared the specifications which were the nucleus of the entire text of his new book, and, in fact, the raison d'être of the work, a fact for which I take some credit to myself in addition to what Mr. Waddell has given me in his preface. A year's experience in the use of these specifications has proved to me their usefulness and efficiency. In no particular have they thus far been found wanting.

Readers of your review might form an opinion from your second paragraph that Mr. Waddell's ideas in respect to bridge designing are very different from those of other authorities; but such a conclusion would be incorrect, as can be seen by perusing the discussions on the various papers which Mr. Waddell has submitted to the engineering profession during the last ten years. I have read them all thoroughly and have come to the conclusion that, in respect to disputed points, the consensus of opinion is nearly always with the author of "De Pontibus," and that in every case he has several eminent authorities on his side. Incidentally I might mention, concerning the specifications of "De Pontibus," that they were submitted to several prominent authorities for comment and criticism, and were, in many minor points, modified to conform with such criticisms.

In regard to the index, it seems to me that you are rather severe in saying that "the author has provided an index which is about as crude an attempt at indexing as has recently come to our notice." The fact that the index covers about 31 pages ought to show that it is pretty thorough and comprehensive. These 31 pages index 347 pages of text, thus amounting to 9% of the latter, and I doubt whether you can point to any other engineering work which has such a proportionately large index. By the same methods of figuring Trautwine's "Pocket-Book" shows 4%, Pencoyd's, 3%, and Carnegie's 2%.

You must have searched the index pretty thoroughly for flaws when you compiled your list of faults, because a study of it shows that the cross-referencing in general is very thorough indeed. Let us analyze a little these so-called faults, taking them up in the order you have adopted. Although "assumed uplift for draw-spans" is not under "draw-spans" we find it cross-indexed under "uplift," which is the fundamental idea in the item. Although "best kinds of paint" is not under "paint," nevertheless, the same item is covered under "painting, investigations for." "Character of flange-section for plate girders" is not under "plate girders," but it is under "sections for compression flanges of plate girders." Here again the main idea is "section of flanges," and not "plate girders," so in each of the cases you have referred to, I find the subject proper, cross-indexed. Hence it seems to me that the index of "De Pontibus" will compare favorably, to say the least, with those of other engineering books.

It is quite a disappointment to me that the reviews of this work, which have thus far appeared in the technical press, have been of such a superficial character. Not one of them attempts to discuss the finer points of the book, or seems to recognize the great amount of new and useful information it contains. On every page of it there is information of value to every one engaged in the designing, manufacture, or building of structural work.

The book in one sense is absolutely unique, for the author has in it presented to the engineering profession what too many members thereof would consider their whole stock in trade, and has withheld nothing of value which he has learned from his own experience or from that of others. For this Mr. Waddell deserves the hearty thanks of the engineering profession and especially the young members who are at present just entering upon their work.

There is a great amount of labor and expense connected with the preparation of such a book, and as the price is low, it is hardly probable that the little royalty which the author receives will ever reimburse him for his actual cash outlay, to say nothing of the value of his own time. The main object of Mr. Waddell in writing the book was to benefit the profession, and to raise the standard of his chosen specialty from rule-of-thumb methods to a systematized science.

I trust that you will pardon me for my plain speaking, but what I have said has been prompted by a desire to see "De Pontibus" given a fair showing, for there is no one more familiar with the work and its author than myself.

Yours very truly, Ira C. Hedrick.

Kansas City, Mo., April 4, 1898.

(We are pleased to give space to the opinions of a critic who is evidently so familiar with the subject of which he writes; and if he will read our review carefully, he will find no serious disagreement as to the real merit and value of the book in question. Our comments upon the index to "De Pontibus," however, appear to have been so misapprehended by our correspondent, that we have thought it worth while to explain at length in our editorial columns this week, some of the foundation principles which must be observed in any attempt at indexing, if an index is to be of use to others than those who compile it.—Ed.)

THE CONSTRUCTION OF LOCK NO. 1 OSAGE RIVER, MISSOURI.

By F. B. Maltby,* M. Am. Soc. C. E.

(With full-page plate.)

The Osage River is one of the largest and most important tributaries of the lower Missouri River, and is the largest stream in the State of Missouri, except the Mississippi and Missouri Rivers. It empties into the latter stream about 140 miles above its mouth, and about 8 miles below Jefferson City, the capital of the state. During high and medium stages it is navigable for a distance of about 220 miles from its mouth, and throughout this distance flows through a country very poorly served with other means of transportation.

The United States government assumed charge of its improvement in 1871, previous to which time efforts had been made by the state of Missouri to partially improve it by the construction of wing walls to concentrate the flow over shoals. From 1871 to 1891 the improvements made by the government consisted in dredging the shoals, removing snags and obstructions, and by building a number of wing and training dams. The construction of a lock and dam near the mouth of the river was authorized in the River and Harbor bill of 1890, but owing to lack of sufficient appropriations, construction was not commenced until 1895. In June of that year a contract for the construction of a portion of the lock was entered into with McGee, Kahman & Co., of Kansas City, Mo., and during that summer and fall the coffer dam was built, and some dredging and excavating done. In the spring of 1896 it was thought advisable to make some changes in the plans, and, as the government was unable to make any satisfactory agreement with the contractors as to prices to be paid under the new conditions, it was decided to terminate the contract, purchase the contractors' plant and continue the work by hired labor. On receipt of the necessary authority from the Chief of Engineers, this was done, and during the season of 1896 nearly all the excavation was completed and most of the foundation piles driven. On resumption of active operations in 1897, the writer was placed in local charge of the work, under the direction of Captain H. M. Chittenden, Corps of Engineers, U. S. A., and Secretary of the Missouri River Commission, the improvement of the Osage River having been turned over to this Commission in 1894.

The lock is about 7 miles above the mouth of the Osage River, at which point is the nearest railroad station to the lock. All the material used in construction, except sand, gravel and piling, was received by rail at this station and towed by water to the lock. The river at this point has a range between high and low water of about 25 ft., and owing to the duration of high stages the working season is confined to the period between Aug. 1 and Jan. 1, or only about five months in the year.

The lock as constructed is 220 ft. long between quoins, and 42 ft. wide in the clear. It is 276 ft. 3 ins. long over all, and 76 ft. wide. It will have a maximum lift of 16 ft., though ordinarily the lift will not exceed 12 to 13 ft. In making preliminary borings, the materials encountered were a rather fine gravel, with layers of clay from 18 ins. to 3 ft. in thickness. No rock was encountered and it was decided to make the foundations for the lock walls of piles with the usual timber grillage surmounting them.

The floor of the chamber of the lock is made of concrete 3 ft. thick, deposited around piles driven 4 ft. center to center, and cut off level with the top of the floor. Excavation extended about 13 ft. below ordinary low water. A coffer dam, sur-

*U. S. Asst. Engineer Missouri River Commission, 1515 Locust St., St. Louis, Mo.

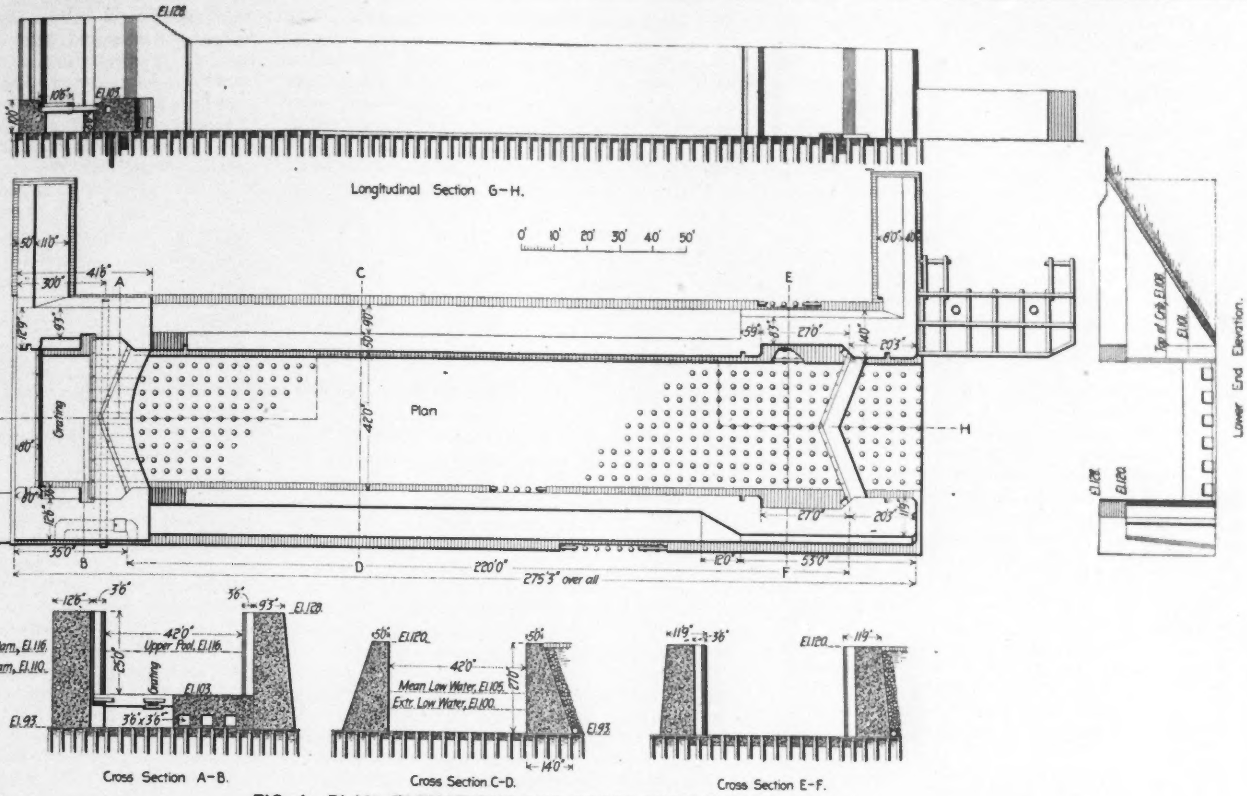


FIG. 4. PLAN, ELEVATIONS AND CROSS-SECTIONS OF LOCK.

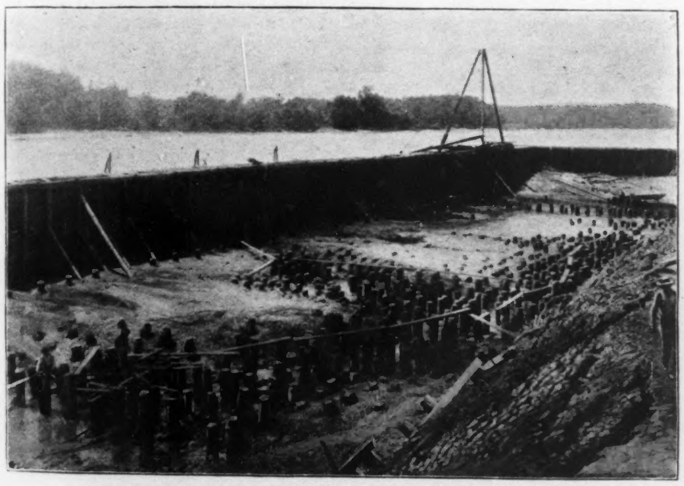


FIG. 1. VIEW OF COFFER DAM AFTER PUMPING OUT IN 1897.
SEDIMENT BEING WASHED OUT.

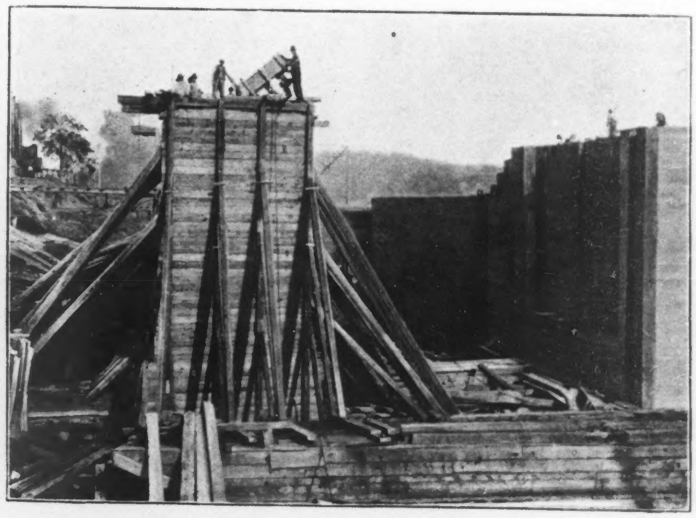


FIG. 2. FILLING THE TIMBER FORMS FOR THE LOCK WALLS.

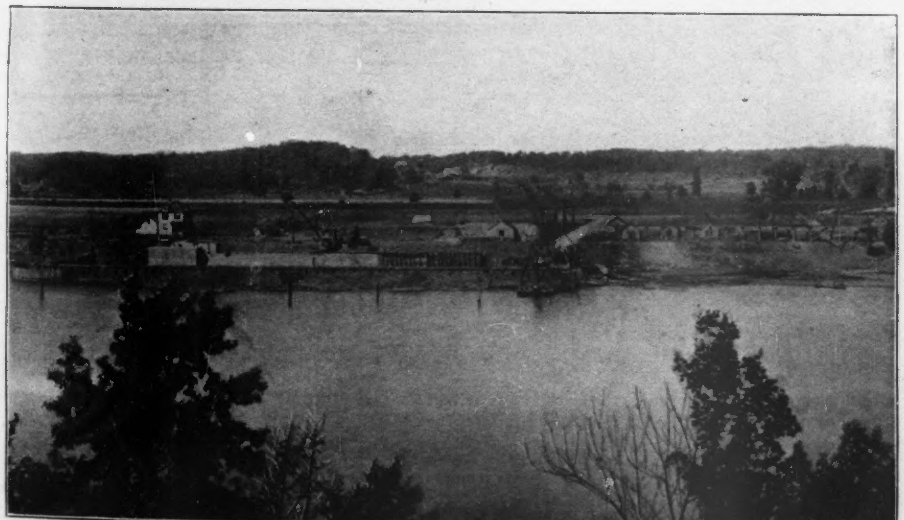


FIG. 3. GENERAL VIEW OF LOCK.

CONCRETE LOCK ON THE OSAGE RIVER, MISSOURI.

Built under direction of the Missouri River Commission.

Capt. H. M. Chittenden, Corps of Engineers, U.S.A., Secretary and Engineer.

F. B. Maltby, M. Am. Soc. C. E., U.S. Asst. Engineer in Charge.

rounding the lock on three sides, was constructed by driving two rows of piles 11 ft. apart, center to center, and 8 ft. apart in the rows. These piles had waling pieces bolted to them, and 3-in. sheeting was driven against the waling pieces, and to a depth somewhat above the bottom of the excavation. The interior of the dam above the river bottom was filled with clay from the adjacent banks. The top of the coffer dam is 21 ft. above the floor of the lock, which is about 10 ft. below low water. The excavation was done with a clam shell dredge as far as the material could be reached with a derrick mounted on the coffer dam. The greater portion was excavated by hand, loaded into boxes and hoisted and dumped outside the coffer dam, a slow and expensive method.

While making the excavation, an extraordinary and unlooked-for flow of water was encountered, which came, not from the river, but from the gravel beds which were penetrated. This fact was clearly demonstrated when the pumps were shut down, at which time the water in the coffer dam rose about 2 ft. higher than the water in the river. To keep down this flow required the combined efforts of three centrifugal pumps, 8, 12 and 15 ins. diameter, respectively. The water was lifted about 19 ft. The maximum flow was about 12,000 gallons per minute, but this was greatly reduced after the foundation piles were driven. After completing the foundations and the floor of the lock the flow was only about 6,000 gallons per minute. The pumping has been a very expensive item, costing for both seasons, covering 192 days of pumping, $13,334.94, exclusive of cost of plant. It has very greatly increased the cost of excavation and pile driving.

After completing the excavation to about one foot above the desired depth, the foundation piles were driven. The coffer dam was allowed to partly fill and the piles were driven with a floating driver. A few were also driven with an ordinary land driver after the coffer was again pumped out. A line of Wakefield triple lap sheet piling was driven across the lock under the upper miter sill and well into the bank.

The total amount of excavation in both seasons, 1896 and 1897, was 11,063 cu. yds., costing, including pumping, $1.034 per yd. The cost of pumping charged to excavation amounted to $0.512 per yd. The total number of piles driven in foundations, including sheet piles, was 1,955, or 46,356 lin. ft., costing for driving, excluding pumping, 10 cts. per ft. The cost of pumping charged to pile driving amounted to $0.076 per ft. These prices are, perhaps, subject to a slight correction, owing to the fact that in the season of 1896 no attempt was made to keep the exact cost of separate kinds of work. It is thought, however, that the distribution made is very close to actual costs, as only two kinds of work, excavation and pile driving, were done during that year.

Active operations were resumed Aug. 1, 1897, after a shut-down since Jan. 2, 1897. The pumps were started Aug. 6, and the coffer was not allowed to fill until Nov. 6, when the work was closed for the season, a period of 90 days, during which time the engines and pumps were not shut down. On pumping out the coffer dam it was found that sediment had been deposited over the entire foundation to an average depth of about 5 ft. This sediment was all removed by stirring it and washing it, with strong streams of water from a fire hose, to the centrifugal pumps and pumped out through them. About 4,000 cu. yds. were thus removed at an estimated cost of from 18 to 20 cts. per yd; 78,698 ft., B. M., of timber were placed in foundations at a cost for placing, excluding pumping, of $8.13 per 1,000 ft., B. M.

Perhaps the most interesting feature of the lock to an engineer is the concrete construction of the walls. The head walls for a length of 41 ft. are 35 ft. high and 16 ft. wide on the bottom. The chamber walls are 27 ft. high, 5 ft. wide on top and 14 ft. wide on the bottom, and are all formed of concrete deposited in place. The floor of the lock chamber, the breast wall and a small portion of the core of the land wall is made of Milwaukee cement concrete, 1 part packed cement to 2 parts loose sand and 3½ parts of loose gravel. With the above exception the walls are of Portland cement concrete, in proportion of 1 part packed cement to 4 parts loose sand and 9 parts loose gravel. The faces of the walls, where exposed, are made in proportions of 1, 2 and 3, to give a slightly smoother appearance.

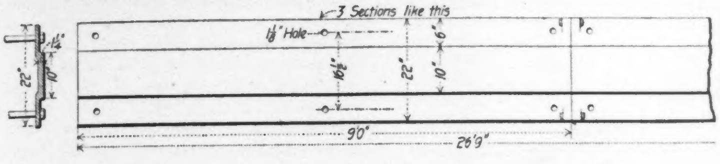


FIG. 5.—FLAT CAST-IRON QUOIN FOR OSAGE RIVER LOCK.

The forms for the walls were made of frames or bents of 8 x 10-in. timber braced thoroughly with 6 x 8-in. and 7 x 9-in. braces. The posts were tied together at the top with 4 x 10-in. oak pieces, which also formed the supports for a track on which the concrete was brought from the mixer. The bents were placed 4 ft. apart center to center and were sheeted or lined with 4 x 10-in. plank. All the timber used in forming was of long-leaved yellow pine, and the posts for the 35-ft. wall were single sticks 36 ft. long. The forms are divided by bulkheads into sections from 20 to 24 ft. long, and alternate sections were filled. The bulkheads were then taken down and intermediate sections filled. A section was usually filled without interruption, though in a few instances work was suspended from 12 midnight to 7 a. m.

Timber enough for forming only one-half of one wall was provided. On completion of a portion of the wall the forming was taken down and again erected in position for another portion of the wall. The timber was thus used on an average four times, and thereby reduced the cost of forming per cubic yard of concrete. It was found that the loss or damage from use and handling was very small. Atlas Portland cement was used generally for the walls, though, owing to the failure of the dealers to deliver cement as fast as desired, several hundred barrels of Lagerdorfer cement were used. The Atlas cement was purchased under specifications requiring 99% fineness on No. 50 sieve and 88% fineness on No. 100 sieve. Tensile strength, neat 7 days, 500 lbs., 1 to 3 of sand, 7 days, 160 lbs. Every tenth barrel was tested. Several hundred briquettes were made and broken and have given satisfactory results.

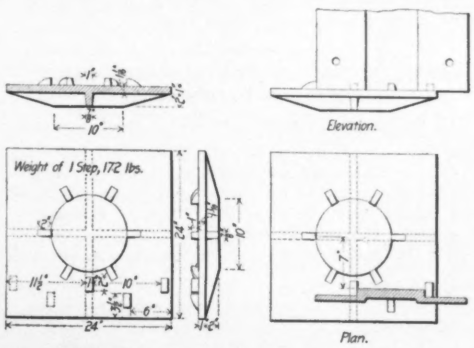


Fig. 6.—Cast-Iron Step for Gates of Osage River Lock.

The sand and gravel were procured and stored on the bank prior on the resumption of active construction in 1897. The sand was dredged from the Missouri River, about 8 miles from the lock, and cost, stored on the bank adjacent to the work, 80 cts. per cu. yd. It is clean and sharp, but contains a rather large proportion of fine material; about 30% will pass a No. 50 sieve. The gravel was dredged from the river within ½ mile of the lock. A ladder dredge was used, elevating it into screens where it was thoroughly washed and screened and delivered onto a barge. It is of superior quality, being of a flinty character, and although the faces are quite smooth, the stones are very irregular in shape. It contains 37% of voids, and cost, stored on the bank, $0.571 per yd.

The concrete was mixed in a cubical mixer with 4-ft. sides. The mixer was run with a belt from a pulley put in place of a winch head on a Mundy double-drum hoisting engine, the same engine being used to hoist the material from the ground and dump it into the hopper of the mixer frame. Sand, gravel and cement were loaded by hand into 2-ft. gage side-dump cars. They were run to the mixer and dumped into a box which was hoisted and dumped into the mixer hopper. After mixing it was dumped into cars which ran around a track on top of the forms, and dumped into place. In mixing it was the practice to use as much water as possible, and yet avoid quaking under the rammers. Eight or ten men, using steel rammers weighing 22 lbs. apiece, were employed in ramming the concrete in place. This number of men was all that could be employed economically in a section at a time. The capacity of the mixer was only limited by the progress of the tampers, and an average of 12 to 15 cu. yds. per hour was deposited and rammed in place. The batches mixed were of such size and proportions as to use a full barrel of cement at a time. Concreting was begun on Sept. 3, and was completed Nov. 6. It was not, however, carried on continuously, as forming could not be kept out of the way. During this time a total of 6,708 cu. yds. of concrete was made at an average cost, as shown in the accompanying table:

Cost of 6,708 cu. yds. of Concrete made at Lock No. 1, Osage River.—1897.

	Per cu. yd.
6,010 yds. of gravel at $0.571	$0.513
3,021 yds. of sand at $0.80	.360
Cement	2.205
Material used in erecting mixer, tracks, etc.	.032
Storing cement	.014
Coal and wood	.027
Labor.	
Erecting mixer, tracks, etc.	.169
Unloading, storing, handling cement from Osage	.220
Mixing	.394
Placing	.069
Ramming	.174
Finishing top of walls	.016
Testing cement	.011
Forming.	
Labor erecting and removing forms	.665
Lumber, nails and bolts	.293
Towing lumber from Osage City to lock	.073
Total	$5.238

The cost shown in the table is the average cost of all the concrete made. Of this amount 2,030 cu. yds. of natural cement concrete were made, costing per yard:

	Per yd.
For cement	$1.834
" sand	.348
" gravel	.479
" mixing, placing, forming, etc.	2.160
Total	$4.821

There were made 4,678 cu. yds. of Portland cement concrete, costing:

	Per yd.
For cement	$2.362
" sand	.365
" gravel	.523
" mixing, placing, forming, etc.	2.160
Total	$5.410

The above cost is made up of the items as shown in the table, and does not include general superintendence, office expenses, plant and pumping. A fair proportion of these expenses incurred during the season, and which might be charged to concrete, is about $1.64 per yd.

The only novel features of the lock itself lie in the quoins, which have a flat surface instead of the usual curved or hollow form. This surface is normal to the line of resistance at this end of the gate, and has a contact surface 10 ins. wide. The center of motion is in such a position that the gate leaves the quoin as soon as it begins to open. It is thought that a larger bearing surface will be obtained for the quoin post at a less expense for fitting than with the common shape.

The dam to be built in connection with the lock will be a movable one of the type known as a "Drum weir," and along the general lines advocated by Captain Chittenden in the Journal of the Association of Engineering Societies of June, 1896. The fixed dam will be 9 ft. high and the movable weir will have an additional lift of 7 ft. It will be

750 ft. long, divided into sections 75 ft. long, each one of which can be operated independently and from the shore. Plans have been drawn and approved for this structure, and it is hoped to begin its construction this year.

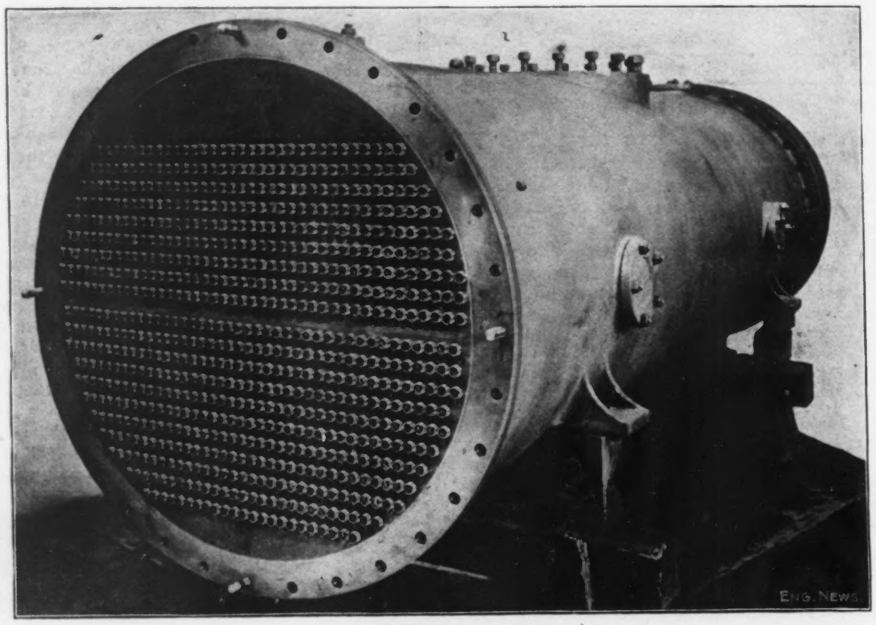
AN IMPROVED SURFACE CONDENSER.

We illustrate herewith an improved form of surface condenser, recently patented by Mr. D. McLeod Cobb, formerly proprietor of the South Brooklyn Steam Engine Works. Mr. Cobb has for many years been engaged in the manufacture of the well-known Lightall surface condenser, which is in extensive use in marine service. His new condenser is an improvement upon it, designed to effect a saving in the space occupied, and also in weight and cost. In the ordinary form of condenser the tubes are expanded in one tube plate and in the opposite one are secured in a small stuffing box with corset lace, paper, or other packing, secured by screw glands. The glands take up considerable space in the tube heads, and prevent the tubes being set as close together as they otherwise might be. Mr. Cobb conceived the idea of economizing space by altering the horizontal rows of tubes in each tube plate, one row being expanded and the next having stuffing boxes. By having half of the glands in one tube head and the other half in the other, the tubes may be placed closer together. The construction is clearly shown in the accompanying cuts. It is claimed that by this arrangement of alternating the rows of the expanded and packed ends of the tubes, together with proper designing of the screw gland, a saving of 40% of the area of the brass tube heads may be made, for an equal amount of cooling surface. A saving in the circumference of the shell is also made, and these savings, together with the dispensing with one-half of the screw glands commonly used, amount to a considerable saving in weight and in cost, as well as in space, which latter is usually of most importance in steam vessels. The tube head is stiffer than in the old construction, if made of the same thickness, for the reason that there is less metal cut out between the tubes in the expanded rows.

While the expanded ends are perfectly tight against water or steam pressure, they can be driven out by a smart blow with a tool made to fit the tube and bear upon its end, and can thus be backed out in either direction; so that tube-room is necessary only at one end of the condenser, and it matters not which.

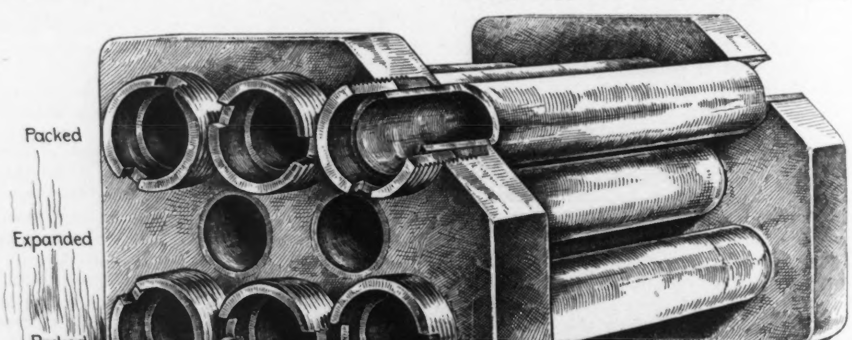
A condenser recently finished upon this system and illustrated herewith, has 2,400 sq. ft. of cooling surface, within a diameter of 41 ins., and a length over all of 137 ins., with a weight of 10,200 lbs., against a listed size and weight of 63 ins. × 173 ins., and 17,290 lbs. of the standard build of the Lighthall type. These condensers are manufactured by D. McLeod Cobb, whose father was the original and sole manufacturer of the Lighthall Surface Condenser up to the time of the expiration of the patents.

The present office and works is at Huntington and Smith Sts., Brooklyn, and the New York office, at 38 Burling Slip, New York.



SURFACE CONDENSER WITH IMPROVED SYSTEM OF TUBING.
Patented and Manufactured by D. McLeod Cobb.

Cooling Surface between Tube Heads, 2,400 sq. ft.
Number of ⅝ O. D. Condenser Tubes, 1,468.
Length of Tubes, 121¾ ins.
Length over all, 137 ins.
Diameter over all, 45 ins.
Weight of Condenser, complete, 10,200 lbs.



SKETCH FROM MODEL OF COBB'S IMPROVED SYSTEM OF TUBING SURFACE CONDENSERS.

MOVING A PIER OF THE BISMARCK BRIDGE; NORTHERN PACIFIC R. R.

An important and difficult piece of work which has been recently carried out under the direction of the engineering department of the Northern Pacific R. R., is the moving of one of the piers of the bridge over the Missouri River, at Bismarck, No. Dak., the pier having been forced out of position by the pressure of the earth against its base. The pier is on the east bank of the river, and supports the ends of a deck shore span of 113 ft., and one of the through channel spans of 400 ft. The bank is steep, and rises to a height of about 100 ft., while near the edge are the reservoirs of the Bismarck water-works. It is said that leakage from these has saturated the entire slope, causing it to slip and throw such a pressure against the pier as to force it 44 ins. toward the river, the total movement of the pier being 10 ins. greater than the sum of the successive movements of the spans. The base of the pier is about 47 ft. below the ground.

To prevent the failing of the two spans the smaller was propped up on timber falsework, and the large one was dragged west 34 ins., by means of locomotives and tackle, so that its shoe would still rest upon the pier. These measures were merely temporary, and two plans were then considered for the permanent work. One was to prop up both bridge spans, tear down the pier and rebuild it in the proper position. The second plan, and the one finally adopted, was to remove the earth from around the pier, to build a new and stable foundation at a greater depth than before, and to move the pier back into position upon this new base.

The old pier, from bridge to foundation, is 83 ft. in height, its base measures 24 × 60 ft., and with the superimposed load its weight is more than 4,500 tons. The work must be carried to a depth 60 ft. below ground, and 30 below low water mark. The earth on the land side of the pier has been removed and a shaft sunk 13 ft. below the old foundation. At a depth of 3½ ft. a vein of coal was struck, and it is on a slippery seam above this that the earth has slipped, bearing the pier along with it. Immediately under the center of the pier a tunnel has been dug, about 5 ft. wide, 13 ft. high and 32 ft. long, running from the river face, under the pier, to a distance of 8 ft. beyond the shore face. This tunnel will be partially filled with cement concrete, and on this a framework of timbers, 8 × 8 ins., will be constructed, reaching up nearly to the bottom of the old pier, and supporting two tracks, each consisting of four 56-lb. steel rails. On these tracks will be placed two rows of steel rollers, 2 ins. diameter and spaced 1 in. apart. Resting on these rollers, and touching the bottom of the pier above, will be eight more steel rails, upon which the weight will rest during the moving. The two tiers of rails with the rollers between, are to be securely fastened, wedged up tight, and brought to an even bearing against the bottom of the pier, after which the tunnel will be packed with cement concrete clear up to the lower rails, which are imbedded in it. On each side of the rails only sufficient space is left between the bottom of the old pier and the top of the new concrete for a man to crawl in to adjust any rollers which might need attention.

A second tunnel will then be dug parallel with the first, and the same operations followed—partial filling up with concrete, erection of woodwork, laying and wedging up of rails and rollers, complete filling with concrete. In the same way ten tunnels will be driven, removing all the material below the old masonry, and from the earth which formerly supported it, gradually shifting the weight of the pier to 40 steel rails, resting upon 960 steel rollers, which in turn bear upon the 40 rails of the lower tier imbedded in the new concrete. This has now assumed the form of a monolithic concrete foundation, and bears the entire weight of all above it—rails, rollers, pier and bridge. On the river side this great block is flush with the face of the pier, but on the land side it extends like a shelf 8 ft. in width. To roll the pier across this shelf to its proper place will require a pull equal to nearly 1,500,000 lbs., which will be applied through ten large screw-jacks bolted to the lower block of concrete, and pulling on the ends of the upper tier of rails. Six levers of heavy oak, 10½ ft. long,, will actuate each of the ten screws, and under their combined strains the old pier will roll slowly across its new foundation, while the ends of the two bridge spans above will come into place on rollers adjusted under them. When the pier is finally in place, and all temporary appliances are removed, the narrow manholes left unfilled between the new work and the old will be rammed tight with concrete so that the old pier and the new base become one. The new foundation will be 1 ft. longer, 8 ft. wider and 13 ft. deeper than before. As much masonry and concrete will be added as may be deemed sufficient to prevent all danger of any future movement.

The plans were prepared under the direction of Mr. E. H. McHenry, M. Am. Soc. C. E., Chief Engineer of the Northern Pacific Ry., who informs us that the above particulars are correct. The work was carried out under the direct charge of Mr. W. L. Darling, M. Am. Soc. C. E., Division Engineer, the plans being drawn by Mr. S. J. Bratager, Assistant Engineer. The foreman in charge of the work was Thomas J. Molloy, of Cincinnati, O. The work was commenced on Oct. 1, 1897, and will probably be completed about June 1, 1898.

NOTES FROM THE ENGINEERING SCHOOLS.

Iowa State College, Ames, Ia.—The entrance requirements of the engineering courses have been raised about one year. The entering class, however, was larger than usual this year.

A new forge shop and foundry has been completed, and a new carpenter shop, 40 × 120 ft., is under contract. The civil engineering department is fitting up a new hydraulic laboratory, which will be connected by about 700 ft. of 8 and 10-in. cast-iron pipe with the college water tower, an elevated steel tank of 163,000 gallons capacity, whose top is about 160 ft. above the laboratory floor. Arrangements will be made for determining at any time the loss of head in the cast-iron pipe, and in its several parts, and this can be done at very high velocities. A tank 50 ft. long will serve as a discharge and measuring tank for motors, weir tanks, orifices, etc., and will also permit experiments on the resistance of models to propulsion. Two experimental sewers, one 6 and the other 15 ins. diameter, which will serve to remove the waste water, will be so arranged as to permit experiments to demonstrate the laws of flow at different depths. Experiments may also be made on flow in open channels near the mouth of the sewers.

Professor A. Marston has just been made "Engineer to the College," at an increased salary, in addition to his duties as head of the civil engineering department. The intention is to continue and officially recognize the supervision and designing by him of the engineering features of college improvements. As examples of the work intrusted to him there may be mentioned the college water-works, just completed, a sewage disposal system, and the supervision of the construction of a chimes tower, now building. His examination of the architect's plans for one important college structure resulted in doubling the size of the foundations.

University of Illinois.—Among the matters now under investigation may be mentioned the following:

Recent investigations in the laboratory of applied mechanics on the shearing strength of rivet steel indicate that the values ordinarily used by engineers in designing riveted joints are too large. An investigation is in progress to determine the relation between the standard method of testing paving bricks adopted by the National Brick Manufacturers' Association, and the standard method of the University of Illinois, which has been used in the tests made by the University for the Department of Public Works of Chicago. A series of tests on impact effect on beams is being conducted as thesis work. In the hydraulic laboratory experiments on weir tubes are being made.

In the electrical engineering laboratory complete tests on all the electric meters on the American market, and a special study on the design of rheostats for absorbing power, are in progress.

In the steam engineering laboratory experiments are in progress on Serve and other locomotive boiler tubes, and on the effect of scale on boiler tubes. The mechanical engineering department is also conducting a series of locomotive road tests on the Illinois Central and on the C., C., C. & St. L. railways.

The University has recently completed a new electrical and mechanical engineering laboratory, at a cost of $25,000, exclusive of equipment. A considerable quantity of new equipment has been purchased. A new central heating and lighting plant has just been completed and has been arranged with reference to facilities for testing combustion of coal, efficiency of boilers, etc., on a large scale.

Massachusetts Institute of Technology.—The collection of physical apparatus has recently received a number of important additions. Among these are a large automatic mechanical air-pump, made by Ritchie, and new vacuum tubes of all kinds for experiments with X rays, making the collection probably the most complete of any in the country. There are many novel forms illustrating peculiar phenomena and new discoveries, including crown tubes for illustrating the phosphorescence of gases; the Holtz tube, showing the influence of funnel-shaped apertures on the resistance; a series of Hittorf's "longway tubes," showing how, at a certain pressure, the electrodes must be separated by a considerable distance in order that a discharge may pass directly between them; partition-tubes for showing the existence of a great resistance to the passage between a metal and gas; a series of tubes at various exhaustions for exhibiting the changed luminous phenomena due to change in pressure of the residual gas; a like set for showing the change of gaseous resistance under like circumstances; the electrodeless tubes used by Professor J. J. Thomson in his studies of the true resistance of gases, and various others illustrating the researches of Tesla, McFarlane, Moore and other investigators in the direction of utilizing the electric discharge as a means of illumination. One series illustrates the effect of electric discharge in causing phosphorescence of minerals.

For the study of cathode rays, besides the ordinary Crookes tubes, there is the apparatus used by Lenard in his classical research, and the tubes of Goldstein showing the existence of several kinds of cathode rays with diverse properties; also several tubes showing the repulsion phenomena observed by Goldstein. Others illustrate the curious change of colors of salts subjected to the action of cathode rays, discovered by Goldstein and the capillary light recently studied by Schott. There is also a large colleeton of electrical and other radiometers illustrating the electrical and heat-phenomena studied by Puluj; a new apparatus for illustrating the phenomena of the Hertzian waves, and also the apparatus of Elster & Goitel for studying the effects of light and of the X rays in causing the discharge of electrified bodies.

To the equipment of the laboratory of physical chemistry has been added apparatus for measuring the dielectric constant of substances by means of electric waves. The method, which is due to Professor Drude, of Leipzig, consists essentially in measuring the length of the electrical waves set up in a system of two parallel wires by a suitable spark-exciter, first when the wires are in air, and second when surrounded by the liquid to be investigated. A Geissler tube placed in the path of the waves indicates by a sudden glow when a movable bridge placed across the wires reaches a so-called node. The apparatus has proved very satisfactory in the preliminary experiments of an investigation now being carried out in the laboratory.

For the laboratory of heat measurements there has been purchased a Junker calorimeter for the determination of the heating value of gas; a new apparatus for the measurement of the heat of combustion of coal, and a callendar resistance pyrometer.

Purdue University.—The agricultural experiment station is conducting a number of interesting experiments on the growth of plants, and although these have no connection with engineering, they involve the use of some interesting apparatus. A little motor about 4 ins. in diameter is used to revolve a disk on which plants are growing in order to see the effect of gravity upon roots, and another humble plant records the progress of its growth on a sheet of paper on a revolving drum.

University of Nebraska.—An appropriation has been made for the purchase by the department of civil engineering of a testing machine of 200,000 lbs. capacity. O. V. P. Stout is advanced from associate to full professorship of civil engineering. Geo. R. Chatburn is promoted from instructor to adjunct professor of civil engineering. C. R. Richards, Associate Professor of Practical Mechanics, has been advanced to a full professorship, with the title of professor of mechanical engineering. A course in mechanical engineering will be offered.

A department of drawing and machine design has been established, and Instructor R. E. Chandler, of the department of electrical and steam engineering, is in charge with the rank of adjunct professor.

The new mechanic arts building will probably be completed in time to be occupied by the engineering departments at the beginning of the next school year.

Cornell University.—The college of architecture has established an annual fellowship, valued at $2,000. It is to be awarded on a basis of competition, the winner to spend two years in advanced study at Cornell or in Europe, under the direction of the faculty of architecture. Competitions will be limited to alumni of the college of architecture, who are under 30 years old, and to special students who have completed a two-year course.

University of Kansas.—Mr. George A. Fowler, president of the Fowler Packing Co., has offered $18,000 to put up a new electrical engineering building in the place of the one that was destroyed by fire on March 22, on condition that the board of regents provide $20,000 for equipment and machinery. The board will accept the offer. The burned building will be repaired and used as a power and heating plant.

West Virginia University.—Eleven fellowships have been established, one in each of eleven departments of the University. The departments of mechanical engineering, civil engineering, and mathematics will each have one. These fellowships are established for the purpose of encouraging advanced study and promoting higher scholarship.

Some of the regulations governing them are as follows:

Each Fellow will be paid $300 annually, and will be excused from the payment of all University fees.

The Fellowships will be awarded annually by the president of the University to candidates for advanced degrees who are graduates of the West Virginia University, or other institutions of recognized standing.

All Fellowships will be filled each year. Fellows may be re-elected for one additional year only.

Each Fellow will pursue his studies under the direction of the professor or professors in charge of his special studies. Assignment of University service to the Fellows will be made by the president in consultation with the head of the department to which the Fellow has been assigned. The work assigned will be equivalent to one hour of teaching daily, or the supervision of laboratory work for two hours daily.

Candidates for Fellowships will send in their applications, together with evidences of merit, attainments and ability, not later than June 1st each year. The appointments will be announced at Commencement.

STEEL RAILS for the Manchurian division of the Trans-Siberian Railway, to the extent of 30,000 tons, have been contracted for by the Maryland Steel Co., with delivery on board vessels in 60 days. Another 10,000 tons, according to one authority, has been taken by Continental firms, and according to another will also come to the United States. London "Engineering" says that the locomotives for this Manchurian railway are also to be made in the United States; and this journal ascribes the loss of this order, by British firms, to the uncertainty in delivery resulting from the late engineering strike and the present coal strike in England. The Russians are evidently intending to open the line as speedily as possible, and the fact that the 15 steamers and 40 barges, ordered for use on the Amur and Sungari rivers, will not be ready for delivery until next year, owing to the engineering strike, has doubtless had something to do with the placing of these last orders.

MANGANESE ORE, suitable for the manufacture of ferromanganese, has been found in Jefferson county, Pa., according to the Pittsburg "Dispatch." It is said that a vein, from one to three feet thick, has been located. A discovery of a large mine of high-grade manganese ore in the United States would be of great importance at this time. The present supply is nearly all obtained from abroad and it is becoming scarcer.

THE PIG IRON PRODUCTION of the United States is now stationary at the maximum point it has now reached. According to the monthly statistics of the "Iron Age," the weekly capacity of the furnaces in blast on April 1 was 233,339 gross tons, as compared with 234,430 tons on March 1. The "American Manufacturer's" figures show an increase from 235,937 tons on March 1 to 237,394 tons on April 1. A year ago the production was also nearly stationary from March 1 to June 1, at about 170,000 tons.

THE WORLD'S COPPER CONSUMPTION is increasing at a very rapid rate, as is shown in the following estimate by Aron Hirsch & Sohn, of Halverstadt, published in the "Iron Age":

Consumption of Copper—Metric Tons.

	1893.	1894.	1895.	1896.	1897.
Germany	60,513	62,955	70,349	85,371	96,385
France	33,886	31,837	40,323	49,007	58,336
England	96,615	90,069	91,084	115,557	110,210
Austria-Hungary..	14,901	16,457	15,735	16,498	18,288
United States	77,443	94,511	108,000	93,698	101,404
Totals	283,348	295,829	325,491	360,131	384,653
Production in world (Merton)	303,530	324,505	334,565	373,363	396,728

The United States now supplies 54% of all the copper produced in the world. Its export in 1897 amounted to 125,000 tons.

VARIATIONS IN THE RESULTS OF CHEMICAL analyses are discussed in a paper by Mr. Thos. D. West, read at a meeting of the Pittsburg Foundrymen's Association on March 28. Identical samples of borings from three pieces of pig iron were sent to different chemists, and the results obtained by 18 chemists on the samples of foundry iron, by 14 on Bessemer iron and by 13 on charcoal iron are recorded, together with the names of the chemists. The range of variations in the several sets of analyses was as follows:

	Sil	Sul.	Phos.	Man.	Graph. C.	Comb. C.	Total C.
Foundry iron..	0.27	0.015	0.114	0.23	0.77	0.59	1.09
Bessemer iron.	0.32	0.018	0.031	0.36	0.73	0.60	1.04
Charcoal iron.	0.21	0.020	0.067	0.22	0.61	0.58	0.30

INFUSORIAL EARTH has been found in the Caucasus, near Akholtsikh, Kissatybe and Tskhordza, in beds reaching 33 ft. in depth. Near by is found an analogous mixed deposit, containing kieselguhr colored by oxide of iron. Chemical analyses show this earth to be of excellent quality and preparations are being made to market it in Russia, where it will doubtless supplant the German kieselguhr for industrial purposes.

SEWAGE DISPOSAL AT MANCHESTER, ENGLAND, is giving the authorities much trouble. According to "The Engineer" the sewage from a population of 500,000 is now treated by chemical precipitation, lime and protosulphate of iron being used as chemicals. The effluent goes into the Manchester Ship Canal, but under protest from the Canal authorities. The works were put in operation in December, 1893. It was proposed to treat the clarified sewage on land, but the great cost seems to have led to the postponement of this. So-called bacteria filter beds were next investigated, but these seem to have promised to be too costly, besides which the Local Government Board rigidly insists on the old-fashioned land treatment, even if the new kind of filter beds are used. A proposition to construct a long outfall sewer for carrying the effluent far down the River Mersey was recently voted down by the taxpayers. A committee has since reported in favor of bacteria filter beds, hoping that the stand of the Local Government Board against a loan for this purpose could be overcome, but the Board will not recede from its position. The city is now considering a plan for raising money without the necessity of approval by the Local Government Board. The early construction of four acres of bacteria filter beds is proposed, with more to follow as experience is gained. The city surveyor estimates the cost of 37 acres of these beds at from some $400,000 to $635,000, according to the depth and mode of construction employed. The English papers do not make clear the difference between bacteria filter beds and the intermittent filtration beds in such successful operation in this country. Coke breeze, crushed cinders and other materials seem to be employed in some cases in place of sand, and possibly forced aeration is brought into service in some cases. The great aim is to secure a higher rate of filtration for a given area.

THE COTTON INDUSTRY OF THE SOUTH was the subject of a late address before the Merchants' Association of New York, delivered by Mr. W. J. Mercer, of the "Journal of Commerce" editorial staff. Mr. Mercer said that in 1880 the South contributed 542,000 spindles out of the 10,653,000 then operated in the United States. In 1890 the South's quota was 1,712,000 out of a total of 14,188,000; and in 1898 the South is credited with 4,100,000 out of 17,400,000 spindles. Up to 1892 Southern manufacturers made coarse cotton goods almost exclusively; but since that date finer goods are being turned out, and at the present time 500,000 spindles in the South are working on the "Fall River" class of goods. The Southern rate of wages is low, as compared with the North, ranging from 20 to 30% below, and in South Carolina and Georgia the working hours are 66 per week; and in other states there is no limit fixed by law. But living in the South is also comparatively very cheap. The Southern mills now have the home market; and as a result of over production, North and South, the price of cotton goods is declining everywhere in the United States. Mr. Mercer then said that the only remedy was a more vigorous effort to secure a foreign market. We now only export about 5% of the quantity exported by Great Britain; and to China, our own best market, England exports eight times as much as we do.

A CONGRESS FOR THE PROTECTION OF INDUSTRIAL Property, in inventions, etc., will be held in London, on June 1, 2, 3, of this year, under the auspices of the International Association for the Protection of Industrial Property. The latter association was founded last year at Brussels, with Eugene Pouillet, of Paris, as President. One object is the improvement and assimilation of patent laws in various countries.

EUROPEAN RUSSIA, at the beginning of 1897, had a population of 94,215,000; the Caucasus had 9,248,000 inhabitants; the Previsliansky Provinces, 9,455,000; Siberia, 5,727,000; Central Asia, an estimated population of 7,721,000. The total population of European and Asiatic Russia is thus placed at 126,368,000; and including the Russians in Finland, Bokhara and Khiva the total is placed at 126,411,000, of which number 63,253,000 are males. U. S. Consul Smith, of Moscow, says that the population of the cities and towns of Russia is only 16,289,000, or about 13% of the aggregate population. If the people of the villages and small settlements are added the actual town population is still only 20,000,000.

A WATER TANK ONE HUNDRED YEARS OLD has been exposed to view by the partial destruction of buildings occasioned by the widening of Elm St., now in progress in New York city. The tank is about 35 ft. in diameter and 15 ft. high, and is composed of three courses of segmental iron castings, with flanged and bolted joints. The castings are about 2½ ft. wide by 5 ft. high and are reinforced midway in their height by a web, the flanges at the joints also being reinforced by angle webs. An ornamental effect is obtained by the use of beads forming panels on each half of the outer facings of the segmental castings. Four iron hoops are placed around the tank. The tank rests on a masonry tower some 15 or 20 ft. high. The supply pipe is 10 ins. in diameter and is provided with a gate enclosed in a rectangular chamber formed by bolting together two flanged iron castings. This tank was erected and for a century has been kept filled with water by the Manhattan Co., through which Aaron Burr and others surreptitiously launched out in the banking business on the strength of a charter to supply New York with water. It is said that the tank is kept full in order to maintain the charter of the company. For years the tank has been enclosed by a building.

IMPROVEMENTS TO THE WATER-WORKS of Council Grove, Kan., now nearing completion, are designed to give a purer supply and one more reliable in times of drought. A pressure mechanical filter plant will be used and a storage dam has been built across the Neosho River, from which the supply is taken. The dam is of masonry and gravel-fill, and its crest will be used as a highway. It is designed to give the least possible resistance to floods and to avoid scour. The slopes are very gentle and the roadway and downstream side are heavily paved with stone. Depressions in the coping of the heart-wall will pass the normal dry weather flow, the coping affording a broken footway for pedestrians. The dam has been completed a few weeks and has already satisfactorily passed a number of floods. The improvements were designed by Mr. L. L. Tribus, M. Am. Soc. C. E., of 84 Warren St., New York city, to whom we are indebted for the above information.

THE BURSTING OF A NEW WOODEN WATER TANK at Delta, Colo., is reported as having occurred on April 16. It is said that the tank had just been filled for the first time to soak up the wooden staves.

THE POROSITY OF THIN STEEL PLATES was tested at the Washington Navy Yard on April 14. Readers of Engineering News may remember that in our issue of July 23, 1896, was published a letter from Mr. Charles Steiner, proposing to transmit hydraulic power long distances by driving tunnels, lining them with metal and forcing water through them at a pressure of several thousand pounds per square inch. To see whether water would percolate under steel plates, small pieces of sheet steel of ¼, ⅛, 1-16 and 1-32-in. were each subjected to a water pressure of 6,000 lbs. per sq. in., and in no case was any percolation found; a ⅝-in. rivet joining two ¼-in. plates also proved tight under the same pressure. A test was also undertaken to determine the friction of water under high pressure, and while it was inconclusive, there was no evidence that the friction of water under high pressure was any greater than the friction of water not under pressure. We need hardly remark that this result, as also the results with the steel plates, are what engineers would naturally expect.

A POWER DISTRIBUTION SYSTEM using compressed air obtained from compressors run by the James River is under consideration at Richmond, Va. The scheme contemplates installing turbines and suitable apparatus for compressed air which will be piped to parts of the city where power is needed. It is said that a similar plant is in operation at Magog, Canada, where a large cotton mill abandoned steam and adopted compressed air.

PRICES FOR POWER furnished by the Cataract Power & Conduit Co., of Buffalo, N. Y., for manufacturing and general purposes are given in a schedule just issued. Payments for power are required to be made monthly, and the rates are arranged upon a sliding scale varying with the power consumed as shown by meters. The charge for power for small size motors amounts to about 75 cts. per HP. per month. The following is the detailed schedule:

Units used per month.	Rate per unit.	Rate for current used in excess.
Up to 1,000..........	2.0 cts.	1.5 cts.
1,000 " 2,000..........	1.5 "	1.2 "
2,000 " 3,000..........	1.2 "	1.0 "
3,000 " 5,000..........	1.0 "	0.80 "
5,000 " 10,000..........	0.8 "	0.75 "
10,000 " 20,000..........	0.75 "	0.70 "
20,000 " 40,000..........	0.70 "	0.66 "
40,000 " 80,000..........	0.66 "	0.64 "

THE STRENGTH OF BRICK PIERS laid up in Portland cement mortar, has been under test at McGill University, at Montreal. The mortar was made of one part cement to three of sand, and the test piers were about 8 ins. square by 10½ to 11½ ins. high. Two piers were made of ordinary well burned brick, and two were made of pressed brick, keyed on one side. The mortar had set for three weeks before testing. The general results were as follows:

	Number of pier.			
Compression strength, lbs. per sq. in.:	1	2	3	4
First crack	822	990	1,130	1,204
Maximum load	1,234	1,230	1,524	1,985
Compression, per ft., in ft.:				
400 lb. unit stress......	0.001	....	0.0025	0.003
800 lb. " "	0.0025	....	0.004	0.0045
Thickness of joints, ins.....	0.33	0.33	0.5	0.25

In each case the failure was in the brick, though the strength of the mortar, in a 3-in. cube, never equalled the stress causing the first crack. A brick similar to those used in Piers 1 and 2, when laid flat in plaster of Paris, had a crushing strength of 1,400 lbs. per sq. in. for the first crack; and 2,400 lbs. for the maximum load.

THE NICARAGUA CANAL COMMISSION, through Admiral Walker, Chairman of the Commission, asks Congress for an appropriation of $50,000 to complete the work for which the Commission was sent to Nicaragua. Admiral Walker, in his communication, says that much valuable information has been gathered; but that much still remains to be done: especially in the completion of investigations at the sites of the principal dams. He thinks it would be most unwise to stop until all engineering questions are definitely settled by actual survey.

THE GOOD ROADS LAW OF NEW YORK, passed at the last session of the legislature, has already brought in three petitions for road improvement from Erie county. These came from property holders, have been approved by the Erie county supervisors, and were then forwarded to State Engineer Adams. The fate of these petitions depends, however, on that of the Supply Bill, not yet signed, which carries with it the appropriation for making the Good Roads law effective. This year's appropriation for this purpose will be $50,000; provided, the bill is approved.

THE BUILDING CODE OF NEW YORK CITY will have to be revised to meet the altered conditions following the consolidation of the cities of Brooklyn and New York. A Joint Committee, composed of representatives from various local building organizations, has been for several months endeavoring to secure the appointment of a committee in accordance with the provision in the charter of Greater New York, which provides for the formation of a new code. The matter was submitted to the present Commissioner of Buildings, Mr. Thomas J. Brady, who stated that at present nothing could be done owing to the limit placed on the city's bonded indebtedness. The matter will be referred by the committee to Mayor Van Wyck with a view to securing the proper action necessary for the preparation of a new code of building laws.

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