ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

VOL. XLI No. 3.

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MORE APPOINTMENTS to the Corps of Civil Engineers, U. S. Navy, are to be made, and the rules for the examination of candidates have just been announced. Applicants must be between 25 and 35 years of age and must pass a physical examination, which will take place at the Navy Yard, Washington, D. C., on Jan. 23, at 10 a. m. Applications for permits to be examined must be made to the Secretary of the Navy. Each applicant must present testimony as to character, evidence of American citizenship, evidence of having received a degree in the civil engineering course of some professional institution of good repute, and a record of at least three years' practical experience as a civil engineer.

Those who pass a satisfactory physical examination will be later subjected to a competitive written examination to determine their mental and professional abilities. The subjects included in this examination will be: Testimonials; English grammar and composition; elementary physics; elementary geology; drawing; arithmetic; algebra; geometry; trigonometry; analytical geometry; differential and integral calculus; applied mathematics, including mechanics of solids and fluids and strains in structures; construction materials; engineering constructions, such as workshops, chimneys, steam and electrical machinery, quay walls, wharves, dry docks, sewers, yard railways, pavements, water distribution, foundations, etc.; surveying (topographical, trigonometrical, and hydrographical) and mapping; instruments, their use and adjustment.

No candidate will be considered as having passed a satisfactory examination who does not attain a general average of 75%, and an average of at least 80% in applied mathematics, constructional materials, and engineering constructions. The lists of questions published in this issue and our issue of Jan. 27, 1898, indicate quite clearly the character and difficulty of the questions which candidates are required to answer in these examinations.

THE HANKOW-CANTON RAILWAY CONCESSION is given in abstract by the "London Globe" as follows: The Chinese Emperor grants to Sheng Tajen the right to build a railway from Hankow to Canton; and, under imperial sanction, the China Railway Co. has been formed, with Sheng Tajen as Director General. The latter deputed its right and powers to Wu Tong Fang to enter into a contract with the American-China Development Co. By this contract the latter company agrees to provide a sum of £4,000,000 for the construction and equipment of the road. To secure this loan the Chinese government agrees to issue imperial gold bonds, similar to those secured on the imperial customs, and take a first mortgage on the railway. These bonds will be issued, at 90% of the face value, to the American-China Development Co., and must be sealed by the Director General and signed by the Chinese Minister at Washington. They will carry 5% interest, and the company may sell these bonds to the public at discount, or otherwise. The American Company is to construct the road on plans approved by the Chinese Director General. It is provided that after this line is built the company may have the right to build and equip a line from Canton to the sea, and to such other points "as may be agreed upon," probably meaning short branch lines. The American-China Co. agrees to pay particular heed, whenever possible, to Chinese habits and traditions, and to employ Chinese in places of trust in both the construction and administration of the line. The Chinese, on their part, are to permit no interference or obstruction in building after the plans are approved, and the survey party is to be in no way hampered. All material is to be purchased in the open market at the lowest price; but when Chinese material is equally cheap it is to be preferred. All material purchased outside of China will be admitted duty-free. The American-China Co., as compensation, is to receive 5% of the cost of construction, except for land and earthwork. The sixth clause is a somewhat peculiar one. Providing as it does for the ordinary expenses in maintaining and conducting, it goes on to state that the American-China Co. shall, after these have been paid, receive 20% of the net profits, "to be represented by and in form of debentures to an amount equal to one-fifth of the cost of the line." These are to be issued at the same time as the first mortgage bonds, the Chinese-American Ry. to have the right to redeem these at any time at par, and if not redeemed shall expire after 43 years without payment. On the signing of the agreement work is to commence at once on the surveys; and the American-China Co. must deposit $100,000 in trust in Washington, and forfeit this amount if an equal sum is not expended on the line within six months after signing. On compliance with this condition the deposit will be handed back. If the Belgian concession of 1897 is cancelled for building the Lukow-Chiao-Hankow line, then the agreement provides that the American-China Co. may construct this line and raise £5,000,000 on the same terms as for the Hankow-Canton railway.

RUSSIA'S RAILWAY BUDGET, for 1899, proposes the expenditure of 99,000,000 rubles, or nearly $51,000,000. Minister of Finance de Witte says that the ordinary revenue exceeds the ordinary expenditures by 6,468,970 rubles; and the deficit of 98,604,443 rubles for extraordinary expenditure on railways is fully covered by the Treasury reserve fund of 115,000,000 rubles, and there is, consequently, no need for another loan. He points out that the gold in the state banks, the exchequer and in circulation has increased by 121,000,000 rubles within the year. The present value of the ruble is about 51½ cts. in gold.

THE MOST SERIOUS RAILWAY ACCIDENT of the week occurred, Jan. 14, on the Greenwood Lake branch of the Erie R. R., near Pompton Lakes, N. J., in which three men were killed, three were fatally injured, and about 20 received minor injuries. The train, composed of an engine and one car, was returning a gang of 30 laborers from Greenwood Lake, where they had been cutting ice, to various points as far as Midvale. As the train turned a curve at Monk's Station, the car left the track, probably owing to spreading rails, and rolled down a high embankment.

A LARGE FLYWHEEL BURST on Jan. 17, at the works of the Lorillard's tobacco factory, Jersey City, N. J. Two persons were killed and two severely injured. The wheel was 18 ft. in diameter, with a 40-in. face, and weighed 18 tons. It is stated that the governor failed to work, causing the engine to run away.

A LARGE BRIDGE recently erected over the Cuyahoga River, at Cleveland, O., fell on Jan. 18, through the undermining of its masonry supports by a flood, caused by heavy rains and melting snow.

THE NEW YORK AUTO-TRUCK Co. was incorporated in New Jersey, on Jan. 14, with $10,000,000 capital. The incorporators are Arthur P. Gorman, of Baltimore, Md.; Lewis Nixon, of the Crescent Ship Yards; Nathan Strauss, of New York; Richard Croker, of New York, and Joseph H. Hoadley, inventor of the Hoadley-Knight compressed air system. Mr. Hoadley is president of the company, and compressed air is to be utilized as the motive power. The motors will be manufactured by the Leiter-Rothschild syndicate at their Providence and Worcester shops, and Mr. W. H. Knight, formerly Chief Engineer of the General Electric Co., will be the chief engineer of the above companies; Mr. Knight is also engineer of the American Air-power Co., of New York, owned by the Whitney syndicate. The purpose of the company is to handle heavy freight, transport coal, etc.; and Mr. Croker is the authority for saying that the carting of coal alone in Greater New York represents an annual expenditure of $7,500,000.

MOTOR CARRIAGES of three different makes were exhibited and operated at the recent Cycle and Automobile Exhibition in Chicago. The Fischer Equipment Co., of Chicago, had a hansom cab and two styles of open carriages, equipped with the Woods system of storage batteries. A pinion on each end of the motor shaft gears with a spur wheel attached to the inside of the spokes of each rear wheel. The gearing is not enclosed. The American Electric Vehicle Co., of Chicago, whose vehicles have been described in our columns, exhibited a handsome open carriage, operated by storage batteries, and having the gearing enclosed. The Oakman Motor Vehicle Co., of Greenfield, Mass., exhibited the Hertel motor carriage, which is propelled by a gasoline engine. A small grooved friction wheel on each end of the motor shaft engages with the inside rounded surface of a ring secured to the metal portion of the rear wheel tires, the spokes being of wire. This carriage was easily distinguished by the sharp sound of the unmuffled exhaust from its engine, and by a pervading odor of gasoline. A noticeable feature of all these vehicles was their facility of steering. An L-shaped space was railed off, and the carriages went round the corners and around the columns of the building with remarkable ease and closeness at a rapid rate of speed. This is due to the fact that each of the fore wheels turns independently on a vertical axis. In the two styles of electric carriages the wheel hubs have vertical pivots and are connected by the steering rods, while the gasoline carriage has a bicycle fork to each wheel, one fork carrying the steering handle, and the forks being connected by rods. Another feature of the carriages was their rapid rate of acceleration.

HORSELESS ICE WAGONS are being considered by the Consolidated Ice Co., of New York city, and according to reports the company will order 1,000 wagons provided a satisfactory vehicle can be found. Plans and estimates have been invited for these wagons. The routes traveled by the company's regular wagons average, at present, from 10 to 15 miles in the city, and from 20 to 25 miles in the suburbs. These wagons weigh when empty about 3,500 lbs. and have a capacity of from 6 to 8 tons. Owing to the nature of the load the form of motor used in the new wagons must be free from heat and of small size, besides being powerful and cheap in first cost and cost of operation.

TESTS OF BICYCLE TIRES, recently made by Prof. R. C. Carpenter, of Cornell University, show that, other things being equal, the larger the tire the easier runs the wheel. A marked difference in ease of running is found between a 1½-in. and 2-in tire. A single tube tire runs easier than a double tube tire.

THE STEAMSHIP "OCEANIC," of the White Star Line, was launched on Jan. 14 at the Harlan & Wolff yard, at Belfast, Ireland. The "Oceanic" is 704 ft. long, 72 ft. beam, 26 ft. draft, is 17,000 tons displacement and her engines are expected to develop 45,000 I. HP. Her coal capacity is said to be sufficient to enable her to circumnavigate the globe at a speed of 12 knots per hour without recoaling. She is the largest ship ever built, and compares as follows with the "Great Eastern." This latter ship was 680 ft. long, 83 ft. beam, 30 ft. draft, and was 13,000 tons register with only 2,700 HP. The "Keiser Wilheim der Grosse" is 648 ft. long, 66 beam, 26 ft. draft, 14,000 tons register and has engines of 30,000 I. HP.

THE SOUTHWEST PASS PROJECT for the improvement of the mouth of the Mississippi River has been reported upon by the board of Army Engineers appointed under a resolution of Congress calling for a channel 35 ft. deep and of adequate width. The board proposes a system of jetties to cost $13,000,000, and presents a further estimate of 2% of this for maintenance, and another 1% for extending jetties.

A SIDEWHEEL STEAMER, 320 FT. LONG, is to be built by the Detroit Dry-Dock Co. for the White Star Line, plying between Detroit, Toledo and Port Huron. This steamer will be 320 ft. long over all, 36 ft. beam on hull and 68 ft. over the guards, and her molded depth will be 13½ ft. She will be fitted with triple-expansion engines, and is expected to make a speed of at least 20 miles per hour. There will be accommodations for 3,500 passengers, but she has no provision for night travel.

AMERICAN SHIPBUILDING is active, says "The Marine Review," and 262 vessels, valued at $62,110,092, were either building or under contract on Jan. 1, 1899. Of these 204 were merchant vessels, aggregating 254,216 tons, valued at $19,760,900. The warships number 58, of 146,499 tons displacement and 372,150 HP., and valued at $42,349,192, exclusive of armor and armament. Of the merchant ships, 155, of 172,040 tons displacement, are being built on the seacoast; 26, of 71,400 tons, are being built on the lakes, and 23, of 10,776 tons, are being constructed on the Western rivers.

FOREIGN COMMERCE FOR 1898, says the U. S. Bureau of Statistics, shows a total of exports for the calendar year of $1,254,925,169, with $137,847,448 for December, the highest record for any one month in our history. Only two yearly returns approach that of 1898; in 1897 the value of exports amounted to $1,099,709,045, and in 1896 it was $1,005,857,241. The largest record for any prior month was $129,780,014, in November, 1898. The imports for 1898 were the smallest since 1885, though the consuming population is now 33% greater. The imports amounted to only $633,664,634, against $742,623,893 in 1897. The excess of exports of merchandise, in 1898, is thus $621,260,535.

STEEL FREIGHT CAR OF 100,000 LBS. CAPACITY; PITTSBURG, BESSEMER & LAKE ERIE R. R.

The sharp competition in the coal and ore carrying traffic has had an important influence in hastening the introduction of improved means of handling this traffic in order to reduce the cost of transportation to a minimum. A material economy in this cost may be effected by increasing the live load per car and per train, and for the particular class of traffic noted above several railways are using wooden cars of 70,000 and 80,000 lbs. capacity (Engineering News, June 6, 1895, and June 16, 1898), instead of the 60,000-lb. cars which are now practically the standard for general freight traffic. Beyond the 80,000 lbs. capacity, however, it is not practicable or economical to go without some material change in car construction, and this condition has led to the somewhat extensive introduction of steel cars for hauling coal and ore

The general and economic features of this change in transportation methods are discussed in another column, and in the present article we describe one of the latest styles of steel cars, several hundred of which are now in use on important roads. This is a double-hopper gondola car of 100,000 lbs. capacity, built for the Pittsburg, Bessemer & Lake Erie R. R., and resembling in general style and in the arrangement of the hoppers the 70,000-lb. wooden cars of the Pennsylvania Lines, described in our issue of June 6, 1895. The principal traffic of the P., B. & L. E. Ry. is in carrying coal from the Pennsylvania mining regions to the lake ports, and iron ore from the lake ports to the Pittsburg iron and steel manufacturing districts. The road has been built and equipped with special regard to the economical handling of this traffic. The grades have been kept low, the track is laid with 100-lb. rails, and the equipment includes immense mogul engines which can haul 30 of these 50-ton cars. Such a train would weigh 2,010 tons, of which 1,500 tons, or 75%, would be paying load.

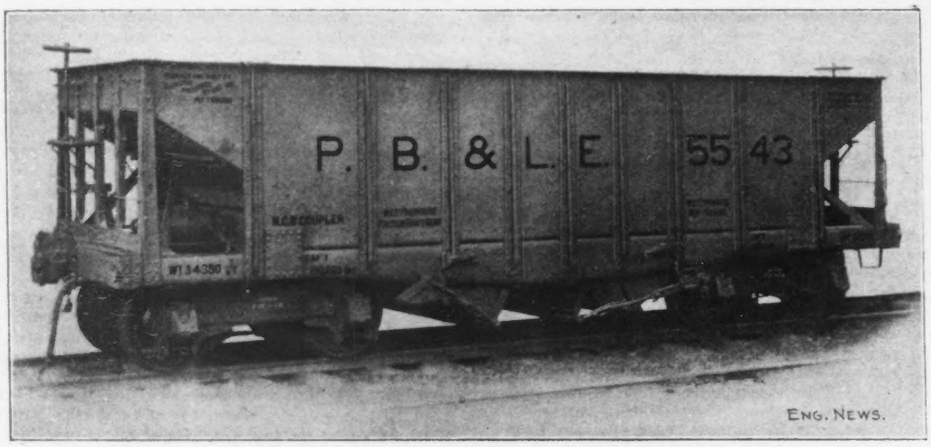

FIG. 1.—STEEL FREIGHT CAR OF 100,000 LBS. CAPACITY FOR THE PITTSBURG, BESSEMER & LAKE ERIE R. R.
Schoen Pressed Steel Co., Builders.

Fig. 1 is a view of one of the first of the steel cars built for this road, and Fig. 2 shows the details of construction of the latest cars. All the main parts are of pressed steel shapes, with the exception of the plating. The framing consists of four longitudinal pressed steel sills of channel section, 29 ft. 6 ins. long, 3⅞ ins. wide, 17 ins. deep at the middle and 10 ins. deep at the ends. This shape gives ample strength and stiffness, without an excessive weight of material. The center sills are 20 ins. apart, back to back. The end sills are of similar construction, with a broad Z-shaped plate riveted to the sill and to the end braces of the body. The body bolster consists of two steel channels, placed between the sills, and having the ends of the webs flanged out and riveted to the webs of the sills. Directly over the bolster is a transom or transverse member, supporting the sloping floor of the car, which is further supported by diagonal struts on the underframe. Horizontal transverse members are fitted between the sills, while diagonal braces run from the center sills to the corners of the frame, to take care of racking strains, such as may be set up when cars are moved by poling.

The sides are of steel plates, each plate being the full depth, so that there are no horizontal joints. The depth inside is from 1 ft. 4 ins. at the ends to 7 ft. 9 ins. at the bottom of the hopper. The upper edge is pressed over to form a horizontal flange around the top of the body. The floor is of similar plates, and the portion of the floor above the sills is supported by shoes and diagonal struts or braces. The sides are stiffened against buckling, by means of pressed steel stakes of U section, which are riveted to the sills and the plates, the spacing between the stakes being from 2 ft. at the middle of the car to 3 ft. 7 ins. at the ends. Thus each side, with its stiffeners and its top flange, forms a plate girder in itself.

There are four hoppers, the floors having an unbroken slope of 30° from the end of the car to the bottom of the hopper, while the ends of the hoppers are inclined 60° to the horizontal. Sloping cover plates prevent the coal or ore from lodging on the center sills, where they pass through and divide the hoppers. There are four doors, 2 ft. 4½ ins. long and 3 ft. 5⅝ ins. wide (transversely to the track), and these are operated in pairs. The doors are operated by rods and toggles instead of chains, so that their movements are under positive control in opening and closing. The sectional elevation shows an open door, while the side elevation shows a closed door.

The draft gear is fitted between the center sills, and the brake cylinder and reservoir are mounted above the sills, under the sloping end of the car floor. In this arrangement of the brake equipment, and in the door operating mechanism above described, these cars are similar to the 70,000-lb. cars designed by Mr. G. L. Potter, Superintendent of Motive Power of the Pennsylvania Lines (Eng. News, June 6, 1895). The cars are fitted with M. C. B. couplers, the Westinghouse friction draft gear, and the Westinghouse brake. The brakes are hung inside the wheels, and they can be operated by hand, a brake wheel and shaft being placed at each end, with a footboard for the brakeman. These footboards are the only wooden parts in the entire car.

The trucks are of the Schoen pressed-steel diamond-frame pattern, the frames being built up of pressed steel shapes instead of flat bars. Channel-shaped transoms of pressed steel carry U-shaped hangers, in the loops of which are the seats for the coiled springs, upon which rest the ends of the bolsters. This truck and the Schoen plate-frame truck were discussed in an article on "Metal Trucks for Freight Cars" in our issue of Sept. 15, 1898.*

The Pittsburg, Bessemer & Lake Erie R. R. has had 1,000 of these cars built by the Schoen Pressed Steel Co., of Pittsburg, Pa., and we are indebted to the builders for blue prints and other particulars. Similar cars have been built for other roads, including the Baltimore & Ohio R. R., Pittsburg & Lake Erie R. R., Butte, Anaconda & Pacific R. R., the Pennsylvania Lines, and the Lake Superior & Ishpeming Ry. The cars for the Pennsylvania Lines have a capacity of 110,000 lbs. of ore, or 104,000 lbs. of coal. The cars for the Lake Superior & Ishpeming Ry., while of 100,000 lbs. capacity, weigh only 26,000 lbs., and are only 26 ft. long. They are specially designed for the ore traffic, and have the hoppers arranged for unloading at the docks into ore pockets 12 ft. apart.

The leading dimensions of the cars of the P., B. & L. E. R. R. are as follows:

100,000-lb. Steel Car; P., B. & L. E. Ry.

Length over end sills	29 ft.	6 ins.
" inside body	28 "	0¼ "
Width over top flanges of sides	9 "	9½ "
" over stakes	9 "	8 "
" side sills	.	.
" inside body	9 "	2 "
Height, rail to top of sill	3 "	6 "
" " to top of side	8 "	9 "
" " to center of coupler	2 "	10½ "
" " to bottom of hopper	1 "	0 "
Depth inside at ends	1 "	4 "
" " at middle	3 "	1 "
" " at hoppers	7 "	9 "
Wheels, diameter	2 "	9 "
Trucks, center to center	19 "	9 "
Wheelbase, truck	5 "	7 "
" total	25 "	4 "
Journals		5 x 9 "
Carrying capacity		100,000 lbs.
Weight, empty		34,000 "
" loaded		134,000 "
Live load		74.62%
Dead load		25.38%
Weight per wheel		16,750 lbs.
Weight per ton of live load		680 "
Cost (approximate)		$810

*As already noted, two of the titles on the sheet of drawings of metal trucks in that issue were accidentally transposed, and Fig. 6 is properly Fig. 5, the Schoen plate frame truck.

QUESTIONS USED IN THE EXAMINATION OF CANDIDATES FOR THE CIVIL ENGINEER CORPS, U. S. N.

The first examination under the rules governing the appointment of engineers to fill vacancies in the Civil Engineer Corps of the United States Navy, which were recently issued by Commodore M. T. Endicott, Chief of the Bureau of Yards and Docks, U. S. N., took place at Washington, D. C., on Sept. 6, 1898. As stated in our issue of Aug. 25, 1898, the new rules require that each applicant must give evidence of American citizenship, and sustain an examination as to physical fitness. As to professional qualifications there must be evidence of having received a degree in civil engineering from some professional institution of good repute, and a record of at least three years' practical experience as a civil engineer. The examination of the candidates in scholarship and professional attainments must be competitive and in writing. To pass a satisfactory examination candidates must attain an average of at least 80% in applied mathematics, construction materials and engineering construction, and a general average of 75%.

As indicating the quality of the men intended to be obtained for this branch of the naval service, the questions asked of the candidates who took the examination on Sept. 6, 1898, will, we think, be of interest to many of our readers. In our issue of Jan. 27, 1898, a similar set of examination questions were published. For the permission to publish these questions we are indebted to the courtesy of Hon. John D. Long, Secretary of the Navy. The questions in full were as follows:

(1) Name in full.
(2) Whether or not a citizen of the United States of America.
(3) When and where born; age in years and months on Sept. 6, 1898.
(4) Present address in Washington.
(5) Usual address, town, county and state.
(6) Statement in detail of engineering instruction received.
(7) Tabulated statement of positions held; time in each; detailed description of work.

GRAMMAR.

(1) Name the principal marks used in punctuation and give their relative value and uses.
(2) What mood most frequently occurs in specifications, and what moods and tenses may be used?
(3) "Purchasing pay officers will be furnished with funds for the payment of bills upon requisitions prepared in the office of the Paymaster General, due notice of the drawing of which will be sent to the purchasing officer."
Analyze the above sentence. Parse the underscored words, giving part of speech, number, person, degree, mood, tense, etc., so far as applicable.
(4) Give a list of the relative pronouns. Give a list of the prepositions of place and direction. What are the regular endings of participles?
(5) Name the most frequently used conjunctions; divide them into classes, and define the characteristics of each class.

COMPOSITION.

Give a description from 300 to 500 words in length, of some engineering work with which you are familiar, and upon which you have been employed.

ARITHMETIC.

(1) Given three buildings 129.2 ft., 191.4 ft. and 295.8 ft., respectively, c. to c. of end posts, in which it is desired that the panel lengths shall be the same and as long as consistent with this condition, what is the length of panel to be used?

(2) The length of a bridge panel is 16 ft. 1-32 in., c. to c. The depth of truss is 24 ft. c. to c. of chords. What will be the centre length of an eye-bar providing for a 6-in. pin and a clearance of 1-50-in. in each eye of the bar?

(3) A rectangular prism has a base of 496 × 558 ft., and a height of 186 ft. What is the edge of a cube having the same volume?

(4) Find the weight in kilograms of a hexagonal prism of a substance whose specific gravity is 2.3, and whose dimensions are 554.256 mm., on each edge of the hexagon, and 3 m. perpendicular distance between the hexagonal end faces?

(5) A square test piece, originally 8 ins. between measuring points, measuring 10.35 ins. after fracture. What is its percentage of elongation? Its original area was 0.567 sq. in., its rectangular dimensions at fracture are 0.493 in., and 0.562 in. What is its percentage of reduction of area at fracture? What were its original dimensions?

(6) What is the cost per cu. yd. of finished concrete in place when composed of the following ingredients, and worked by the following labor?

16 cu. yds. of silica sea washed gravel, voids 37%, at $1.45 per cu. yd.

Sand used in excess to extent of 22%, voids, 43%, at $0.85 per cu. yd. Portland cement used in excess to extent of 16%, $1.96 bbl. Labor, 1-10 superintendent at $6.00; ½ leading man at $3.76; two second-class masons at $3.28; four first-class hod carriers at $1.76; two third-class laborers at $1.28, and two fourth-class laborers at $1.04.

PHYSICS.

(1) Define the term "hygrometric condition of the atmosphere," and describe a method of determining this condition. What trouble is experienced in compressed air machinery on account of moisture in the air?

(2) How is sound transmitted from point to point, and at what rate in an ordinary occupied hall? Show how you would construct a building so as to prevent sound passing from one room to another. Explain how such a construction attains the desired end.

(3) Draw diagrams to show the arrangement of lenses, the axes and the paths of rays of light in an ordinary direct telescope, an inverted telescope and a field glass. What advantage has the second over the first?

(4) Define specific heat, and state which is greater, that of gases at constant pressure, or at constant volume. What work is a measure of the difference? Show how to measure the temperature of a furnace, when the only tools at hand are a pocket thermometer, reading to 1-5° between 20° and 120° F., and such articles as can ordinarily be found in a country general store.

(5) Draw a heat engine diagram, and indicate at what points entrance and exhaust parts were opened and closed, which curves are isothermal, which are adiabatic, and state upon what the theoretical efficiency of a heat engine depends.

(6) An alternating current dynamo delivers 20 amperes under 140 volts at the terminals of a step up converter, the efficiency of the converter being 68%, which current will be delivered in the line at a voltage of 3,000? Allowing 3% loss in the line up to the terminals of a converter of 85% efficiency, which delivers current to a lamp circuit of 56 volts, what current flows in the lamp circuit? What is the efficiency of distribution from the dynamo terminals of the step up converter? Describe the principle and construction of the converters. What is the most prominent mechanical difference between the construction of alternating current and direct current dynamos?

GEOLOGY.

(1) Explain the formation of anthracite and bituminous coals, petroleum, and natural gas.

(2) What are the principal ores of iron, and about what per cent. of metal does each contain?

(3) What is the composition of granite? Of gneiss? Of syanite?

(4) What are artesian wells? Whence is drawn their supply? In what formation would you expect to find artesian water? What is the difference between ordinary driven wells and artesian wells?

(5) Explain amorphous and laminated structure in building stones, and state what precautions should be used in laying each kind.

ALGEBRA.

(1) Find the value of,

$$\frac{\sqrt{(a^2+x^2)}+x}{\sqrt{(a^2+x^2)}-x} \text{ when } x = \frac{(6-c)a}{2\sqrt{hc}}.$$

(2) Divide the product of x^2+3x+2, x^2-5x+4, x^4+5x^2-14, by the product of x^2-1, x^2-2.

(3) Extract the cube root of $27x^4 - 27x^5 y -$ [illegible]$x^4 y^2 + 35x^3 y^3 + 30x^2 y^4 - 12x y^5 - 8 y^6$.

(4) Find values of x and y by solving the expressions, $x^2+y^2=136$ and $x^2-24\ y=11$.

(5) Define logarithms, and explain their use in extraction of roots, and determination of powers of numbers.

GEOMETRY.

(1) Using the double circle method, construct graphically an ellipse whose major and minor axes shall be in the ratio of 3 to 2.

(2) Find graphically the center of a given circular arc. Explain the geometrical reason for the method.

(3) Bisect the angle A of any triangle A B C at A, draw a perpendicular to the bisectrix. Prove that the sum of the distances from any point P on this perpendicular to B and C is greater than the sum of A B and A C.

(4) Reduce, graphically, the area given to a right angled triangle of equal area. Give geometrical proof of the method.

(5) Prove, geometrically, that the frustrum of a pyramid is equal to the sum of three pyramids, whose height is the height of the frustrum and whose bases are the bases of the frustrum, and a mean proportional between them.

TRIGONOMETRY.

(1) Given, sin. a = 0.5; cos. a = 0.87; sin. b = 0.8; cos. b = 0.65. Find sin. (a — b); cos. (a + b). Is the sum of a and b greater or less than 60°? Show how this can be proven.

(2) Find the value of tan. (a + b) when tan. a = 1 and tan. b = 1.4. Is the sum of a and b greater than 30°, greater than 90° and greater than 135°?

(3) Given a triangle whose sides are 8, x and y, and whose angles have the following functions:

	Sin.	Cos.	Tan.	Cot.
a	0.82	0.57	1.43	0.70
b	0.90	0.44	2.05	0.49
c	0.87	0.48	1.80	0.55

Find the lengths of the other sides.

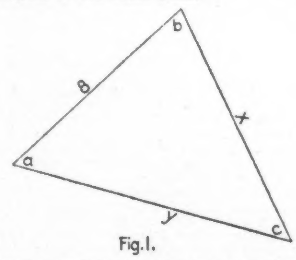

Fig. 1.

(4) Represent, graphically, the sine, versed sine, cosine, tangent, cotangent, secant and co-secant of an arc of 60°. Find their values.

(5) Prove that in a circle, the sine of 90°, the tangent of 45°, and the chord of 60°, are all equal.

ANALYTICAL GEOMETRY.

(1) Prove that every equation of the first degree between two variables is that of a straight line.

(2) Given the equation of the circle $x^2+y^2=25$, find the equation of a tangent at the point 4, 3.

(3) Deduce the equation of a parabola referred to rectangular co-ordinates, origin at the vertex.

(4) Give the equation of the equilateral hyperbola referred to its asymtotes, these co-ordinate axis being rectangular. Where is this equation of practical use?

(5) Given the general equations of line and circle: $Ax+By+C=o$, and $x^2+y^2+Ax+By+C=o$. prove analytically that the common chords of three intersecting arches, intersect in a common point.

DIFFERENTIAL CALCULUS.

(1) Differentiate $a\,x^2$ and prove the result.

(2) Differentiate $\frac{a}{x^2}$, log. Ax.

(3) A square piece of sheet metal is to have a square cut out from each corner, and the four projecting flaps are to be bent up so as to form a tank. What must be the side of the part cut out that the volume of the tank may be a maximum.

INTEGRAL CALCULUS.

(1) Find $\int (a-4x)^2\,dx$.

(2) Deduce the general formula for the area of a plain figure in polar co-ordinates. Find the area of a circle by this formula.

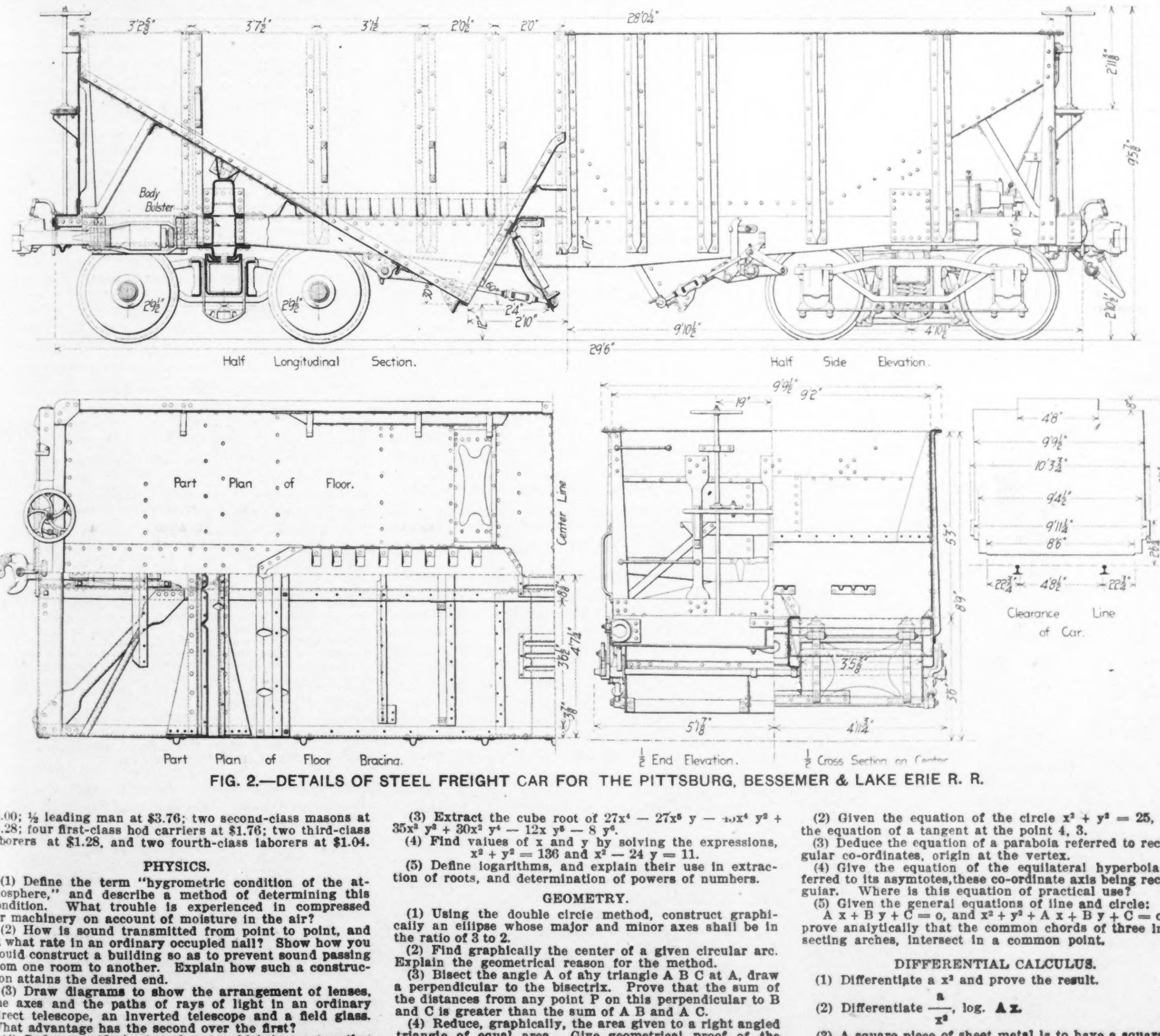

FIG. 2.—DETAILS OF STEEL FREIGHT CAR FOR THE PITTSBURG, BESSEMER & LAKE ERIE R. R.

INSTRUMENTS.

(1) Draw a diagram which shall show the principal features of a plain transit. Give the adjustments in order and describe them.

(2) Draw a diagram which shall show the principal features of a Y-level. Give the adjustments in order and describe them.

(3) Describe the surveyor's compass and state in what important respect the mariners' compass differs from it.

(4) Having no leveling instrument or leveling tool at hand, construct a level of sufficent accuracy for ordinary drainage work.

DRAWING.

(1) Draw a plan and two elevations of a pile of blocks as follows: The lower $3 \times 1\frac{1}{2} \times \frac{1}{2}$ ins., lying on the horizontal plane its long edge, making an angle of 30° with the vertical plane; the second of the same section, but 1 in. shorter, lying on the first and making with it an angle of 45°; the third, a rhomboid, with largest edge 1 in., lying upon the second. Show the shade lines, the light rays making an angle of 45° with both the horizontal and vertical planes. Show shadows.

(2) Draw in isometric projection a cube of 8 ins. edge. Show a square hole with 1 in. edge through the middle of the cube from top to bottom. Show circular holes 1 in. diameter through the cube from the centers of the other faces. Show recess 2 ins. diameter and ½ in. deep around hole on left hand side. Show square collar ¼-in. high, 1 in. internal diameter and 2 ins. external diameter, around hole on right hand face.

(3) Make a finished tracing of either 1 or 2.

(4) From the drawing furnished; state each element and its function in the machine.

(5) Make a finished topographical map from the sketch furnished.

SURVEYING.

(1) Fill out the notes given below; correct the readings for curvature and refraction; and find the elevation of the second hench mark:

Sta.	Dist. fr. level.	B. S	H. I.	F. S.	Elev.
B. M., No. 1........	100 ft.	4.522	......	......	25.373
A.	500 ft.	.....	......	11.167	......
A.	75 ft.	1.277	......	......	......
B. M., No. 2........	450 ft.	.....	......	7.423	......

All readings are in feet.

Describe method of making and locating bench marks in a wild country.

(2) A hench mark on shore reads 24.96 ft., referred to Cairo datum; this datum is 21.26 ft. helow mean Gulf level; the zero of a standard tide gage is 20.91 ahove mean gulf level. Starting from the bench mark, set a tide gage with gulf level for zero. Tide gage reads 3.7 ft.; reduce a sounding of 59 ft. to zero of the standard gage.

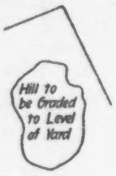

Fig. 2.

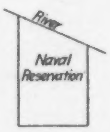

Fig. 3.

(3) Show how to make a topographical survey of the hill indicated (Fig. 2), and determine the number of cubic yards it contains. Assume any elevations and distances you may choose.

(4) Having a property located on a river front, as indicated (Fig. 3); locate soundings and the course and rate of current, having only one transit. Graduate a sounding line for use on the above work. Describe a float for use in ascertaining the discharge of a stream.

(5) Having a field bounded by the lines passing between the points A, B, C, D, E, F, G, H, I, J (Fig. 4), all of

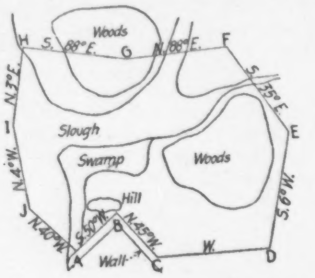

Fig. 4.

which are about 5 ft. above the level of high water in the river; dense woods in the areas indicated; a hill 35 ft. high; a wall 20 ft. high; a swamp and a slough in the indicated positions; and the points I and J marked by piles in the river, show how lines would he traced and their lengths and directions determined. The branch of the slough where it is crossed by the lines H, I, I, J and J A are about 700 ft. long.

GRAPHICS.

(1) Given a beam 25 ft. in length, and weighing 150 lbs. per foot, with weights distributed as shown in sketch

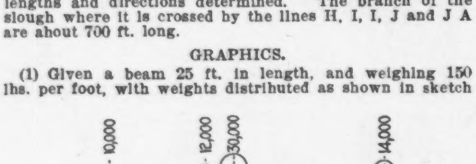

Fig. 5.

(Fig. 5) find graphically the amount and location of the greatest bending moment. Also show graphically the shear. Find hoth analytically.

(2) Determine graphically the stresses in the members of the roof truss shown in diagram (Fig. 6), the load, including the weight of the roof, to equal 45 lbs. per sq. ft. Trusses to be 24 ft. c. to c.

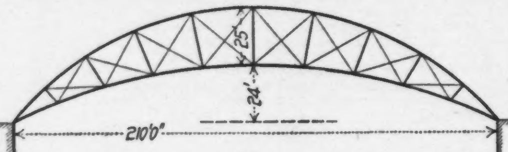

Fig. 6.

GENERAL PRINCIPLES OF MECHANICS.

(1) A train's speed is 45 miles per hour. Its wheel base, uniformly distributed is 8 ft. The curve upon which it is running is of 1,000 ft. radius. The load upon each axle is 14,000 lbs. Ties are spaced 2 ft. centers. The side resistance of a spike is 1,200 lbs. How many spikes are required in each tie to make the factor of safety 4?

(2) Show how to find, experimentally, the centre of gravity of a shape of irregular section (Fig. 7), where the end

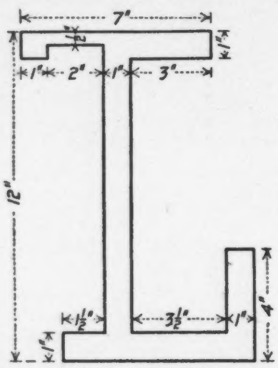

Fig. 7.

is cut in a plane normal to the longitudinal axis of the piece, and can be easily reached for inspection and measurement. Let the section be that shown in the diagram. Find, also, the centre of gravity of this section analytically.

(3) Find the moment of inertia of the above section about an axis through the centre of gravity, and parallel with the long edge.

(4) Given a pile which has been driven 40 ft., and which is 6 ins. in diameter at the lower end and 13 ins. at the surface of the ground; what is the frictional resistance per square inch of the pile if the next blow of a 3,000-lh. hammer, falling freely 20 ft. sinks the pile 1 in.?

(5) A car starts down a grade of 1%. What is the coefficient of friction? What kinds of friction exist, and at what points? Which kind is the greater in this case?

MECHANICS OF FLUIDS.

(1) Find entire pressure and centre of pressure on a trapezoidal gate, the upper edge of which is 80 ft. long; the lower edge 65 ft.; the depth of water heing 28 ft.

(2) A wooden sphere, the diameter of which is 8 ins. and the specific gravity 0.75 is placed in water. To what depth will it sink?

(3) Give the Chezy formula; explain the meaning of all the terms entering into it; and state what modifications, if any, you would make in its use.

(4) Make a diagram of and explain the principle of action of the hydraulic ram.

(5) Explain the purpose, principle and action of an accumulator.

CRANES.

(1) Determine the stresses in the members of this crane (Fig. 8), both analytically and graphically.

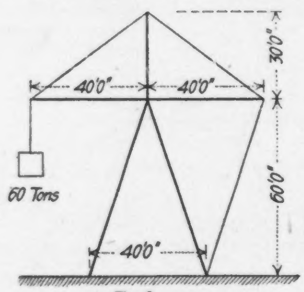

Fig. 8.

CHIMNEYS.

(1) A steel chimney 150 ft. high and 9 ft. in external diameter is to be constructed. What number of ¾-in. rivets will he required in the horizontal joint 30 ft. above the ground, the wind pressure being assumed at 40 lbs. per sq. ft?

CONSTRUCTIONAL MATERIALS.

(1) Provided Indiana limestone and the commonly used hrownstone cost the same per cubic foot, which would be preferable for ashlar work in the vicinity of New York or Boston? Why?

(2) For polished decorative work on huildings, what stone would you use for outside work? What for interior work? For what work would you use blue stone?

(3) How are brick classified? What kind would you use for house fronts? What in boiler settings? What in steel chimney linings? What in pavements?

(4) What cement would you use where it is desirable to have as great strength as possible? What where less strength is required and economy in first cost is essential? What tensile strength would you expect each to show in test hriquettes at the end of seven days? What is the difference in composition and action of these cements?

(5) Of what is concrete made? What are the proportions commonly used? How should it he mixed? How put in place? On what does its value depend? What precautions should he taken in its use?

(6 What are the principal kinds of glass used in ordinary building construction? What would you require for a six light sash, 12 × 15 ins. panes, to be used in a good store house? What glass would you use in good skylights? What are the standard sizes of tin roofing plates? Is IC or IX the heavier plate? How should tin he laid on a steep roof? How on a roof of little pitch?

(7) Describe the characteristics of cypress, yellow pine, white pine, hemlock, spruce, poplar, ash and oak.

(8) State what should be used for each of the following purposes: Norfolk bearing piles; Boston bearing piles; wales; first-class floor beams and joists; door and window trimmings; office and house wainscotting; sheathed partitions; and wooden ceilings.

(9) How does prime inspection differ from mercantile inspection?

(10) What is the composition of the best paints for wood, iron and tin surfaces? What would be used on stained uncarpeted floors? What on hardwood trimmings to show the natural color and grain?

(11) Name the principal metals used in engineering work and give their range of strength in tension. Name the common elements occuring in metals of engineering and describe their effects upon the physical properties.

(12) What is galvanized iron. In what form is it commonly used for roofs and sidings of buildings? In what for gutters and down-spouts? Thickness commonly used? Usual sizes of manufactured sheets? Upon what does its durability depend?

(13) In what form is copper used in building? What are its advantages over tin or galvanized iron? What two kinds are used? What are the characteristics of each?

(14) What considerations of theory and practice determine the sections of the usual commercial forms of structural iron and steel?

ENGINEERING CONSTRUCTION.

(1) Draw diagrams of sections of the following floor: End construction, hollow tile; side construction, porous terra cotta; huckle plates; slow hurning mill construction.

(2) Describe the construction of each of the above floors, and its action under fire and water and under repeated hlows.

(3) Design a flight of stairs, 4 ft. wide, between two floors 14 ft. apart vertically; strings to be of steel and treads of yellow pine.

(4) In a 100-ft. plate girder, having continuous flange angles, and a weh consisting of five plates, explain why holes may mis-match after being correctly laid off and accurately punched. How may this difficulty be avoided?

(5) What are the requisites of good machine riveting? Why is machine riveting preferred to hand riveting? How can loose rivets be detected?

PAVEMENTS.

(1) Describe Telford and Macadam roads. Make sketches of cross-sections, showing the construction of each. What amount of crowning would you give? What is the hest stone to use and why?

(2) Describe the construction of the best quality of granite block paved streets, of brick paved streets, and of asphalt paved streets.

(3) Under heavy traffic, can a wooden pavement be used economically? If so, how heavy must the traffic he? Show the best construction for wood pavements.

DRY DOCKS AND QUAY WALLS.

(1) Draw the transverse section of a concrete dry dock 90 ft. wide on the floor and 39 ft. deep, with blocks 4 ft. high and top of blocks 30 ft. below high water. Determine the thickness of concrete floor which will be required if water under bottom of dock is in connection with that outside the gates, and if the weight of the floor is to be depended upon to balance the existing pressure. Show a method of building a floor in a dock of this width which will be more economical.

(2) Sketch a section through a floating dock to take ships drawing 18 ft. of water.

(3) Design a quay wall to be built under the following conditions: Mean rise and fall of tide, 12 ft.; extreme rise and fall, 19 ft.; bottom slope, about 1:10, running out to depth of 35 ft. at extreme low water; character of bottom sand and indurated gravel into which timber piles can be driven by impact about 6 to 8 ft.; the teredo is very bad, destroying timber in from one to three years; timber plentiful; material for fill, sand and gravel from dredging or from the neighborhood; broken stone obtainable from quarry near by; depth of water alongside to be at least 20 ft. at extreme low water; and 30 ft. at a distance of 20 ft. from the wall; dredged slopes have stood for years in deep water at 1 on 1.

WHARF.

(1) Given conditions as shown in the subjoined sketch (Fig. 9), design a wharf alongside of which ships 400 ft. long, drawing 28 ft. of water, can lie.

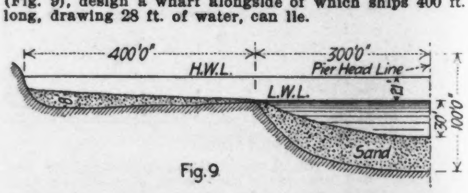

Fig. 9

BOILERS, ENGINES AND ELECTRIC PLANT.

(1) Draw a longitudinal diagram of a brick boiler setting for a horizontal return tubular boiler in which the fire sheet is extended beyond the head tube sheet to form the bottom and sides of the smoke connection.

(2) State what ratio should exist between the area of grate and the area over hridge wall. What is a good ratio of heating surface to grate area?

(3) Where should hand and man-holes be located? Draw sketch of man-hole cover, and show how it is fastened in place to ensure steam-tight joint. How many back-stays should be provided for an 18-ft. tubular boiler, 60 ins. in diameter?

(4) Make a diagram of and explain the principle and action of an injector on a steam boiler. Where is the exhaust pump located in a jet condenser and why?

(5) Give essential differences between engines for mills and for electric light plants.

(6) Draw a section of a brick chimney 100 ft. high, having a flue 4 ft. square on a concrete foundation placed upon a good bed of gravel, which is 50 ft. thick.

(7) Illustrate by diagram the three-wire system of electric distribution. State what voltage you would specify for generators, motors, arc lamps, and show how they would be connected in the same three-wire system. Explain the use of feeders.

MASONRY AND FOUNDATIONS.

(1) What are footing courses and what purpose do they serve? Draw diagram showing stone footing courses for a 32-ft. wall, and brick footing courses for a 24-ft. wall.

(2) Design a flying buttress to give a clear space of at least 12 ins. wide by 15 ft. high between it and the building and to take the thrust of 125,000 lbs. at an angle of 45° with the horizon at 25 ft. above the surface of the ground.

(3) Design an abutment for a double-track railway bridge to span a street 60 ft. wide, to give a clear headway of 15 ft. and to be located on a good gravel foundation.

(4) Draw diagram of and explain the construction of a foundation such as is much used in Chicago to support a heavy steel frame building on a light compressible soil.

(5) Design a foundation for a column to be placed at A (Fig. 10) to support a load of 350,000 lbs.

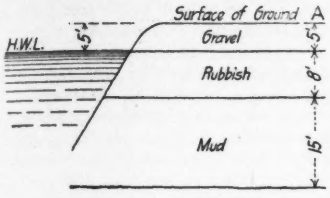

Fig.10.

YARD RAILWAYS.

(1) Draw a diagram to show a system of construction when a girder rail is used. What objection is there to the use of girder rails, in the streets of navy yards where ordinary freight cars can be hauled over them?

(2) Show a system of track construction in which T-rails are used in paved streets in such a way as not to interfere with the ordinary wheeled traffic.

(3) Put a light curve in a T-rail track without the use of a rail bender.

(4) Draw diagram of a turnout, using a safety switch and bolted frog.

(5) Illustrate by diagram and describe apparatus necessary to transfer freight cars from floats to yard tracks, the coping level being 5 ft. above mean high water, and the mean rise and fall of the tide being 6 ft.

WATER DISTRIBUTION AND SEWERS.

(3) A yard supply is drawn from springs flowing, approximately, 100,000 gallons per day. Design a well so that this entire flow can be utilized by a pump working eight hours per day. Sketch plan and section of well.

(2) Given a yard supply as in the above question, design a steel tank or tanks to hold 500,000 gallons, sketching plan, section and elevation, and showing foundation on slightly compressible soil, thickness of metal, size and spacing of rivets. Give also details of pipe connections.

(3) The above tank or tanks being located on a hill 200 ft. above the working portion of a yard, and three-quarters of a mile distant, what thickness would you give to the cast-iron distributing mains, from tank to tide-level, for 4-in., 6-in., and 8-in. pipe?

(4) A large circular city sewer 6 ft. in internal diameter, discharges into the water fronting a navy yard. Design a diverting sewer of semi-circular section, with pile and timber foundation, to carry the sewage through the yard to its boundary. The sewer to be strong enough to support the passage over it of the heaviest weights likely to be met with in navy yards. The junction with the old sewer to be arranged to permit the use of the latter for storm waters. What change in bottom and foundation would you make where it passed over a compact bed of gravel of considerable thickness?

(5) Describe methods of giving grade, and the laying of pipe sewers.

THE PRESIDENTS OF FOUR AMERICAN ENGINEERING SOCIETIES.

(With portraits.)

We present to our readers with this issue, in accordance with our annual custom at this time, an inset sheet containing the portraits and autographs of the Presidents of the four National American Engineering societies, together with a brief account of the life and professional career of each.

Mr. Desmond FitzGerald, the newly-elected President of the American Society of Civil Engineers, was born in Nassau, New Providence, on May 20, 1846. He was educated in Providence, R. I., and at Phillips Academy, and began his engineering career as a student in the office of Cushing & De Witt, in Providence. In 1867 he entered the service of the Indianapolis & Vincennes R. R., as axeman, and in three years rose to the position of Assistant Chief Engineer of the Cairo & Vincennes R. R. After a year's service with the R., R. I. & St. L. R. R., Mr. FitzGerald accepted the position of Engineer of the Boston & Albany R. R. in 1871, and in 1873 he became Superintendent of the Western Division of the Boston Water-Works. He remained in this position until the system was absorbed into the Metropolitan Water-Works, on Jan. 1, 1898. For a number of years he was also Resident Engineer in Charge of Additional Supply, thus controlling the extension as well as the maintenance of one of the most important divisions of Boston's water supply system. In this position he has designed and constructed some of the largest and most important storage reservoirs built by the city of Boston. He is now Engineer of the Sudbury Department of the Metropolitan Water-Works, thus remaining in charge of the same works he had already managed for 25 years for the city of Boston.

Mr. FitzGerald has given particular attention to the question of the quality of water supplies. He was the first to design and put in practice the stripping of reservoir sites of all soil containing organic matter, and the shallow flowage treatment now adopted in Massachusetts. He established the first, and for many years the only, biological laboratory operated in connection with a water-works system in this country, and has carried out many investigations in hydraulic engineering, the results of which have usually been communicated to the profession through the American Society of Civil Engineers.

Besides his work for the city of Boston, Mr. FitzGerald has been widely consulted by other cities and towns, and has also been prominent as an expert in a great many water cases in the courts. As consulting engineer, he has reported on the water-works systems of the following places, among others: Washington, D. C.; Cleveland, O.; Newport, R. I.; Exeter, N. H.; Windsor, Vt.; Taunton, Lynn, Newburyport, Uxbridge, Wellesley, and Reading, Mass. He has appeared as expert in the Stony Brook case, Boston, the Monatiquot, Abbott Run, Whitehall Pond, Stoughton, Haverhill, Quincy, Newburyport, Gloucester, Union Water Power Co., of Lewiston, Me., Syracuse, and other noted water cases.

In Brookline, the suburb of Boston, where Mr. FitzGerald resides, he occupies a number of positions of public trust, among them those of Chairman of the Park Commission and Trustee of the Public Library. He is also Chairman of the Topographical Survey Commission of Massachusetts. He has been President of the Boston Society of Civil Engineers, and of the New England Water-Works Association, and is a member of the Corporation of the Massachusetts Institute of Technology.

Mr. FitzGerald was elected a member of the American Society of Civil Engineers on Sept. 3, 1884, and was vice-president from 1895 to 1897. He has been a frequent contributor to the "Transactions"; among the best-known of his papers are those on Evaporation; Temperature of Lakes; Rainfall; Flow of Streams, and Storage; and Flow of Water in 48-in. Pipes. The first two of these are valuable contributions to pure science, as well as to hydraulic engineering.

We are indebted to Mr. Chas. W. Sherman, Jun. Am. Soc. C. E., for the above sketch.

The American Society of Mechanical Engineers, at its recent annual meeting in New York city last month, elected as its president for the ensuing year Commodore George Wallace Melville, for many years Chief of the Bureau of Steam Engineering of the United States Navy.

Commodore Melville was born in New York city Jan. 10, 1841, and is a descendant of a well-known Scotch family. His grandfather came to the United States with several sons, among them Commodore Melville's father, in 1804. His father later returned to England to complete his education, and again came to America, becoming a professional chemist, and locating in New York city.

George Wallace Melville, the oldest of three sons, received his early education in the New York public schools, and later entered the Brooklyn Polytechnic Institute, where he paid special attention to the scientific and engineering studies. After leaving the Institute, his father apprenticed him to James Binn, of East Brooklyn, the proprietor of a machine shop and engineering works, where he served until the opening of the Civil War. On July 29, 1861, he entered in the engineer corps of the Navy. He was then in his twenty-first year, and from this time until the close of the war he was an active participant in many of the thrilling scenes of that great struggle. He served at various times on the "Michigan," on the Great Lakes; the "Dakota," of the North Atlantic Squadron, and the "Wachusett." He was also present in Hampton Roads on board the "Detroit" at the time of the destruction of the "Merrimac." After recovering from an attack of typhoid fever, which confined him to the hospital, at Key West, Fla., he was ordered successively to the "Santiago de Cuba," the "Wachusett" and the "Tonawanda." Returning to the "Wachusett," he accompanied her to Brazil, where she cruised about in search of the Confederate commerce destroyers which were creating such havoc among American shipping.

On Oct. 7, 1864, the "Wachusett" took part in an episode that came near involving the United States in an international difficulty. On the evening of Oct. 5, while the "Wachusett" was refitting in the harbor of Bahia, Brazil, the Confederate cruiser "Florida" came into the harbor, received permission to remain 48 hours, and anchored within a short distance of the 'Wachusett," then lying in the inner harbor. Captain Collins, of the United States vessel, challenged the Confederate cruiser to a naval duel to take place outside the neutral limit of three miles. No attention was paid to the challenge, however, and it was determined to capture the vessel in the harbor, regardless of consequences. Of the many schemes suggested, that of Melville, to ram the "Florida," was finally adopted. To quiet the objections of those that feared the shock would loosen the boilers of the "Wachusett," Melville volunteered to run the engines single-handed, a feat he would have performed except that one fireman refused to leave him. Previous to the attack Melville succeeded in boarding the "Florida" in daylight, disguised as a boatman, and obtained a knowledge of her armament that proved of value later. The actual capture of the Confederate vessel was accomplished at 2 a. m. on Oct. 7. With Melville and his loyal fireman standing by the engines, the "Wachusett" rammed the "Florida," cutting into her side to and below the water line, and burying her crew beneath the wreckage of her mizzen-mast and main yards. No sooner had she struck than a boarding party took possession, and the captured vessel was towed to sea, and the two vessels returned together to the United States. From some unknown cause, however, the "Florida" sank after reaching Hampton Roads.

During the stirring months toward the close of the war, Melville took part in the capture of Fort Fisher, serving on a torpedo boat, and later he joined the "Maumee," on the James River, and witnessed the capture of Richmond and the close of the war.

Notwithstanding the cessation of the hostilities, and the reduction in the naval force which followed, the young engineer officer had proved his ability so thoroughly that he was retained in the service, and was continued on steadily, serving successively on the "Tacony," the "Penobscot," the "Lancaster" and the "Tigress," taking in the latter his first Arctic trip. Then came a trip to China in the "Tennessee," followed by a second Arctic voyage, in the famous "Jeannette," and later by the expedition in the "Thetis" to relieve Greely and his party.

It is in connection with these Arctic trips that Commodore Melville's name and fame became familiar the world over. The strange fascination of the North, with all its cold and suffering, took possession of Melville at the time the "Tigress" was chartered to return for the remainder of Captain Hall's party, after having brought down a portion of the party found off Labrador in the spring of 1873. Melville volunteered to act as engineer officer of the relief expedition, and through his ability and ingenuity Hall's vessel, the "Polaris," was found, though not the crew, which had left the vessel and was finally rescued by a whaling vessel at Cape York.

His second and most famous Arctic trip was made in the steamer "Jeannette," a vessel fitted out by Mr. James Gordon Bennett, and commanded by Lieut. George W. De Long. The party numbered, all told, 33, including officers, scientists and crew, and on July 8, 1879, sailed from San Francisco bound for the North Pole via Behring Straits. In September of that year the vessel became fast in the ice and drifted slowly to the northwest until June 21, 1881, when she sank. At the time of her loss she was in latitude 77° 15' N., and longitude 155° E. The party was thus left in mid-ocean, 500 miles from land, and an equal distance from the nearest haven.

It can well be understood that during the two years' drift in the ice, Melville's engineering ability found ample scope for exercise. Not long after the "Jeannette" became ice-bound she was pinched so badly that there was danger of her sinking, and she was only saved by Melville's skill and ingenuity. From that time till her final wreck, pumping was necessary day and night.

On May 4, De Long sent Melville and a small force to unfurl the American flag over an unknown island which had been sighted, and was named Henrietta Island. The trip required the surmounting of untold difficulties and the display of an extraordinary amount of courage and determination. That his efforts on this trip were regarded as exceptional by his companions is shown by the words of De Long, who, in referring to the incident, says:

> If this persistence in landing upon this island, in spite of the superhuman difficulties he encountered, is not reckoned a brave and meritorious action, it will not be from any failure on my part to make it known.

After the sinking of the "Jeannette" it was necessary to retreat to the nearest land, in the hope of obtaining food and supplies, and for 41 days the sledges and boats were dragged over hummock ice and ferried across leads and channels between floes. A more desperate and dangerous trip can hardly be imagined, yet through it all Melville was the leader in spirit and deed. A brief stop was made at Bennett's Island, and then the journey began again. Now, however, the large open leads permitted sailing, a less tiresome but colder and most disagreeable portion of the trip. Frequent portages were necessary, causing great labor and great suffering, for the clothing of all was getting thin and scant, and the food supply began to fail.

On September 11, after 35 more toilsome days, open water was reached, and it was necessary to cover the 90 miles between them and the Lena Delta in the three boats which they had dragged so many miles over the ice. Melville had command of one of these, a whale boat, one of the two which lived through the storm that came up shortly after starting, and he and his party finally reached the Russian village, Geeomovialocke, 110 days after the destruction of the ship. Here the entire party fell sick from the privations they had undergone and the poor food they were forced to eat at this place. Three weeks slipped by before they could send to Bulun for supplies, and two weeks more before their messenger returned with the needed supplies and a message from two of the party from the second boat's crew under De Long's command.

Weak as he was, having only partially recovered from his illness, and from the effects of frost bites, Melville started at once for Bulun, and from the two seamen of De Long's party learned the details of the starvation and suffering which had befallen the second boat's crew, and the fact that the rest of the party were then in all probability beyond hope of rescue. Melville, however, determined to find them, and leave no possible chance to save them untried. He at once started out with two dog-teams, two natives and only 10 days' food supply. The history of this hunt after companions whom he knew must be lying dead in that Arctic wilderness is a story of toils and privations which dragged out into 23 days, instead of only 5, and a journey of over a thousand miles. Almost by a miracle the cache erected by De Long was discovered, and with it the instruments and records of the expedition. From this point Melville continued his search, only to lose all traces of De Long and the remnant of his party. Disheartened and worn nearly to his life's limit, Melville returned to Bulun to recover and prepare for another search in the spring. During the period of waiting Melville perfected arrangements to continue the hunt with a well-equipped party. This time he was successful, and on March 23, 1882, the remains of De Long and his brave followers were found and suitably buried. Melville and the remnant of his followers reached the United States Sept. 13, 1882.

After the hair-breadth escapes and years of suffering which Melville experienced in the Jeannette expedition, one would have thought that he would have foresworn further journeys to the Arctic seas; but on May 1, 1884, we find him again starting for the farthest North, this time on a mission not of exploration but of rescue. As many of our readers will remember, the Greely expedition had then been in the polar regions since August, 1881, and the "Thetis" and "Bear" were sent out to find and bring home the party. This expedition scored a quick success. On June 22, 1884, Greely and the few of his followers who were still alive were found and saved from the death by starvation that was almost at hand. Had Melville's advice and offers been acted on in the fall of 1883, the story of the Greely expedition would have been a less tragic one.

The heroism and bravery displayed by Melville in these Arctic journeys, which won him a worldwide fame, were at last recognized by the 51st Congress, which awarded him a gold medal and promoted him 15 numbers.

Turning now to the more strictly professional service which Commodore Melville has rendered, we find him after his Arctic journeys were over busily engaged in the design of machinery for the new vessels of the United States Navy, then just beginning to be built. Early in 1887 he designed the engines for the "San Francisco," and on August 9 of that year he was made Chief of the Bureau of Steam Engineering of the Navy Department, with the relative rank of Commodore. This position he had held ever since, and he has had the responsibility for the design, construction and maintenance of the steam machinery for all the new vessels in which the nation takes so just a pride.

Under his direction the machinery for over 60 vessels, aggregating over 350,000 HP., has been designed and constructed, the whole involving an expenditure of over $30,000,000.

It need hardly be said that Commodore Melville has long been a staunch advocate of some means of adjusting the long-standing difficulties between the Naval Engineers and the Line Officers. The Naval Personnel Bill, now before Congress, has had his hearty support. As an inventor he has been as prolific as could be expected from one so engrossed in active affairs. Among his inventions are a method of absorbing the recoil of large guns, a system of torpedos, a door for water-tight bulkheads and a system of dredging scows.

At various times in his later years he has been the recipient of honors from scientific and professional societies. He is a member of the National Geological Society of the United States, an honorary member of the Royal Swedish Society of Anthropology and Geography, a member of the Geographical Society of Philadelphia, and an honorary member of the Institution of Naval Architects of Great Britain. He is also a member of the Grand Army of the Republic, of the Naval Order of the United States, and of the Loyal Legion. In 1896 the degree of Doctor of Engineering was conferred upon him by the Stevens Institute of Technology. In 1893 he served as Chairman of the Marine Engineering Section of the International Engineering Congress at Chicago. At present he is serving his third appointment as Engineer in Chief of the United States Navy. The few failures of even minor parts of our battleships and cruisers during the recent war, and the wonderful efficiency of the engineering force, so largely responsible for the successful outcome of our naval conflicts which attracted the attention of the whole world, stand as an enduring monument to the energy and ability of the man who for years previous had been gathering together and training up a designing, constructing and operating corps of engineers unequalled by that of any navy in the world.

Mr. Charles Kirchhoff, President of the American Institute of Mining Engineers, was born in San Francisco, Cal., March 28, 1853. He attended school in this country and in Germany, and in 1870 entered the Royal School of Mines, at Clausthal, in Germany, where he graduated in 1874, taking the two degrees of mining engineer and metallurgist. From 1874 to 1877 he was chemist, assayer and assistant superintendent of the Delaware Lead Mills, a lead refining and desilverizing plant, at Philadelphia. During the Centennial Exhibition, in 1876, he acted as correspondent of English, German and Capetown, Africa, papers. Thus began his career in technical journalism, in which he has since remained. In 1877 he became connected with the editorial department of the "Metallurgical Review," an ably edited monthly magazine, which was in advance of the demand for such a journal, and lived only one year. Soon afterward he joined the staff of the "Iron Age." From 1881 to 1884 he was managing editor of the "Engineering and Mining Journal." He returned to the "Iron Age" in 1884, became its editor-in-chief in 1889, and became vice-president of the David Williams Co., publishers of the "Iron Age," in 1897. Since 1883 he has been Special Agent of the U. S. Geological Survey for the collection of the statistics of the production of copper, lead and zinc, and served in the same capacity on the Census of 1890. He is a member of the American Society of Mechanical Engineers, the Iron and Steel Institute, and the Verein Deutscher Eisenhuttenleute. The American Institute of Mining Engineers, in electing him its president, has followed its long-established custom of honoring technical journalists, for at least four of its former presidents have been distinguished as editors of engineering papers, namely, Messrs. Rothwell, Raymond, Bayles and Weeks. Mr. Kirchhoff is one of the youngest men who has ever held the office.

In his editorial work, Mr. Kirchhoff has won distinction as a writer of unusual insight, especially in the field of commercial and industrial affairs. He has made the journal of which he is the responsible head the recognized national authority upon questions affecting the iron trade upon the commercial side. His wide range of technical information has enabled him to be among the foremost to comprehend and point out the influence of modern machinery and improved processes in various departments of iron and steel manufacture.

Dr. Arthur E. Kennelly, the President of the American Institute of Electrical Engineers, is an Englishman by birth, although most of his professional life has been spent in America. He was born in Bombay, India, Dec. 17, 1861, his father being at that time the commander of a frigate in the East India Navy.

Like most children born in India of British parents, he was sent to England to be educated, and after preparatory study he finally entered the University College, in London, where his attention was first attracted to the study of electricity by a lecture on telegraphy given by the late Latimer Clark. In 1876 he left school and entered upon the duties of assistant secretary of the Society of Telegraph Engineers, which later became the British Institute of Electrical Engineers. At this time he was assigned duties in connection with the library of the society, known as the Ronalds library, and it was this position that enabled him to continue his electrical studies and eventually connect himself with the Eastern Telegraph Co. This was in 1877, and as a result of ability and conscientious effort displayed in all his work, he received various promotions, until the year 1880 saw him assistant electrician of the cable steamer "John Pender." The next year he was again promoted, this time being made chief electrician of the same vessel, and while holding this position and during the several following years he was engaged in submarine cable-laying and repair work. This experience suggested to him the necessity of more simple and reliable means of cable testing, and started him on a series of investigations that resulted in the system of cable testing and fault locating known by his name. He also developed several other original improvements in methods of cable laying, operation and testing.

He twice received the premium of merit from the Institution of Electrical Engineers, London, for papers read before that body in connection with these subjects.

In 1888, Edison's work in developing incandescent electric lighting was beginning to attract attenion, and Dr. Kennelly, feeling that there was a greater field in that direction, resigned his position with the Eastern Telegraph Co., as senior electrician afloat, and became associated with Thomas A. Edison as electrician at his Orange laboratory. Later he became consulting engineer to the Edison General Electric Co., which was then producing all the Edison electrical apparatus so rapidly coming into use. When the Thompson-Houston and Edison companies combined to form the now well-known General Electric Co., he was appointed consulting engineer to the consolidated company. In this capacity exceptional opportunities were presented for experimental work, and his investigations on the heating of conductors, presented in a paper before the Association of Edison Illuminating Companies in 1889, and a further treatment of the subject in a report on a series of experiments on the carrying capacity of underground and submerged cables are known the world over.

He is a Fellow of the Royal Astronomical Society of London, a member of the American Philosophical Society, the Franklin Institute and other scientific bodies.

For the last five years Dr. Kennelly has been engaged in consulting engineering work associated with Prof. Houston, of Philadelphia, under the firm name of Houston & Kennelly. Since the formation of this firm, its members have published a series of valuable and remarkably clear papers on various electrical subjects which have appeared from time to time in the electrical press.

While connected with the Edison and General Electric companies most of the experimental work conducted by or under the direction of Dr. Kennelly was kept private by those companies for business reasons. Since severing his active connection with them he has devised various methods of electrical testing, and a number of instruments for making electrical or magnetic measurements. Dr. Kennelly has been a frequent contributor to the transactions of the American Institute of Electrical Engineers, of which he has always been a very active member, and he has already served as Vice-President. He received the honorary degree of D. Sc. from the Western University of Pennsylvania in 1896 for electrical research.

His work as chairman of the Committee on Units and Standards, a committee which rendered important service to the art of electrical engineering, is too recent to require more than a mention. Besides the works in technical literature already referred to, Mr. Kennelly is the joint author, with Mr. Wilkinson, of a book entitled "Practical Notes for Electrical Students," and of a more recent book entitled "Theoretical Elements of Electro-Dynamic Machinery." He is the joint author with Prof. Houston of some 15 different books on applied electricity.

STEEL AND CAST-IRON WATER MAINS.

A valuable collection of papers on water mains was presented at the meeting of the New England Water-Works Association on Jan. 11, brief abstracts of which are given below:

"Cast-Iron Pipes Used on the Metropolitan Water-Works."

This paper was by Mr. Dexter Brackett, M. Am. Soc. C. E. The use of steel for large mains was carefully considered. That material was not adopted, owing partly to certain conditions peculiar to this work. These were the crookedness of the streets of Boston and vicinity; the impracticability of leaving pipe uncovered until it was tested, as would be necessary with steel, and the extreme care required in coating the pipe, which is a prime essential if the life of such thin plates as are used is to be maintained.

In view of the large quantity of pipe to be used, its thickness and weight were of great importance. The following formula for thickness was used:

$$T = \frac{(p + p')\, r}{3{,}300} + 0.25,$$

in which

T = thickness in ins.;
p = static pressure;
p' = pressure due to water hammer;
r = the radius in ins.;

3,300 is 1-5 the tensile strength of cast iron, and 0.25 ins. is an allowance for inequality in manufacture, damage by handling and deterioration while in use. The allowance for water-ram ranged from 70 lbs. for 48-in. to 120 lbs. for the smallest sizes of pipe.

By using a pipe somewhat lighter than has sometimes been used on other work, about $200,000 was saved. About 80% of the pipe was from 36 to 60 ins. in diameter. At river crossings 36-in. pipe was made 1.65 ins. thick, 0.25-in. being added for increased deterioration due to salt water.

All pipe was carefully inspected by the Board at the foundries. For each day's foundry work four bars were subjected to a transverse strain until broken, 5,000 bars being tested in all. The contract specifications for the breaking load were exceeded by some 20%. Transverse tests, rather than tensile, were preferred, owing to the fact that the dangers to the pipe are sudden shocks, similar to blows.

Care was taken to make the pipe interiors as smooth as possible. The means to this end are generally the application of coal dust and molasses to the core, by means of a brush. Instead of a brush one of the foundries used a straight edge held against revolving cores. This gave much smoother interiors.

Studies of coatings for cast-iron pipe showed nothing superior to the coal tar now employed by the best foundries. This is sometimes diluted by dead oil, but seldom by linseed oil, notwithstanding the fact that some specifications still call for it. The mode of applying the coating is of great importance, and efforts for improvement centered here. The pipe was kept in the bath for some five minutes, instead of one-tenth that time, as is sometimes the practice. With short immersions there is not time for the air that follows or accompanies the pipe into the bath to be expelled, and hence air bubbles would be left under the coating. There is an optimum temperature for the pipe at dipping, the coating not forming properly if the pipe is too cold, and excessive heat driving off the more volatile portions of the coating, or even scorching it.

As the pipe was unloaded from the cars, men employed by the Board applied either paraffine varnish or vulcanite with brushes to the interiors, to fill any imperfections in the coating. These are coal tar products, the paraffine being imported from Holland, and the vulcanite coming from New York.

The sockets of the pipe are shallower than the Boston standard, and deeper than the Newton and Providence sockets.

A few hydraulic gate valves were used, and some 48-in. check valves having a dozen or so separate valves, instead of a single large one. Some air valves were used, but not automatic ones, these not being necessary on cast-iron pipe, besides which Mr. Brackett feels the latter are not reliable. As it might be very awkward to shut off a 48-in. main, each air valve was provided with a lower, subsidiary valve, for shutting off the water, while the air valve proper was being repaired.

"The New Steel Force Main for the New Bedford Water-Works."

This paper was by Mr. Geo. S. Rice, M. Am. Soc. C. E. The main is 48 ins. in diameter, eight miles long, of 5-16-in. plates, coated with asphalt. A railway four miles long was built by the city for use in constructing this line, the pumping station and for hauling coal to the station. The road nearly paid for itself by the saving it effected in the cost of the pipe line.

Where the pipe is covered expansion and contraction has not made itself evident, but the reverse is true on 1½ miles of uncovered pipe, supported over a swamp by piles.

Air valves are used on the line, with satisfaction.

The pipe was tested for leaks, in sections about 2,000 ft. long, for from 4 or 5 to 14 days. Only one leak, large enough to photograph, was found.

The Old Wrought-Iron Conduit at Rochester, N. Y.

A communication from Mr. Emil Kuichling, M. Am. Soc. C. E., was read. It described briefly the old wrought-iron pipe line laid over 20 years ago for the Rochester water-works. Expansion and contraction has caused some leaks at lead joints. Only a few plates have corroded badly enough on the outside to leak, and these have been repaired without removal. Little is known regarding the interior of the pipe, except that the carrying capacity has diminished about 1% a year for a few years past, and perhaps from the start. The life of the pipe is uncertain, but may be put at 40 years.

Mr. L. M. Hastings read a paper on

"The Use of Steel Water Mains."

Such mains, in sizes of 24 ins. and upwards, may sometimes be used to advantage where they do not have to be tapped by smaller mains, in rough country and for bridge crossings. Estimates made in connection with steel pipe lines would indicate that cast iron would have cost 23% more for the 48-in. main at New Bedford; 28% for the 50-in. at Minneapolis; 31¼% for the 40-in. at Cambridge; and 33% for the 42-in. at Duluth.

As to carrying capacity, Mr. Hastings reviewed the available information for both cast iron and steel, saying that not enough allowance had been made in the past for the diminution of the value of the factor c in Chezy's formula through tuberculation of cast-iron pipes. He placed c at 105 for cast iron and 90 for steel. On this basis a 42-in. steel main would have been necessary at Cambridge to be equal to a 40-in. cast-iron pipe, and for equivalent carrying capacities the saving would be only 26%, instead of the 31½% given above.

The coating for steel pipes is of the greatest importance, owing to the thinness of the plates. Asphalt makes a good coating. Coatings may be applied by dipping alone, or by dipping and baking. At Cambridge, Sabin's coating was used, and the pipe was baked after dipping.

Mr. Hastings believes that steel will last longer than wrought iron, and that cast iron has but little advantage over steel.

The last paper to be read was by Mr. F. A. McInnis, on the

"Salt Water Fire System of Boston."

A 12-in. cast-iron main, 5,000 ft. in length, extends from the shore line to the vicinity of the post-office, and is provided with relief valves. Two fire boats may be connected with the main by means of hose. Hydrants are provided at intervals and are drained after service. The main is kept under constant pressure, the pressure being supplemented between pumping by means of a small connection with the regular city service. The valves are of solid composition, insulated from the iron mains by means of rubber to prevent galvanic action.

At Buffalo, Clevelend, Milwaukee and Detroit the special fire mains are drained after each fire. This is not possible in the Boston line, owing to the uneven grades.

The cast-iron pipe has a thickness of 1 in. and is under about 140 lbs. pressure. This material was adopted after careful consideration. Its life is estimated at 30 years. If the salt water seems to have a bad effect on the metal, the pipe can be drained after each fire and filled with fresh water.

There is an electric signal system between each hydrant, the fire boats and fire department stations.

Tests of the pipe line developed no appreciable leaks, and showed that very powerful and high streams can be thrown.

All of the papers read, except the communication from Mr. Kuichling, were illustrated by lantern slides. The following papers were omitted, owing to lack of time: "Wooden Stave Pipe," by Mr. Arthur L. Adams, M. Am. Soc. C. E.; "Short Description of the Wooden Stave Pipe at Manchester, N. H.," by Mr. Chas. K. Walker; "Improved Wyckoff Water Pipes," by Mr. Geo. L. Wells; "A Compilation of Reecnt Data Relating to the Flow of Water in Pipes of Wooden Stave, Steel Riveted and Cast Iron," by Mr. F. F. Forbes.

A CATTLE GUARD OF VITRIFIED CLAY is being introduced, which consists of blocks, rectangular in plan, with three triangular ridges formed longitudinally. Each block is 18 ins. long, 13 ins. wide and 5 ins. high. They are placed in rows between and outside the rails, the end blocks being beveled and having slots for the spikes. The ties are spaced 18 ins. c. to c. The complete guard is composed of 36 blocks, and weighs 1,000 lbs. It is not easily damaged or displaced, and any broken blocks can readily be renewed. It has, however, the disadvantage of forming a close cover over the ties, tending to keep the ties damp and thus leading to decay. The device is in use on about 30 different roads, and is manufactured by the Climax Stock Guard Co., of Canton, O.

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ADVERTISING RATES: 20 *cents per line. Want notices, special rates see page* 18. *Rates for standing advertisements sent on request. Changes in standing advertisements must be received by Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.*

The movement toward an international agreement for the exemption from capture in time of war of private property on the sea is making excellent progress. As many of our readers will remember, President McKinley in his annual message asked Congress to authorize him to submit proposals looking to this end to the principal maritime powers, a joint resolution to this effect has been introduced in both houses of Congress, and an organized effort is being made to acquaint the committees in charge of the resolution with the public sentiment in its favor.

The fact is that the capture and confiscation of inoffensive merchant vessels in time of war is an anachronism; and is only less out of harmony with modern civilization than privateering itself. It causes loss and suffering to non-combatants, many of whom in these days when marine commerce is carried on by stock corporations, may be citizens of a neutral country, or even of the country whose warships make the capture. On the other hand, it does little or no harm to the enemy, for it must be understood that the laws governing blockades are not affected by the proposed measure.

In the war in which this country has been recently engaged, no one remembers with any particular pride the capture of the unarmed Spanish merchant vessels by the United States cruisers in the West Indies; and it can hardly be claimed that these captures had any serious effect in bringing about the final victories and the conclusion of peace.

"The New York Auto-Truck Co." is the curious name of a concern incorporated in New Jersey last week, with a capital of $10,000,000, to manufacture and operate trucks and other vehicles for the conveyance of merchandise in the streets of New York and adjacent cities. It is proposed to use compressed air as the motive power. According to the statements made by some of the promoters of the company, the horse as a drawer of heavy loads is soon going to be supplanted by the "auto-truck," and relegated to his proper sphere of pleasure driving; the streets will be all paved with asphalt, and New York will become one of the most beautiful cities in the world. The capital of $10,000,000 is only for a beginning, of course. It is to be increased as the business grows, and the present truckmen are to be given "an opportunity to join the enterprise, and make this a company owned by the people of our city."

We have not yet heard of any "auto-truck" driven by a compressed air motor having been tested in competition with a dray horse, and to engineers who have studied the subject it does not appear that a compressed air motor would be the best kind of motor for the purpose. Steam, compressed gas, calcium carbide, gasoline and electric motors all have to be considered as possible rivals, and we do not think that any one can safely predict which one of them, if any, is going to be the horse's great rival in the work of common drayage.

The attitude of most engineers toward the proposal to use compressed air for such motors is one of languid interest only, tinged with faint hope, but great doubts. It appears to them that the first thing needed by an "auto-truck" corporation would be a successful "auto-truck," and that if such a machine were found it might make a basis for raising capital. The compressed air promoter, however, does not see things with the narrow view of the engineer. He is an expansionist, and not a conservative. He knows that in order to do anything with compressed air one must "raise the wind." The air may be compressed, but the air company's stock must be inflated and floated. The public must be interested, so as to "make this a company owned by the people of our city." The capital must be millions, on paper, so as to make the thing impressive, and great names must be on the list of directors and stockholders, so as to create confidence. The Auto-Truck Company's promoters have looked after all these essentials, and have also obtained a large amount of gratuitous advertising in the news columns of the daily papers. Here are some of the names of those interested in the Auto-Truck Co.: Ex-Senator Arthur P. Gorman, of Maryland; Nathan Straus, proprietor of R. H. Macy & Co., New York city; Lewis Nixon, proprietor of the Crescent Shipyards, Elizabeth, N. J.; Joseph H. Hoadley, one of the inventors of the Hoadley-Knight compressed air motor for street cars; Ex-Justice Augustus Van Wyck, who ran on the Democratic ticket last fall for Governor of the State of New York, and Mr. Richard Croker, whose name is not a wholly unknown one in New York politics.

The "Auto-Truck Co." seems to be a near relative of the "International Air-Power Co," owned by a syndicate which is said to comprise the Rothschilds, the great financiers of Europe, and Mr. Joseph Leiter, who was a year ago famous for the great Chicago wheat corner. Mr. W. H. Knight is engineer, both of the Air-Power Co., and of the Auto-Truck Co., as well as of the American Air-Power Co., of New York, owned by the Whitney syndicate.

There are thus companies galore, and lots of stock to be put on the market, through which the promoters will "make this a company owned by the people of our city." It may be many years before New York is beautified by the removal of the horse and the substitution of the "Auto-Truck," but it will only be a few months, probably, before the dear people will own the stock of the company.

We had occasion a few months ago (Engineering News, June 16, 1898), to discuss the tendency to increase the capacity of freight cars, more especially those used in coal and ore traffic, and referred in that connection to the somewhat extensive introduction of steel cars of exceptional capacity for this class of traffic. Wooden gondola cars of 60,000 lbs., 70,000 lbs., and even 80,000 lbs. capacity, have been described in our columns, but the latter appears to be about the maximum capacity which can be practically and economically obtained with the ordinary construction of wooden cars, even with the use of metal body bolsters, and very heavy trussing. To carry the economy in cost of transportation due to large car loads beyond this point, steel cars of 100,000 lbs. and 110,000 lbs. capacity have been put in service on several roads having a heavy traffic in coal and ore, and an example of these cars is described and illustrated in another column. In the latest cars of this type the weight or dead load has been very materially reduced below that of the earlier steel cars, with apparently no loss in strength, the reduction being effected by careful designing and the elimination of all unnecessary metal. The cost is somewhat higher, but the cost per ton of capacity is about the same as that of high-capacity wooden cars, and is even lower than that of wooden cars of the ordinary 30-ton capacity. The life and the cost of maintenance cannot yet be definitely stated, but the builders estimate the maintenance at $20 per year for a life of 30 years, as compared with $40 per year for a 30-ton wooden car with a life of 15 years. On this basis and with a first cost of $810 and $525 respectively, at 6% interest, the actual cost for 30 years is estimated at $2,868 for the steel car and $3,195 for two wooden cars, or a difference of $327. Besides this, the old steel car would have a higher scrap value than the two old wooden cars.

The increased wheel loads will, of course, necessitate the use of larger journals, and will also in most cases require some improvement in the track and roadway construction, to ensure ease and safety in train service. The extra cost of the larger axles is already figured into the cost of the cars, and the expenditures on the roadway and bridges will probably be fully warranted by the reduction in cost of transportation of bulk freight in larger train loads. Another advantage of the steel cars is that they are shorter than the wooden cars of lower capacity, thus giving a greater train load within a shorter length of track, with a consequent reduction in yard track and siding lengths. For a train carrying 1,500 tons of paying load, there would be required 30 cars of 50 tons capacity (32 ft. over couplers), 37 cars of 40 tons capacity (38 ft. 6 ins.), and 50 cars of 30 tons capacity (36 ft. 6 ins.). These trains would be 960 ft., 1,424½ ft. and 1,825 ft. long respectively. Where the freight traffic is heavy, and the yards are worked to their full capacity, this difference is an important one, and more especially so when we take into consideration the practical difficulties of enlarging yards and of operating very large yards. In view of these facts, and taking for granted that the maintenance cost will be low, it seems not improbable that steel cars of smaller capacity and lighter weight may eventually be introduced for ordinary freight traffic. In order to show the general comparison between the wooden and steel cars now in regular service in coal and ore traffic, we have prepared the following table,* the figures in which will be of interest to the operating department as well as to the motive power department:

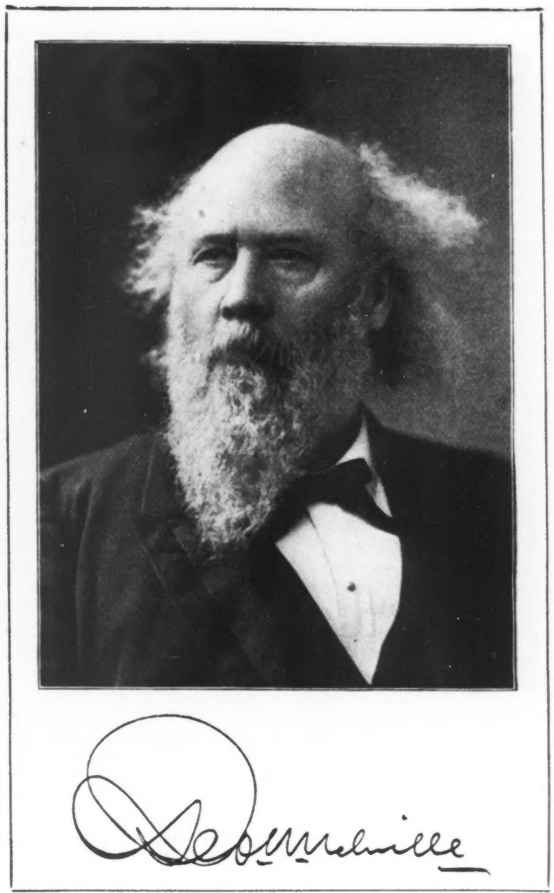
	P. B.& L. E. R.R.	Ill. C. R.R.	Penn. Lines.	L. S. & M. S. Ry.
Material	Steel	Wood	Wood	Wood
Capacity, lbs.	100,000	80,000	70,000	60,000
Weight, empty, lbs.	34,000	31,500	35,000	26,000
Weight, loaded, lbs.	134,000	111,500	105,000	86,000
Live load, %	74.62	71.75	66.66	69.76
Dead load, %	25.38	28.25	33.34	30.24
Live load*	680	787.5	1,000	866.60
Wt. per wheel, loaded, lbs.	16,750	13,937.5	13,125	10,750
Journals, ins.	5 x 9	5 x 9	4½ x8	4¼ x 8
Length over end sills, ft.	29½	36	30	34
Total wheelbase, ft.	25⅓	31 1-6	24 5-6	29½
Cost, approximate	$810	....	$550 to $575	$525
Cost per ton of capacity	$16.20	....	$15.71 to $16.43	$17.50

*Per ton of capacity, lbs.

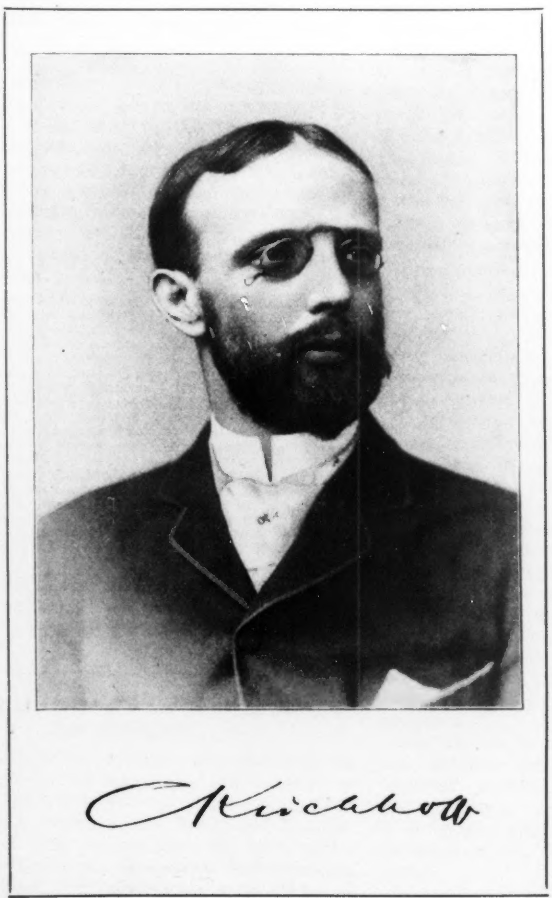
The school for health officers, which is to be established by the University of Ohio, at Columbus, is a move that might be followed to advantage by other state institutions. Provision was made in 1897, at Rutgers College, located at New Brunswick, N. J., for the examination of any persons who might present themselves as candidates for certificates of fitness for filling the positions of inspectors of foods, nuisances and plumbing, and it was expected that eventually regular instruction in these subjects would be given in courses. Some of the regular courses of study, with electives, at the Massachusetts Institute of Technology, lay a most excellent foundation for the development of good health inspectors, at least three graduates

*The 80,000-lb. coal car of the Illinois Central R. R. was described in our issue of June 16, 1898; the 70,000-lb. car of the Pennsylvania Lines, June 6, 1895; and the 60,000-lb. car of the Lake Shore & Michigan Southern Ry., March 19, 1896.

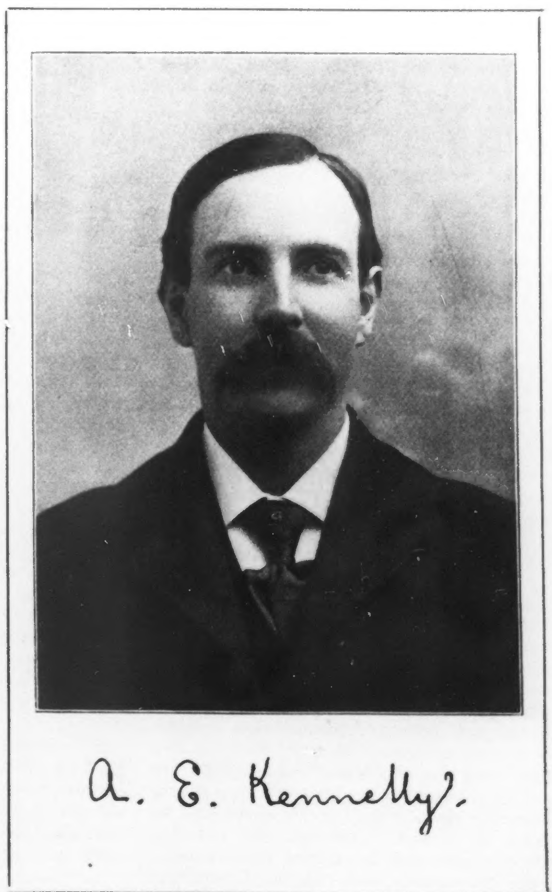
President of the American Society of Civil Engineers.



President of the American Society of Mechanical Engineers.



President of the American Institute of Mining Engineers.



President of the American Institute of Electrical Engineers.

THE PRESIDENTS OF FOUR AMERICAN ENGINEERING SOCIETIES.

from that school, to our knowledge, having filled such positions with great satisfaction.

The proposed work at Columbus will stand between the mere examination provided for at Rutgers and the full courses at the Institute. There will be a special course of lectures, some three a day for six weeks (April 4 to May 12), open "to health officers and to those of mature years who may desire the benefit of this instruction because looking forward to the position of health officer." The fee will be the moderate sum of $5. The subjects thus far named, with the lecturers, are as follows: "The Chemical Examination of Water Supply" and "Sanitary Engineering," by Prof. N. W. Lord; "Bacteriology," Prof. A. M. Bleile; "The Legal Status, Duties and Responsibilities of Health Officers," Prof. E. O. Randall; "General Sanitation, Including the Cause and Prevention of Contagious Diseases and Disinfection," Dr. C. O. Probst, Secretary of the Ohio State Board of Health, and also of the American Public Health Association. If the advantages thus offered are improved by the health officers of Ohio, present and prospective, a marked improvement in sanitary affairs may be expected to result. The state has been coming rapidly to the front, of late, in public sanitation, and it is gratifying to see the University co-operating so effectually with the State Board of Health, to increase the efficiency of both the state and local boards. Such action on the part of state universities tends to bring them into close touch with people in every-day walks of life, instead of having their direct influence confined to a selected few. Perhaps we ought to say that we do not mean to convey the idea that the Massachusetts Institute of Technology is the only engineering school whose regular courses are in the direct line of fitting men for health inspectors, or sanitary engineers for boards of health, but it certainly has done some notable work in that line. The University of Ohio, it should also be said, gives excellent instruction in sanitary engineering in its regular courses, but the special lecture course outlined above is designed to reach men outside the regular courses. Many of these will be physicians, which suggests the remark that the instruction in most of our medical schools is wofully deficient in matters pertaining to public sanitation, while only the most recent graduates have received much instruction along this line in their courses of medical study.

A question that has never arisen as a practical one in the United States, but of which we are likely to hear a great deal in the future, is the question of the treatment of outlying colonies,—whether they should be left free to buy where they can get goods the cheapest, or compelled to make their purchases from the mother country. The following quotation from London "Engineering," shows how the question is regarded on the other side of the water:

> A striking illustration as to the fashion in which prominent Frenchmen are inclined to regard their over-seas possessions as mere milking cows for the home manufactures, is presented by a speech delivered by M. Meline to l'Association de l'Industrie et de l'Agriculture Francaise. M. Meline demanded legislation to prevent the establishment of cotton factories in Tonquin. He stated that were this allowed it would be the ruin of the French Colonial Empire, "for never in France would they consent to act as the English do." It was certain that on the day in which their colonies thus emancipated themselves commercially, it would be said that they were not worth the many sacrifices made. Their aim had been to create outlets for their own industries. Obviously the French have not yet got over the mediæval notion that colonies exist solely for the benefit of the Mother Country, though in excuse it must be added that it took us a long time and a sharp lesson to learn the fallacy of the above theory.

It is sincerely to be hoped that we in the United States may not forget the lesson which this nation taught England at the outset of its national existence.

THE SAVING IN LIVES AND LIMBS BY AUTOMATIC CAR COUPLERS.

The first satisfactory evidence that the progress in the introduction of automatic car couplers is effecting a reduction in the casualties among railway employees is furnished by the accident statistics for the year ending June 30, 1897, gathered by the Interstate Commerce Commission's Statistician, and commented upon in the Commission's annual report, of which an advance abstract has been given to the press. In this the Commission says:

> Since the enactment of the law in 1893 there has been a decreasing number of casualties. There were 1,034 fewer employees killed and 4,062 fewer injured during the year ending June 30, 1897, than during the year ending June 30, 1893. In the Spanish-American war 298 men were killed and 1,645 were wounded. In 1897 there were 1,693 men killed and 27,667 injured from all causes in railway service. In coupling and uncoupling cars alone 219 fewer men were killed and 4.994 fewer were injured in 1897 than in 1893. The number of such employees killed has been reduced one-half, and the number of injured also practically reduced one-half. The reduction in the number of accidents from all causes largely exceeded in a single year the entire casualties during the late war.

To test for ourselves the soundness of these deductions, we have compiled from the Interstate Commerce reports the following table, showing the increase in the percentage of freight cars equipped with automatic couplers and the reduction in the number of deaths and injuries sustained by those engaged in coupling and uncoupling cars:

Year ending.	Total No. of railway employees.	Per ct. of freight cars with automatic couplers.	Total casualties in coupling and uncoupling cars. Killed.	Injured.
June 30, 1890....	749,301	8	369	7,842
June 30, 1891....	784,285	12	415	9,431
June 30, 1892....	821,415	18	378	10,319
June 30, 1893....	873,602	23	433	11,277
June 30, 1894....	779,608	26	251	7,240
June 30, 1895....	785,034	30	291	8,137
June 30, 1896....	826,620	40	229	8,457
June 30, 1897....	823,476	49	214	6,283
June 30, 1898....	....	69	...	.....

The figures in the above table show that, making all allowance for the fluctuations in the accident record from year to year, a considerable decrease in the number of deaths and injuries to the men engaged in coupling and uncoupling cars has taken place during the present decade. It may appear at first sight that the decrease in casualties does not keep pace with the increase in the number of cars equipped with automatic couplers. We showed many years ago, however, that the saving in life and limb from the use of automatic couplers will not be secured in any large degree until the equipment with these couplers approaches completion. This is because a coupling is not made automatically except when two cars with M. C. B. couplers are brought together. If we take the conditions which existed on June 30, 1897, when substantially half the cars were equipped with M. C. B. couplers, and suppose that all cars circulate in traffic equally, we shall have only one-fourth of the whole number of couplings made between automatic couplers, while one-fourth will be made between link-and-pin couplers, and one-half will be made by a link-and-pin coupler joined to an M. C. B. In practice a somewhat larger proportion of couplings than this would indicate are made automatically between M. C. B. couplers, first because the cars with M. C. B. couplers are generally the newer cars, and those that are most used, and second, because cars of the same class are kept together to a considerable extent.

It remains true, nevertheless, that the proportion of couplings made automatically has been so small that the reduction in the casualties in car-coupling which the above table shows can only partially be ascribed to the increase in the number of automatic couplers in use. The decrease shown in the number of killed and injured is still more gratifying and unexpected, because it has been generally believed that the period of introduction of the M. C. B. coupler would be a period of unusual hazard. It has been claimed, repeatedly, that the danger in coupling a link-and-pin coupler to an M. C. B. coupler was much greater than the risk in coupling two link-and-pin couplers together. As we showed above, a large proportion of all couplings made have for some years been of the "hybrid" sort; and there would have been no occasion for surprise had an actual increase in coupling casualties occurred from the beginning of the introduction of the M. C. B. coupler up to the time when three-fourths or more of the cars were equipped.

The figures in the above table, however, appear to show that the added danger in making "hybrid" couplings was much over-estimated; and that those who in the early days of the M. C. B. coupler urged this as a valid reason against its adoption and use, were wholly wrong in their views.

It appears to us, moreover, that the showing in the above table fully vindicates the wisdom of the National Safety Appliance law of 1893, which made the equipment with air brakes and automatic couplers compulsory. When this law was passed, about one-fourth of the freight cars in service were fitted with M. C. B. couplers. This work had been done chiefly by the live and progressive roads; and they were getting little benefit from their investment because of the dilatory action of the other roads. In the absence of legislation upon the subject, it is probable that from a dozen to a score of years would have been occupied in completing the change to automatic couplers. From this point of view, we believe that the safety-appliance law, which was so vigorously fought by the railways, was really a measure for their interest and benefit, as well as for the benefit of their employees. Had the dilatory and stubborn railway companies, which postponed the work of equipment until they were "rounded up" by the Interstate Commerce Commission a year ago, accepted and acted on the law in good faith when it was enacted, the benefits from the use of automatic couplers might have been secured by the railways as a whole, at least two years earlier.

As our readers will remember, the Commission a year ago granted an extension of time, to Jan. 1, 1900, to some 300 railways who were delinquent in the work of equipment, and required the delinquents to make semi-annual returns of their progress. They now state that the work is proceeding so rapidly that it is probable that all cars in service will be equipped with automatic couplers by the date set. A further large reduction in the annual sacrifice of lives and limbs among those engaged in coupling cars may, therefore, be looked for in the near future.

THE NAVY PERSONNEL BILL AND ITS PROVISIONS.

House Bill No. 10,403, entitled "A bill to reorganize and increase the efficiency of the personnel of the Navy and Marine Corps of the United States," was passed by the House on Jan. 17, and has a fair prospect of passage in the Senate. The most radical change proposed by this bill is the amalgamation of the line and the steam engineering staff of the navy, and from the discussion, as reported in the "Congressional Record," the following points are gathered explaining the purposes of the framers of the bill.

The proposed amalgamation of these two branches of the service is not so recent a proposition as some people think. As long ago as 1864 and 1865 the Secretary of the Navy, then the Hon. Gideon Welles, pointed out in his annual reports that the radical changes wrought by the introduction of steam as a motive power on naval vessels necessitated a change in the training of the line officer. The ship was no longer dependent upon the winds, or at the mercy of currents; but the motive power which propels and controls her movements was subject to the mind and will of her commander—"provided, that he was master of his profession in the future as he has been in the past." To retain the control which he had when seamanship was the most important accomplishment, said Secretary Welles, the line officer must be qualified to guide and direct this new element of power; and unless he has these qualities, "he will be dependent on the knowledge and skill of him who manipulates and directs the engine. For the line officer to confine himself to seamanship without the ability to manage the steam engine will result in his taking a secondary position as compared with that which the accomplished naval officer formerly occupied."

This clear-headed suggestion for amalgamation, over a generation ago, passed unheeded, and the naval personnel, along with the ships themselves, received little public attention until the discreditable conditions of 1882 finally brought about a reaction, and our new navy was inaugurated. The friction that existed for years between the line and the staff may be charged largely to the conflict between new conditions and moss-grown tradition; and while this conflict gave rise to a series of bills intended to adjust these differences, this old-time line and staff dispute, at least on the original lines, cuts out a small figure in the measure now proposed. The present bill aims to secure the increased efficiency of the whole Navy,

Mr. Higginson's Pamphlet on Coal Burning.

Sir: I was rather interested in having sent to me a clipping of your review of a little pamphlet on coal-burning that I issue from time to time mainly for my friends, and for use upon our system of railroad. I must dissent from your conclusions in regard to the matter for several reasons. While, as you state, there is nothing practically new in the pamphlet, it is the old principles in the use of coal that are neglected by ninety per cent. of all the coal users. The only new feature that I at all claim as original, is in insisting upon the use of a perforated bridge wall, or something which corresponds with it, to get a perfect mixture of the hydro-carbon gases with atmospheric air.

I differ from you very materially as to the merits of the Hawley furnaces; they are not as a rule smokeless, and I have at times replaced them by other settings, and at times been called upon to make sketches for the improvement of existing settings of this type, and I do not consider them technically or economically good practice. Neither as a rule can you get good results in an ordinary plant with a slow draft. Automatic stokers are an advantage when you have a large plant, but you may have automatic stokers and very poor performance as regards economy. I have at different times been called upon to furnish sketches for improving the economy of plants having automatic stokers of different types.

At the present time there are several mechanical engineers in different cities doing business with very good results, both to their patrons and themselves, from memoranda and sketches I have furnished them. My quest in all this thing, besides, of course, the savings to the road I happen to be working for, is the general betterment of the "state of the art" in this direction, and to-day I am having the thing done on a large scale, not only in railroad work, where we deal with bituminous coal, lignite and oil, but also commercially in a number of cities, so that you see I have some reason for being confident in my position. Some of the tests we have made and the letters from people whom I have helped in this general method, would be of interest to you.

I write rather at length, because I have always considered the Engineering News as standing high in the profession, and I do not like to see you taking a view which is unsound. Yours truly,

C. M. Higginson, Assistant to President, A. T. & S. F. Ry.
77 Jackson St., Chicago, Jan. 9, 1899.

(The above letter is only an additional example of the fact that engineers, as well as doctors, sometimes disagree.—Ed.)

Concerning Caisson Disease.

Sir: I have read with much interest Mr. Aims' letter on "Caisson Disease" in your issue of Jan. 12, because I have talked over this very subject with Mr. E. W. Moir, of the English firm of S. Pearson & Sons, who built the Blackwell tunnel in London.

In 1889, under the advice of Sir Benjamin Baker and Mr. Greathead, the Pearsons sent Mr. Moir to America to finish the Hudson River tunnel, work on which was progressing slowly, because of frequent blow-outs due to the system employed. The shield and cast-iron lining system was substituted. The shield, which weighed 80 tons, was riveted up under 35 lbs. pressure (above atmosphere) 2,000 ft. from the New Jersey heading with considerable difficulty. But by far the greatest difficulty encountered was the illness of the workmen. To quote Mr. Moir:

The Hudson tunnel is noticeable for the fact that the principal cause was discovered and a cure found for a large proportion of the cases of disease due to compressed air. When I first went to New York the men had been dying at the rate of one man per month, out of 45 or 50 men employed, a death rate of about 25% per annum. With a view to improving this state of things, an air chamber like a boiler was made, in which the men could be treated homœopathically, or reimmersed in compressed air. It was erected near the top of the shaft, and when a man was overcome he was carried into the compartment and the air pressure raised to about half or two-thirds of that in which they had been working. Immediate improvement in the condition of the patient occurred. The pressure was then lowered at the very slow rate of 1 lb. per minute, or even less, and even in severe cases the men went away quite cured. After the introduction of the medical lock at the Hudson tunnel, the deaths were reduced to only two in 15 months, with a force of 120 men at work.

The deleterious effects of compressed air may be explained in two ways:

(1) When a man goes into compressed air suddenly more oxygen is forced into the lungs, and the system's rate of combustion increases. When the pressure is removed the oxygen is reduced, and at the previous rate of combustion, some carbon is not consumed, carbonic oxide is formed, and the man is poisoned.

(2) Under pressure the blood absorbs more carbonic acid than under atmospheric pressure, like a mineral water in a syphon, and when the pressure is removed a bubbling off takes place.

When Mr. Moir analyzed the air at the Blackwall tunnel, he found that if the carbonic acid much exceeded 1 part in 1000, an increase of sickness resulted. Yet in mines, under ordinary pressure, eight times that amount of carbonic acid gas gives no trouble. In other words: the greater the air pressure, the less CO_2 can be safely breathed. At high pressures the air can be passed through lime water before being sent below.

As additional safeguards, men who are reasonably thin-blooded and rather spare are to be selected for employment, and they should be furnished with hot non-alcoholic drinks, such as coffee, and with extra clothing for passing through the lock. With these precautions and an air chamber hospital, Mr. Moir has built the Blackwall tunnel, using about 40 lbs. gage pressure, without the loss of a single man. Gilbert Rosenhusch, M. E.

20 Broad St., New York, Jan. 13, 1899.

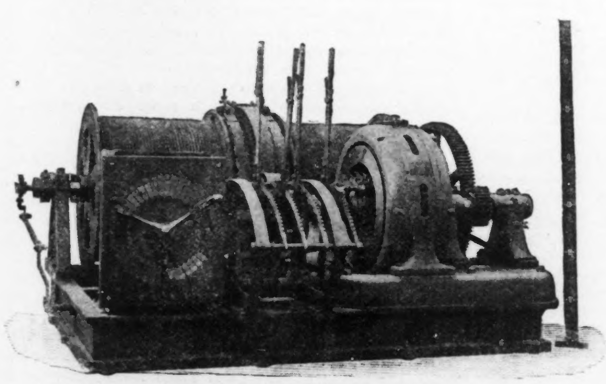
(The "Compressed Air Hospital" referred to was illustrated and described in Engineering News of June 14, 1890.—Ed.)

Notes and Queries.

In the article describing a hydraulic pile-sinking machine in our issue of Jan. 12 (p. 20), we gave the address of the inventor, Mr. J. C. Culnane, as Fairport, Ont., instead of Fairport, Ohio. He is now engaged on the harbor improvement work at the latter place.

A DOUBLE DRUM ELECTRIC MINE HOIST.

The accompanying illustration shows a new electric mine hoist employing double independent



A DOUBLE INDEPENDENT-DRUM ELECTRIC MINE HOIST.
The Lidgerwood Mfg. Co., New York City, and The General Electric Co., Schenectady, N. Y., Makers.

Lidgerwood winding drums and a General Electric induction motor, all mounted upon a substantial cast-iron bed frame, together with the rheostatic controller and various clutch and brake levers.

The motor is a 30-HP. 12-pole 100-volt induction machine, running at 600 revolutions per minute. It is provided with two pinions, one at either end of the shaft, which engage the two large drum gears. The drums are independently thrown into or out of connection with these gears by suitable clutches controlled by the levers seen in the figure. The drums are 42 ins. in diameter, with a 40-in. face, with independent hand brakes, and each has a capacity for 420 ft. of ⅞-in. rope. The maximum hoisting speed is 300 ft. per minute, and the total weight lifted, including load, car and cage, is 2,100 lbs.

THE PRODUCTION OF PIG IRON FOR FOUR YEARS.

The accompanying diagram, exhibiting in a clear manner the fluctuations in pig iron production in the United States, since April 1, 1895, is plotted from the figures given each month by the "Iron Age" for the capacity in gross tons per week of the furnaces in blast. In the first half of 1895 production was proceeding at the steady but low rate of about 160,000 tons per week, corresponding to the depressed condition of general business, or about 75% of the maximum rate that had been reached in the good times of 1892. In June, 1895, an increase in the rate began, culminating in the short-lived "boom" in November, when the production reached 217,000 tons. The rate continued above 200,000 tons till Jan. 1, 1896, and then set in a rapid decline, reaching bottom in the extraordinarily low figure of 112,000 tons in October, just a month before the presidential election. An improvement began just before election, and progressed rapidly for six months, when the former maximum rate for hard times, 170,000 tons was passed. Since April, 1897, the rate of production has never been below 164,000 tons per week. In September, 1897, an increase in rate again began, carrying it in four months to over 225,000 tons. Since that date the rate of production has remained above 206,000 tons and in all except four months out of 14 it has been above 225,000 tons. The figures on Jan. 1, 1899, were 243,516 tons per week. For the last five months, each month has shown an increase in the rate. The stocks at the furnaces amount to 506,575 tons, a decrease of 38,000 tons since Dec. 1, and of 223,000 tons since Aug. 1. The stocks of pig iron at the furnaces are now practically equal to only two weeks' consumption.

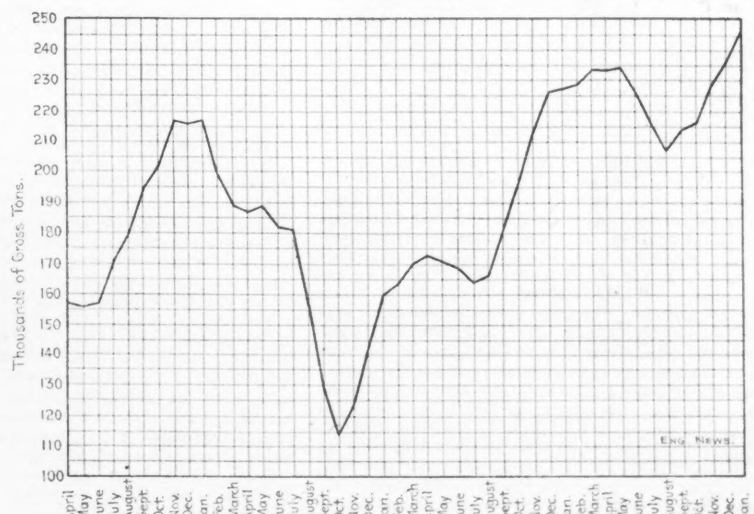


DIAGRAM SHOWING THE RATE OF PRODUCTION OF PIG IRON. (CAPACITY IN TONS PER WEEK OF FURNACES IN BLAST) FOR FOUR YEARS.

KOREAN HOUSE-HEATING METHODS, says U. S. Consul-General H. N. Allen, are admirably adapted to the prevailing type of house and to a country where fuel is scarce and expensive. The better class of houses are built with suites of four rooms opening into each other by sliding doors, with two sets of these rooms opening upon an unheated room, usually 18 ft. square, with a board floor and utilized as an outer hall or reception room. In the floor of the living rooms is a series of curved flues, fan-shaped in plan and commencing at a fireplace in an outer shed and ending in a trench at the rear of the room which leads to a chimney. These flues are covered over with cemented flagstones, and over all is placed a thick oiled paper, to exclude smoke. Straw, or brushwood, is used in the outer fireplace for cooking the rice, etc., and this fuel sufficiently heats the stone floor until the next meal is to be prepared. As the natives leave their shoes at the door the paper floor lasts a long time, and takes on a beautiful brown polish. They sit and sleep on this floor, which European shoes and furniture soon destroys. Korea has little timber, but an abundance of excellent bituminous and anthracite coal. For some reason the government persistently refuses concessions to foreigners for mining this coal; and the native methods of mining are so crude and wasteful that the coal arrives at Seoul as a fine dust and must be mixed with clay before burning. This coal costs about $9 per ton gold.

and is intended to meet demands arising out of the radical changes in the material and methods of modern naval warfare.

About one year ago the Secretary of the Navy appointed a board of naval officers to consider this question of the reorganization of the naval personnel. That the board was well selected and a representative one is made plain by an enumeration of names since made famous in our country's annals. On that board were the Assistant Secretary of the Navy, now Gov. Roosevelt, as its chairman; Commodore Melville, Chief of the Bureau of Steam Engineering; Commodore Crowninshield, Chief of the Bureau of Navigation; Captain, now Admiral, Wm. T. Sampson; Captains Alex. McCormick and Robley D. Evans; Commander Hemphill, Lieut.-Commander Wainwright; Chief Engineers Rae and Kearney, Passed Assistant Engineer McFarland, and Lieutenant Key. After full and careful consideration and discussion, this board formulated a bill which is substantially that now before Congress.

At the present time there are in the U. S. Navy 726 line officers and 195 officers in the Engineer Corps. In this corps the older engineers mostly came into the service from civil life, and under the provisions of the bill these men will still perform their engineering duties until retired. The engineers of the middle grade have all graduated from the Naval Academy; but they will be required to pass an examination in the duties of the line officer before they can be assigned to the new composite line. The younger members of the Engineer Corps have all taken, for three years, at the Naval Academy, the same course of study as have the line officers. This course only differentiates at the beginning of the fourth year, when a part of the cadet class go into the Engineer Corps and a part into the Line. But, under this bill, these younger men will also have to qualify themselves in the duties of the line officer before entering the composite line.

The bill requires line officers, in turn, to qualify themselves for engineering duties; and in this connection Commodore Melville points out that the duties of the line officer are now more or less of an engineering nature. A part of their daily duty is the handling of dynamos, turret machinery, ammunition hoists, etc.; on torpedo boats, the attempt is being made to substitute junior officers of the line for engineers, and in our late war the scarcity of engineers made this a necessity. Line officers are to-day the recognized experts in ordnance engineering, torpedo engineering, and electrical engineering; and many line officers are now fully competent in some branch of engineering, and there are some whose tastes and environments have made them able engineers in the broad sense of that word. The older line officers, like the older engineer officers, will doubtless serve out their allotted time under previous conditions; but as the present system of training and the daily practice of officers develops specialists in equally important branches of engineering, it should also be able to educate men who will be specialists in mechanical engineering.

The reason for the proposed amalgamation is found in the wonderful evolution which has taken place in naval construction and equipment in the last generation. Thirty years ago the most powerful ship in our Navy had one engine, with two steam cylinders; to-day, a battleship has 70 or 80 separate engines, with double that number of cylinders. Sails have disappeared entirely and only a military mast remains; steam and electricity or compressed air move and steer the ship, revolve the turrets, hoist ammunition, boats, etc., and pump out, ventilate, and light the vessel. As a consequence, the engineering force on board these warships now forms nearly 50 per cent. of the whole crew; and as the efficiency of the ship, in peace and war, depends upon the skill and knowledge of the men caring for and operating these many machines, it is not remarkable that the framers of this bill should deem it very important that the commanding officer should know something about engineering. As Mr. Roosevelt tersely put it in his report, "Every officer on board a modern man-of-war must be an engineer, whether he wants to or not"; and the time is near at hand when the successful commander must be very much of an engineer, just as many of the victories of Nelson were due to the fact that he was very much of a sailor. This proposed amalgamation will, in time, give to us naval officers in command rank capable of performing every duty in connection with the management of the ship; that is, all-around fighting men, who can, in an emergency, fill any station, just as the sailor did in his day.

Another important part of the bill proposes to put a stop to the present congestion in the Navy, and to enable a competent officer to reach command rank, or the grade of Commander, while he is still in full mental and physical vigor. Under the present system of so-called advance, as was pointed out by Congressman Foss, the senior Lieutenant Commander on the Naval list of 1898 entered the service in 1862; became an Ensign in 1868, a Master in 1870, Lieutenant in 1871, and then served 20 years in the latter grade. He was made a Lieutenant Commander in 1891, and though he is now 50 years of age, he has not yet reached command rank by one step. The senior Lieutenant on the list entered the Navy in 1864; was made a Lieutenant in 1876, and has remained in that grade since then; he, too, is 50 years of age, and has yet to crawl through the grade of Lieutenant Commander before he reaches command rank. This is practically true for the other officers of like grade; and if this state of affairs is bad for the officer, it is worse for the government which employs him. Admiral Farragut once remarked that in his experience it was a great advantage to command young; and as a rule officers who come into authority late in life shrink from responsibilities, and often break down under their weight.

The bill provides for both voluntary and compulsory retirement, when the latter becomes necessary to relieve threatened congestion. In the latter case a board of Rear Admirals appointed by the Secretary of the Navy selects those least worthy to remain in the service, a maximum number, in the grades from Captain to Lieutenant, being fixed for retirement in any one year. Room for the promotion of competent and younger officers is thus made, and the system is considered less objectionable than the practice of selecting officers to be advanced, as in some foreign navies. Another provision equalizes the pay of the Army and the Navy; the present difference in pay for relative grades ranging from $200 to $3,000 per year.

An excellent amendment to the original bill proposes to abolish prize-money in the Navy. This bounty is a very ancient survival, dating back practically to the Middle Ages, when the loot of cities was the only compensation of mercenary troops. The practice has long been abolished among troops on shore, and it has no place in the modern Navy. A century ago, prize-money was a bonus intended to eke out a very meager regular pay for both officers and men, and when prizes were abundant and the laws of war sanctioned their confiscation, there was some purpose in the practice. But the American naval officer and man do not need this incentive to perform their whole duty; and to offer as a part of the pay due for professional services a chance that now may or may not occur in a lifetime, is a rank injustice that cannot too soon be done away with. The modern tendency among nations is to grant immunity to trading vessels that are not actually engaged in conveying contraband supplies to the enemy; and this tendency, formulated into maritime law, as it doubtless will be, is another strong argument against the continuation of the prize-money system, for it would largely reduce the aggregate value of prizes.

The men who framed this bill were well fitted to know the needs of the American Navy, and to recommend such measures as would promote its efficiency. The proposed amalgamation of the line and staff would bring about harmony, and heal dissensions of thirty years' standing; it is economical, for it provides for an increase of 98 officers, instead of adding 105 engineers, and 165 navigating officers, as proposed in the non-amalgamation bill; the bill gives much-needed elasticity to the service; it equalizes pay with the Army; and last of all, but most important, it fits the personnel to modern naval material. The objections so far made to it in Congress come from men who fail to realize the development in naval warfare within the last few decades, and base their opinions upon naval conditions of a generation ago; and the objection of some Western members—that the bill would tend to foster "the aristocracy of the Navy," is best answered by events. If the service of the Navy in the late war is any index of the manner in which "aristocrats" can handle warships, the nation only wants more of them, and a fuller development of the system that trained them.

LETTERS TO THE EDITOR.

Credit for the Design of the Beaver Station.

Sir: The article on the Beaver Station which appeared in last week's Engineering News gives a wrong impression which I wish to correct. I do not wish any credit for the work upon or design of this building. Mr. R. P. Forsberg, Chief Draftsman, designed the station and full credit for it is due him.

Yours truly,

Pittsburg, Pa., Jan. 14, 1899. K. J. C. Zinck.

(It is, perhaps, due to our contributor to say that he claimed no credit for the design of the station, as reference to the original article will show, and his omission to state the name of the designer was doubtless an unintentional oversight.—Ed.)

The Burr Safety Block for Rope Hoists.

Sir: From my own experience with the Burr Steel Safety Lift, the illustrations and comments in your issue of Jan. 5 do not do full justice to the device as to either its merits or its defects. Only the simple block of small capacity is shown, while the larger block (Nos. 4½ to 6½ per circular) is a much more ingenious device, being interchangeable in power, giving all variations, from a 2 to 1 to a 7 to 1 system.

The lock holds the rope tightly without cutting, tearing or wedging it, thus making it possible to lower the weight by pulling down rope No. 2. I used both forms in rebuilding the large siphon over the levee at McKenney Bayou in Mississippi, and found these features very valuable indeed.

On the other hand, the sides of steel plate into which the sheaves of the upper block are journaled are so thin that the bearings wear away rapidly. After the rope has been drawn past the lock a number of times in lowering a heavy load, it becomes very smooth and the lock fails to work properly unless a slight tension is maintained in line No. 1.

Very respectfully,

C. C. Pashby, Foreman of Mechanics,
Yazoo-Mississippi Delta Levee District.

Sherard, Miss., Jan. 9, 1899.

Professional Qualifications of Members of the American Society of Civil Engineers.

Sir: The recent disaster in this city was, if newspaper reports be true, due to an error in structural work of which the merest tyro in engineering would hardly be guilty. One of the most prominent mistakes resulted from the fact that the designer did not know that tables for safe stresses on struts composed of two channel bars are not applicable if the bars are placed close together. This leads to the query, how many members of the American Society of Civil Engineers are there who would be guilty of the same error? I do not refer to the prominent members of the society who furnish the material for its papers and discussions, and whom everybody knows. While these men are the life and soul of the society, they constitute really only a small minority of the membership. The remainder are of all grades, from the ones who have just missed being famous through lack of opportunity down to the "Consulting Engineer," who is really only a traveling salesman for a cheap bridge shop. It is this latter class that one would like to exclude from membership in the society, provided it can be done in a way that will not cause injustice.

I am speaking only of bridge engineers, but I suppose the same rule holds good in other lines of engineering. The point I wish to make is that a man may be a very successful bidder, and still his structures may not be such as would entitle him to membership in the society. In other words, the handle to a man's name, Am. Soc. C. E., should indicate superiority to the "common herd."

This is an old problem. I do not wish to propose scholastic examinations, for that has been dismissed as impracticable. What I wish to propose is this: While it is, of course, impossible to publish the details of work performed by a member; it is practicable to require him to submit his work for examination, not only before his application for membership is received, but after election also. Of course the spirit of the society contemplates this and there should be no need of such a regulation. In fact this rule is not required for those who write or discuss the papers of the society, but only for the cheap inferior class of designers. We have a good many of that class, especially among the builders of cheap country highway bridges.

Yours truly,

Yours truly,

Detroit, Mich., Jan. 12, 1898. Associate.

sign of corrosion, and the nuts could easily be turned on the threads. Other portions of the steel pipe (some of it No. 12 gage) have since been replaced by cast iron pipe; while, on the contrary, the wooden pipe is, so far as known, in practically the same condition as when first laid.

The oldest continuous stave pipe of any magnitude was built by Mr. J. T. Fanning, in 1874, for the Manchester, N. H., Water Works. (See Trans. Am. Soc. C. E., March, 1877.) The pipe is 72 ins. in diameter, banded with ½ x 2½-in. flat iron hoops and is buried. It has been in constant use, has required no repairs and is stated to be in good condition so far as known.

After carefully weighing all evidence on both sides of this question, the author concludes that, even assuming the presence of alkali in the soil, a longer life is insured—supposing the bands to be thoroughly coated—when the wooden pipe is buried than when left exposed.

As to riveted pipe, it is, as a rule, buried; the only exceptions which occur to the author being where the pipe had to be frequently moved, as in hydraulic mining and dredging, and occasional short stretches, where special conditions intervene. The life of buried steel pipe is very uncertain. In many cases even light gage pipe has lasted remarkably well; in others it has had to be abandoned in a very short time, as in the case of Hollister above cited.

Of numerous instances, one more may be quoted, showing the short life of light steel pipe laid in alkali soil. Echo Lake and West Lake, forming part of the irrigation system of the city of Los Angeles, are connected by pressure pipe. Originally a 20-in. No. 16 B. W. G. steel pipe was used, about one mile of which had to be abandoned at the end of three years, after considerable expense had been incurred in stopping leaks, which were all the more annoying because of the pipe's location near the center of the city. A No. 14 B. W. G. steel pipe was then laid, which lasted four years, and in the spring of 1895 was replaced by wooden stave pipe.

The lightest gage for the Coolgardie steel pipe recommended by the experts is 3-16-in., and, as previously stated, it is proposed to lay this pipe on the surface in order to lessen the danger from corrosion and to facilitate the detection of leaks. A double asphalt coating is specified, all of which may fairly be expected to insure long life for the pipe proper. While the gain in the life of the pipe, in being kept from contact with the soil, cannot be questioned, it may be asked whether this is not too dearly paid for by the necessity of providing and maintaining an enormous number of expansion joints, unless indeed some type of joint can be devised which does not depend for its tightness on rubber or other elastic material promising but a short life under severe climatic conditions and which can be repacked without interrupting the flow in the pipe.

It is interesting to note here that the much discussed question of comparative endurance of steel and iron is disposed of by the commission with the statement that they see no reason for preferring one to the other.

The author next presents a summary and discussion of the various experiments upon the carrying capacity of wooden and riveted pipes. Mr. Henny concludes that in estimating the capacity of wood stave pipe of 24 to 30 ins. diameter, the Kutter formula may be safely used with a value of 0.010 for the coefficient "n." This would mean a frictional resistance of 1.838 ft. per mile. The author has heard the possibility advanced of a vegetable growth starting on the interior surface of the pipe, which would impede the flow, but, so far as known, no such growth has yet been observed in pipes after many years of service. Nor has he ever heard of any growth in the interior of bored wooden pipe, of which hundreds of miles have been in use.

Concerning the question of the relative cost of wood-stave and riveted pipe, we make the following extract:

In order to bring out the economical possibilities of wooden stave pipe it may be stated that the author finds that under conditions as regards freight rates, etc., similar to those stated in the chief engineer's report as applying to the Coolgardie main pipe line, the cost of 30-in. redwood stave pipe, laid and buried, may be estimated at $1.70 per ft. for pressures less than 20 ft., increasing gradually with the pressure to $3.90 per ft. for 200 ft. pressure. The cost of the steel pipe was estimated by the chief engineer at $5.29 throughout for all sizes and weights and inclusive of fixtures.

Since Mr. Henny's paper was written the actual contract for the Coolgardie line has been let, and the Ferguson locking-bar pipe has been adopted, as noted in our issue of Dec. 28. The contract price for the 328 miles of pipe made up and coated, together with the steel joint rings, all delivered at Falkink, West Australia, is about $5,-300,000, or about $3.06 per lin. ft. This does not include, of course, the valves, fittings, etc., and the cost of transporting and laying, together with the trenching and backfilling, all of which are included in Mr. Henny's estimate above given.

In the discussion upon this paper, the question was asked, whether wood-stave pipe might not be bored into by ants, bumblebees, gophers, or other gnawing rodents or insects. Mr. Henry replied to this as follows:

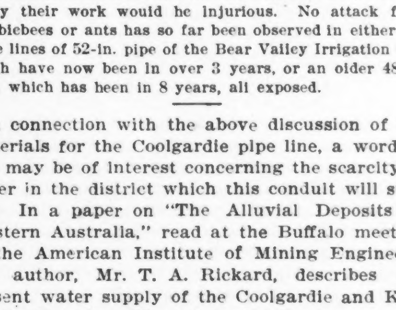
The question of rodents injuring stave pipe has been frequently raised. The stave pipe supplying Butte, Montana, passes through ground honeycombed in places by prairie dogs, which, however, have never disturbed it. There are a great many gophers around Denver, where stave pipe has been buried for 15 years, and we have yet to hear of a gopher having eaten into the pipe. They do not seem to like it.

As to ants, we had some experience in Los Angeles. Staves were piled up along the line. In one place they were laid in brush on the hillside, and there it was observed, when pipe building commenced, that ants had eaten into the staves, making small holes never over ⅜-in. in depth. The ants were always found in pairs in these holes and may have bored in to deposit their eggs. That portion of the line has been carefully watched, but no further evidence of their existence has been discovered. A number of these ants were laid before Dr. Behr, of the Academy of Science, who pronounced them to belong to the same family as the white ant of Central America. He said similar ants had attacked wooden sidewalks in this city. It is the author's belief that while they may eat into dry or partly dry wood, they will not attack wood that is thoroughly saturated. If they require air for life, they cannot live in a saturated stave. In the Santa Ana pipe, which is exposed, the wood may dry out possibly a quarter of an inch at times, and an ant or a bumblebee might eat into it to that depth, but at night the moisture would come to the outside, so it is not likely their work would be injurious. No attack from bumblebees or ants has so far been observed in either the three lines of 52-in. pipe of the Bear Valley Irrigation Co., which have now been in over 3 years, or an older 48-in pipe, which has been in 8 years, all exposed.

In connection with the above discussion of the materials for the Coolgardie pipe line, a word or two may be of interest concerning the scarcity of water in the district which this conduit will supply. In a paper on "The Alluvial Deposits of Western Australia," read at the Buffalo meeting of the American Institute of Mining Engineers, the author, Mr. T. A. Rickard, describes the present water supply of the Coolgardie and Kalgoorlie districts. The total rainfall amounts only to 4 to 5 ins. per annum. Enough of this penetrates the dry soil partially to saturate the earth in local depressions, called "soaks," where a scant supply of salt water can be obtained by sinking wells. Whereas sea-water contains about 3½% of salt, the water from these "soaks" and from the deep mines contains 12 to 30% of salts. For stamp mills, etc., this salt liquid is used and is bought at prices varying from $5 to $50 per thousand gallons. For drinking purposes, water is distilled in crude condensers, which are dotted all over the mining region, and form the most characteristic feature of the landscape.

THE COLD BEND AND THE QUENCH TEST FOR STEEL PLATES.

In our issue of Nov. 24, 1898, we reprinted a discussion by Mr. Wm R. Webster, M. Am. Soc. M. E., before the Franklin Institute, on the sub-



Bending Tests of Steel Plates.
Cracked piece, bent cold in natural state.
Flattened piece, bent after heating and quenching.

ject of specifications for structural steel and rails. In this discussion he pointed out the fact that the "quench test" for soft steel, that is, the test by heating to cherry red, plunging in water, and then bending the test piece through 180° without cracking it, is not in itself a sufficient test to show the quality of the material, and that plates which have stood this test perfectly have failed under the ordinary cold bending test. The reason for this is that the steel as it comes from the rolls may have been rendered brittle by overheating in the furnace, but if the carbon is so low that the steel does not harden on heating and quenching, such heating and quenching may remove the brittleness caused by the overheating.

Mr. Webster has since sent to us two samples cut from the same plate of boiler steel, which we have had photographed, as shown in the adjoining cut. They were exhibited by Mr. H. V. Wille, Engineer of the Department of Tests of the Baldwin Locomotive Works, in the discussion at the meeting of the Franklin Institute of Mr. Webster's remarks. We quote from the "Journal of the Franklin Institute" for January Mr. Wille's remarks on the two samples:

A sample of steel recently came under my observation which, when judged by the tensile strength, reduction of area, elongation and chemical analysis, would be regarded as the highest grade of material, and, in fact, it passed two inspections on such tests. Notwithstanding the results of these tests, the plate cracked in numerous places between holes when an effort was made to roll to a 60-in. ring. A test was now cut from the plate, and failed, as you will see by this sample, on the ordinary cold bend; but a second test cut from the same portion of the plate, when heated to dull cherry and quenched in water, bent flat without signs of distress, proving that a good plate of steel was injured by finishing it at an improper temperature. The quality of the steel can be judged by the following tests: Tensile strength, 59,200 lbs. per sq. in.; elongation, 28% in 8 ins.; reduction of area, 60.2%. Analysis: Carbon, 0.24; manganese, 0.39; phosphorus, 0.012; sulphur, 0.020; silicon, 0.020; copper, trace.

Mr. Webster's remarks, and the appearance of the test pieces exhibited, are of the greatest importance in showing that it is necessary to use the ordinary cold bend test as well as the quenching test for soft steel, but we hope they will not be interpreted as meaning that the quench test may be neglected. It is fully as important a test as the other. It shows whether the metal contains too much hardening material, such as carbon or phosphorus, to be suitable for boiler plate or similar purpose, while the cold bend test shows, when the steel cracks under it, that the steel is brittle as it came from the rolls, but does not indicate whether that brittleness is due to too high carbon or to overheating. Both tests, taken together, are necessary to tell the story. In the case shown in the photograph, the quench test proves that the brittleness shown in the cold test was not due to high carbon or phosphorus, but to overheating, which fact the cold test alone was insufficient to prove.

THE TWELFTH ANNUAL REPORT OF THE INTERSTATE COMMERCE COMMISSION.

The annual report of the Interstate Commerce Commission, an advance abstract of which is before us, opens with a strong statement of the existing situation respecting the enforcement of the law. The Commission declares that the situation has become intolerable.

Tariffs are disregarded, discriminations constantly occur, the price at which transportation can be obtained is fluctuating and uncertain. Railroad managers are distrustful of each other, and shippers are all the while in doubt as to the rates secured by their competitors. Enormous sums are spent in purchasing business and secret rates accorded far below the standard of published charges. The general public gets little benefit from these reductions, for concessions are mainly confined to the heaviest shippers. All this augments the advantages of large capital and tends to the injury and often to the ruin of smaller dealers. These are not only matters of gravest consequence to the business welfare of the country, but they concern in no less degree the higher interests of public morality.

There is ample testimony that the Commission does not at all overrate the magnitude of present evils. The most essential point in the laws governing railway traffic is that rates and charges shall be alike to all, and the wholesale infractions of this law which are now carried on are a crime against the public welfare that cannot be condoned. The specific amendments to the law that are necessary to secure its enforcement have been fully set forth by the Commission, in previous reports, and they are again urgently brought to the attention of Congress.

The question of the legalizing of pooling is discussed by the Commission at much length, and

THE COMPARATIVE MERITS OF WOOD-STAVE PIPE AND RIVETED PIPE FOR LONG CONDUITS.

In our issue of Feb. 17, 1898, discussing the Coolgardie water supply project in West Australia, we suggested that the Commission of English Consulting Engineers which had reported upon the project did not appear to have given sufficient consideration to the merits of wood-stave pipe for the 330 mile conduit, which forms the most notable engineering feature of the enterprise.

In a paper recently presented before the Technical Society of the Pacific Coast,* Mr. D. C. Henny, of San Francisco, takes up our suggestion and discusses in detail the comparative merits of wooden stave and riveted pipe for this and similar conduits. He brings out some facts respecting the relative durability of these pipes, their liability to leakage, etc., which, so far as we are aware, have never before been put on record in technical literature. Mr. Henny's paper, in connection with the recent paper on wood pipe of Mr. A. L. Adams (Eng. News, Oct. 27, 1898), really forms a fairly complete treatise on this subject.

In the opening portion of his paper Mr. Henny explains the general features of the problem which the designers of the Coolgardie pipe line have to solve and continues as follows:

Leakage. This is mentioned first because of its exceptional prominence in a pipe line 328 miles in length. So far as anticipated losses from a wooden stave pipe are concerned, they may be due to two causes,—leakage proper and evaporation from its surface when exposed. For the estimation of either, measurements of actual losses from existing pipe lines alone will give the needful information. To the writer's knowledge, there are three pipe lines upon which measurements have been made to determine the actual losses from wooden stave pipe. The first was a buried 18-in. pipe in Astoria, Oregon, in regard to which the following is stated by Mr. A. L. Adams, in his paper on the "Astoria Water Works" (Trans. Am. Soc. C. E., Vol. 36, p. 20).

A test for tightness was made of the upper 2½ miles of this pipe line after the water was first turned in. This gave results which the author believes have never been surpassed by any other pipe construction of any class. The pipe was filled from the head works, and, the gate at the lower end of the section being closed, the water rose and passed off through the overflow from the stand pipe immediately adjoining the gate. The head gate was afterwards closed. This gate was not absolutely tight, but permitted the passage of a little trickling stream, not exceeding perhaps one quart in a minute. The assistant engineer in charge of the works was much surprised on the following day to observe this same little trickling stream, apparently undiminished in quantity, passing through the waste pipe at the end of the line.

The second pipe line mentioned consists of 4.3 miles of 14-in. pipe near Los Angeles, a section of the pipe line supplying the National Soldiers' Home with water. The pipe is buried, the cover being generally 24 ins. in depth. At each end of the section a concrete manhole, with cross wall and steel plate weir, permitted the measurement of the flow by means of carefully placed hook gages; the weirs, the cross walls and the gages being as nearly alike as possible. Three successive experiments were made, also by Mr. Adams, with flows gradually reduced in order to increase the relative importance of the leakage, in the last experiment the flow being at the rate of about 32,000 gallons per day. The first two measurements showed a slight excess of flow at the lower end over that of the upper end, probably resulting from unavoidable differences in the finish of the weir plates. In the last experiment the flow measured at both ends was, as nearly as could be measured, the same, showing the pipe to be absolutely tight. The pressure in the Astoria pipe ranged from 0 to 80 ft., the thickness of the Douglas fir staves being 1⅜ ins. In the Soldiers' Home pipe the pressure varied from 0 to 65 ft. and the thickness of the redwood staves was 1⅛ ins.

The third experiment mentioned was made by the author and included the combined losses from leakage proper and from evaporation under unusually severe conditions.

A 52-in. wooden stave pipe, 968 ft. in length, was built to carry the water of the Santa Ana Canal across Deep Canyon, near Redlands, California. (Trans. Am. Soc., C. E. Vol. 33; Hall, on Santa Ana Canal.) The pipe has the form of a U, with the sides inclined instead of vertical. The connecting curve has a radius of 300 ft., with its lowest point subject to a water pressure of 165 ft., and is supported by a wooden trestle 50 ft. high in the middle. The pipe rests on sills, both on the mountain sides and on the trestle, and is therefore entirely exposed to the hot and dry climate of Southern California. The staves are of redwood, the finished thickness being 2 ins. for pressure less than 50 ft., 2.3 ins. for pressures from 50 to 100 ft., and the remainder 2.6 ins.

When, upon completion early in July, 1893, it became apparent that it would be a question of months before water could be let into the pipe through the flume, it was decided to fill the pipe by pumping in order to avoid the possibly injurious lengthwise shrinkage, after completion, of the staves, which were not thoroughly dry when put in. At the lowest point connection was accordingly made with a 1-in. pipe leading up from a small pump below, which drew its supply from the creek in the canyon. Pumping continued until the creek finally dried up, the pipe being then filled to within 25 ft. vertical of the ends.

The trestle, which supports only a portion of the bottom curve, had settled perceptibly as the pipe filled, and it continued to settle for some time, as was apparent from the buckling of the feed pipe, which had to be twice cut and shortened. The effect on the pipe of this settlement was that, as the pipe off the trestle could not follow the downward movement, severe longitudinal strains were induced, which were further aggravated by the breaking of some of the sills under the pipe on the trestle. These strains manifested themselves by the slight opening of the butt joints, many of which commenced to drip. Attempts were made to stop these leaks, but, so long as settling continued, leaks would persistently reappear either where stopped before or at new points. Settlement finally ceased and all leaks were permanently stopped, but this was not until after the end of the experiment. The surface of the water in the pipe, as it gradually lowered, was measured from time to time, with the following results:

Average length pipe fil'd in ft.	Length of pipe emptied, in ft.	Time in hours.	Loss: U. S. galls.	Loss: U.S. galls. per day.	Loss: U.S. galls. per day pr sq. ft. exterior surface.	Av'g prsure, bottom, ft. during experim't
757.5	85.0	231	9,384	975	0.085	132
708.5	12.9	57	1,419	597	0.057	123
692.5	19.2	93	2,120	547	0.053	120

It was impracticable to determine separately the losses from dripping leaks and from evaporation, although it may be assumed that a large portion of the loss, as last measured, was due to evaporation both from the water surface at the open ends and from the surface of the pipe. There would be nothing surprising in this, considering the prevailing temperature of the air and of the stagnant water in the pipe, the permanent sunshine throughout the day and the frequent hot winds blowing up or down the canyon.

While it is admitted that the results are not conclusive, they point to the probability of losses from evaporation, that may become serious in very long pipe lines exposed from end to end. So far as they go, the measurements may be valuable as establishing a maximum value for all losses under conditions as described.

Whether asphalt or paint can be made to adhere to the outside of the pipe, and whether a coating would materially reduce the losses from evaporation, are subjects in regard to which there exists difference of opinion among engineers, and which cannot be settled except by trial. The author knows of only one line of pipe that is exposed and coated on the outside, and when he had occasion to examine it, after about four years' service, he found the asphalt coating in bad condition and practically offering no protection at all. Whether this was because the coating was driven off by the water pressure, or because the asphaltum had not been of the proper consistency, he had no means of determining, but he is inclined to believe that the first-mentioned cause is liable to prevent firm adherence and effective protection.

The exterior surface of 328 miles of 30-in. pipe would, in round numbers, amount to 15,000,000 sq. ft., and, if the daily evaporation from its surface should reach 0.05 gallons per sq. ft., the entire daily loss would be 750,000 gallons; on the other hand, the first two experiments mentioned indicate that the loss from a buried wooden pipe, even if 328 miles in length, would be very small, provided it be well designed and carefully constructed.

Measurements of the loss from riveted steel pipe have not come to the author's knowledge, nor is it stated in the report of the Commission how the estimate of 5%, or 300,000 gallons per day, which includes losses from the intermediate reservoirs, has been arrived at. Why it has been expressed in percentage of total flow is not clear, as there is no connection between the velocity and the leakage.

One of the arguments in favor of laying the pipe on the surface was that leakage could be more readily found. This may be true in the case of very open, gravelly soils, but in ordinary ground it has been the author's experience that even exceedingly small leaks will make themselves apparent if the pipe is buried at ordinary depths, which is in part borne out by the records of the Astoria and Los Angeles pipes mentioned.

Limiting Pressure. The pressure which wooden stave pipe can be made to withstand safely depends upon the hardness of the saturated wood, and a working pressure of 200 ft. is considered by the author and shown by experience to be a safe practical limit in the case of redwood and Douglas fir, for reasons which it is beyond the scope of the present paper to discuss. If the staves are carefully selected, there will be no loss from percolation through the wood at the highest pressure when the pipe is buried.

The author then states that the hydrostatic heads on 80% of the Coolgardie conduit as located are less than 200 ft. and discusses the feasibility of changing the location of other portions and of introducing relief outlets to limit the pressure on the pipe. He then continues:

With stave pipe, the close relation between cost and pressure renders any inexpensive method of reducing even moderate pressure highly desirable, and it is for this reason that most wooden stave pipe lines now in use have been carefully protected from unnecessary pressures. In case waste of water cannot be tolerated, the same object can in part be attained by the construction, at each summit, of a small basin into which the pipe discharges through a balanced valve operated by a drum float. The section of pipe down stream from this basin cannot be subjected to any pressure greater than that due to the depth below high water in the basin, for, even should the balanced gate fail to act, the basin would then overflow. This simple and inexpensive arrangement reduces the maximum pressure by steps, and has been successfully applied to the 14-inch wooden stave pipe near Los Angeles already quoted.

Life.—At the outset it will be necessary to distinguish the two cases of pipe buried and pipe exposed. When exposed, the steel bands of a stave pipe can be constantly inspected and repainted whenever deemed necessary, and the life of this portion of the pipe may be considered sufficiently long to satisfy all requirements. As to the staves, it must be evident that changes of temperature and winds will cause a steady movement back and forth of the limit of saturation within the staves, thus leaving the outer skin of the wood in a condition where it would eventually decay. This decay need not necessarily result in the loosening of the bands, as the wood under the bands would be protected from evaporation; yet it would finally reach a depth where there is a permanent saturation, with a consequent steady increase of the losses from evaporation. Uncertainty as to the effect of a coating of asphalt or paint applies to this subject as well as to that of losses from evaporation.

There are short trunk lines for power purposes in the New England States, which, though built of pine, exposed, and, moreover, at times running but partly full, have seen from 20 to 40 years of service and are still in use, and from sound redwood better results might be expected. The general practice, however, is to bury the pipe, except where, owing to rocky formation or necessity of placing pipe on a trestle or bridge, such course is impracticable, and then the pipe has generally been boxed in.

When buried, the conditions determining the life of the stave pipe are reversed. Supposing the pipe to be filled at all times,—a vital condition to be strictly adhered to,—the staves will remain permanently water-soaked for their full thickness and no decay can take place. But the steel bolts and iron couplings will then be in contact with the soil; nor will it be practicable to re-coat them. Hence the endurance of the pipe will then be measured by that of the metal, and will be, to a great extent, dependent upon the protective coating and the character of the soil. On this important subject experience has not been sufficiently long to warrant any definite estimate, and only general conclusions can be drawn. It is important in this connection to disabuse the mind from considering the life of steel pipe as in anyway furnishing evidence on this point, for the cases are by no means parallel. The life of an iron or steel pipe is not limited by any consideration of weakened strength resulting from corrosion, but rather by the peculiar pitting action to which the plates are subject. The result is that leaks occur in some places, while at others the plate is yet perfect, and the constant recurrence of leaks finally forces abandonment of the pipe when the actual percentage of metal lost by corrosion is very small. Were it practicable to line with wooden staves the inside of a completely worn out metal pipe, a serviceable pipe would be obtained, promising long life, and the steel would not be strained up to its limit of strength until about 75% of the metal had rusted away. This is the condition of the wooden pipe, with the important exception that the metal on the outside of the pipe does not occur in a form exposing a relatively very large surface to corrosive influences as with plate; but, on the contrary, in a condensed form, the round section of the bolt presenting a minimum of surface to contact with the soil.

A forcible illustration of this difference was furnished on a compound wooden and riveted steel pipe line built in the spring of 1896, for the Hollister (California), Water Co. In the fall of 1897 a portion of the steel pipe, after having required an ever-increasing expense for repairing leakage through pit holes in the plate (No. 14 B. W. G.) had to be replaced, and as this portion was near a point of junction of wooden and steel pipe, and the pressure presented no obstacle, it was decided to extend the wooden pipe and connect with the steel pipe beyond where the trouble occurred. The soil in which the wooden and the steel pipe had been buried was adobe, and, so far as could be judged, was identical for both kinds of pipe. The corrosion of the steel pipe seemed to have proceeded mainly from the outside, and it therefore became a matter of interest to note the condition of the steel bands on the wooden pipe. It was found that the asphalt coating had deteriorated, but the metal under it showed hardly any

*Published in full in the "Journal of the Association of Engineering Societies," for November, 1898.

the fact is plainly set forth that it is the unrestricted competition between the railway companies that has led to the present universal discussion in rates. The contradictory character of the interstate law itself is also plainly shown.

The purpose of the act was to do away with preferences and discriminations, and it also aimed to keep railway competition alive by prohibiting pooling arrangements. It, in other words, endeavored to eradicate the results and to perpetuate the cause.

The conclusions which the Commission reached are summarized as follows:

If unrestricted competition produces discrimination, one obvious way to prevent such discrimination is to restrict competition. Whether existing conditions would be improved by legalizing railway contracts would depend upon the extent to which the agreements were made and actually enforced by the carriers. So far as the Commission can obtain information, there is at present no other great nation which endeavors to enforce competition between its railways, although in many cases that method has been tried and abandoned. But just as no other great nation to-day enforces competition between railways, so there is no other great nation to-day which does not regulate and control railway rates. If this country is to change its theory of railway regulation, it should adopt the new theory in its entirety. Carriers ask authority to combine in order to fix and maintain reasonable rates. But who shall decide what rates are reasonable? Shall it be left to the carriers to fix their own rates, or should the people who grant this extraordinary privilege reserve to themselves the right to determine this question?

The rate should be reasonable as well as stable and uniform, and hitherto competition has been mainly relied upon for that purpose. Now, if competition is to be removed what is to take the place of it? The conclusion of the Commission in reference to agreements of this sort, and the degree of control over rates which should be exercised by public authority, is substantially as announced in its last annual report. The amendments there recommended would not invest the Commission with any different or any greater authority than it was long supposed to possess; they would simply enable the Commission to carry out the purposes of the act as declared in its first three sections. If the present Commission is not qualified to discharge that trust then a more competent tribunal should be created.

If combinations in restraint of competition are to be permitted, the following additional observations should be borne in mind: (1), to permit only a limited and feeble restraint would be to doom the experiment to failure before it was tried; but it might be well to provide that the provision granting the privilege should expire after a certain number of years by its own limitation. (2), the contract itself and everything done under it should be open to public inspection. (3), it would probably be to the advantage of both the public and the railway if the public had some voice or representation in any organization of the kind under consideration. If the public appointed one or more of the Board of Managers, to whom the shipper would feel free to submit his complaint, and who would bring the shipper's views before the association, it might do much to promote just conduct and harmonious relations between the railways and the public, and thus prove materially beneficial in a high degree.

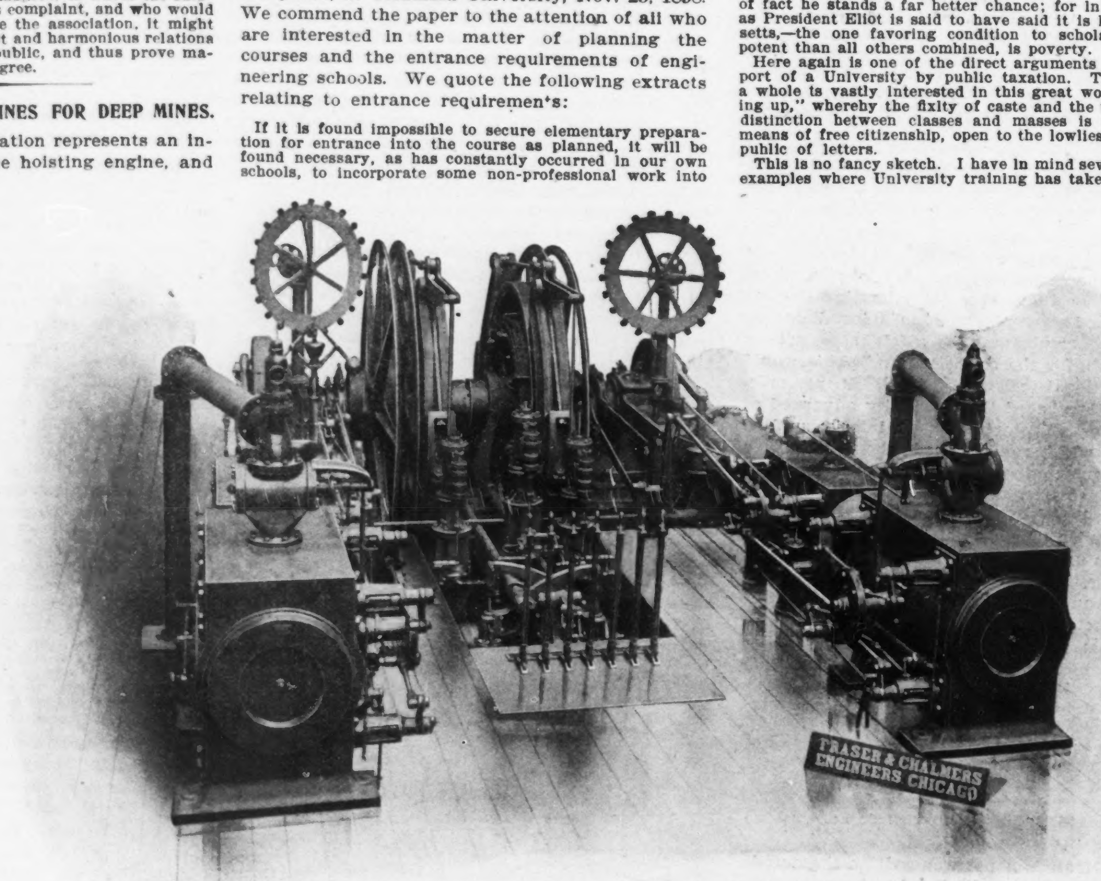
DOUBLE-REEL HOISTING ENGINES FOR DEEP MINES.

The accompanying illustration represents an interesting type of deep-mine hoisting engine, and two of these engines have recently been built by Fraser & Chalmers, of Chicago, for the Chihuahua Mining Co., of Chihuahua, Mexico, and the Grand Central Mining Co., of La Colorado, Sonora, Mexico.

The engine is a direct-acting, double-reel hoist, with duplex, tandem-compound, Corliss engines, designed specially for high-duty, and sensitive response to the demands, combined with moderate first cost and economical working in service. In these respects, the builders consider that this type compares favorably with many vertical hoisting engines, and they prefer the tandem-compound to the cross-compound type for hoisting purposes, as being easier to start, better balanced under all conditions of load, and more economical under the usual range of service conditions. The engines may be run condensing or non-condensing, and in large mines the service required of them is sufficiently constant and steady to secure the advantage of the compound system. They are being adopted for reasons of economy in places where fuel costs $2 to $2.50 per ton.

The cylinders are 16 x 42 ins. and 24 x 42 ins., and high pressure steam can be used in the low pressure cylinders by means of an arrangement of by-passes. All the cylinders are fitted with Corliss valve gear, that of the high pressure cylinders being controlled by the governor, while that of the low pressure cylinders has a positive cut-off. Each cylinder has a separate rotary throttle valve, and all these valves are operated by a steam cylinder under the engineman's platform. The reversing gear is of the Stephenson type, operated by steam cylinders, and the friction band brakes and post brakes are also operated by steam cylinders. All the operating mechanism is balanced as fully as practicable, and all the auxiliary steam cylinders have oil cataracts, arranged tandem, so as to give an easy and steady motion. Steam is supplied by return tubular boilers, carrying a pressure of about 125 lbs. per sq. in.

The rope reels are 4 ft. in diameter, and will take 2,700 ft. of flat rope, ⅜ x 6 ins., but a smaller rope, ½ x 5 ins., is now in use. The indicators are compensated, so that the hands move at the same relative speed as the rope, which is a precaution against overwinding. The shaft is 2,500 ft. deep, and the speed of hoisting is 1,600 ft. per minute, the total load, including the rope (10,200 lbs.), being 18,200 lbs.



TANDEM COMPOUND HOISTING ENGINE FOR DEEP MINES.
Fraser & Chalmers, Builders.

NOTES FROM THE ENGINEERING SCHOOLS.

Entrance Requirements of Engineering Schools. —We have received from Dr. R. H. Thurston, Director of Sibley College, Cornell University, a pamphlet report from the January number of the "Educational Review," of a paper entitled "Professional and Academic Schools, their Plans, Courses and Preparation," read by the author before the annual meeting of the Association of the Colleges and Preparatory Schools of the Middle States and Maryland, at Columbia University, Nov. 25, 1898. We commend the paper to the attention of all who are interested in the matter of planning the courses and the entrance requirements of engineering schools. We quote the following extracts relating to entrance requirements:

If it is found impossible to secure elementary preparation for entrance into the course as planned, it will be found necessary, as has constantly occurred in our own schools, to incorporate some non-professional work into the professional scheme; but this means simply that the professional school is compelled to do work outside its province. Should it prove, as has usually been the fact in this country, that so much non-professional work must be performed in the professional school as to compel excess of load, the surplus is necessarily left out and the student is compelled to defer professional study of importance until actually entering upon professional practice. Such a mongrel course is now illustrated more or less by practically all engineering schools, and it may be a generation before the average can be raised to a professional level. • • •

To increase entrance requirements by introducing those which do not furnish suitable introduction to work to be taken up is to deprive deserving men, usually the most deserving classes of young men, of the right of gaining a scientific knowledge of the fundamental principles of their chosen profession, or art, or vocation. To raise requirements for sentimental reasons, simply to make entrance into such courses as difficult as into others, is, in the opinion of every person familiar with the equities and the facts of the case, a crime against the people, and especially against the "industrial classes," the special care of whom is made, by the fundamental law and by the charter of the State university, a primary duty. "Procrusteanizing" is had in all departments; but procrusteanizing in any university seeking to adapt itself to the needs of a people, including the "industrial classes" as well as the cultured, is an educational blunder, a political mistake, and a crime against those classes of society which it is the great purpose of its founders to give most effective aid. Every faculty must be the judge of the best methods of accomplishing its purposes.

University of California.—We have received a pamphlet containing a report on an article by Mr. Charles S. Greene, published in the "Overland Monthly," containing "A Birdseye View of Recent Progress" of the University. It is handsomely illustrated and gives the reader such an idea of the delights of the location and of the general excellence of the University as to make him wish he could live his college days over again, and live them in California. The University now has 1,600 students. It received an income from the State of $128,415 in 1897. Besides offering free tuition there are 84 scholarships or fellowships for the assistance of students whose means are inadequate for their maintenance. The argument in favor of state aid to universities is thus presented by Mr. Greene:

An institution that takes students of the humblest possible origin, so only that they themselves are bright and determined, and gives them an education which puts them in the way of becoming leaders in the lifework they may choose, goes very far toward carrying out that proud democratic ideal of the early republic that the poorest man's son stands an equal chance with the richest to become President of the United States. As a matter of fact he stands a far better chance; for in California,—as President Eliot is said to have said it is in Massachusetts,—the one favoring condition to scholarship, more potent than all others combined, is poverty.

Here again is one of the direct arguments for the support of a University by public taxation. The public as a whole is vastly interested in this great work of "leveling up," whereby the fixity of caste and the undemocratic distinction between classes and masses is overcome by means of free citizenship, open to the lowliest, in this republic of letters.

This is no fancy sketch. I have in mind several concrete examples where University training has taken sons of the poorest parents and put them as equals among the best in the land.

Massachusetts Institute of Technology.—A quarterly magazine has been started by the Association of Class Secretaries, 71 Newbury St., Boston. It is called the "Technology Review," and is a finely-printed pamphlet of 143 pages, on heavy paper. The price is 35 cents. In the first number, which we have received, the "announcement" states the object of the review is to be "a clearing-house of information and thought" in Institute affairs. "Nothing concerning the life of the Institute will fail of recognition." The Association of Class Secretaries includes men of every class from 1868 to 1899, embracing representatives of the corporation, the faculty, and the students.

Fig. 1.—Head Car of East-Bound Train Telescoped by the Tender. (The passengers killed were all in this car.)

Fig. 2.—Wreckage of Locomotive Running Gear.

VIEWS OF THE WRECK ON THE LEHIGH VALLEY R. R., AT WEST DUNELLEN, N. J., JAN. 9, 1899.

The "Review" is not intended to be a technical journal nor a student record. The "Technology Quarterly" will continue to be the technical journal of the Institute, and the "Tech" will represent the students, as heretofore. The first number contains a biographical sketch of President Crafts, a paper on "The Function of the Laboratory," by Prof. S. W. Holman; an illustrated description of the new Pierce Building, and much other matter of interest to graduates of the Institute.

The U. S. Naval Academy.—The Secretary of the Treasury has submitted to Congress an estimate for the establishment of a course of naval architecture at Annapolis. It includes four professors, one of naval architecture, one of mathematics, one

Fig. 3.—View From the Front, Showing Least Injured Boiler.

Fig. 4.—View from the Rear. (The boiler on top was turned completely around.)

VIEWS OF LOCOMOTIVE BOILERS IN LEHIGH VALLEY WRECK.

of mechanics and one of marine engineering, at $2,500 each; one assistant professor of naval architecture, at $2,200; one clerk, at $1,200; messenger, $400; temporary construction, $2,500; books and periodicals, $1,200.

THE LEHIGH VALLEY HEAD COLLISION AT WEST DUNELLEN, N. J.

We reproduce herewith several photographs of the recent wreck on the Lehigh Valley R. R., the circumstances of which were briefly noted in our last issue. Restated somewhat more in detail, the original cause of the accident was the breakage of an axle on a freight train, causing a wreck which blocked both tracks of the Lehigh Valley R. R., just east of Bound Brook, about 5 a. m., on Jan. 9. During the forenoon, the Lehigh Valley trains were moved over the tracks of the Central R. R. of New Jersey, from Port Reading junction to Roselle. By noon the west-bound track was cleared so that trains could pass. Section 3 of east-bound express No. 20 arrived at Bound Brook heavily loaded with passengers, and was sent forward on the west-bound track. At the same time west-bound local passenger train No. 71 was dispatched from South Plainfield on the same track. The information at hand tends to show that both trains had proper orders to proceed, and that the engineers both ran at a high rate of speed, knowing that the single track would be crowded with traffic. The trains came together near South Dunellen, on a curve, where woods interfered with the view ahead, and the engineers had not time to partially check the speed of their trains before they came together. The local train had but two cars and few passengers, and none of these were injured beyond slight bruises. The east-bound express train, however, had five passenger cars, and these, crowding forward when the crash came, caused the tender to telescope its way completely into the forward car; and it was this which caused nearly all the deaths and serious injuries in the wreck.

The locomotives were completely demolished, as our views show, and the boiler of the west-bound locomotive was turned entirely around, so that it lay close beside the other boiler and pointing in the same direction. The photographs from which our views are reproduced were taken by Mr. Clayton T. Coon, a photographer of Plainfield, N. J., who reached the scene of the wreck shortly after it occurred.

PROPOSED SEWERS IN CALLAO, PERU, are reported upon by U. S. Consul Dickey, under date of Oct. 10, as follows: The work contemplated includes 4,819 lin. ft. of concrete sewers, 3.6 ft. diameter; 5,945 lin. ft. of 3.28 ft. concrete sewers; 27,488 lin. ft. of 2.95 ft. sewers; 35,641 lin. ft. of "drains" with iron covers. The latter appear to be 31½ in. cast-iron pipe, with stone and concrete foundations. The specifications and plans of this work are deposited for reference in the Bureau of Foreign Commerce, at Washington, D. C. The bidder must deposit 2% of the estimated cost of the work, which is $112,914, gold, with proposals; and if the bid is accepted bonds to the amount of $4,360, gold, or 10,000 silver soles, must be deposited in the city treasury within five days thereafter. The work must begin in 30 days after signing contract and be finished in three years; with $3,488 premium if finished within two years, and $1,744 if finished in 2½ years. Delay will cost $872 for the first month over three years, and $1,744 for each ensuing month. On the estimated cost of $112,914 the annual value of the work will be $37,496 gold, and the municipality will pay 75% of this amount per year, paying the balance on completion and acceptance of the work.

SIX WATER FILTRATION PLANTS at Philadelphia, with a combined daily capacity of 420,000,000 gallons, are provided for in an ordinance prepared by the Director of Public Works, Mr. Thos. M. Thompson, in accordance with the request of Councils. The estimated cost of the plants, including some pumps, sedimentation basins and land, is $9,325,000. Slow sand filtration would be used for most of the proposed capacity, with mechanical filtration at stations where no land is available for filter beds. The water committee of Councils has agreed to report a recommendation for the appropriation of $2,700,000 and the receipt of proposals for the filtration and extension of the water supply east of the Schuylkill River, this sum being all now available. It also authorized Director Thompson to prepare plans and secure proposals for a 150,000,000-gallon pumping station, sedimentation basins and filter beds on the Delaware River. In view of past experience at Philadelphia, it will be more surprising than otherwise if this action results in anything definite.

A CHICAGO UNDERGROUND RAILWAY is proposed by the amended ordinance for the Wisconsin Lakes Inland Electric Ry. Under the original ordinance, the road was to pass under the river by a tunnel, and then continue as a surface line to its terminus at Kinzie and Kingsbury Sts. The council committee on track-elevation, however, opposed the granting of a franchise for a surface line, and demanded that the road should be overhead or underground. The company has agreed that if the city will allow it to continue its line into the heart of the city, it will build it underground, the tunnel following under Kinzie St. to State St., where it will turn to the south, pass under the river, and extend under State St. to 14th St. The company proposes to build an electric railway from Chicago to Milwaukee and Madison. Mr. A. E. Case is president of the company.

STREET RAILWAY STATISTICS of the United States are given in the "American Street Railway Directory" for Nov., 1898, from which it appears that there are 1,089 street railways in operation, of which 926 are electric, 21 cable, 31 steam and 111 horse. The total track mileage is 16,698.78 miles, of which 14,914 is electric, 485 cable, 680 horse and 618 steam. The total capital stock is $979,542,827 and the bonds outstanding aggregate $530,565,220. There are in operation 48,352 cars of all kinds, including 32,832 motor, 7,844 trailers, 2,920 cable, 1,887 steam and 2,869 horse cars.

WEATHER TABLE FOR DECEMBER, 1898. (Furnished to Engineering News by the Department of Agriculture.)

	Stations	Temperature. (Degrees Fahrenheit.)				Wind.			Precipitation—Rain or melted snow. (Inches.)		
						Velocity in miles per hour.		Direction at time of max. velocity.			
		Average.	Max.	Min.	Range.	Average.	Max.		Total.	Heaviest in 24 hours.	No. of rainy days
Northern Cities.	Northfield, Vt.	21.0	56	—24	80	9 5	34	S	1.36	0.44	14
	Portland, Me.	26 6	48	— 6	54	7.5	50	E	2.85	0.97	13
	New York City	34.4	57	12	45	16 8	78	E	2 93	0.84	10
	Pittsburg, Pa.	32.9	65	8	57	7 7	30	NW	1.92	0.65	14
	Chicago, Ill.	24.3	46	0	46	19 9	47	S	1 11	0.42	8
	Omaha, Neb.	22.0	48	—10	58	7.4	28	NW	0.31	0.14	6
	St. Paul, Minn.	13.3	40	—19	59	7.4	35	NW	0.15	0.06	6
	Duluth, Minn.	13.5	43	—24	67	9 2	45	NW	0.19	0.09	4
	Bismarck, N. Dak.	16.9	50	—18	68	9.5	36	NW	0.44	0.20	5
	Average	22.8	50	9	59	10.5	43	—	1.25	0.42	9
Southern Cities.	Washington, D. C.	35.6	68	12	56	6.3	36	E	3.56	1.04	10
	Louisville, Ky.	34.7	62	7	55	9.6	36	W	2.61	0.93	10
	St Louis, Mo.	32.6	62	3	59	11.8	33	N	1.03	0.58	6
	Savannah, Ga.	51.4	73	31	42	8.4	31	W	2.16	1.07	11
	Kansas City, Mo.	27.4	59	— 2	61	9.7	30	NW	1.44	0 80	7
	Jacksonville, Fla.	54.8	78	33	45	7.5	36	SW	4 74	1.55	14
	Chattanooga, Tenn.	41.1	69	16	53	7.5	38	W	2.04	1.29	9
	New Orleans, La.	50.8	75	30	45	9.8	35	W	2.03	0.82	11
	Memphis, Tenn.	41.0	67	14	53	11.1	40	NW	2.96	1.76	7
	Palestine, Tex.	4[illegible].0	75	14	61	8 1	30	NW	5.22	2.50	7
	Average	41.4	69	16	53	9.0	34	—	2.78	1.23	9
Western Cities.	Helena, Mont.	20.7	54	—12	66	7.6	36	SW	0.28	0.10	7
	Port Crescent, Wash.	39.4	58	27	31	3 7	24	SW	4.41	0.76	19
	San Francisco, Cal.	49.[illegible]	66	38	28	6.9	44	NE	1.62	0.70	4
	Salt Lake City, Utah.	25 2	47	6	41	5 1	48	NE	1.[illegible]8	0.60	9
	Santa Fe, N. Mex.	24.0	46	1	45	7.0	36	NE	0 40	0.21	4
	Denver, Colo.	25.8	60	—20	80	8.2	38	NW	0.99	0.40	4
	Yuma, Ariz.	—	—	—	—	—	—	—	—	—	—
	Average	30.8	55	7	48	6.4	38	—	1.50	0.46	8

AN ANTI-HIGH BUILDING RESOLUTION was passed by the New York Board of Trade at its annual meeting. The Board has been laboring in this direction for three years. The Committee on High Buildings recommended the enactment of a bill providing that on the wider streets and avenues no building should hereafter be erected exceeding 200 ft. in height; no building used as a hotel or apartment house should exceed 150 ft. in height and proportionate lesser heights should be fixed for structures erected on narrower streets. The bill should further provide that in every building 137 ft. and over in height, there should be two separate stairways, reaching from the ground floor to the roof, and one of these should be remote from the elevator shaft; and in all buildings of 137 ft. or over, now in existence or to be erected, there should be a fully equipped auxiliary fire plant, satisfactory to the City Fire Department. At the same meeting a resolution was adopted asking the Committee on Legislation to consider the feasibility of drafting a law prohibiting the laying of more than one street railway track on narrow streets; and to provide for the removal of all over one track on streets 60 ft. or less in width, and all over two tracks on the wider avenues.

BONDS FOR THE NEW EAST RIVER BRIDGE have been issued to the amount of $3,074,650, and a further issue of such bonds is authorized and can now be made to the amount of $487,823. The Board of Estimate and Apportionment has made provision in the budget for 1899 for the further issue of $2,000,000 of bonds as occasion requires. This will ensure the continuance of the work during the present year without delay on account of funds.

TURF BRIQUETTES are made in Germany as follows, says U. S. Consul John E. Kehl, of Stettin: The wet turf, as cut from the moor, is put in a breaking machine and reduced to small pieces; and it then passes to a second machine which cuts and grinds it quite fine. This turf powder or "mull" is dried by passing it through a cylinder carrying exhaust steam from the engine; the inside of this cylinder is filled with large steam tubes and is continually revolved on an angle. From this cylinder the "mull" passes to the hopper of a pressing machine operated by a 75-HP. engine. This press makes 80 briquettes per minute or 35 tons per day. These turf briquettes retail at a little more than 8 briquettes for 1 cent. Among its advantages are great cheapness; it is clean in handling; packs well in bins and gives a good heat. At Langenberg, the cost of material and working is about $1.55 for one ton of briquettes; but this cost is figured on wages of 75 cents per day for a man, and 25 cents for a woman.

THE WORLD'S GOLD PRODUCTION IN 1898, says Director Roberts of the U. S. Mint, will be about $300,000,000, and the United States contributed $67,000,000 of this amount. Of the total, about $60,000,000 was consumed in the arts, adding $240,000,000 to the world's stock of gold or 5% of the whole stock of gold in the world.

THE SANITARY CONDITION OF HAVANA AND SAN Juan, the principal cities of Cuba and Porto Rico, respectively, is being improved by the American officials in charge. It is stated that at Havana a hundred resident physicians have been engaged to make a house-to-house inspection; that all cesspools under houses are to be closed; that garbage is to be removed daily; and that on Jan. 16 a thousand men were at work cleaning the streets and public buildings. Surgeon-General Sternberg is reported as having said, on his return from Cuba a few days ago, that:

In Havana General Ludlow is exhibiting great energy in organizing the civil government and in preparing to carry out necessary sanitary measures. The sanitary regeneration of Havana is, however, a difficult problem, and one which will require time, as well as money and energy. I consider it entirely impracticable to place this city in such a condition that it will be safe for non-acclimated persons to remain there during the coming summer without serious risk, and especially if they frequent the more unhealthy parts of the city. Occasional cases of yellow fever occur in this city throughout the winter months, but the epidemic prevalence of this disease does not usually commence before the month of May, and the extent of an epidemic depends entirely upon the number of unacclimated strangers exposed in the infected localities during the unhealthy season. Yellow fever is epidemic at Havana, Matanzas, Cardenas, Cienfuegos, Trinidad and various other seaport cities. It occasionally prevails at Puerto Principe, Holguin, Pinar del Rio, Remedios and several other interior towns.

Regarding Porto Rico, Surgeon Glennan, of the Marine Hospital Service, is reported as follows on Jan. 5:

The average width of the streets is 25 ft., with a cement footwalk upon either side, leaving a stone-paved roadway of 17 ft. At least two-thirds of the streets have a fairly steep descent to the water-fronts—equal to the incline of the streets leading down from the Capitol at Washington. Heavy and frequent showers of rain wash them, and there are no cleaner looking streets in the United States. This is the superficial view. In the rear courts there are between 1,300 and 1,500 pits and cemented vaults, which have not been emptied for years and whose condition is indescribable. They are located next to kitchens and cemented cisterns, and the heavy rainfalls overflow them so that the back courts and areaways are covered.

The water supply of the city at present depends upon these cisterns. Many sewer and water pipes have been laid, and a good water-supply system was projected by the municipal authorities. A pumping station, filter beds and reservoir are constructed at Rio Piedras, 12 kilos. (7.44 miles) from San Juan, and many large water mains laid, but the work was interrupted by the war. An excavation has been started within the city heights for a reservoir. I have recommended that it be abandoned and stand-pipes used instead, for the reason that they are less expensive and, principally, that they expose less surface to a tropical sun, besides less danger of animal and vegetable pollution.

BOOK REVIEWS.

LA FONDERIE.—Par U. le Verrier, Ingenieur en Chef des Mines, Professeur au Conservatoire des Arts et Metiers. Encyclopedie Scientifique des Aide-Memoire. Paris: Gauthier-Villars. Paper; 7½ × 4¾ ins.; pp. 164; illustrated. 2.50 francs.

The author first describes the various metals used in casting, and gives their physical and mechanical properties, the qualities necessary for good work, the influence of foreign bodies in the molten metal, etc. Under the head of steel he refers to nickel and Hadfield steel, and then discusses the various alloys and their composition and characteristics. In a second part he treats of the fusion of metals by various processes, and then proceeds to describe the methods of making the molds for casting. In this latter part he commences with the properties and preparation of the sand and shows by illustration and text how various forms are molded, the molds dried and preparations made for casting. In the final chapter he takes up the installation of a foundry and the necessary appliances, including drying ovens, various processes used, the breaking of large castings, etc. Malleable iron and the casting of small objects in this metal are briefly discussed in an appendix.

RAILWAY ECONOMICS.—By H. T. Newcomb, LL.M., Chief of the Section of Freight Rates in the Division of Statistics of the U. S. Department of Agriculture, and Instructor in Statistics and Transportation in Columbian University. Philadelphia: Railway World Publishing Co. Cloth; 5¼ × 7¾ ins.; pp. 152. $1.

This little book contains a condensed and comprehensive discussion of a number of features of railway transportation, viewed in the light of economic principles. After a brief review of the growth of transportation, and the present railway service in the United States, as compared with that of other countries, the author proceeds to discuss such subjects as railway and commercial competition, discrimination, the decline in rates, profitable and unprofitable transportation, long and short haul, pooling, consolidation, etc., etc. In regard to the speculative construction of railways, Mr. Newcomb considered that this has practically ceased within the last five years, but that before another period of too rapid construction begins, steps should be taken to provide against the wasteful duplication of existing lines.

The author refers to the tendency towards consolidation of individual lines into large systems, each controlled by one company, and he points out the economic and practical advantages of such consolidation, which results in reduced expenses and improved service. In connection with actual consolidation, such subjects as through rates and through trains, car interchange, etc., are discussed. He advocates pooling under government regulation, on the ground that pooling is essentially correct in principle and will be carried on more effectually under such regulation than in any other way.

It is shown that the expenditures prior to the commencement of operation do not (as is sometimes assumed) represent the total capital invested, but that the subsequent expenditures for improving grades and curves, double tracking, enlarging yards, building new stations and structures, and renewing the track with heavier rails, are all properly included in capital investment. The author also claims that the term "stock watering" cannot properly be applied to the distribution of securities to investors to represent earnings which it has been deemed wise to expend upon improvements (which enhance the value of the property) rather than to distribute directly to the investors.

LES BALLONS-SONDES ET LES ASCENSIONS INTERNATIONALES.—Par W. de Fonvielle, Secretaire de la Commission International d'Aeronautique; precede d'une Introduction, par J. Bouquet de la Grye, Membre de l'Institut, President de la Commission Scientifique d'Aerostation de Paris. Paris: Gauthier-Villars. Paper; 7½ × 5 ins.; pp. 148. 2.75 francs.

This work treats of what the author terms sounding-balloons; or balloons unaccompanied by human beings, but carrying automatic instruments for registering physical changes during its ascent. These balloons are made extremely light; have been sent up to heights exceeding 52,000 ft., and the observations thus made are purely in the interests of the advancement of science. The credit for the first of these balloon experiments is due to Messrs. Herniete and Besancon, at Paris, in 1891. The author describes these first experiments, and illustrates and describes the instruments employed in registering heights, temperature, humidity, etc. German experiments in a similar line are also referred to. In the third chapter the writer gives the theory of fitting up sounding-balloons, noting the dimensions necessary for a given material, weight and height to which it is to ascend. This is accompanied by a table of dimensions, etc., for balloons from 1 to 20 m. diameter; and the best manner of disposing of the instruments and launching the balloon is also dealt with. A species of cinematograph, for continuous photography, was also employed in some of the ascensions. In an ascension made at Graffenhausen, Oct. 20, 1895, the balloon carried a baro-thermometer, a thermograph, a minimum barometer, a photographic thermometer, and an apparatus for securing air specimens. In conclusion a record is given of various international ascensions, accompanied by tables showing time, height, pressure and temperature. In these records the maximum height is about 25,000 ft., the lowest temperature recorded was about zero of the Fahrenheit scale. According to a scale made by Mr. Hergesell, the relation between temperature and altitudes in kilometers was about as follows: Starting with 5°C. at the surface, at 3 kilometers altitude the temperature was — 7°C.; at 6 kilometers, it was — 20°C.; at 9 kilometers, — 42°C.; and at 12 kilometers of altitude it was — 66°C.. On June 8, 1898, a fleet of 24 balloons was simultaneously launched at Paris, Brussels, Berlin, Varsovie, St. Petersburg, Strasburg, Munich and Vienna, under the auspices of the International Society of Aeronautics. Of these 15 balloons contained observers and 9 were equipped only with self-registering apparatus. The first class of balloons ascended to variable heights up to 18,000 ft., and some of the sounding-balloons reached an altitude of 49,200 ft. The minimum temperatures recorded fell as low as — 64°C. In commenting on the scientific value of the observations made the writer urges a special and elaborate experiment with sounding-balloons as one of the features of the Paris Exposition of 1900.