greatest ease. Unfortunately it was ditched at Westport, Conn., when turning out for a wagon; and the water-cooling coils becoming damaged, together with trouble with the pump, caused the owner to drop out of the test after he reached New Haven.

The absence of electric vehicles was distinctly noticeable. None of the manufacturers tried to demonstrate the feasibility of these machines for long-distance travel, although in view of the recent statements of some of them concerning runs of 75 or 80 miles on a charge, one would expect to see some attempts made at covering this distance daily for a week, especially since an hour and a half was allowed each noon for recharging.

The tour was a most delightful one, in every way, and it showed as never before the ease with which 100 miles a day can be traveled in a modern automobile. With almost any of the present machines the chance of serious accident appears to be slight, since but few cars had a breakdown occur which could not be repaired in a short time with what local aid could be obtained.

KING CHARLES I. BRIDGE ACROSS THE DANUBE.

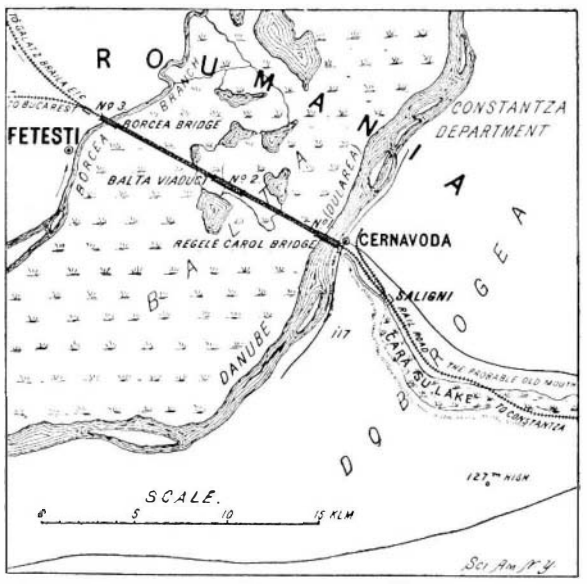
BY NICOLAE IONESCU, LIEUTENANT ROUMANIAN ROYAL NAVY.

After the great Russian-Roumanian-Turkish war of 1877-78, Roumania regained a territory which in former days she had lost, Dobrogea, lying between the Black Sea, the Danube and Bulgaria. For military and commercial reasons it was necessary to place this province in communication with the metropolis. A few years after the war Dobrogea had grown to be an important part of Roumania; its towns were greatly improved, especially Constantza, the most important town of the new province, which was destined to become a great Black Sea port. Besides its political and strategical importance, Constantza early presented itself to the Roumanian government as an excellent seaport for maritime commerce, especially during the hard winter, when the Danube was frozen and the large river ports like Galatz and Braila are inaccessible because of the dangers to which ships are exposed from the ice. It was, therefore, determined to build a railroad connecting Roumania with Constantza, a work which involved a difficult and costly crossing of the River Danube. At the inception of the work the Roumanian government instituted an international competition to secure plans for the bridge. The result was unsatisfactory and no contract was given out to any private firm, the Roumanian government deciding to have the designs executed by its own engineers. The matter was put into the hands of Mr. A. Saligny, Chief Engineer, who with the assistance of Mr. T. Baiulescu was responsible for the whole work.

The Danube at this point, as will be seen from the map, separates into two branches, the Danube and the Borcea. Between them lies a submerged island 13 kilometers in width. The main branch is only 620 meters wide and 7 meters deep, but at high water the river rises 7 meters above the ordinary level and covers the island as far as the Borcea with 2 meters of water. The current runs 2 meters a second, and the fall of water is about 18,000 cubic meters for the principal branch and 26,000 cubic meters in all. On this account the crossing involved the construction of a main bridge across the Danube, another over the Borcea, and the building of a viaduct across the island and the submerged country lying between the two branches.

In detail the crossing consisted first of the main bridge over the Danube, 748.28 meters in length, followed by 912.75 meters of viaduct, which carries the crossing to the island. Then follow 4,126 meters of embankment, 1,455 feet of viaduct, 6,086 meters of embankment and 400 meters of viaduct, which brings the crossing to the Borcea bridge. The latter has a total length of 420 meters, and from the bridge to the mainland is another short viaduct, 150 meters in length. The main crossing, the King Charles I. bridge over the Danube, as will be seen from our engraving, is an exceedingly handsome structure. It is carried on four stone piers and consists of two main cantilevers 240 meters in length and three trussed bowstring girders 90 meters in length. The depth of the girders is proportionate to the moments of the bridge, and its greatest depth, which is, of course, over the piers, is 32 meters. The webs of the girders are built up of inclined members, and the bridge is of the through type, that is, the floor is supported on the lower chords. The plane of the trusses is inclined, 1 to 10 from the vertical, after the manner followed in the construction of the great cantilever bridge over the Firth of Forth, Scotland. The width, center to center, of the trusses is 9 meters at the lower chords and 2.63 meters center to center over the piers. The most interesting feature of the bridge, next to its great length, is the foundations for the King Charles I. bridge, which on account of the great depth at which rock was found, namely 31 meters below mean water level, involved some very difficult foundation work. The foundation caissons were sunk by the compressed air method. The caissons were of steel with double walls and, in spite of the abnormally high pressure under which work had to be carried on, no serious accident occurred on any of the piers, notwithstanding that there was a rise of the water level at times of 10 meters above low water mark. It will be noticed that, as in all Continental bridges, particular attention has been paid to the architectural features, and as usual with very good effect. The Cernavoda pier is the great monumental portal of the bridge. It is built of Italian granite on a massive and dignified design, and is flanked by two colossal bronze figures representing two Roumanian soldiers "Dorobanti" in commemoration of the army corps which was the first to see active service in a war which resulted in the recovery of Dobrogea by the Roumanian people. The stretch of viaduct 912.75 meters long between the Charles I. bridge and the island consists of fifteen deck trusses 60.85 meters in length, carried on stone piers. Then follow 4,126 meters of stone embankment and 1,455 feet of viaduct over the ground at Balta. These viaducts are through structures 42.80 meters in length. The next stretch of crossing consists of 6,086 meters of embankment followed by 400 meters of viaduct, the latter made up of eight deck trusses, 50 meters in length. The Borcea crossing consists of a single cantilever having a center span of 140 meters and two connecting bowstring girders 90 meters in length, the cantilever arms being each 50 feet in length, thus making three clear spans of 140 meters. The approach on the Fetesti side consists of three 50-meter spans.

In a work of this size the total quantities necessarily reached a very large figure. There are 110,207 cubic meters of masonry, while the total weight of the steel superstructure and caissons was 16,823 tons. The total cubical contents of the earth-work in the whole crossing is 2,950,000 cubic meters. The cost of the work completed was $7,000,000. The subsequent



Map Showing in Full Black Line Location of the Bridge Across the Danube and the Borcea.

results since the opening of the bridge have fully justified the confidence which led to the undertaking by the Roumanian people of this great engineering work; for Roumanian commerce has been directed to the Black Sea port of Constantza, and several new and important lines of steamships have been inaugurated with excellent results.

World's Production of Coal in 1901.

The forthcoming volume of the Mineral Resources of the United States for the calendar year 1901, United States Geological Survey, estimates the world's production of coal in 1901 at 866,165,540 short tons. The three great coal-producing countries of the world are the United States, Great Britain and Germany. The output of these three countries combined makes up 81.61 per cent of the world's total. Austria-Hungary comes fourth, France is fifth, Belgium sixth, and Russia seventh. The last country, notwithstanding its vast area, produces only about 6 per cent as much coal as the United States. The three countries which lead in the production of coal are the three countries that lead in industrial development. Prior to 1899, Great Britain led among the world's coal producers, but during 1899, 1900 and 1901 the United States has made such remarkable increases in coal production, due principally to the unprecedented activity in the iron and steel and in other metal trades, that we now stand far in the lead of all competitors, with a production in 1901 exceeding that of Great Britain by 47,965,938 short tons, or 19 per cent. Up to the close of 1900 the coal production of Great Britain and her colonies, if taken together, still exceeded that of the United States, the excess in 1900 being 3,368,825 short tons; but the enormous output of the coal mines of this country last year exceeded by about 26,000,000 short tons the entire output of Great Britain and her dependencies, including India and the Transvaal.

Of the output of coal in 1901, the United States produced 33.86 per cent, Great Britain and her dependencies 30.86 per cent, and Germany 19.42 per cent, or, combined, 84.14 per cent of the total production.

Electrical Notes.

The failure of the electric vehicle trials of the Automobile Club of Great Britain to take place, owing to lack of competitors, would seem to indicate that in the United Kingdom at least the electric automobile has retrograded during the last two years. At that time a successful test of electric vehicles was held under very adverse conditions. This year, after a committee had spent considerable time perfecting rules and classifying vehicles under the heads of town and country machines, the tests for the former of which were extremely easy, but one firm was willing to enter the contest, and so it had to be abandoned. This result is pretty much in line with what occurs in this country when a chance is given electric vehicle manufacturers to demonstrate what their vehicles can do in a well-conducted, impartial test, such as the recent reliability trials, for example. It ought to be an easy matter for a machine equipped with a battery capable of propelling it 118 miles on smooth asphalt streets, as it is claimed that one of the National Electric Vehicle Company's runabouts did recently, to cover fifty miles of country roads per charge, and keep this up twice daily for a week, yet neither this nor any other company saw fit to enter one of its carriages in the test.

The last of the main generators and engines intended to be installed in the power plant of the Mersey Tunnel Railway are about to be shipped from the Westinghouse Works at East Pittsburg. These generators are of the railway type (1,200 kilowatts, 650 volts, 90 revolutions per minute) and are to be direct-connected to vertical cross-compound Westinghouse-Corliss engines of 1,500 horse power each. The power house lighting and the electric light of all stations, sidings, etc., will be supplied from a separate generating plant comprising two compound-wound generators, each having a capacity of 200 kilowatts at 650 volts, direct-connected to Westinghouse compound engines and running at a speed of 250 revolutions per minute. The power-generating plant will have an aggregate output of about 6,600 horse power—6,000 horse power for the railway proper, and 600 horse power for lighting. The Westinghouse electro-pneumatic system of train control is to be used, and the cars will be equipped with Westinghouse high-speed air-brakes. The rolling stock will consist of sixty cars, each about 60 feet in length. The trains will be formed of five cars each, the first and last cars of a train being motor-cars equipped with four 100 horse power motors each.

In demonstrating the ionic charges of the atmosphere, H. Ebert describes some simple and instructive experiments. A plate of tinned iron two square meters in area is supported four meters above the earth's surface on insulating pillars planted on the top of a slope seventy meters high overlooking the River Isar. In clear weather the plate was first connected to earth acquiring a negative charge, then being disconnected and left to itself for some time so as to acquire the potential of the surrounding air. It was then earthed through a galvanometer, and showed a current proceeding from the plate to the earth. The charges acquired vary within wide limits by the weather, being largest in fine and smallest in foggy or damp weather. This shows that the connection of negative ions from the atmosphere of the earth varies in accordance with their mobility in the atmosphere. A rough estimate of the quantity of electricity thus conveyed on a fine day gives about 300,000 electrostatic units per square kilometer per minute.—Physikalische Zeitschrift.

Wireless Telegraphy for Yachtsmen.

The Marconi Wireless Telegraph Company of America has secured a site for a station at Eaton's Neck, Long Island, where a station will be installed, the first of a series along the Sound, and the territory adjacent to it, which will be operated for the convenience of yachtsmen. While the service will not begin until next season, several of the best known yachtsmen in America, who are identified with vast business interests, have already made arrangements to have their craft equipped with Marconi apparatus. The Sound service and the stations on the ocean side at Cape Cod, Sagaponack and Babylon will make it possible for yacht owners cruising in these waters to keep in communication with New York whenever necessary.

Reconstruction of the "Philadelphia."

The "Philadelphia," one of the original "White Squadron," is being remodeled at the Puget Sound navy yard. The vessel is to be completely re-equipped in every respect. When she is launched again she will be a vessel of which the navy may be justly proud. At least a year and a half, or perhaps two years, will be required to remodel her completely.

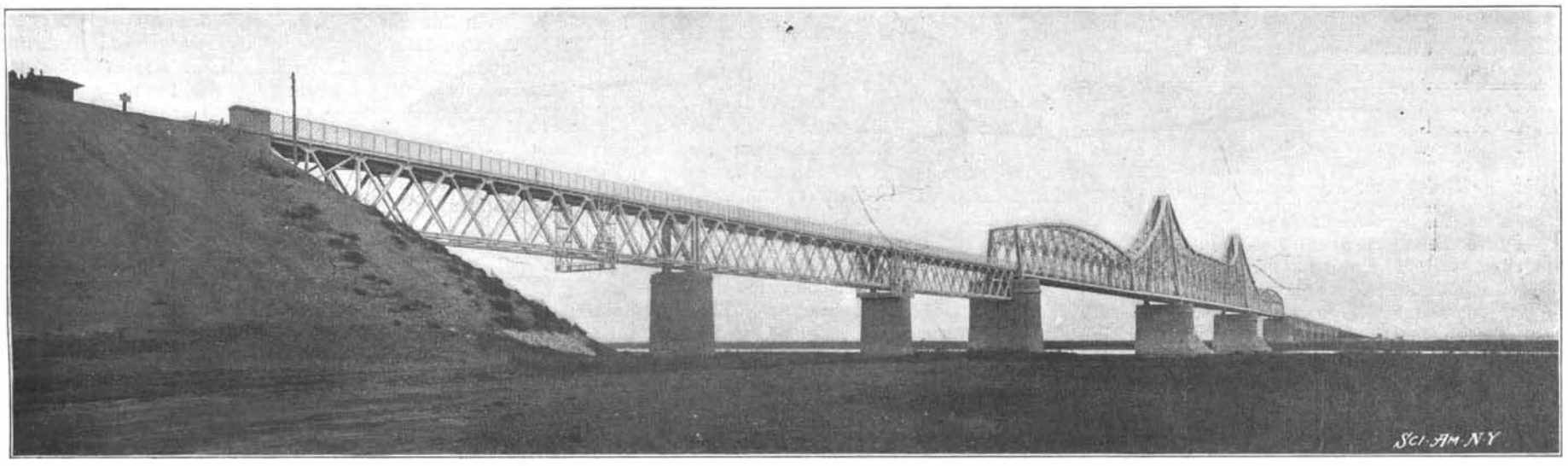
SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class Matter. Copyright, 1902, by Munn & Co.]

Vol. LXXXVII.—No. 17.
ESTABLISHED 1845.

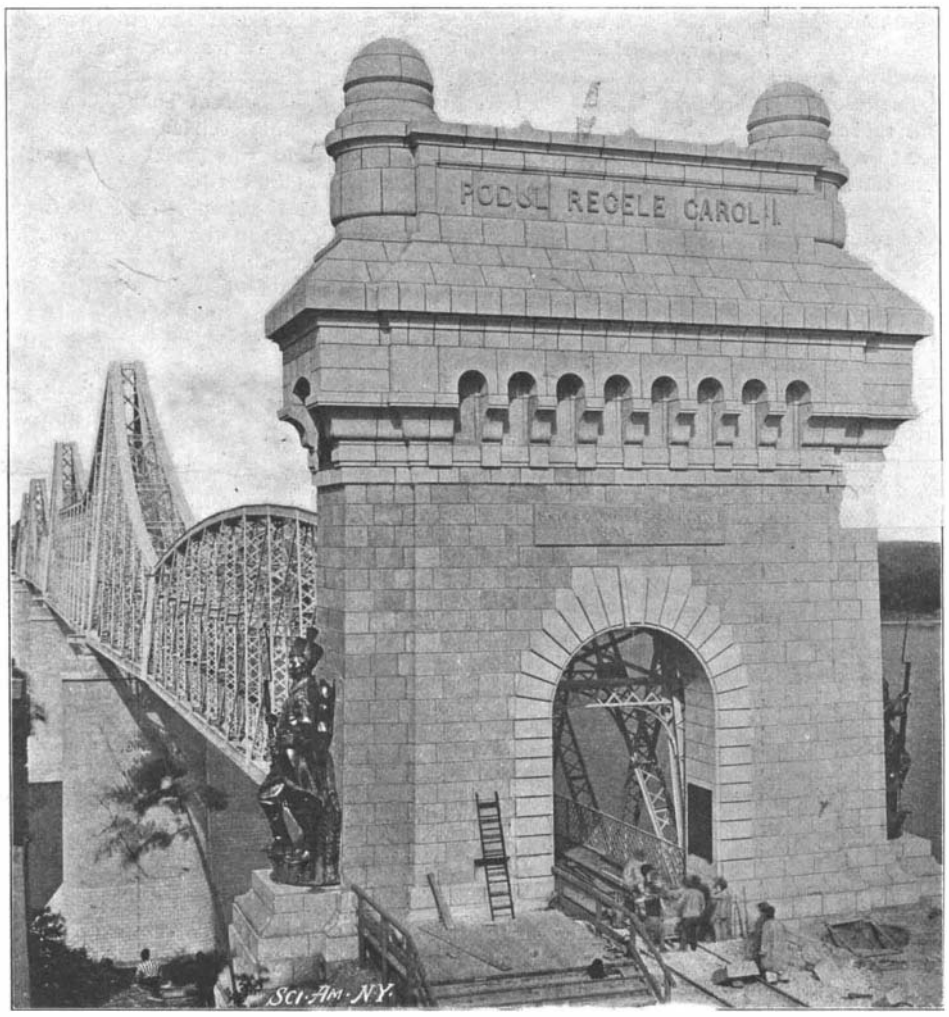
NEW YORK, OCTOBER 25, 1902.

$3.00 A YEAR.
8 CENTS A COPY

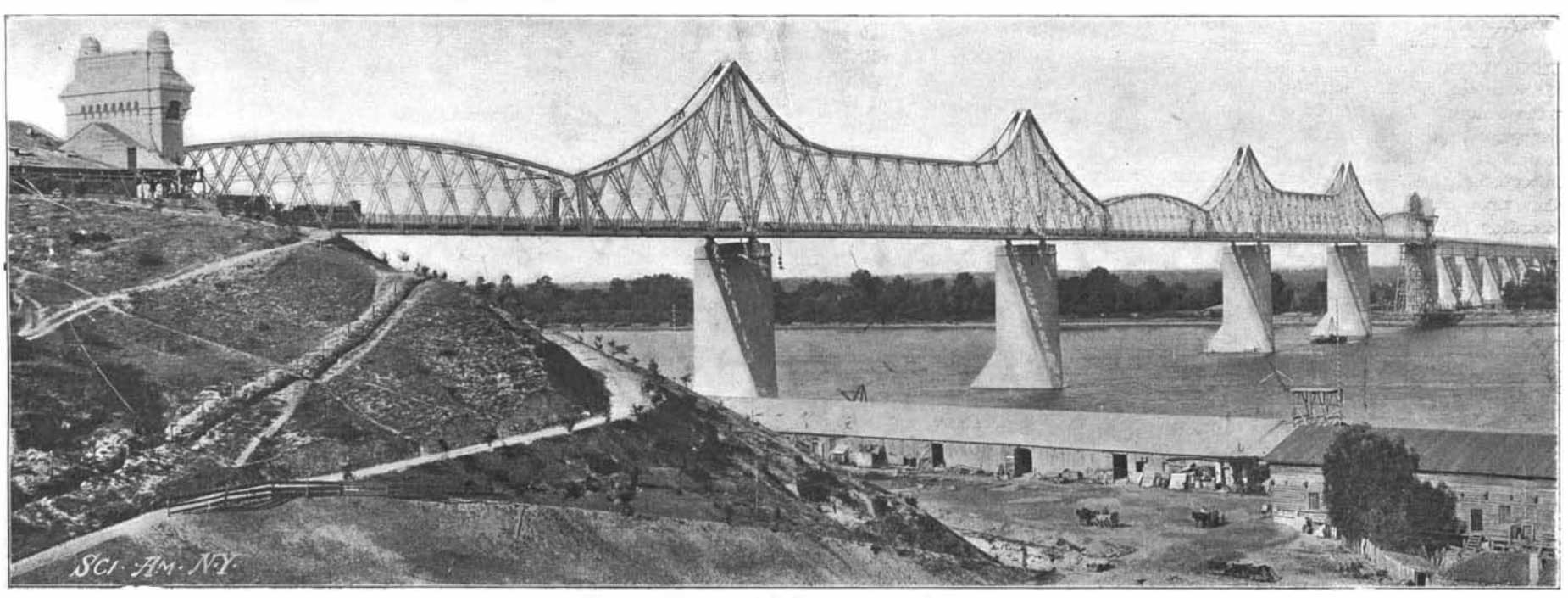


The Borcea Bridge Across Branch of Danube. Length of Bridge and Viaduct, 3,152 Feet.

Colossal Bronze Figure of Roumanian Soldier.



Monumental Portal of Charles I. Bridge.



Length of Bridge and Viaduct, 5,448 Feet

THE CHARLES I. BRIDGE OVER THE DANUBE.—[See page 272.]

Engineering Notes.

The Baltimore & Ohio Railroad Company has built four miles of line in Pennsylvania, which is believed to be the crookedest railroad in the United States. This little road will extend from Boswell, Pa., to Friedens on the Somerset & Cambria branch of the Baltimore & Ohio. The air-line distance is about five miles, but the peculiar conformation of the country makes it necessary to loop a number of hills in order to get an easy grade. The new road doubles on itself four times, and at one point, after making a loop of about five miles, the road comes back to within 300 feet of itself on a grade 50 feet lower.

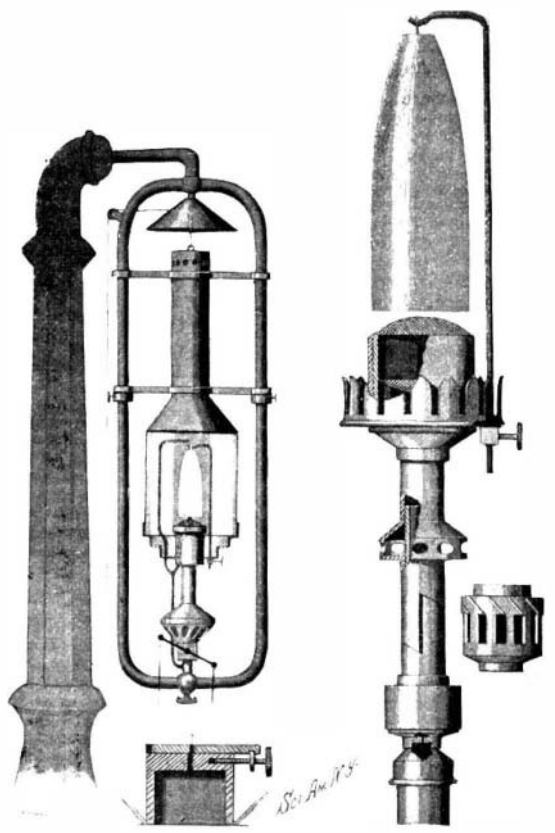
The southern press dilates upon a new plow, the invention of which is accredited to Dr. Gatling, famous for the gun that bears his name. Dr. Gatling has devised a motor plow driven by a gasoline engine. The truck is said to be constructed like the trucks of traction engines, except that the steam boiler is displaced by a strong platform on which is mounted the motor connected with the traction gearing. A set of disk plows is attached to this truck, and these plows can be made to run at any depth or any angle required. It is estimated that with this machine one man can plow from thirty to thirty-five acres in one day.

The city of Bahia, which is situated on the coast of Brazil, South America, has a population of about 200,000 inhabitants who are housed in 17,000 dwellings. The water supply for these people has been furnished by a local company ever since 1852. It is brought from the nearby mountains, and thus far the expenditure for the works, including the pipe system, fire plugs, etc., has amounted to $1,500,000. According to the Municipal Journal and Engineer, the supply is not adequate to the needs of the city, and for a long time negotiations have been going on between the company and the city for the purpose of increasing the supply. The monopoly has been renewed for a period of forty-five years and some valuable franchises and privileges have been awarded the company. On the expiration of this contract the city will have the option to buy the company's plant at the valuation of expert engineers. Every dwelling in Bahia must use water, and the municipal officials of the city regulate the price. For the average dwelling for 422 quarts a day, ten cents is charged; twenty-one quarts of water is furnished to the public fountains and hydrants, at a low price. The improvements contemplated by the company will cost in the neighborhood of $600,000, but owing to the financial crisis prevailing in Brazil, the company has been unable to obtain the money required to complete the water system and therefore desires to sell its plant and privileges. The price asked is $1,100,000. It is estimated that the earning power of the water works, when completed in accordance with the new contract, will be $300,000 a year, and the company purchasing its rights will doubtless be awarded a contract for establishing a drainage system in the city and for furnishing the houses with sanitary plumbing.

One of the original locomotives, writes a correspondent of the London Railway News, built by George Stephenson in 1822 for the opening of the line of the Hetton Colliery, near Durham (England), between their works, a few miles northwest of Durham, and the shipping staiths on the Wear at Sunderland, is still employed hauling the trucks at Hetton, and is now, after eighty years' continuous service, claimed to be the "oldest working locomotive in the world." The principal dimensions of this "old-timer" are: Diameter of the cylinders, 10¾ inches; piston stroke, 24 inches; diameter of the wheels, 3 feet. The weight of the engine is 15 tons, and it has a haulage capacity of about 129 tons at a speed of 10 miles an hour on a fairly level track. Its general design (excepting the cab) remains as originally constructed, while some parts, notably the steam dome, are actually portions of the engine as constructed in 1822. After this long and faithful service, it is not surprising to learn that the engine is at last becoming unequal to the ever-increasing demands made upon it, and the directors of the Hetton Colliery, therefore, and with commendable appropriateness, shortly intend to withdraw the relic from Hetton, and it will in the course of a few weeks find a permanent resting-place at the Durham College of Science, Newcastle-on-Tyne, where it will be preserved to this and future generations as a worthy example of the earliest period of locomotive engineering. It may be noted here that Stephenson's "No. 1 Locomotion," built for the opening of the Stockton and Darlington Railroad in 1825, continued in working on "the first public railway" until 1850, when it passed into the hands of Messrs. Pease & Partners, by whom it was used for colliery purposes until 1857, at which time it was placed on a pedestal for exhibition at Darlington Station, where it is to be seen to-day, so that not only in point of date of construction, but also as regards years of "active service," must the engine used at the opening of the first public railway give place to that constructed for the Hetton line by George Stephenson fourscore years ago.

TWO NEW INCANDESCENT GAS BURNERS.

Two important improvements in incandescent gas burners are herewith illustrated. The burners are designed to insure a perfect mixture of the air and gas and at the same time use but a minimum of gas in the mixture. The arrangement causes a proper burning of the mixture, producing a complete and brilliant incandescence of the mantle and hence a light of great strength, brilliancy and softness. The burner shown at the right is adapted for ordinary use in rooms of limited size; that on the left is intended for street lighting or the illumination of halls, large rooms and the like. The former type is adapted to be placed upon the tip of an ordinary gas supply pipe. The supply pipe is covered by a cap having a small outlet opening which admits gas into the mixing chamber just above. This chamber is provided with apertures in its side wall, as shown in the small detailed view. A nut having an internal thread is adapted to be screwed down over these apertures. By adjusting this nut the apertures may be more or less uncovered to admit more or less air into the mixing chamber. A tube extends upward from this chamber, and is surrounded near its upper end by an annular chamber having large inlet openings to admit the air. On the bottom of this chamber is a sleeve extending downward over the tube referred to, and provided with a spiral engaging a corresponding spiral on the tube, so that by turning the sleeve the annular chamber is raised past the upper end of the tube and more or less air is admitted thereto. From the top of the chamber a conducting pipe extends to the main mixing chamber. This is provided with two wire screens spaced a



NEW INCANDESCENT BURNERS.

suitable distance apart. The gas and air in passing through the fine meshes of these screens become thoroughly mixed, forming an easily combustible mixture which, when ignited, renders the mantle incandescent and produces a powerful light that combines brilliancy with softness. Since so small an amount of gas is admitted into the burner, it is evident that great economy of gas is had.

The second type of incandescent burner, which is illustrated on the left, embodies certain novel features by which it is adapted to produce a much more powerful light. The gas supply is connected to a service pipe, preferably made in the shape of an elongated loop. A feed pipe extends upward from the bottom of this loop, and enters a mixing chamber. Mounted on the top of the feed pipe is a slide-valve controlled by a thumb screw, as shown in the small detail. An inlet port in the mixing chamber is formed by a small opening in the top of the feed pipe, which registers with a similar opening in the slide-valve. By moving this valve inward or outward, the inlet port is more or less closed, and thus the flow of gas may be regulated to a nicety. The mixing chamber is provided with openings for the admission of air which thoroughly mixes with the gas in passing up the long conducting tube to the burner. The burner is provided with a screen of fine mesh which minutely divides the mixture and prepares it to be properly burnt in the mantle. The chimney carrier is provided with openings which admit air to the outer surface of the mantle, thus insuring high incandescence. A tube with a flaring bottom rests upon the top of the chimney and is provided with lugs mounted to slide on the side arms of the service pipe. The tube is provided with openings at the top to permit the escape of the products of combustion. The purpose of the tube is to create a draft and cause the air and gas to be forced up under additional pressure, thus affording a brilliant light. When it is desired to remove the chimney, this tube may be raised out of the way by pulling the cord or chain fastened thereto, which passes up over a pair of pulleys and hangs down within easy reach.

Just below the mixing chamber is a valve carrying on the valve-stem the usual lever, from the ends of which the operating chains depend. From a point immediately below this valve a pilot pipe leads upward and projects through the screen at the top of the burner. A branch from this pipe extends upward to the top of the mantle. By this means when the valve is closed, two small flames continue to be fed by the pilot pipes, and when the valve is again opened the gaseous mixture is again ignited by these flames, both from the top and bottom of the mantle. The pilot pipe is made in two sections which are joined together by a coupling within the mixing chamber. By this arrangement the parts may be readily disconnected to give access to the regulating valve in the mixing chamber.

Patents on these improved burners have recently been granted to Mr. James Buchanan, of 203 Broadway, New York.

The Finding of the Revolutionary Prison Ship "Jersey."

In building a section of the new ways for the construction of the battleship "Connecticut" at the Brooklyn navy yard, the famous English prison ship "Jersey" was discovered. She was one of six prison ships used during the Revolution. Probably built somewhere around the year 1720, she saw some thirty years of service, fought many a battle and was then condemned to be used as a receiving vessel for American prisoners of war.

Of the six prison ships, the "Jersey" was by far the worst. She was a kind of floating Black Hole of Calcutta, and in her damp, leaky hold half-starved American patriots perished miserably. In her palmy days the "Jersey" had a crew of about 400 men, huddled together as crews were in those days. How appalling were the conditions to which American prisoners were subjected may be gathered from the fact that 1,200 prisoners were kept on board almost constantly. One historian says: "She was never cleansed, and lay in that condition seven years. No fires warmed her occupants in winter, no screen sheltered them from the August sun, no physician visited the sick, no clergyman consoled the dying there. She remained throughout the contest a center of sickness and death, always replenished with new victims. The bones of her dead, estimated at 11,000, lie buried on the Brooklyn shore." When the war ended, the "Jersey" was burned at her moorings.

For years historical societies and government officials have tried to locate the ship. The half-burned hull lies in about two fathoms of mud and water about 500 feet from the dock. Unless the hull is removed the battleship "Connecticut" must be built directly over it. Whether the hulk will be raised seems doubtful. About $500 would be required, and the delay in the construction of the battleship would be considerable. The ways are already behind time as it is.

Interest in the old ship reached its height when, some years ago, the skeletons of 300 men were found in the yard. That these were the remains of the men who had died in the "Jersey" was definitely established. The bones were afterward buried in Fort Greene Park with impressive ceremonies.

The Current Supplement.

The current SUPPLEMENT, No. 1399, contains a wide range of interesting articles. The first article deals with a novel block signaling system in which electric semaphores are used. Mr. S. D. Mott explains a novel plan of mechanical aerial flight or air suspension based on well-known ascertained facts. The machine for this purpose he terms an "aerodrome." For manufacturers and exporters an explanation of the business opportunities in Portuguese colonies should be valuable. The coal strike has brought home to the dwellers of large cities the need of some device whereby it is possible to burn soft coal without smoke. Therefore an article on a locomotive stoker which has been successfully used on railways should prove of interest. The value of alcohol as a fuel has been more than once commented upon in these columns. A further discussion of the subject will be found in the current SUPPLEMENT, the occasion for which is the International Alcohol Exposition of Lighting and Heating Apparatus, recently held in Paris.

Mr. Frank H. Mason, our Consul-General at Berlin, tells much of the German processes and machinery for briquette manufacture. Dr. Peter T. Austen concludes his paper on the "Chemical Factor in Human Progress." The usual Trade Suggestions from the United States Consuls as well as Trade Notes and Recipes are also published.