## THE DISPOSAL OF NEW YORK'S REFUSE.

The scientific disposal of the refuse of New York city can hardly be said to have been undertaken until comparatively recently—indeed, not until the appointment of the late Col. George H. Waring, Jr., as Commissioner of Street Cleaning. Before the advent of his ever-memorable administration, the wastes of the city had been removed in a way which would have done credit to a medieval town, but which was shockingly discreditable to the most progressive community in the world. Garbage and ashes were indiscriminately piled on scows, towed either out to sea and dumped, or to tide lands which had been bulkheaded. Both plans were equally cheap and unsanitary. The first resulted in polluting the beaches of New Jersey and Long Island; the second, in rendering positively uninhabitable the vicinity of the tide lands. Despite the fact that the residents along the seashore complained bitterly of the defilement of their beaches, and the courts prohibited the dumping of garbage in places where the heat of the summer was sure to breed stenches almost insupportable, New York continued to dispose of its wastes in this disreputable fashion. Finally, sumptuary legislation effected a partial improvement. Even then the dumping of garbage at sea continued unabated.

One of the first orders issued by Commissioner Waring commanded householders throughout the city to separate their refuse material, to deposit in one receptacle the garbage that had accumulated through the day and in another the ashes from the fires, and to tie up in a package the rubbish and waste paper that had been formerly mingled with garbage. After that order had been carried out with the combined assistance of the Police and Health Departments, the beneficial effects of household separation began to be felt. Wastes were far more expeditiously removed than had theretofore been possible. Garbage was sent to Barren Island, where a private company converted it by chemical processes into commercially valuable products; the rubbish was picked by Italian laborers, employed by men who paid the city thousands of dollars for the privilege, as a partial return for the valuables found in the dumps.

The Tammany administration which came into power after Col. Waring's term expired, all but undid the good work which had been accomplished. Under the present energetic administration of Commissioner Woodbury, Col. Waring's methods have not only been carried out with renewed vigor, but many a decided improvement has been inaugurated. So completely new was the problem of scientifically disposing of the city's refuse at the time when Col. Waring first took charge of affairs, that the most he could hope to do was to get rid of the collected material as quickly and as cheaply as possible. The present Commissioner has gone even further. He has actually succeeded in converting much of New York's refuse material into a positive source of revenue for the city. Col. Waring's system of primary separation is again enforced. Garbage, as before, is towed out to Barren Island to be converted into useful compounds. Over a hundred thousand dollars is paid to the city for the picking of the rubbish containing valuables which have been swept by householders into the rubbish heap; the ashes are sold to contractors as a filling material, or else are dumped behind a crib at Riker's Island, with the result that the city is fast acquiring land worth $10,000 an acre. This, in brief, is the work which has latterly been accomplished in New York city.

In order to understand clearly just what is being done to better the sanitary conditions of the city, it becomes necessary to explain the meaning of certain terms, and also to give a few statistics to show something of the scope of the problem solved. By "garbage" is to be understood kitchen or table waste, vegetables, meats, fish, bones, and fat; under the general term of "ashes" are included not only furnace and stove ashes, but also sawdust, floor sweepings and street sweepings, broken glass, broken crockery, oyster and clam shells, and tin cans; "rubbish" is classified into bottles, paper, rags, mattresses, old furniture, carpets, and the like. Every working day some 9,920 cubic yards of ashes, 3,404 cubic yards of rubbish, and 1,399 cubic yards of garbage are collected in the boroughs of Manhattan, Bronx, and Brooklyn. The total annual amount is, therefore, equal to 3,096,091 cubic yards of ashes, 1,061,913 cubic yards of rubbish, and 437,515 cubic yards of garbage. The area from which this refuse material must be collected is equivalent to 949 miles of paved streets in the three boroughs mentioned. Geographically, New York city, with its enormous water frontage, is admirably situated for the rapid removal of this vast amount of refuse material. And yet in the two boroughs of Manhattan and Bronx there are but twelve water dumps and eight land dumps; in Brooklyn, but one water dump and twenty land dumps. This almost absurdly low number of points for the loading of material upon scows is to be accounted for, not by any lack of energy in the Street Cleaning Department, but in the hostility of property owners, who have used every legal means in their power to prevent the establishment of new dumps, despite the fact that the Street Cleaning Department's work is thereby seriously hampered. Between 47th Street and 134th Street on the North River, a distance of nearly five miles, absolutely no dump whatever is to be found. As a result, it is necessary to cart the material at great expense over a great distance to the nearest available wharf. When it is considered that the annual cost of carting in New York city is not very much less than that of sweeping (the actual figures being respectively $1,648,492.25 and $2,090,392.87) the fruit of this opposition becomes apparent. In the end the taxpayer must suffer.

Rubbish on the Traveling Conveyer Belt. The Pickers Sort Out Over Half the Material and Sell it; the Rest is Conveyed to the Furnaces.

Thus far the attempts of the city of New York to destroy its garbage totally by incineration have not proven successful. An experimental plant installed in the Borough of Bronx for the burning of garbage proved a failure. The city must, therefore, rely entirely upon the Barren Island plant, which is controlled by a private company, for the reduction of its garbage. In some European cities the practice of mingling the garbage with fuel has been tried, with more or less success. Indeed, sufficient power has been obtained to drive electric lighting plants, and thus to make at least a partial return for the cost of combustion. But actual profit by these experiments none of these cities can show.

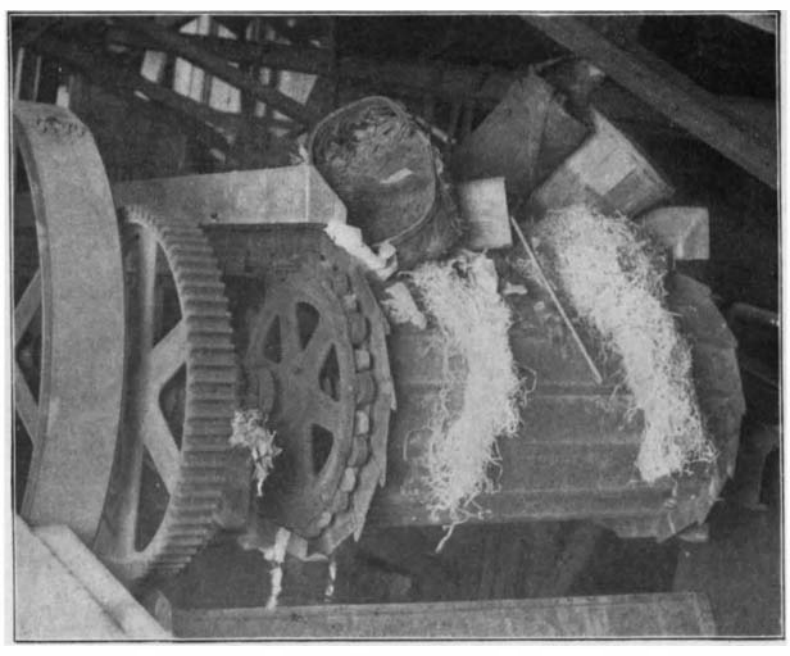
Although the burning of the garbage has not been as successful as it might have been, the same does not apply to the destruction of rubbish. At the foot of 47th Street and North River an incinerator has been installed, which has conclusively proven that not only can rubbish be burnt, but that the heat thus generated is sufficient to drive an engine for the propulsion of a belt conveyer, upon which the rubbish is scattered to be picked by Italian laborers. In time, an electric light plant will be operated, and steam engines driven, all from the power thus obtained. A brief description of this plant may not be without interest.

The carts containing the rubbish dump their loads on an endless conveyer belt, 104 feet long, traveling between two rows of pickers, who sort out certain material and drop it to the floor below. One picker selects manila paper, another shoes, another bottles, cans and metals, another cloth and rags, until finally fully sixty per cent of the material which New York householders consider worthless is picked out as worth saving. The metal consists of tin cans and is sold to sash-weight manufacturers; the paper goes to paper manufacturers, as do also the rags. The boots and shoes are either worn by the pickers themselves, or sold. Were it not for the fact that many of the sofas, bedsteads, and mattresses come from the poor quarters of the city, where disease prevails, and must for that reason be burnt, the amount of actual material supplied by the traveling conveyer to the furnace would be still less.

Paper, rags, and the like are at present baled by hand. Presses, however, are soon to be installed which will simplify the process considerably and also cheapen it. It is doubtful if this baling and selling of paper will be allowed to continue long. In the opinion of the Health Department paper is as much a source of contagion as a mattress or a sofa. At no distant day it will probably be dumped into the furnace with the other worthless matter.

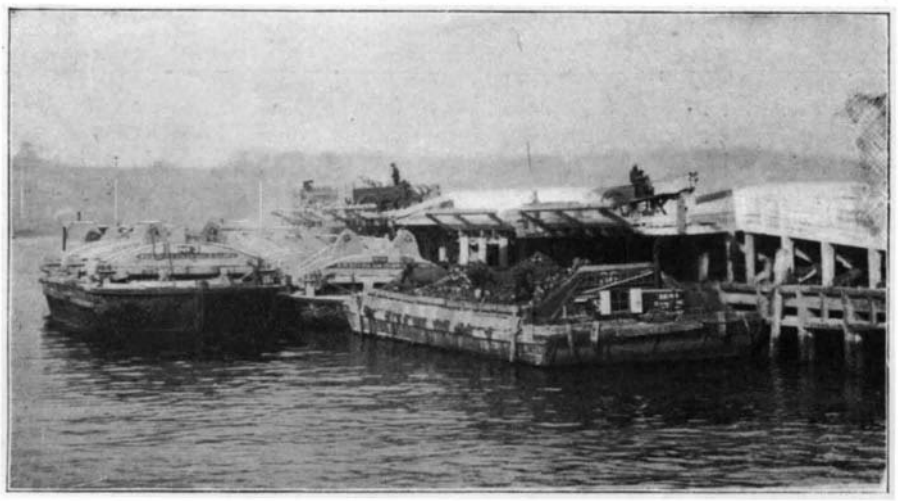
Three fire boxes are provided. After having been picked, the rubbish is carried by the belt to the furnace hoppers and discharged on a single grate. In this manner the gases of combustion from one grate are made to mingle with those of a hotter furnace. The gases are discharged directly to a 114-foot stack, after passing beneath two 50-horsepower vertical boilers near the stack. There is heat enough for another boiler of 150 horse power. At this plant 150 loads of five cubic yards each are burnt every day. Since the actual cost of the plant was $20,000, and the privilege of handling the material brought to this point is sold at $240 a week, the rather good return of $2,480 per annum may be recorded.

Through the courtesy of Mr. F. L. Stearns, the engineer in charge of this plant, we are enabled to give some data and results of the actual efficiency of an incinerating plant based upon tests made by him. During a six-hour trial, with a single boiler plant on North Moore Street, 3,324 pounds of rubbish were fired upon grate surfaces of 40 square feet. The water-heating surface of the boiler is 324 square feet. It was figured that the actual horse power developed was 134.7, which is equivalent to 22.4 horse power per hour. The average weight of material burnt per yard was 175 pounds. From this it would follow that the horse power per yard of rubbish is at least 7.1.



Rubbish Discharged by Conveyer Belt Into Furnace Hopper.

For the towing of the garbage to Barren Island and for the removal of ashes to Riker's Island, twenty-six scows altogether are used. Up to 1895 the only dumping boat capable of handling the refuse of New York was the Barney scow, whose inventor had a very clear conception of what was necessary for successful operation, namely, an opening at the bottom of the cargo larger than that at the top, a clear run of water through the center of the boat when open, and the discharge of as much material in a single mass as possible. These boats do their work well, but are adapted solely for sea dumping; they will not dump when at rest, on account of the tendency of the two hulls to close after the first weight of the load has been removed. A boat was therefore proposed by Lieut. Com. Daniel Delehanty, which was designed and built by Lewis Nixon. The first boat, named with admirable fitness the "Cinderella," was faulty. Changes, however, were made which corrected these faults and prove the worth of the system. Two additional boats have since been built which have proven a marked success. The compartments in which the load is carried, between the pontoons, are wider at the bottom than at the top. This form of compartment does away with arching and bridging of the material on its downward passage, and moves the mass more or less as a unit according to the proportion of elements it contains, such as street sweepings, ashes, and the like. Typical of the entire fleet of dumping boats is the "Aschenbroedel," a steel pontoon steamer carrying its cargo of ashes and street dirt in seven compartments situated between two pontoons.

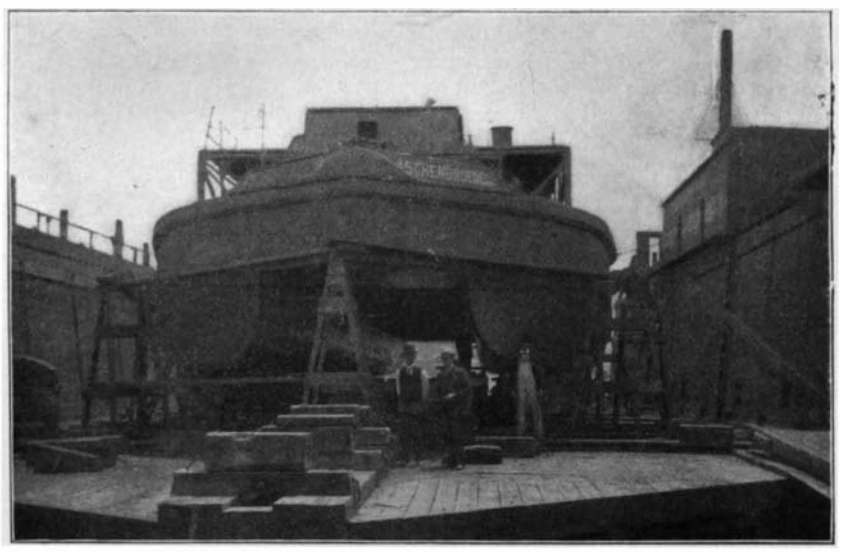


**A Typical New York Dumping Board.**

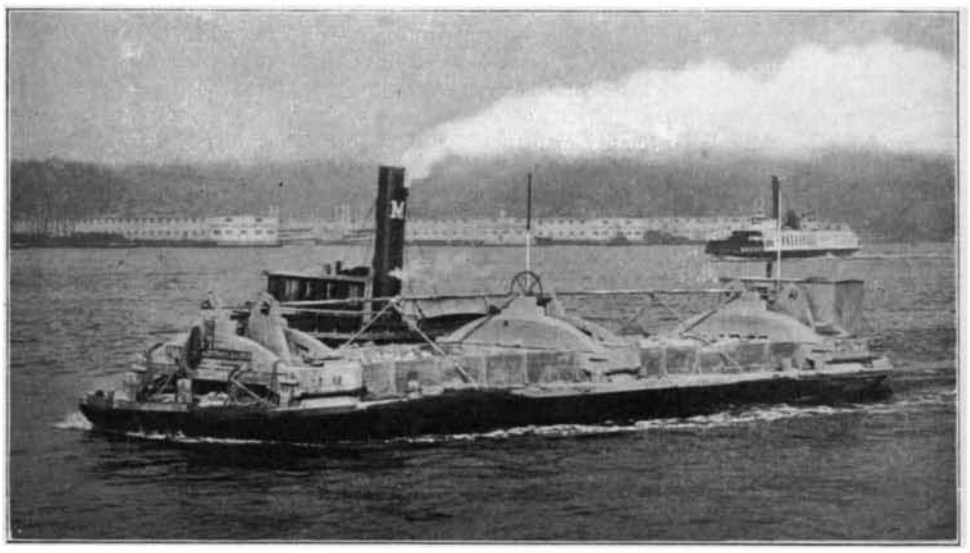
Barney dumper under outer board is receiving ashes; scow under nearer board is receiving garbage.

**One of the New Steel Collecting Wagons.**

A vehicle for the sanitary carrying of refuse.



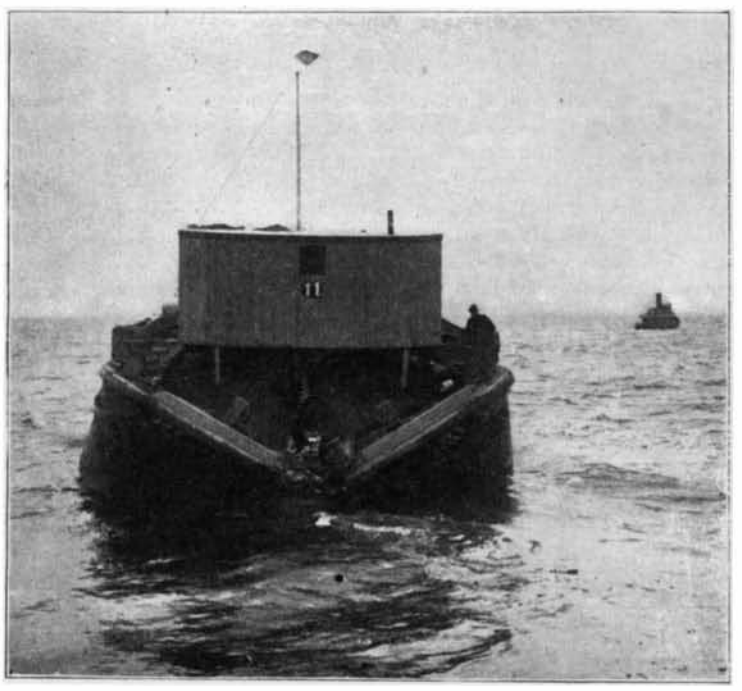
**A Delehanty Steam Scow in Drydock, Showing the Double Pontoon Construction.**



**Towing a Barney Dumper Out to Sea.**

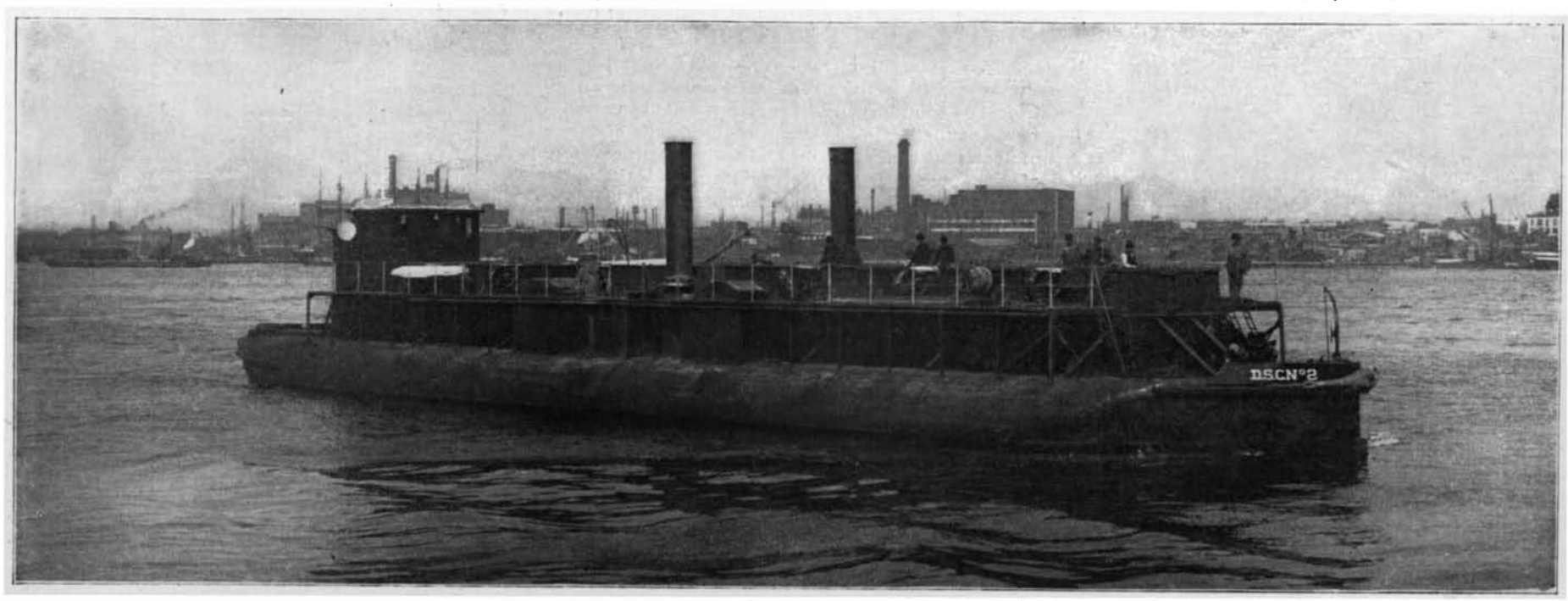
**The Old Way of Dumping Garbage at Sea.**

A former cause of the defilement of beaches in the vicinity of New York.



**A Barney Scow in the Act of Dumping at Sea.**

The two bulls have separated to discharge the material.




**The Delehanty Automatic Steam Dumping-Scow "Aschenbroedel."**

**THE DISPOSAL OF NEW YORK'S REFUSE.**

Her dimensions are 140 feet over all; beam, 33 feet; draft, light 4½ feet, loaded, 7½ feet; beam of pontoon (amidships), 10 feet; depth of hold, 10 feet. In each pontoon is a compound surface condensing engine, with two cranks set at 90 degrees, the stroke being 14 inches, and the cylinders 12 and 24 inches in diameter. As auxiliary apparatus the vessel carries a circulating pumping engine, condenser, air pump, two feed pumps, two injectors, a fire and bilge pump, two ventilating engines, besides gearing controlling the cargo compartment doors. The vessel has a speed of eight miles an hour. Her capacity is 400 tons of ashes.

Commissioner Waring had adopted the plan of selling the manure street sweepings for use as a fertilizer. The termination of his commissionership and his untimely death unfortunately prevented him from carrying out this plan personally. Commissioner Woodbury has, however, realized to a great extent Col. Waring's idea, and is now selling 1,600 sacks daily to the Long Island division of the Pennsylvania Railroad for the grassing of cuts on the south side of Long Island.

Brief mention has previously been made to the filling in of land about Riker's Island with the ashes of the city. It is largely due to the present administration that in this manner land has been formed which in value more than offsets the cost of handling the filling material, and which has filled the city's pockets with thousands of dollars. In an empty crib inclosing 63½ acres, ashes have been dumped at the rate of 100,000 cubic yards per month. By this scheme the city has acquired land worth $630,000 at an expense considerably less than would have been entailed had the same material been towed out to sea and there dumped.

## A HEAVY ELECTRIC LOCOMOTIVE.

The most powerful electric locomotive in the world has just been built by the General Electric Company at Schenectady, for the Baltimore & Ohio, for use in the tunnel at Baltimore. It will handle all the freight traffic of the Baltimore & Ohio which passes through Baltimore, and will operate over the same section as the present electrical locomotives built by the General Electric Company, and which have been in successful operation for the past eight years.

The specifications called for an electric locomotive capable of handling a 1,500-ton train, including the steam locomotive, but excluding the electric locomotive on a maximum grade of 1½ per cent at 10 miles per hour, with corresponding higher speed on lighter grades. This required a weight of approximately 160 tons on the drivers for purposes of adhesion, and it was decided that the most practicable scheme was to build an articulated locomotive consisting of two complete 80-ton units, operated together as one locomotive by means of the Sprague-General Electric multiple unit control system.

The section of the road to be operated runs from Camden Street Station, through the tunnel, to the summit of the grade outside the tunnel, a distance of 3½ miles. Under practical operating conditions the motors have sufficient capacity to maintain this service hourly, running loaded up the grade and returning light.

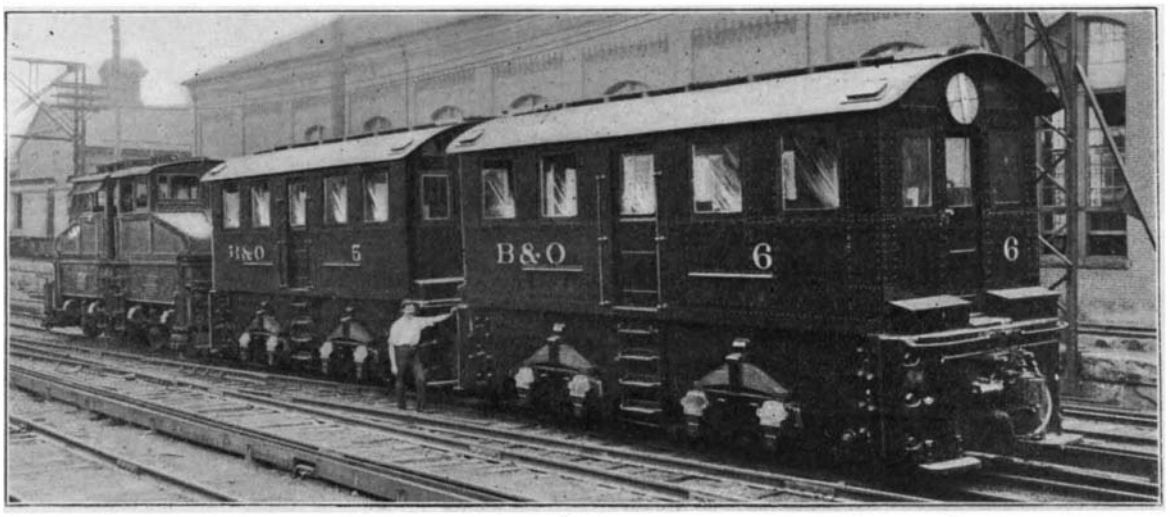
The whole locomotive consists of eight G. E. 65 motors, four on each section. These motors have a capacity of 225 horse power each, making a total capacity of 1,800 horse power. The main body of the truck frame consists of a rectangular framework of cast steel built up of four pieces, two side frames and two end frames, made strong and heavy. The parts are machined at the ends and securely fitted and bolted together, forming a strong and rigid structure capable of withstanding the most severe shocks without injury. The end pieces form the buffer beams, and to these a suitable standard draft gear of approved design is attached.

The journal boxes slide in machined jaws in the side frames protected by wearing shoes. The truck frames are supported at four points on equalizers. Each equalizer rests on a pair of half elliptic springs, the ends of which are supported on top of the journal boxes through suitable wearing plates. The journal boxes are made quite similar to standard car journal boxes, the parts, however, being made larger and stronger. The brasses can be easily removed, and by dropping down the wearing shoes it is possible to remove a complete journal box without removing the wheels and axles or other parts of the truck. In order that the locomotive may round curves easily, the axles are given considerable lateral movement in the journal boxes, reducing the effective rigid wheel base.

The steel-tired spoke wheels have tires 2⅞ inches thick, with M. C. B. standard tread and flange, and are securely held in place by approved fastenings. The axles are made of forged steel, machined all over, with 6-inch by 12-inch journals, 8-inch diameter wheel fit, and 7½-inch diameter motor bearings. The cab is large and roomy, with the floor resting on the truck frame. The lining floor is made of 1¾-inch hard pine, tongued and grooved, the upper floor of hard pine ⅞ inch thick, tongued and grooved, and laid in the opposite direction from the lining floor. The sides and roof of the cab are made of sheet steel. On each side there is an entrance door, and at each end there is an additional door, which permits of ready communication between sections when coupled together. Large windows afford an unobstructed view in all directions.

The controlling apparatus, consisting of master controller, engineer's valves, etc., is in duplicate, a complete set being located in diagonally opposite corners of each cab so that the engineer can stand in the front end of the locomotive when running in either direction.

Each section of the locomotive is equipped with a bell and whistle, two locomotive headlights, air-brake apparatus, including two engineer's valves and air gages, the necessary brake cylinders, foundation brake gear, air reservoirs, couplers, draft gear, and pneumatic track sanders. The control system is so arranged that each section may be operated independently, or two or more sections coupled together.




THE OLD AND NEW ELECTRIC LOCOMOTIVES OF THE BALTIMORE & OHIO RAILROAD.

## The Pennsylvania Railway Tunnels in New York.

The plans for the construction of the Pennsylvania Railway tunnels under the North and East rivers have been decided upon. The North River tunnel will comprise two single cast-iron tubes entering the city at the foot of West Thirty-second Street and running underneath that street. The shield process will be used in its construction. In order to insure safety, the tunnel will be provided with two concrete sidewalks on a level with the car windows, the object being to provide exit for the passengers in case of accident. The warning given by the recent Paris disaster has not been ignored. The plans include a lighting current separate from that which operates the cars. Numerous hydrants and hose nozzles will be provided in case of fire. The East River tunnel will be similar in construction to the North River tunnel, but will carry four tubes.

## New Balloon Experiments of Count Zeppelin.

According to the Swiss journals, a new activity reigns at Manzell, on the eastern shore of Lake Constance, which has become celebrated from the airship trials of Count Zeppelin. It appears that the aeronaut, whose emulation is awakened by the results of the recent airship trials, has decided to begin a new series of experiments. It will be remembered that after making several trips over the lake with his immense balloon, he was obliged to abandon the experiments for lack of funds. Count Zeppelin is firmly persuaded that the dirgible balloon will soon enter the domain of practice, and is now to renew the trials which have already cost such a large outlay.

The danger from electricity, particularly for the fireman in directing a stream of water upon an object carrying electric current, was the subject of an article in a recent issue of Energie, of Berlin, recording the results of a number of tests. A man wearing wet shoes and standing on a wet plank flooring, threw a jet of water on an electrified plate. At 500 volts and an aperture of 0.74 inch in the nozzle, he felt the current at a distance of 2¾ feet, and with an aperture of about 2 inches could not get nearer than about 3¼ feet. Under the same conditions, but with alternating current, he could not stay within 8.2 feet. and at 3,600 volts he had to remain at a distance of 26¼ feet.

## The Azure Sky—Its Cause.

BY J. W. DAVIDSON.

Everyone notices the blue color of the sky. It has grown familiar to us by daily observation from childhood, yet few persons realize the great scientific and artistic interest attaching to this beautiful color.

Sir Isaac Newton tried to explain the color in the year 1675, by referring it to the blue colors seen in thin soap bubbles used in his experiments. He thought the air above our heads was filled with small particles of water, which reflect the blue portion of the sun's light falling upon our earth, and thus produce the blue tints of the firmament.

Sir John Herschel explained the color of the sky by Newton's theory, but later writers have proved that in some important respects his theory was wrong.

In 1869 Prof. John Tyndall, the famous British physicist, found that he could produce "sky blue" by experiments in the laboratory.

For this purpose he filled a glass tube about a yard long, and three inches in diameter, with air of one-tenth the ordinary density mixed with nitrite of butyle vapor, which is extremely volatile. Then on passing through the mixture a powerful beam of electric light, in a room otherwise dark, the mixture precipitated a beautiful blue cloud, which in color rivaled the finest Italian sky. Further experiments proved to Tyndall that he had at last discovered the secret of the blue color of the sky, which had puzzled the greatest philosophers of all ages.

Lord Rayleigh, the famous professor of experimental physics at Cambridge, England, and one of King Edward's original twelve members of the new Order of Merit, has investigated Tyndall's theory of the color of the sky by profound mathematical researches extending over many years. He confirms Tyndall's theory that the blue arises from the reflection of sun's light from small particles in the air less than one one-hundred-thousandth of an inch in diameter. Billions and trillions of these atomic particles fill the atmosphere, and by reflecting the blue part of the sun's light give the dome of the heavens a bluish tint.

Some of the particles are water; but most of them are composed of the oxygen and nitrogen which we breathe.

Prof. T. J. J. See, of the United States navy, is one of the American scientists who have studied the subject in another aspect. He has observed the color of the sky in various altitudes in high mountains, and in dry and moist countries, such as Egypt and Greece, and Arizona, and the Mississippi Valley. His conclusion is that the beautiful red colors of sunsets and sunrises so much spoken of by Greek and Roman writers, and so often illustrated in landscape painting, arise from water vapor in the lower layers of our atmosphere, absorbing the blue and transmitting the red light. According to Dr. See, the reddish colors come from that part of our air within five miles of the earth's surface, while the deep blue of the sky arises from reflections of minute particles in the higher parts of our atmosphere. The water vapor does not extend very high, clouds never rising higher than ten miles above the earth. The blue streaks cast by clouds at sunset show that the red arises near the earth, while the blue has its seat very high up. Above our atmosphere the sky has all the blackness of the darkest night.

Prof. See has watched the duration of the blue sky after dark, and found it to continue for about an hour and fifteen minutes, and from this he shows that our atmosphere extends to a height of fully one hundred and thirty miles. Astronomers have usually found the height of the atmosphere by computing the height of meteors, but none ever made the height of the atmosphere over one hundred miles.

The study of the blue color of the sky thus proves also that our atmosphere extends considerably higher than scientists have heretofore supposed.

On our dark days the blue color of the sky is shut out by clouds, and combinations of colors due to reflecting clouds and countless myriads of particles in the ethereal regions high above the earth give the bright light which is so much relished in daily life. The nature of the blue sky so much admired by all mankind since the days of Homer and Job, now fully explained by modern science, still preserves its ancient beauty, and will inspire man's mind through coming ages.

Among the interesting exhibits shown by Arizona at the World's Fair will be an ostrich farm.