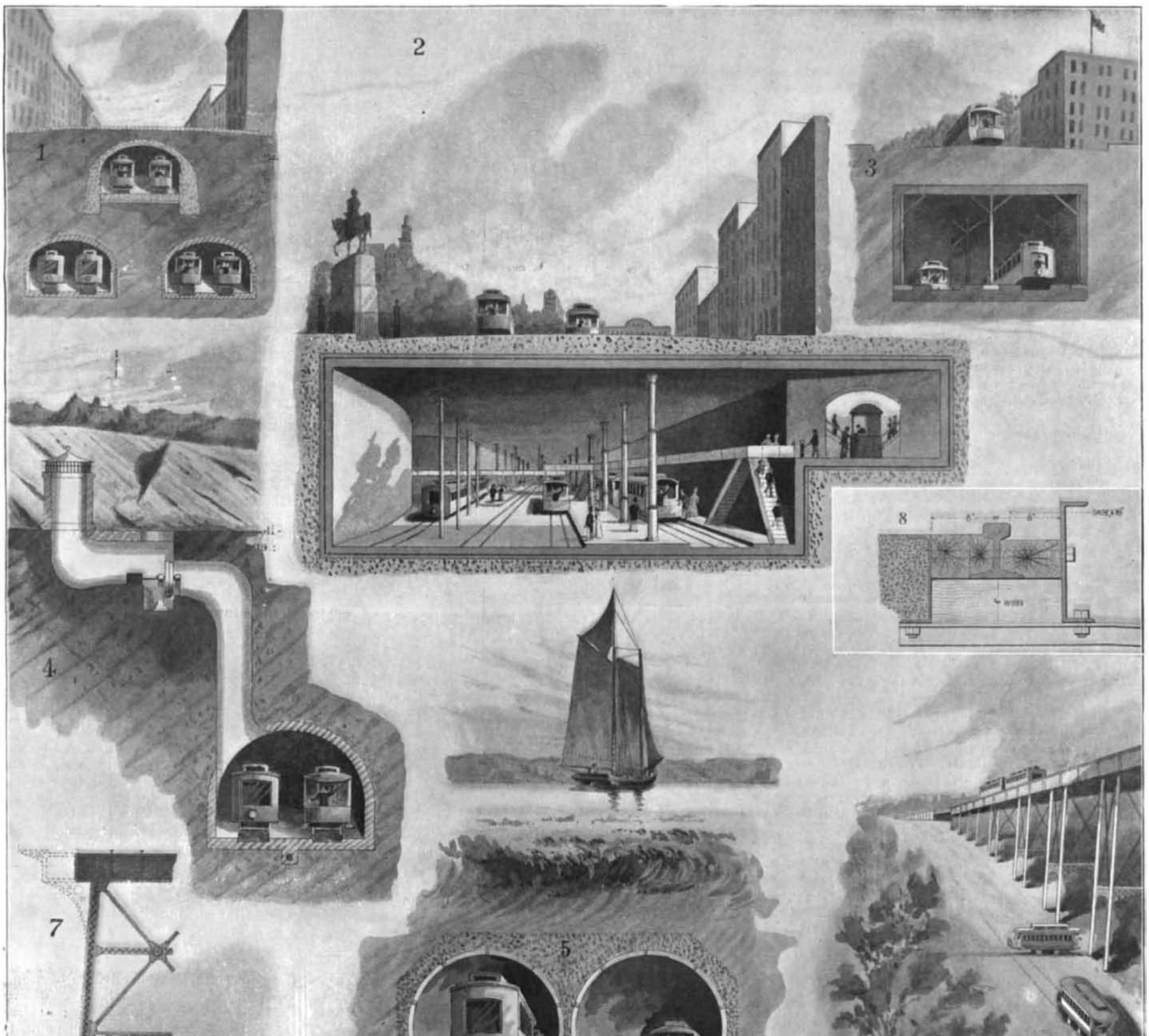
wedging effect of the forward portion of the shaft, coupled to the engine, riding over the after length, smashed three of the "stools" or plummer blocks and their caps, lifting the shafting out of its bearings. The force of the waves, as the ship rose and fell in the trough of the sea, was sufficient to drive the propeller violently against the rudder post, leaving 10 inches of opening at the point of fracture. The first thing to be done was to uncouple the after portion of the shafting and draw the broken ends together with screw bolts. Two spare crank-pin brasses were then placed around the break, two of the main-bearing caps from the main engine were placed above and below the brasses, and two spare holding-down bolts of the main intermediate shaft. This was done by placing a series of large washers above the main brasses and trusting to the strength of the brasses to hold the crank shaft down in place. Steam was then turned on, and the vessel completed the remaining 1,600 miles of her voyage at a speed of 10 knots an hour, only two or three stops being necessary to tighten the bolts on the broken shaft.

The repairs were made in terrific weather, while the ship was lying helpless in the trough of the sea and was being boarded by occasional seas which smashed the upper works and found their way into the hold and the cabins. When the vessel reached New York, it was noticed that the tremendous wedging strains at

THE NEW YORK RAPID TRANSIT TUNNEL.

Although the New York Rapid Transit Tunnel is such a really stupendous undertaking, far exceeding in magnitude any work of the kind elsewhere, the details of its construction and the manner of executing it are not so complicated but they may be easily understood by the average lay reader. The accompanying series of illustrations cover pretty well all the main features of the construction, the various views having been selected with the object of showing the general plan which will be followed throughout the major portion of the route and the various sections of the road where local conditions call for departure from the general plan.



1. The four-track road in two tunnels below the Park Avenue tunnel. 2. Fourteenth Street station, looking north. 3. Two-track line below Lenox Avenue. 4. Ventilating shaft for tunnel beneath Central Park. 5. Tubular tunnels beneath Harlem River. 6. Elevated portion at One Hundred and Twenty-fifth Street. 7. Details of viaduct construction. 8. Details of track.

THE NEW YORK RAPID TRANSIT TUNNEL.

bearings were used to bolt the brasses and caps together, as shown in the accompanying illustration, which was taken in the shaft tunnel after the arrival of the "Manica" at New York.

So far, so good. There still remained the three broken caps of the shafting in the shaft tunnel. It was impossible to replace these, and all that could be done was to utilize some sling-chains from the deck, winding several coils around the shaft and fastening them to the tunnel floor. The after portion of the shafting was then drawn up to place and the coupling-bolts inserted. Before steam could be turned on it was necessary to make some provision for holding down the main bearings, whose caps, as we have shown before, had been used to splice the break in the the fracture caused the white metal of the brasses to squeeze out at the edges. The sling-chains, whose duty it was to hold down the shafting in its bearings, were also, of course, considerably worn, in spite of the fact that they were kept thoroughly lubricated. Great credit is due to Capt. C. G. Smith and Chief Engineer J. Gooding and his assistants for pulling their ship out of such an ugly and apparently hopeless predicament. We are indebted for our illustrations and particulars to Consulting Engineer A. McDermott, of New York, who had charge of the repairs.

AN order from France for fifty pressed steel cars has been received. If these cars prove successful, it is expected that much larger orders will follow.

The route of the road, as shown in the accompanying map, starts from a large underground loop which will be built beneath the City Hall Park. The four tracks within this loop will be carried in two stories, two tracks above and two below, but at the point of junction between the loop and the main four-track line, the tracks will converge to a common level, and will continue at the same level practically throughout the whole length of the system. The four-track road will pass beneath Center Street and Elm Street to Fourth Avenue, which it will reach in the neighborhood of Ninth Street. Thence it will continue beneath Fourth Avenue and Park Avenue until it swings to the left into Forty-second Street, beneath which it will run to Broadway. The four-track road will continue underneath Broadway and the Boulevard (now known as Broadway) until One Hundred and Fourth Street is reached, where the system will divide into two two-track lines. The western branch of the road, which will be known as the West Side Line, will continue along a route which is approximately parallel to the North River, passing through Spuyten Duyvil to the neighborhood of One Hundred and Thirtieth Street. The eastern branch, which will be known as the East Side Line, will swing to the northeast, passing beneath the northwest corner of Central Park, and running beneath Lenox Avenue to the Harlem River, under which it will be carried in two tubular tunnels. It will then continue in a general northeasterly direction to Bronx Park. The distance from City Hall Park to the northern terminus, both of the East and West Side lines, will be about 13½ miles.

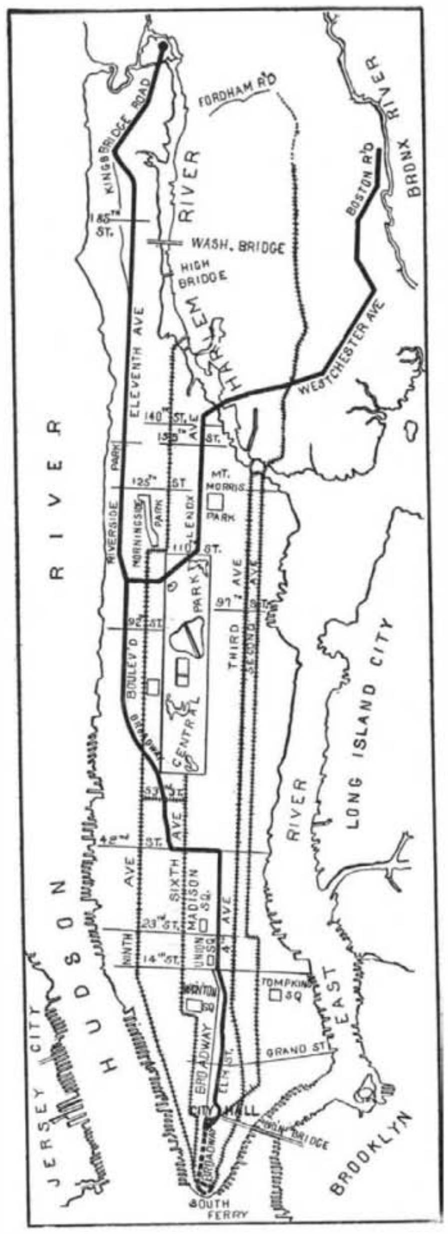
While the rapid transit system will essentially provide a through express service, it will, of course, run a certain number of local trains. The express trains will make but few stops, and the two inside tracks of the four-track road will be reserved exclusively for their use. There will be express stations at the most important centers only. The local trains will make use of the two outside tracks and will, of course, stop at every one of the forty-three stations between City Hall Park and east and west side terminals. The small number of stops and the considerable distance between stations will enable the express trains to maintain a high average of speed and will bring the total time of making the trip from City Hall Park to the Harlem within measurable distance of the "fifteen minutes" which has long been the dream of the New York traveling public.

With the exception of that portion of the road beneath the present Fourth Avenue tunnel of the Metropolitan Street Railway (Fig. 1), below Central Park (Fig. 4), and where the road passes beneath the Harlem River (Fig. 5), and the elevated portions of the lines (Fig. 6), the road will be carried in a steel and concrete conduit of absolutely waterproof construction, details of which are shown in Fig. 10. The floor of the conduit, or tunnel, consists of a foundation layer of concrete, which will vary in thickness from 8 inches upward, according to the conditions of the underlying material, being 8 inches on rock, with an increasing thickness on loose and damp material. Above the 8-inch layer will be spread a layer of waterproof material which will be put down as follows: After the 8 inches of concrete has been carefully smoothed off, a layer of hot asphalt will be spread upon it. Above this will be laid and rolled down a sheeting of felt. Then another layer of asphalt will be spread, the process being continued until the desired thickness of waterproofing has been put down, the layers of felt varying from two to six according to the moisture and general characteristics of the surrounding material. Above the waterproofing will be placed another layer of concrete, in which will be set the tracks and stone pedestals for the steel columns and I-beams supporting the roof and sides of the tunnel. The steel framework of the tunnel is made up of transverse bents consisting of built-up columns spaced 5 feet apart longitudinally, and 12 feet 6 inches apart laterally. Above each bent will be heavy I-beams, the wall columns consisting also of heavy I-beams. The space between the I-beams of both the wall and roof will be filled in with concrete, which will be smoothed off flush with the outer flanges of the metal work. Immediately upon the flanges and the outside surface of the concrete filling, as thus finished off, will be placed a complete layer of asphalt and felt waterproofing similar to that used in the floor, and described above. After the felt has been put in place, an outer layer of concrete, which will vary in thickness according to the nature of the excavation, will be carefully rammed in place. It will thus be seen that the whole concrete tunnel is inclosed by a waterproof envelope which extends entirely around it.

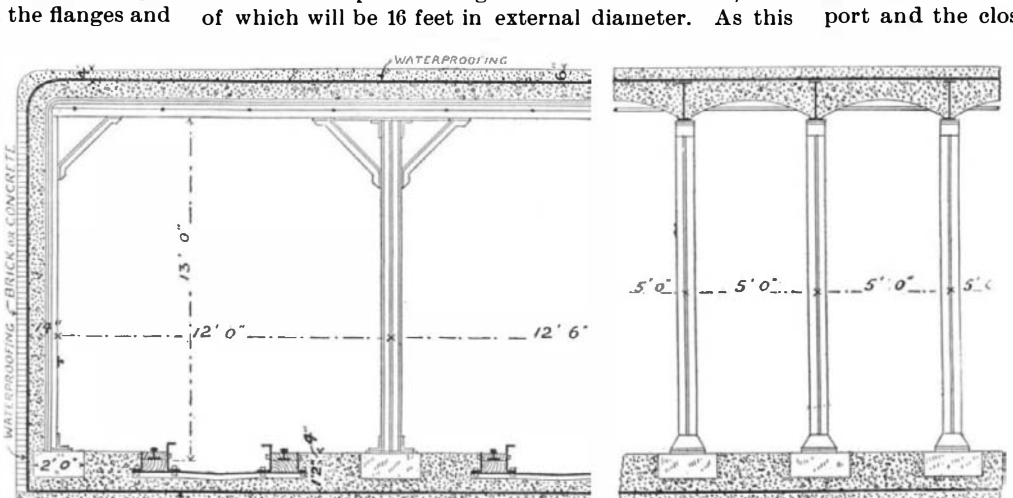
In Fig. 8 is shown the detail of the track construction, which is built into and forms an essential part of the concrete flooring of the tunnel. The 80-pound steel rail is carried on white oak wooden blocks, which are laid with the grain transverse to the rail. The rails with their bearing blocks are held in place by two deep channel-iron guard-rails which are bolted to metal cross ties embedded in the concrete. The inner channel is sufficiently deep to form an effective guard rail to keep the cars in line in case of derailment.

The double-track subway, as shown in Fig. 3, is in all essentials similar in construction to the four-track portion, and this drawing will apply equally to the west and east side lines.

As we have already stated, there are several points at which the standard construction of the tunnel, as already described, is replaced by tunnel construction of the ordinary type. The first of these will occur beneath Park Avenue (Fig. 1), where the four tracks will be placed in two tunnels below the level of the present Fourth Avenue tunnel. These tunnels will be excavated through the solid rock and will be lined with concrete or brick with a back filling of masonry or concrete. The next tunnel will occur where the east side line passes beneath Central Park, and as it will lie at a considerable depth below the surface, it will be necessary to install a system of artificial ventilation, as shown in Fig. 4, where a vertical shaft will lead from the tunnel to the surface. In the shaft will be installed a powerful, electrically-driven, ventilating fan. The next departure from standard construction will be at the Harlem River, where the track will be carried in two parallel single-track cast-iron tubes, each of which will be 16 feet in external diameter. As this part of the tunnel will pass through the soft material under the bed of the river, the tubes will be laid in a casing of concrete, as shown in the drawing. The roof of the tunnel will be approximately 21 feet below mean low water on the Harlem River.



9.—MAP SHOWING, BY HEAVY LINE, ROUTE OF NEW YORK CITY RAPID TRANSIT ROAD.



10.—CROSS SECTION AND LONGITUDINAL SECTION, SHOWING STEEL-AND-CONCRETE CONSTRUCTION.

Both the east side and the west side branches will contain a considerable amount of elevated structure. On the west side lines the tracks will leave the tunnel construction at One Hundred and Twenty-second Street and will be carried on a masonry and steel viaduct to near One Hundred and Thirty-fifth Street, over 2,000 feet of this distance consisting of a steel viaduct of the kind shown in Figs. 6 and 7. The approaches of the elevated structure will be of masonry, and the steel portion will consist of plate girder spans supported on plate cross girders carried on built-up columns which will be set on the curb lines.

As first constructed, the structure will provide for two tracks, but with wise forethought, the engineers have provided for an enlargement of the floor system by means of a bracket construction (see portion of drawing, Fig. 7, shown in dotted lines) which will enable an additional track to be placed on each side of the structure. This arrangement will render it possible in the future to double the capacity on both the east and west side branches when the necessities of traffic call for it.

We show in Fig. 3 a view of one of the most important stations on the line, namely, that at the intersection of Fourteenth Street and Fourth Avenue, which may be taken as typical of most of the stations of the system. Access to the station will be had by means of double stairways descending from the edge of the sidewalks, one on each side of Fourteenth Street, east of Fourth Avenue, and one on the south side, west of Fourth Avenue.

At the foot of the first flight of stairs from the street will be the ticket offices, from which the passengers will proceed by elevated crossings to the platforms, which will be four in number, the two outer platforms being for local traffic and the two inner ones for express trains. The interior of the stations will be lined with white enameled brick, and, as they will be brilliantly lighted with electricity, there will be none of the gloominess which is naturally associated with the idea of an underground station.

The cars will be commodious and well lighted, and will, indeed, embody all the latest improvements known to the electric car builder. It is probable that the third-rail system of electrical construction will be used, although, we believe, the details of the electric installation have not been thoroughly determined upon.

The plans for the road were drawn up by the chief engineer of the Rapid Transit Commission, Mr. William Barclay Parsons, and the contract, which has been let for a round sum of $35,000,000, has been undertaken by Mr. John B. McDonald, who expects to have it completed within three years' time.

Explosion of Chlorate of Potassium.

M. Berthellot, in a series of experiments recently made, has succeeded in bringing about the explosion of chlorate of potassium by operating in a special manner. This compound, although it enters into different explosive mixtures, has not hitherto been considered as an explosive body; when gradually heated, it decomposes into chloride of potassium and oxygen, which latter is given off with disengagement of heat. M. Berthellot finds that he can bring about a detonation under ordinary atmospheric pressure and in an open vessel; it is necessary to introduce it suddenly into a vessel which has been previously brought to a temperature higher than that necessary for the decomposition of the chlorate. The experimenter has already brought about in this way the detonation of picric acid, which burns, under ordinary circumstances, in the open air. He takes a glass tube, closed at one end, of 25 to 30 millimeters diameter; this is fixed vertically in a support and the closed end enveloped by the flame of a Bunsen burner, it being heated over a length of 50 to 60 millimeters until this part of the tube is visibly red. The chlorate of potassium has been prepared in advance by fusing it in a capsule and then cooled until it commences to solidify; a glass rod, drawn out to a long point, is dipped into this repeatedly, so as to accumulate a globule of considerable size at the end of the rod. The tube being kept at a red heat, the rod is introduced into it and the globule brought to within 10 millimeters of the bottom, care being taken not to touch the tube at any point. In a few moments the chlorate becomes liquefied under the influence of the heat and commences to drop upon the bottom of the tube; each drop makes an explosion, at the instant it touches the red-hot glass, with a very sharp noise and a white smoke formed of chloride of potassium. This explosion does not, however, affect that part of the globule remaining on the end of the rod. M. Berthellot considers that an explanation may thus be found for the explosions of chlorate of potassium which has been stored in large quantities in certain chemical works.

AT the Pan-American Exposition at Buffalo, in 1901, the buildings will be lighted up by electricity generated by gas engines using natural gas.