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The editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE NEW CHEMISTRY.

Just what shall be done with the newly-discovered radio-active substances is a problem that perplexes every thinking physicist. They refuse to fit into our established and harmonious chemical system; they even threaten to undermine the venerable atomic theory, which we have accepted unquestioned for well-nigh a century. The profound mathematical deductions of the modern school of English physicists, based upon the startling phenomena presented by the Roentgen and Becquerel rays, as well as by the emanations of radium and polonium, may compel us to change our notions of ultimate units to such an extent that the old-time atom may be compelled to give place to something infinitely smaller. The elements, once conceived to be simple forms of primordial matter, are boldly proclaimed to be minute astronomical systems of whirling units of matter. This seems more like scientific moonshine than sober thought; and yet the new doctrines are accepted by Lodge, Crookes, and by Lord Kelvin himself.

The abandonment of the atom, at first faintly advocated, is now seriously discussed. When it is considered that radium, despite its prodigious radio-activity, loses an inappreciable amount of its mass—an amount calculated by Becquerel to be one gramme in a billion years per square centimeter of surface—the enormity of the atom and its utter inadequacy to account for the phenomena presented become manifest. Radium does emanate particles of some kind—this much at least is certain. These particles cannot be atoms; for atoms are so large that the active substance would rapidly lose in weight. The necessity of abandoning the atomic theory was long ago discussed by Crookes. His study of the phenomena of the vacuum tube at high exhaustions had led him to formulate his "radiant matter" theory, for which he was compelled to bear not a little ridicule. To him it seemed that the luminous, electric, or mechanic phenomena of the vacuum tube could be accounted for only by assuming the existence of something much smaller than the atom—fragments of matter, ultra-atomic corpuscles, minute things very much lighter than atoms, and indeed, the foundation stones of which atoms are themselves composed. Prof. J. J. Thomson, Sir Norman Lockyer, and Lord Kelvin later adopted some of his views. The discovery of the radio-active substances has placed the radiant matter theory on a firmer footing.

If we must discard the atom, what are we to accept in its place? Two new conceptions have been found necessary—the "ion" as the unit of matter, the "electron" as the unit of force. The new chemistry holds that matter and force are different manifestations of the same thing. Inertia is the characteristic, indeed the indispensable, property of both matter and electricity. What could be simpler than to assume that the ultimate particles of each are one and the same? Prof. Fleming has declared that "we can no more have anything which can be called electricity apart from corpuscles, than we can have momentum apart from matter." And Sir Oliver Lodge has given it as his opinion that the Dalton atom, which was once an axiomatic conception of chemistry, may consist of a certain number of electrons rapidly moving in orbits.

Vague though many ideas of the modern chemist must necessarily be when his science is passing through an important transition stage, still he has calculated with no little nicety the masses of ions and electrons. Sir Oliver Lodge puts it thus: If we imagine an ordinary-sized church to be an atom of hydrogen, the electrons constituting it will be represented by about 700 grains of sand, each the size of an ordinary full stop, rotating, according to Lord Kelvin, with inconceivable velocity. Crookes puts it still more graphically. The sun's diameter is about one and a half million kilometers, and that of the smallest planetoid about twenty-four kilometers. If an atom of hydrogen be magnified to the size of the sun, an electron will be about two-thirds the diameter of the planetoid.

If the electrons of all elements are exactly alike, or in other words, if there is but one matter, just as there is but one force, and if the elements be but the various manifestations of that one matter, due to a different orbital arrangement of electrons, it would seem that we are fast returning to the conceptions of the middle-age alchemist. The transmutation of metals involves but the modification of the arrangement of electrons.

Many an old chemist looks askance at these modern views on matter. Few indeed venture to accept them without qualification. Of one thing at least we are certain—the atomic theory, if it is not a theory of the past, must be satisfactorily modified to account for the phenomena of radio-activity.

FIRE PERIL ON UNDERGROUND RAILROADS.

We have no wish to play the rôle of alarmist; but in the presence of the recent railroad tragedy in Paris, in which nearly a hundred people were smothered like rats in a hole, it is scarcely possible to exaggerate the risks which may attend the operation of electrically-driven cars in a subway or deep-tunnel road. While it is true that there were conditions peculiar to this French railroad that contributed to the swiftness and thoroughness of the disaster, conditions which are not present in our own New York subway, the fact still remains that the chief contributory cause is one that is inseparable from electrically-operated tunnel roads employing cars of wooden construction.

The immediate cause of the Paris disaster seems to have been the combination of poor insulation with cars of highly inflammable construction, for, judging from press reports, the latter seem to have been built of pitch pine, and to have embodied little, if any, really reliable fireproof construction. The burning cars were being pushed ahead by the following train, when by what seems to have been a piece of inconceivable mismanagement, two other loaded trains were permitted to run up close to the burning train ahead of them. In the height of the confusion the lighting system in the tunnel broke down, and the passengers found themselves enveloped in utter darkness and in an ever-increasing cloud of dense and suffocating smoke. The exits from the tunnel appear to have been very limited in capacity and the struggling mass of victims was unable to find even those that existed. Hence, it was only a question of a few brief minutes before the panic-stricken mob succumbed to suffocation.

Judging from the comments of the public press and of the men who are responsible for the construction and operation of existing and proposed underground roads, both here and in Europe, the chief lessons of the disaster have been laid well to heart. It is recognized that all underground tunnels should be provided with ample and easily-reached exits; that a complete system of ventilation must be installed; and lastly, and most important of all, that the cars must be of the very best fireproof construction. As regards the 20 miles of subway that are shortly to be opened in this city, the risk of suffocation due to the burning of a train are claimed to be not so great as on the Paris subway, for the alleged reasons that, generally speaking, the subway lies very close to the surface, the stations are closer together, and that the openings from the tunnel are ample for ventilation. As a matter of fact, the provision for ventilation throughout the greater part of the road is merely that which exists at the stations, where it consists of nothing more than the stairways for the entrance and exit of passengers. It is true that along the Boulevard there are open wells, but below 42d Street the subway will have to depend upon station stairways alone for ventilation. This is to be accounted for by the fact that the crowded condition of the streets renders it undesirable to provide openings through the street surface if they can be avoided, although we have always considered that it was a grave omission that special ventilating shafts were not put in at regular intervals throughout the whole length of the road. Certain it is that if a fire should occur, say on Fourth Avenue or beneath 42d Street, the smoke and gases would have no ready means of escape from the tunnel, and dependence would have to be placed upon the movement of the trains to effect its discharge at the station openings. But when we consider that just as many trains will move in one direction as the other, it is difficult to see how the much-talked-of "piston effect" of the moving trains will clear the tunnel atmosphere by promoting a circulation of pure air. Indeed it is pretty safe to say that it will do nothing of the kind, and in the event of a fire there will be nothing for it but to close the particular section of the tunnel where it occurs to all traffic until the fire is subdued and the smoke and gases have had time to dissipate.

Evidently, then, in our own subway it is more a question of prevention than of cure. That is to say, it is absolutely imperative that the construction of the rolling stock be such that the burning of a car or train of cars will be rendered impossible. The only certain way to insure this immunity from fire is to exclude from the cars every particle of inflammable material; and this can be accomplished satisfactorily only by building them entirely of metal.

We are well aware that the management of the Interborough Railroad Company have stated that the new cars are to be very thoroughly fireproofed, and it must be admitted that on paper the precautions that are to be taken in the way of incombustible linings for the floors of the car, asbestos protection, the use of fireproof paint, etc., are among the most approved methods of protecting inflammable material. In the present case, however, the risks attendant upon the break-down of this system of fireproofing are so frightful that it should certainly be abandoned in favor of the only absolutely sure method of abolishing every particle of wood and making the cars, from trucks to ventilator, entirely of metal. We will admit that the system of insulation of the wiring and protection of the wooden floor framing of the cars as outlined by the Interborough Company will probably prove to be effective against the blowing out of a fuse, or the other break-downs incidental to an electrical installation; but in the present case we have to provide against the extraordinary risks of fire, such as would occur in the smash-up of a collision. It can readily be seen that in a bad train wreck, whether by collision or derailment, these elaborate fireproof precautions might lose all their value, and in the rupture of the wires and the short-circuiting and arcing that would probably occur, there would be not one, but many opportunities for a rapid conflagration of the wreckage.

Here lies the great and ever-present danger of wooden car construction (however well insulated its electrical equipment may be) in a confined and crowded underground system such as is shortly to be opened in this city. Ours is to be no ordinary underground road. Its like has never been seen before. For where can we find a parallel to a road on which crowded express trains will be running under a headway of a few minutes at speeds of fully fifty miles an hour?

If the merchants of the city, who are agitating so volubly the question of a slight change of route over a single short section of the road, would devote their attention to this far more serious question of the safety of the road itself, their energies would be applied to better purpose. As we have said, we have no wish to play the rôle of alarmist, and we are satisfied that in drawing attention to this matter we are merely urging the city to take precautions which, if they are not taken at the very outset, may ultimately result in a disaster second only in horror to that which has recently occurred in Paris.

Many of our readers will remember that it was not very long ago that George Westinghouse drew attention to this question of fire risk on tunnel roads, and advocated the very means of preventing it which we now urge. That the point was well made is proved by the fact that the most progressive railroad in this country, namely, the Pennsylvania, is already constructing experimental all-steel cars for use on its great tunnel system between New Jersey and Long Island. It is obviously the only thing to do, for, in the presence of this Paris horror, what was formerly expedient now becomes absolutely imperative.

FOREIGN GAS ENGINES AT THE WORLD'S FAIR.

The power plant of the forthcoming World's Fair, St. Louis, will contain among other items a 3,000 horse power gas engine, the product of Société Anonyme John Cockerill, Seraing, Belgium. This engine, we believe, will be the largest gas engine in service up to the time of its installation, and it is interesting to note that it will go to St. Louis wholly on an exhibit basis; that is to say, the Exposition is put to no expense for the power obtained other than the cost of transportation, installation, and maintenance. The World's Fair power plant will, we understand, embrace more than 40,000 horse power, and the installation will be wholly within the buildings comprising the machinery department of the exposition. For the most part, the prime movers of the power plant will be placed on either side of the main aisle running the full length down the center of Machinery Hall. This aisle will be about 1,000 feet in length. The engines comprising the driving power of the exposition will include gas engines, turbine engines, and high-speed steam engines; but by far the most interesting feature of this power plant to Americans must be the gas engine display.

The 3,000 horse power gas engine, above referred to, has two cylinders, each having a diameter of 51 inches. The length of stroke is 55 inches and the revolutions per minute when developing 3,000 horse power will be 85. The length over all of the engine is 67 feet 1 3-8 inches. The bed-plate or foundation proper will have a length of 77 feet, 6 inches. The foreign exhibits for the St. Louis power plant were gathered by Lieut. Godfrey L. Carden, R.C.S., of the machinery department of the exposition, who was detailed by the Sec-