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ELECTRIC SUBWAY EXPLOSIONS.

On March 25, a serious explosion occurred in this city, which emphasized the danger that seems inherent in the electric subways in cities. Three manholes in the vicinity of Fifth Avenue and Twenty-third Street were blown up by explosions undoubtedly due to the ignition of a mixture of illuminating gas and air. The explosions occurred a little before noon; three hours previously the manholes had been opened. Any leakage of gas into the subway must have occurred during those three hours, unless it found its way from other parts of the subway to the particular manholes which exploded. The effects of the explosion were to lift off the heavy cap with its double covering plates that shut in the top of the manhole. These parts weigh about 1,600 lb. The upper, loose plates, that are flush with the surface of the road, were thrown to one side; the lower plates, held each to its seat by a screw and cotter bar, were not displaced to the same extent, but rose with the iron cap or curb and settled back with it. One of the manholes was cracked down the four corners. No serious damage to person or private property ensued. The subway lines were quite uninjured. Men working in adjacent manholes were undisturbed.

The manholes are brick-lined pits about five feet square and eight feet deep, the size varying according to the requirements of each case. They are placed at varying intervals; in the present instance the three exploding ones were within two hundred feet of each other. From manhole to manhole run rows of iron pipes embedded in solid concrete; the pipes are generally of 2½ or 3 inches internal diameter, and have screwed joints. The electric cables, of about two inches diameter, are passed through the numerous ducts thus provided, leaving a small portion open to the transmission of air or gas. The ducts may safely be assumed to be gas tight. The manholes, constructed of masonry with the greatest care, are far from being as impervious as the iron pipes. Their capacity may be put at 200 cubic feet each one. Six per cent of gas, equivalent for this volume to 12 cubic feet, mixed with the entire volume of air in one manhole would produce an explosive mixture. The top of the manhole is tightly closed, the inner lid being forced down by the central screw against a rubber gasket. In three hours ample time would be afforded for 12 cubic feet of gas to accumulate in a manhole if there were any crevices or open pores. But the tightness of the cover, which renders the accumulation possible and easy, makes the cause of the explosion a mystery. A mixture of gas and air can only be exploded by heat; concussion is without effect; spontaneous combustion is impossible as far as known; external ignition from a cigar or match seems impossible, on account of the tightly fitting lid; the most obvious cause would seem to be an electric static discharge or an arc. But in the case of the exploding manholes, all the cables were dead or had no current passing; it is not possible to trace any plausible origin of a spark to them. Disturbances of the electric equilibrium between atmosphere and earth has been suggested as the cause of the production of a minute spark, but this seems eminently improbable.

These three manhole explosions bring up the number that have occurred in this city to a total of ten. In a recent explosion on the corner of Wall and Pearl Streets the manhole contained only telephone cables, and those disconnected. Another explosion, on the corner of Pine and Nassau Streets, took place in a manhole containing no cables whatever.

Forced ventilation, either by through currents or by the *plenum* system—the latter depending on leakage for the escape of air blown into the conduits—might effect a cure, but it would be a large addition to the expense. At present a force blower has been used to ventilate four miles of subway on Broadway and Sixth Avenue, between the limits of 14th and 59th Streets. Upward of seventy thousand cubic feet an hour has been forced into this limited portion at a pressure of six or eight ounces of water. To ventilate all the subways at this rate would require a very extensive plant. Data are, however, wanting on this point. The maintenance of a pressure of one ounce per square inch throughout the system would undoubtedly exclude gas. Natural ventilation of each manhole has also been suggested.

In other cities far worse results in the way of explosions have followed the introduction of subways. In Chicago, pieces of an iron cover were projected into the second story of the Board of Trade building. Another explosion occurred just as a steam fire engine was over the manhole, and was so violent as to overturn the engine. This indicates a degree of violence that is capable of doing as much harm as has ever been done by overhead cables. Explosions in New York have been less violent. A correct policy has undoubtedly been followed in adopting as tightly closed a system as possible, with very heavy iron caps for the manholes.

If the lead coatings of the cables were insulated, the conditions for a static discharge from core to sheathing would be often liable to occur. But lying for the most part in iron pipes, bedded in concrete, it has been assumed that the outer coatings were so efficiently grounded that the Leyden jar condition could not well exist. In cables laid in the asphalt conduit, where insulation was especially sought for and stipulated for in the contracts, the conditions for static discharge might readily exist. But now an exactly opposite line of work is followed, and the grounding of the lead coatings of the cables is considered a definite advantage.

Bids have recently been opened in this city for the maintenance of electric street lamps. The companies generally gave two figures, one for overhead service, the other, greatly in excess, for underground distribution. This comes as an additional blow at the subway system, for it was justly or unjustly seized upon as a pretext for higher prices. A special meeting for April 1 of the Board of Electrical Control has been called by the Mayor, to which representatives of the gas companies have been invited, to confer upon the question of subway explosions.

It may be that some light will be shed upon this subject at this meeting, which we regret is to be held after we go to press.

John Bright.

John Bright, the eminent parliamentarian and radical leader of England, died at 8 o'clock on the morning of March 27. The funeral was fixed for the 30th, and was as quiet as possible. He was born at Greenbank, Rochdale, November 16, 1811. His father was a weaver, his mother was a tradesman's daughter. He was one of eleven children. His father had started a mill two years before the birth of his eminent son, and this laid the foundation of a fortune, something that in England is a very powerful adjunct to a successful political career. John Bright received a plain education, and entered his father's mill. He was called upon in 1831 to move a vote of thanks to a popular lecturer who had appeared in his town. This was his first speech, soon followed by another on the temperance question, and before long the discovery was made of oratorical abilities hitherto unsuspected. In 1841 his attention was called by Mr. Cobden, the great free trader, to the corn laws. For five years, 1841-46, he labored in partnership with Cobden in this cause, speaking on a great number of occasions. In the heat of this agitation, in 1843, he was elected to Parliament. In the fall of 1857, he was elected from Birmingham, and that city has been his political home. It was in the early part of this year that his opposition to the Crimean war caused his defeat as a candidate for Manchester. During the war between the States he espoused the Northern side, principally, it is supposed, on account of his dislike to slavery, as he was on principle a confirmed opponent of the arbitrament of war. A strict radical in English politics, he adopted the other side on the Irish question, and for the last eight or ten years has figured as a pronounced Unionist. He voted for the Gladstone coercion bills, making his record in Irish politics the reverse of his English career. It is true that the efforts, however radical, of Mr. Bright's life were always well within constitutional limits, so that he had some grounds, or at any rate an excuse, for objecting to the unconstitutional methods of agitation adopted in the sister island. He was pre-eminently an Englishman, which probably gives the true reason for his opposite views where England and Ireland were concerned. He died as the representative of a Birmingham district. His powers of repartee and sarcasm were very great, and as a speaker he was peculiarly effective, and many interesting instances of the ever-varying phases of his oratory are preserved in the records of the latter decades.

A Pension for Mrs. Proctor.

The numerous readers of Mr. Proctor's works, says the *English Mechanic*, will be pleased to learn that the Queen, on the recommendation of Mr. W. H. Smith (the First Lord of the Treasury), has been pleased to grant a Civil List pension of £100 a year to Mr. Proctor's widow, who is now in Florida. Mr. Smith's action was prompted by a memorial signed by many others besides men of science. Among the well known names attached to the memorial are those of the Duke of Argyll, Earl of Crawford, Lord Grimthorpe, Profs. Tyndall and Huxley, Sir John Lubbock, Sir L. McClintock, Sir R. S. Ball, Prof. Piazzi Smyth, Drs. Copeland and Huggins, Cols. Tupman and J. Herschel, Messrs. Clements Markham, Grant Allen, and Warren de la Rue.

THE Secretary of the Treasury gives notice that manufactures, articles, or wares produced or manufactured in the United States, which may be sent to the Paris exhibition of 1889 for exhibition, will, upon their return to the United States, be admitted to free entry.

Paintings and other works of art, the production of foreign schools of art, which may be now owned in this country by residents of the United States, and which may be loaned to the French Department of Fine Arts of said Paris exhibition of 1889, for exhibition, will also, upon their return to the United States, be exempted from payment of duty.

The Paris Exhibition.

[SPECIAL CORRESPONDENT OF THE SCIENTIFIC AMERICAN.]

PARIS, March 6, 1889.

ASCENT OF THE EIFFEL TOWER.

I ascended the Eiffel Tower to-day to a height of about 850 feet, and as the greater part of the ascent is made up a spiral staircase winding around an iron column of about 16 inches in diameter, the task is no mean one, as may be judged from the fact that the workmen are allowed three-quarters of an hour to accomplish it. Nobody but an engineer can be expected to find much beauty in the tower as viewed from the interior, since it presents nothing but a network of girders, except perhaps on the first platform, upon which there are various alcoves now being roofed in, and which afford a pleasant relief to the eye. Similar alcoves are to be constructed on the second platform, but they have as yet no visible existence from the interior.

It is after the second platform is passed that the prominent individuality of the tower makes itself apparent, since one has, as he ascends, a spiral panorama, as it were, before him and the proportions of the various buildings in the surrounding city begin to lose their importance as one ascends, until at last a cottage becomes the equal of a mansion. At 800 feet from the ground, the spires of churches and the towers of the Trocadero appear of very little more consequence than the chimneys of some of the taller buildings, and the Eiffel Tower seems to be the one important thing in Paris, the whole of which, with the country beyond, lies within the sweep of the eye upon a clear day.

The efforts of the public to gain admission to the buildings and grounds are very numerous and persistent, particularly with regard to the Eiffel Tower, and it is but fair to say that the officials of the Bureau of Exploitationare courteous, business-like, and *prompt to a degree;* while, when, as in a very large number of cases, it is necessary to decline to give passes, it is done in so courteous and reasonable a manner that the disappointed ones cannot feel aggrieved. The passes are good for one day only, those for the Eiffel Tower being separate and distinct from those for the buildings.

The ornamentation of the tower has scarcely yet begun, nor has work on the elevators as yet progressed sufficiently to make itself apparent. The tower itself will doubtless be completed by May 5, although the elevators and the ornamentation may not be complete; and if the prices of admission are wisely chosen, the number of visitors will be very large. At this present writing there does not seem any hurry in the operations on the tower; indeed, one feels disappointed to find so few workmen at work, but then, of course, the full height is nearly attained, and so far as what may be termed the framework of the structure is concerned, the end is in view, and completion can doubtless be rapidly achieved.

As viewed from the exterior, the tower possesses many or at least several individualities. For example, viewed from a distance, one cannot tell what the shape of the tower is above the height of about 500 feet, and the reason is that the light of course shows through it, thus eliminating the shadows that usually guide the eye in determining the form of a distant building. The impression is that the upper part is round, or from some points of vision it seems as though it was octagonal. It would appear to be round from any distant point, or say any point more than 400 yards distant, but for the fact that the girders do not interlace enough at the sides to warrant a mechanical eye in accepting the shape as circular; an ordinary spectator, however, would without hesitation take it as being so.

The light, in passing through the tower, renders it much less imposing than it would be if it were solid, while, when one is close to it, or rather directly beside it, it does not seem so imposing as the Washington Monument, at Washington, D. C., which occurs because the base is spread, and one cannot, therefore, see the upper part when standing close to the base.

Evidences of the handwork or brainwork of American engineers are to be very frequently found here on machines of French make ; for example, all three of the hoisting engines on the platforms of the tower have Porter governors on them.

While on this subject of engines, let me say that, so far as locomotives are concerned, it is hard to see what is to be gained by exhibiting American locomotives here, except in so far as the colonial trade is concerned, as there are some important elements in the conditions under which locomotives are used in the United States that do not obtain here. For example, the coal used here does not require so much draught; hence there is no need to employ adjustable nozzles to the cylinder exhaust pipes, or to in any way contract the exhaust.

The French, as well as the English, employ copper for their fireboxes, and use also copper stays. The Chemin de Fer du Nord do not use any steel boilers, and I have found some English engineers who object to them on account of their unreliability. This calls to mind a remark made by Professor Thurston at the Washington meeting of the American Society of Mechanical Engineers: "I think, gentlemen," said he, "that we may congratulate ourselves upon having settled the steel question, and that no engineer need henceforth hesitate for one moment to use American steel for boilers."

There is no doubt that a spirit of conservatism has something to do with the use of iron boilers by many here ; or it may be that failures occurred when the steel here was not up to its present quality. But be the cause what it may, steel is nothing like so much used here as in the United States, nor do I think it is so good here.

As to engines, I shall have a good deal to say in the future upon those of French and English construction. Meantime I may say, however, that a great deal more attention is undoubtedly paid to the theoretical as well as practical perfection of construction of engines in the United States than appears to be the case either in France or England, and this statement also applies to the adjustment of the parts and the practical working of the engine. I am not referring particularly to the economy of engines as measured by the number of pounds of coal or combustible burned per horse power per hour, because the best results obtained in either country are, I believe, pretty nearly the same ; and, besides this, it is exceedingly difficult to make comparisons, because the conditions are so rarely equal. Furthermore, it is no easy matter to separate the efficiency of the boiler from that of the engine. The indicator diagram has lost caste here as a guide to the consumption of steam of an engine, and rightly so, because it cannot account for the steam actually used by the engine. I mention this because of a remark made to me by an engineer yesterday to the effect that American engineers appear to attach undue importance to indicator diagrams, inasmuch as that the consumption of water and coal, and the friction of the engine, are often in America, he said, given upon deductions derived from diagrams. "A diagram," I am using his words, "will tell you a good deal about the disposition of the steam in a cylinder, but, in my opinion, not very much more, at high engine speeds, than can be known without it. For example, we are certainly independent of the indicator diagram in determining the width of port necessary for a given engine running at a given speed. We are certainly independent of the indicator diagram if we wish to know whether the steam is wire-drawn or not by the valve gear, or whether the valve or the piston leaks, etc., because we can determine these things without it. On the other hand, diagrams generally show the latter part of the expansion curve to be too high, which *may* occur from re-evaporation ; but it may also occur from a leaky valve, or it may be that a leaky valve may leak enough to just equal the leak of a leaky piston, and the diagram will be all right in spite of both defects. Bah! The diagram will only tell us that we have made blunders that we never ought to have made."

This was his finale, and there is something in it ; but there is something else in it, too, that he and a good many overlook. For example, a loop at the end of the compression line tells us a story that nothing but the diagram will tell, and, what is far more important, the diagram gives a plain, permanent record that is in many cases invaluable. The fact is that there are conditions in the United States that do not exist here, and there is also a call for mechanical refinement in the United States that does not exist here, and that it is hard to make people understand.

An excellent example is given in the engines for buildings. The first thing that strikes an American in a European elevator is its sluggish motion and the next is its jerkiness, and if you go down into the engine room you will find a noisy engine, even at a slow piston speed. Now, it is well known that an engine may run quite quiet at a slow piston speed that would be a complete nuisance at a high speed, and, furthermore, that an engine that would run gently enough for a four story building would be unbearable in the upper stories of an eight or nine story building; and when I told my friend of the refinement required in engines running in most of the tall buildings in New York, he did not seem able to comprehend it. I remember the case of a building in Nassau Street, New York City, the engine being under the sidewalk, and down there the engine seemed to run as quiet as could be desired, but in the top floors there was a disagreeable thud and vibration. That was the cause of several kinds of engines being tried. The fact was that the building acted as a sort of tuning fork, multiplying the vibrations as the length or height increased, and no engine that I have so far seen in England or France would have been at all bearable in the fifth story of that building if the engine ran at American speeds. Of course, in such a case as this, a great deal depends upon the adjustment of the amount of compression and lead, and this is just where the indicator steps in as an invaluable recorder, because it takes in the element of time, etc., and if the boiler pressure is kept fairly constant, an adjustment of the lead and compression may be made that will meet the requirements of each particular case or condition.

While on this subject of engines, let me say that the Porter-Allen engine, exhibited here at the last Paris exhibition, has left a record for quiet running that is not likely to be forgotten in Europe, for it ran at a piston speed of over 1,000 feet per minute, and that without the sign of a pound or thump, and that is almost unheard of here, even at a piston speed of 500 feet per minute.

Now a few words on engine adjustment. I was talking a day or so ago with the engineer of the Yarrow Engineering Co., whose reputation in torpedo boat building is too well known to require mention, and he said that theorists paid no more attention to perfect adjustments of valve setting and the amount of lead than they found necessary in their practice, and that they sometimes got the best results from engines whose valve motions were quite imperfectly set. He also said that the exact adjustment of lead they found of comparatively slight importance, notwithstanding that their piston speeds are 1,100 feet per minute, but then the requirement of perfect quiet running does not exist on board ship, and, to cut this matter short, nowhere do I find such perfect workmanship and engine adjustment demanded as in American stationary engine practice.

Mr. Bailley Blanchard (American commissioner to the exhibition), to whom I am indebted for courtesies, informs me that up to this date he has received advices of the arrival of about 800 exhibits from the United States, and among those already in the machinery department are the following: Singer Manufacturing Company, Newburg, N. Y.; National Cordage Company, New York ; Chadburn & Coldwell Manufacturing Company, Newburg, N. Y. ; Detroit Car Wheel Company, Detroit, Mich.; T. A. Edison, Orange, N. J.; H. G. Shepard & Son, New Haven Conn. ; Brown & Sharpe, Providence, R. I.

The Chemin de Fer du Nord are to have an important exhibit of improved machine tools of novel design which I have seen, but am requested not to describe at present. I may say, however, that if the works of this railroad are fair examples of French locomotive works, the French have nothing to learn from either England or the United States in this matter at least. I shall, however, have something to say on this matter hereafter. Meantime, however, I would suggest that the American engineering societies who are about to visit the exhibition in May next ought to make an earnest endeavor to visit the above company's works at Lille, especially as it lies between Paris and Calais, and need not prolong the journey much, while there is some very interesting machinery there, not, perhaps, new in principle, but good adaptations of American and other systems, the point being that in the adaptation of some of what may be termed the more modern class of machine tools, such as milling machines and emery grinding machinery, the French, so far as I have seen at present, are ahead of all others, if these works are a fair sample.

J. R.

Electrical Engineering at Princeton.

The course of electricity at the J. C. Green School of Science of Princeton College has always been an important and well equipped course, owing partly, perhaps, to the fact that it was at Princeton that the late Prof. Henry conducted his early researches in electrical science, and the apparatus that he constructed for his experiments may now be seen at Princeton. The impulse that he gave to these studies has not been lost, and the importance of sustaining the reputation of the college and of maintaining a high standard of work in this field has always been felt. Electricity, however, has come into such ordinary, every-day use that knowledge of it, practically and theoretically, is considered indispensable in a liberal education, and to that end a department of electrical science is shortly to be instituted. Proper endowment has been provided, and with Prof. Brackett at its head this school will afford unparalleled facilities for electrical research. This will be carried out within the current year, and a new building is to be erected for this department of electrical engineering.

THE oscillation of high structures in storm winds is a much observed fact, and has probably been the cause of many failures in high chimneys by collapse or permanent set out of plumb by excessive pressure from the rocking motion set up in gales of wind. Tall church steeples built of stone are known to have a nerve disturbing motion with persons who have a curiosity to venture high up in them during high winds. Chimneys partake of this motion in a degree proportionate to the stability of their design, and in the proportion of diameter to height.

Observations of the movement of a chimney near Marseilles, France, 115 foot in height and only 4 feet outside diameter at the top, showed a maximum oscillation of 20 inches during a severe gale. Another chimney near Vienna, Austria, 164 feet high, of good proportions, having a 6 ½ feet flue, was found to oscillate 6¼ inches during the severest storms.

The Eiffel tower will no doubt be affected to a marked degree by high winds. Although its form of structure is of the least area to the force of the wind, its form and elastic material favor large oscillation in storm winds.