THE UNDERGROUND RAILWAY, NEW YORK CITY.

NUMBER IV.

Continued from page 339.

For the many interesting details connected with this great work, that have been already published by us, with engravings, the reader is referred to the SCIENTIFIC AMERICAN of November 14, 1874, page 307, where the series begins. In our last paper on the subject, page 338, we printed engravings and descriptions of the novel iron beam tunnels. We now come to the masonry tunnels, which start at the end of the beam tunnel, 24 feet 9 inches south of the south side of 67th street, and extend thence 1,150 feet, to a point 29 feet 2 inches north of the north side of 71st street. By reference to the profile of the road, published in our impression of November 14, 1874, it will be seen that, at 66th street, the grade of the avenue commences to ascend a pretty high ridge, thus increasing the headway so much that the difference of railway and avenue grade is 25 feet at 67th street, 33 feet at 69th street, and 23 feet at 71st street. The hight of the main central tunnel is 21 feet in the clear from railroad grade to the crown of the arch, which thus, at 67th street, gives the ventilating shaft a depth of 4 feet, and at 71st street, a depth of 2 feet.

Like the beam tunnels, the brick tunnels consist of three parallel tunnels, a large central one and on either side a small single track tunnel, having no connection with the central tunnel save by an occasional manhole and the ventilators to be hereafter described. The roofs of the tunnels are semicircular brick arches, resting on four stone abutments. The two outer abutments, which form a continuation of the outer rubble walls of the beam tunnel, are founded 3 feet below railroad grade, and are 6 feet in thickness up to grade, where an offset 6 inches back and front occurs, giving a thickness of 5 feet, as shown in Fig. 12. From this point the wall rises 8 feet and 6 inches to the springing line of the arch, vertical in the inner face but battered on the back ¾ of an inch to the foot, which gives the wall a thickness at the springing line of 4 feet 6 inches. The backs of these walls, however, are carried up 5 feet above the springing line, as shown in Fig. 12, which is a cross section of the tunnel, and the spandrels are filled in with rubble masonry. The masonry of these abutments is gneiss rubble work, laid in cement mortar, with vertical and horizontal joints on the face, the stones being moderately well dressed.

The two inner abutments, which form a continuation of the two inner brick walls of the beam tunnel, are also founded 3 feet below railroad grade, but with a thickness below grade of 5 feet 6 inches. At the grade line, the offset of 6 inches, back and front, again occurs, giving them a thickness of 4 feet 6 inches. From this breadth of bottom, they taper off, with a batter on each face of about ¼ of an inch to the foot, to a thickness of 4 feet 2 inches at the springing line, which is also 8 feet 6 inches above the railroad grade. These abutments are also constructed of gneiss rubble masonry, of the same class as that used in the outer abutments and retaining walls. On top of the four abutments rest three semicircular brick arches, forming the roof of the three tunnels. Each of the arches of the two side tunnels has a span of 16 feet in the clear, from abutment to abutment, and 8 feet rise. These tunnels have thus a width 3 feet greater in the clear than that of the corresponding tunnels in the beam tunneling. Their hight from grade to the crown of the arch is 16 feet 6 inches in the clear. The arch is formed of brick, laid in the usual way and keyed with stretchers, well laid, and has an uniform thickness of 20 inches. The arch spanning the large central tunnel has a span of 25 feet and a rise of 12 feet 6 inches. It is also of brick, laid in the usual manner, but of varying thickness. Its general thickness is 20 inches, but for a distance of 3 feet north and south of the ventilating shafts, its thickness is increased 4 inches, thus forming a kind of rib, 16 feet broad by 4 inches thick. The necessity of this thickening of the arch will appear obvious by a glance at Fig. 13, which represents the tunnels and ventilator, where the thickness is indicated by the dotted lines of the central arch. The spandrels are filled in with rubble masonry and thoroughly drained with clay pipe drains 6 inches in diameter and placed every 50 feet. The backs of the arches are covered with three-ply felt and roofing cement. The centering used in building these arches does not differ so greatly from that in common use as to warrant a detailed description. As regards the manner of joining these arched brick tunnels to the flat roof beam tunnels, it may be mentioned that this connection is always made at one of the rectangular openings which are placed in the roof of the beam tunneling. Thus, for example, the brick tunnel we are describing begins at a point 24 feet 9 inches south of the south side of 67th street, at which point the opening in the beam tunnel ends, the face of the brick tunnel acting as part of the retaining wall of the opening. Some idea of the excellence of the work may be formed from the following fact: Although the work was carried forward with such expedition that the centering was knocked away but a few hours after the arches were turned, and the arches in their green state loaded with earth, sometimes to a hight of eight feet above the street grade, the greatest settlement has in no case exceeded one quarter of an inch, while in many places no settlement whatever is appreciable, though levels have been taken several times. Such a result, after such a severe test, is one most flattering to the engineers and contractors.

In front of the Normal College, which fronts the work on Fourth avenue at 69th street, the work on this tunnel was carried on both day and night. The tower of the college stands within a few feet of the tunnel walls, and the excavation for the latter was carried 21 feet below the tower foundation. The total depth of the cut was 33 feet. Not the least injury to the college walls ensued. This portion of the work was done during the protracted drought of the last summer, which was most favorable to its success. The side abutments were raised just as fast as the earth was taken out.

The manner of ventilating these last tunnels is quite a simple one and clearly shown in Fig. 13, which gives a section of the tunnel through one of the ventilators. Those of the central tunnel consist of cylindrical shafts or openings, built

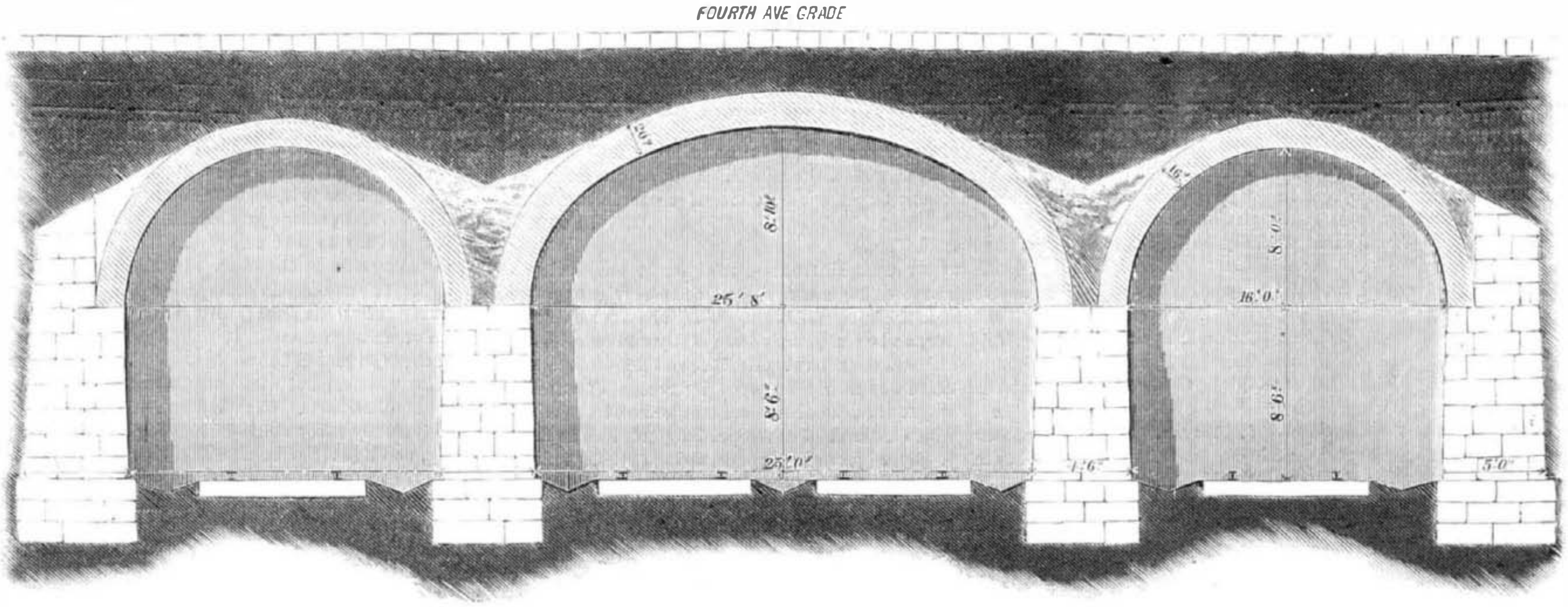

Fig. 12.—THE UNDERGROUND RAILWAY IN NEW YORK.—CROSS SECTIONS OF THE MASONRY TUNNELS.

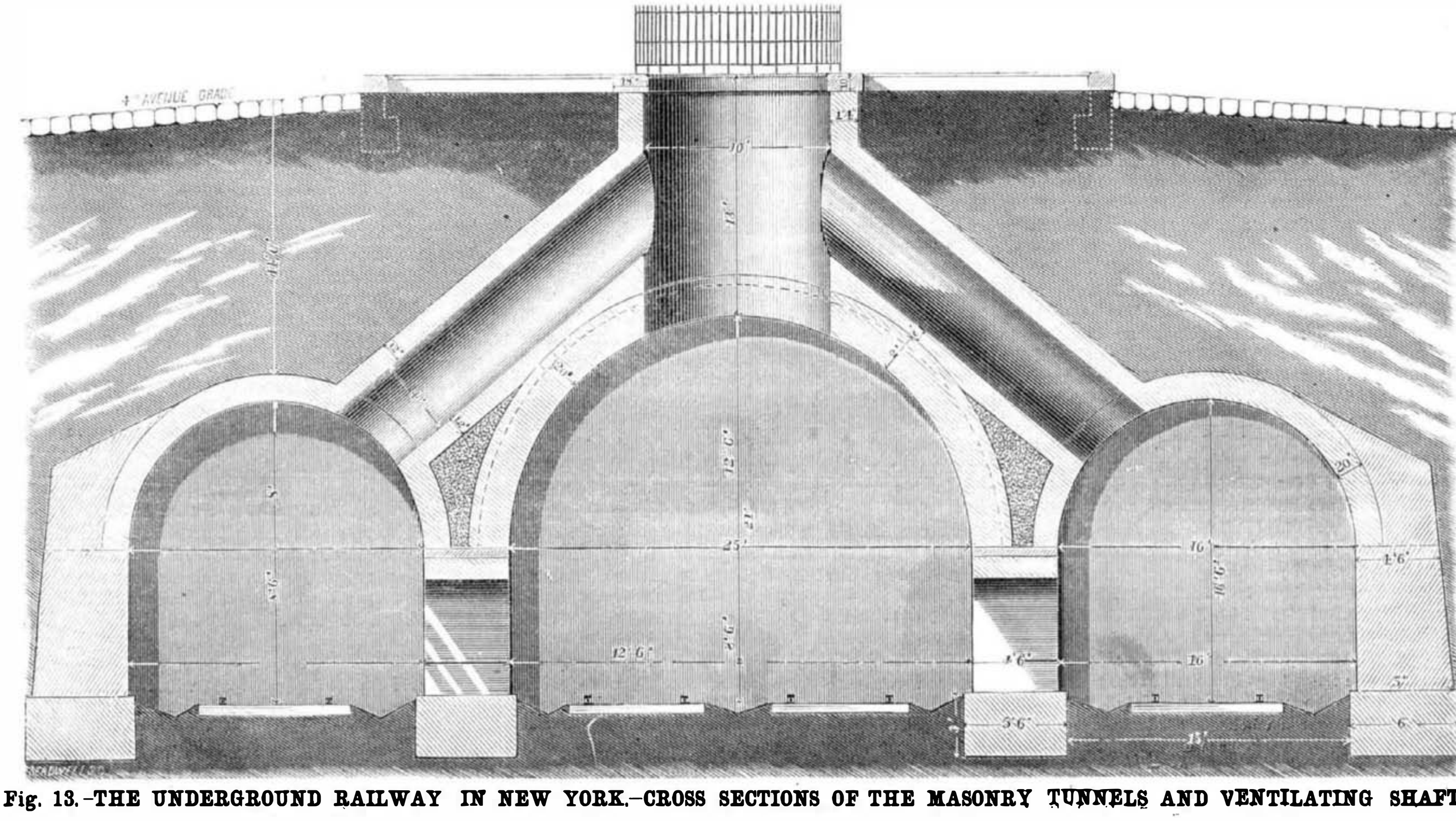

Fig. 13.—THE UNDERGROUND RAILWAY IN NEW YORK.—CROSS SECTIONS OF THE MASONRY TUNNELS AND VENTILATING SHAFTS.

in the crown of the arch, 40 feet apart from center to center, extending from the surface of the street to the roof of the tunnel; they are ten feet in diameter in the clear and lined with brick throughout their whole extent. The thickness of this brick lining varies in the manner shown in the figure. At the street level, this opening is coped with granite coping 10 inches by 18 inches, which is in turn surmounted by an iron railing three feet six inches high, consisting of wrought iron uprights, one inch square, pointed at the top. These uprights are alternately three and six inches above the top rail and are placed four inches apart. The top and bottom rails are one and one half inches by half an inch cross section.

Into the sides of this large ventilating shaft, enter the ventilators of the side tunnels, one for each tunnel. These are also cylindrical in shape, four feet in diameter in the clear, and lined uniformly with twelve inches of brick. They start from the inner side of the side tunnels, some four feet seven and three quarters inches above the springing line, and run out at an angle of 45°, entering the large shaft four feet four and a half inches above the inner face of the central tunnel, which gives them an elliptical cross section at their opening into the ventilating shaft, as shown in Fig. 13. The piece of iron beam tunneling, 2,325 feet in length, which extends northerly beyond the brick tunnels, completes the work upon the first division of the road. It is precisely analogous to the portion described on page 338.

The following are the names of the sub-contractors on this division of the work:

Earth excavation from 49th to 56th sts..Brown & Ryan.
" " " 56th to 67th sts..Brown & Ryan.
" " " 67th to 73d sts..Dillon, Clyde & Co.
Earth excavation and masonry from 73d
to 77th streets........................J. C. Ryan.
Earth excavation and masonry from 77th
to 79th streets......................David Flemming.
Rock excavation from 49th to 56th sts..P. Sessions.
Masonry (stone), from 49th to 56th sts..Blake & Ripley.
" " " 56th to 67th sts..Redfield & Whittlesey.
" (brick), " 56th to 67th sts..Raymond, Rice & Co.
" (both), " 67th to 73d sts...G. A. Williams & Co.
Iron work from 56th to 67th, and from 73d
to 79th streets......................Watson Manfg. Co.

CORRESPONDENCE

The Mechanic of the Future.

To the Editor of the Scientific American:

In your issue of December 5, you have an article with the above caption, commenting upon the difficulty of finding mechanics qualified to undertake the direction of special works requiring the application of their technical experience in new lines, and you give, as a reason for this difficulty, the animosity of trades' unions to the elevation of their members. I do not dispute this position, for it is not in my line of experience, but may I not take the liberty to point out the fact that there are plenty of skilled mechanics, outside of trades' unions, who are ready and willing to fill any situation they are qualified for? If your correspondent had made a direct appeal to the trade at large, he would not have been disappointed.

You also remark that the ambitious and skilled mechanic leaves his shop and establishes himself as a professional man, living on fees instead of wages, to the detriment of the interests of manufacturers who desire this class to remain to direct their works. As regards your statement, it is entirely correct. Merit in a man, whether machinist or mathematician, commands its price, and manufacturers have the remedy entirely in their own hands. If a man educates himself for a higher position than he is filling, and obtains an opening in another market, in what does he differ from the manufacturer who sells his wares at the highest price he can obtain? If a machinist, by reason of his skill, comprehensive mind, and ability to judge of cause and effect better than his fellows, sees that he can earn more in fees than in wages, to say nothing of being more independent, why should he not go for the fees?

Would any manufacturer listen to one of his skilled workmen if he told him that he thought of establishing himself as a possible competitor in the business, and that he would remain at the lathe or planer if his wages were increased to something like what he would be able to earn outside of the works? Naturally he would not increase his wages one cent, and in all probability he would discharge him on the spot as a disaffected man; but after the disaffected man showed that he possessed capacity in a marked degree, there would arise a demand for his services. I speak from actual experience on this point. Many years since I worked at a lathe in the largest machine shop in New York. Out of working hours, I practised in another calling, and was fortunate enough to make it a success. One day the manager heard of it, and came to me, saying: "If you don't give up so and so, your place will be vacant." It so happened that I had just received an offer from parties which I had decided to accept, and I politely informed the manager that my place was then vacant. This was many years since, and I have earned annually more than five times what I received in the shop.

The facts are that the qualifications which belong to a first class mechanic (manager is a better term, because it comprehends the situation more fully) are entirely removed romf mere technical manipulation of tools or metals. There are plenty of good workmen in a shop, who, so far as mere handiwork is concerned, could excel their overseer; but they are not fit for superintendents. A methodical, systematic, and comprehensive mind, joined to workshop experience and thorough knowledge of human nature, are what make the successful superintendent, and such men are to be found if sought after: not at the wages of a workman, however, for their qualifications command more in other spheres. If manufacturers need them, they will come to the surface fast enough.

42 Cliff street, New York. EGBERT P. WATSON.

Incendiary Postal Cards.

To the Editor of the Scientific American:

Of what materials are postal cards composed? I came very near to having my office burned by the ignition of a parcel of old cards, which were hung on hooks over my desk, at a distance of 12 or 14 inches from the top of the chimney of an argand oil lamp, the light being turned down. When I went to tea, the light was burning, and the office was left alone during my absence. Fortunately, I returned in time to extinguish the fire before any material damage was done. After this, I took a postal card and set fire to it; and I found that the card burnt like a taper, with a clear flame. I am now in search of knowledge concerning the formation of these inflammable articles. G. W. FORD.

Rochester, N. Y.

[REMARKS BY THE EDITOR:—Postal cards are made so as to endure pretty rough usage, and thus very good paper stock is used in their manufacture. They are almost wholly vegetable fiber, and consequently burn easily and completely. Ordinary cardboard contains shoddy fiber and mineral matter. Enameled cards are nearly fireproof by reason of mineral matter. The postal cards seem to contain some of the coloring matter which makes buff envelopes dangerous. The dark buff envelope paper ignites by a spark, and burns like tinder.]

Cable Telegraphy.

To the Editor of the Scientific American.

Mr. Little's assertion, in your number for November 21, that Mr. Winter's improvement in cable telegraphy consists in working a galvanometer by an induction coil having primary and secondary wires, is incorrect, as a reference to the diagram and description printed in a previous number of the SCIENTIFIC AMERICAN will show.

Newark, N. J. T. A. EDISON.

Curious Effects of Brain Wounds.

In the recent brilliant address of Professor Huxley, before the British Association, "On the Hypothesis that Animals are Automata," he says:

"I am indebted to my friend General Strachey for bringing to my notice an account of a case which appeared within the last four or five days in the scientific article of the *Journal des Débats*. A French soldier, a sergeant, was wounded at the battle of Bazeilles, one, as you recollect, of the most fiercely contested battles of the late war. The man was shot in the head, in the region of what we call the left parietal bone. The bullet fractured the bone. The sergeant had enough vigor left to send his bayonet through the Prussian who shot him. Then he wandered a few hundred yards out of the village, fell senseless, but, after the action, was picked up and taken to the hospital, where he remained some time. When he came to himself, as usual in such cases of injury, he was paralyzed on the opposite side of the body, that is to say, the right arm and the right leg were completely paralyzed. That state of things lasted, I think, the better part of two years, but sooner or later he recovered from it, and now he is able to walk about with activity; and only by careful measurement can any difference between the two sides of his body be ascertained. The inquiry, the main results of which I shall give you, has been conducted by exceedingly competent persons, and they report that at present this man lives two lives, a normal life and an abnormal life. In his normal life he is perfectly well, cheerful, does his work as a hospital attendant, and is a respectable, well conducted man. This normal life lasts for about seven and twenty days or thereabouts, out of every month; but for a day or two in each month he passes suddenly and without any obvious change into his abnormal condition. In this state of abnormal life he is still active, goes about as usual, and is to all appearance just the same man as before, goes to bed and undresses himself, gets up, makes his cigarette and smokes it, and eats and drinks. But he neither sees, nor hears, nor tastes, nor smells, nor is he conscious of anything whatever, and he has only one sense organ in a state of activity, namely, that of touch, which is exceedingly delicate. If you put an obstacle in his way, he knocks against it, feels it and goes to the one side; if you push him in any direction, he goes straight on until something stops him. I have said that he makes his cigarettes, but you may supply him with shavings or anything else instead of tobacco, and still he will go on making his cigarettes as usual. His actions are purely mechanical. He feeds voraciously, but whether you give him aloes, or assafœtida, or the nicest thing possible, it is all the same to him. The man is in a condition wherein the functions of his cerebral hemispheres are, at any rate, largely annihilated. He is very nearly—I don't say wholly, but very nearly—in the condition of an animal in which the cerebral hemispheres are extirpated.

"His state is wonderfully interesting to me, for it bears on the phenomena of mesmerism, of which I saw a good deal when I was a young man. In this state he is capable of performing all sorts of actions on mere suggestion. For example, he dropped his cane, and, a person near him putting it into his hand, the feeling of the end of the cane evidently produced in him those molecular changes of the brain which, had he possessed consciousness, would have given rise to the idea of his rifle; for he threw himself on his face, began feeling for his cartridges, went through the motions of touching his gun, and shouted out, to an imaginary comrade, 'Here they are, a score of them; but we will give a good account of them.' But the most remarkable fact of all is the modification which this injury has made in the man's moral nature. In his normal life he is an upright and honest man. In his abnormal state he is an inveterate thief. He will steal every thing he can lay his hands upon; and if he cannot steal anything else, he will steal his own things and hide them away."

The London *Lancet* gives the following additional particulars concerning the same patient, whose original profession was that of a *café* ballad singer:

"When he is in his fit, he has no sensitiveness of his own, and will bear physical pain without being aware of it; but his will may be influenced by contact with exterior objects. Set him on his feet, and, as soon as they touch the ground, they awaken in him the desire of walking; he then marches straight on quite steadily, with fixed eyes, without saying a word or knowing what is going on about him. If he meets with an obstacle on his way, he will touch it and try to make out by feeling what it is, and then attempt to get out of its way. If several persons join hands and form a ring around him, he will try to find an opening by repeatedly crossing over from one side to the other, and this without betraying the slightest consciousness or impatience.

"Put a pen into his hand; this will instantly awaken in him a desire of writing; he will fumble about for ink and paper, and, if these be placed before him, he will write a very sensible business letter; but when the fit is over, he will recollect nothing at all about it. Give him some cigarette paper, and he will instantly take out his tobacco bag, roll a cigarette very cleverly, and light it with a match from his own box. Put them out one after another, he will try from first to last to get a light, and put up in the end with his ill success. But ignite a match yourself and give it to him, he will not use it, but let it burn between his fingers. Fill his tobacco bag with anything, no matter what—shavings, cotton, lint, hay, etc., he will roll his cigarette just the same, light and smoke it without perceiving the hoax. But, better still, put a pair of gloves into his hand and he will put them on at once; this, reminding him of his profession, will make him look for his music. A roll of paper is then given to him, upon which he assumes the attitude of a singer before the public, and warbles some piece of his repertory. If you place yourself before him, he will feel about on your person, and, meeting with your watch, he will transfer it from your pocket to his own; but on the other hand, he will allow you, without any resistance or impatience whatever, to take it back again.

We may add that Dr. Brown-Séquard, during his recent course of popular lectures in this country, mentioned a number of cases that had come under his notice, presenting phenomena analagous to the foregoing.

Bursting of a Fly Wheel.

On the morning of November 27, the first coupling of the main shaft in Clark's spool thread mills, at Newark, N. J., suddenly broke, releasing the 600 horse power engine from its work, and instantly increasing its velocity to such a speed that the cogged fly wheel, weighing 20 tuns, and another wheel geared with it, weighing 8 tuns, exploded, tearing away the ends of the engine house and stripping the roof off. Some of the fragments of the fly wheel were four tuns each in weight, the other wheel breaking into small pieces. One piece of the former, weighing three tuns, crashed through the roof, struck the tall chimney of the factory, and afterwards buried itself in the earth at a distance of 60 yards from the locality of the disaster. There were 1,100 work people in the building, many of whom had very narrow escapes; but no one was hurt. The engine was ruined. The damage is estimated at over $25,000.

Hard Rubber Thermometers.

In our issue of November 28, we drew attention to the experiments of Kohlrausch on hard rubber for the making of thermometers. He suggests that a strip of ivory should be glued to one of hard rubber, as in a Breguet's thermometer, so as to bring into play the great expansibility of the rubber. We learn, however, that instruments on this principle have been long in use in the Meteorological Observatory of the New York Central Park. They are the invention of Mr. Daniel Draper, the director of that observatory, and are on a much better construction than those suggested by Kohlrausch, which would be liable to hygrometric disturbances from the ivory. Mr. Draper's consist of a strip of hard rubber riveted to one of brass. A clock attachment renders them self-recording. They are considered as presenting the best form of registering thermometer hitherto introduced, and as supplying what has thus far been a desideratum. Any one interested in the matter can see them working in the Observatory.

A Soda Water Law Suit.

A soda water manufacturer was summoned recently at the Longton, England, police court, for selling as "soda water" an artificially aerated water, which was found on analysis not to contain a particle of the alkali from which it was named, and, further, for depriving his customer of the antacid ingredient of which he was entitled to expect the benefit. The magistrate held that the case did not come under the adulteration act, but it has been appealed and will be passed upon by the higher courts. As so-called soda water is universally known to be nothing but water impregnated with carbonic acid gas, it remains to be seen how the English jurists propose to treat the queer social and legal question of a vendor selling wares under a false name, and the buyer hence presumably negotiating for what he does not wish to buy.