For the Scientific American.

NITRO-GLYCERIN—THE CAUSE OF ITS PREMATURE EXPLOSION.

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In a recent number of the SCIENTIFIC AMERICAN it is suggested that the late disastrous explosions of nitro-glycerin were the result of spontaneous combustion. As the subject is one of great interest at the present time I trust the facts I present herewith, now published for the first time, will be acceptable.

The morning after the explosion of nitro-glycerin in Greenwich street (Nov. 5, 1865), I went to the Wyoming Hotel and made a careful inspection of the premises, being assisted by several of the gentlemen who were wounded. At this time the cause of the explosion and the explosive material were a profound mystery. Inquiries elicited the following facts: A few minutes previous to the explosion, the men, a dozen or more, occupying the bar room, which was on the level of the street, observed a peculiar odor which by some, at first, was taken to be due to a leakage of gas. It was soon apparent, however, that the odor was not of gas, and as it increased in strength, search was made for its cause. The odor was traced to a small baggage room, and there it was found to be issuing from a small chest or packing box provided with rude handles of rope. The box was brought out into the center of the bar room and placed upon the floor. But the stench became stronger and very offensive, and some of the gentlemen saw what they supposed to be smoke and a yellow or reddish flame issue from the box. All were then alarmed and the box was hastily carried to the edge of the side walk. The men who carried the box had barely time to re-enter the bar room and turn round to look at the box through the glass doors when the explosion took place.

The small size of the box, the absence of a smell of sulphur, and the terrific effects of the explosion, indicated something different from gunpowder. We searched in vain for some relic of the box or its contents.

I directed inquiries most minutely and particularly with reference to the odor. Unfortunately none of the gentlemen were familiar enough with the odors, which we of the laboratory know so well, so as definitely to describe that which they had perceived; but I was able to get so many positive statements that when they were put together, I felt warranted in concluding that the odor was that of nitric gas, and that the yellow smoke or flame was nitric gas. Under this state of things, I was inclined to believe that the box had contained gun-cotton, and that here was a case of spontaneous combustion, with which I am quite familiar. As ordinary gun cotton, however, alone could not produce the mechanical effects shown, it was necessary to suppose that it was combined with chlorate of potash, or that the box also contained a fulminate. This theory proved to be incorrect, but its plausibility was singularly confirmed, when next day it became known that nitro-glycerin, a substance so much like gun-cotton, was, in fact, the explosive. I made a very near guess.

I have made the above narrative so minute, for the reason that the peculiar odor, and the red fumes observed at the Greenwich street explosion, so characteristic of the spontaneous combustion of compounds like gun-cotton, seemed of little consequence to others who examined the case. I desire it to be put on record that there is sufficient reason for believing that this disaster was chargeable to spontaneous combustion.

It is also proper to add, that, as a good citizen, shortly after the occurrence, I brought the subject before one of our scientific societies, and sent a communication to one of the daily papers, in which I gave warning of other explosions, in case proper precautions were not taken. Unfortunately, the communication was not published; its publication, possibly, might have prevented the fearful catastrophes at San Francisco and Panama.

As above intimated, I am familiar with the spontaneous combustion of gun-cotton. I am acquainted with the particulars of several cases which occurred unintentionally, and the conditions are now so well understood that we know how to bring it about at will, and with certainty. The conditions are simply that the cotton, slightly acid, be kept so that the acid fumes and the heat, generated by the reaction of the acid, shall be prevented from escaping. For example, take an ounce of gun-cotton, slightly acid, and contained in a bottle, and pack in with cotton wool or saw dust, in a close box; within a few weeks, in warm weather, it will be pretty sure to take fire. An actual case of this sort is described in the *American Journal of Photography*. The spontaneous combustion theory completely explains the many "mysterious" explosions of gun-cotton which occurred within a few years after its discovery.

The constitution and properties of gun-cotton and nitro-glycerin are so similar that little argument is necessary to show that the latter also is liable to spontaneous combustion. To put the question, however, beyond dispute, I have made experiments which demonstrate that nitro-glycerin is subject to the same accidents from spontaneous change, as gun-cotton. Other theories, which have appeared in the newspapers, to account for the Greenwich-street explosion, are altogether insufficient. We have, as yet, very little information with reference to the explosions at San Francisco and Panama, on which to base a perfectly satisfactory explanation. But unless we can have something to the contrary, they too, must be accepted as cases of spontaneous combustion. In the investigations of this nature, I would recommend that inquiries be most particularly directed concerning the temperature to which the packages had been exposed, and as to the escape of acid odors or fumes, previous to the explosion.

Many seem to suppose that nitro-glycerin, being proved to be a dangerous substance, can no longer be used. Congress, I see, are proposing to make its manufacture and sale a penal offense. The people and Congress, nervous under a panic, perhaps reasonable, are yet greatly in error. We cannot afford to allow a substance so useful as nitro glycerin has proved itself to remain unused; we cannot confess that our science and inventive skill are unable to find the means of making it safe. I venture to predict that, in a short time, nitro-glycerin will be esteemed far less dangerous than gunpowder, and that in a great measure it will supersede it; within a few years the annual consumption of nitro-glycerin in the United States will reach a million of pounds.

Gun-cotton was at first looked upon with as much dread as is now nitro-glycerin; the accidents from it were quite as terrific as those from nitro-glycerin, and they were also then quite inexplicable. I quote a few cases. In 1847, the gunpowder factory of Hall Brothers, in England, where they were making gun-cotton, blew up, killing every man at work in the place. On the 17th day of July, 1848, a similar explosion of over 3,000 lbs., took place at Bouchet, near Paris; walls from eighteen inches to a yard in thickness, were reduced to powder from top to bottom, and heavy weights were thrown to a great distance. An explosion took place in a magazine at Vincennes, which no one had entered for several days previously. An explosion of 300 lbs. took place in Connecticut under precisely similar circumstances.

But lately what a change! Wherever there is a photographic artist you may find gun-cotton. It has been manufactured in all quarters of this city. I have myself made tuns of it. During our late war, thousands of pounds were sent by Adams Express from this city to a neighboring State, and the business was conducted in such a way that there was less risk from fire than in the ordinary handling of dry goods. It is only to our ignorance that such things appear dangerous: whenever we are forewarned we must learn how to be fore-armed. Shall we banish edge tools, and steam, and gunpowder on account of the ignorance and carelessness that exist in the world? Let us rather look upon what we call accidents as indications of something to be learned, and something to be invented.

Now, the property of nitro-glycerin, which heretofore we have not understood, and which has rendered its storage and transportation dangerous, is its liability to spontaneous combustion; in other respects it is far safer than gunpowder. It is with great pleasure I feel able to announce, positively, that sure and simple means are known, and will be put in practice, to remove that danger, so that, shortly, nitro glycerin will be thought of only on account of its eminently useful properties.

In conclusion: The preparation of nitro-glycerin must never be intrusted to unskillful hands, and its transportation for some time to come should be regulated by suitable legislation.

MODERN MARINE ENGINEERING.

Although the marine steam engine, in general, is essentially the same to-day as it was ten years ago, the details of it, and the practice of to-day compared with the past are so changed for the better that the mechanical portion of the community are always ready and eager to obtain a knowledge of the construction at the present time.

English writers have, with a few exceptions, supplied all the literature of the profession, and to them we look for the best works on the subject. John Bourne has rendered substantial service in this way, and there are no works on mechanical engineering more useful and reliable than his "Catechism," and later "Hand Book."

We have before us a new work on "Modern Marine Engineering," applied to paddle and screw steamers, by N. P. Burgh, engineer. The work is published in England, and issued in New York by D. Van Nostrand, No. 192 Broadway.

The first number contains drawings of a new set of engines recently built in England for a Russian frigate. These are made to scale, and accurately colored to represent the different metals employed. The colors are those generally used by the profession, not attempts at pictures. They give a clear idea of the plan and general arrangement. The style in which the work is got up challenges attention. The type is large and fine, the matter is double-leaded, and in point of mechanical execution faultless. The scope of the text is somewhat comprehensive; and in view of the interest always attaching to the subject, the reader scans every page attentively. Mr. Burgh goes into the subject quite prepared, indeed confident of his ability to cope with any question, and after discussing some of the types of engines in general use, he alludes to our forefathers as follows:

"To design engines on land, and correctly manage, or rather attend to them at sea, would puzzle some of our forefathers, whose originations were nevertheless fair examples of that age of progression; what may seem perfection of arrangement, even after construction, on land, will often betray want of foresight as to access for repair or renewal at sea."

An Irish member of note, Sir Boyle Roche, is reported to have said in reply to the inquiry of a peer, —"By forefathers I do not mean our descendants, sir, but those who come immediately after us," and taking a view of engineering analagous to that of Sir Boyle Roche, it is hardly fair in Mr. Burgh to reproach those worthy men with not knowing about engines that came immediately after them.

But Mr. Burgh does not always say what he means, as in this paragraph:—

"The parallel motion, direct acting engine, cannot ever claim much favor in the estimation of those who consider natural laws; when the shortness of the connecting rod be taken into consideration, it is not surprising to relate that this type of engine soon proves its worth."

It would seem from the construction of the previous portion that Mr. Burgh intended to deny the utility of parallel motion, but as it closes it claims a special advantage from the shortness of the connecting rod, a thing that is somewhat difficult to comprehend, and that our forefathers are to be reprimanded for not having discovered.

Faults of grammar are, however, so common, that perhaps we are hypercritical, and if Mr. Burgh's English is sometimes cloudy, his drawings will supply all that relates to the construction part of our modern engines. These it seems our forefathers knew nothing about.

Mr. Burgh, in the construction of American engines of the beam variety, is very charitable. He scorns to take advantage of the ignorance of his cousins. He does not even criticise them; he disposes of us in seven lines. He merely says: "Over head motion for paddle engines is not much adopted in England at the present day. Our transatlantic fast cousins still adhere to the arrangement of the beam above the crank shaft. For smooth water and flat bottom vessels there is not much objection to this arrangement, *i. e.*, as far as power is concerned, but for correct locality of detail, to be merciful is to be silent." And that is the way a modern, marine engineer talks of beam engines of 105 inches diameter of cylinder and 12 feet piston stroke, in ships that go around "the Horn."