BURNING OF A FRICTION MATCH.

Among the varied operations of the arts there is perhaps no other involving so many chemical and physical changes, and so many philosophical principles, as the burning of a friction match.

First in importance is the intense affinity of phosphorus for oxygen, as it is this property which makes a friction match possible. This affinity is so strong that when phosphorus is exposed to contact with the oxygen of the atmosphere at ordinary temperatures, the two substances combine slowly, generating light which is visible as a faint glow in the dark; and if the temperature is raised to about 120 deg. the combination goes on with that rapidity which we call combustion. It is easy to produce this degree of temperature by friction—hence the possibility of the friction match.

It is necessary, indeed, to modify the inflammability of phosphorus for its use in a friction match, and this is done by mixing it with a little gum. The gum also protects it from slow combustion in the atmosphere.

The flame of phosphorus, though intensely hot, will not set fire to pine wood; it is, therefore, necessary to interpose some substance more readily inflammable than wood; the substance usually employed is sulphur. Pine wood ignites at a temperature of about 600 deg., and sulphur at 450 deg. to 500 deg. The phosphorus in burning kindles the sulphur, and the sulphur flame sets fire to the wood.

The refusal of the phosphorus flame to kindle wood is fruitful of suggestions. The quantity of heat generated by the burning of any substance is in proportion to the quantity of oxygen with which the substance combines. One atom of phosphorus in burning combines with five atoms of oxygen, producing phosphoric acid, $P O_5$. The atom of phosphorus weighs 32 and the atom of oxygen 8, so the proportion by weight is 32 pounds of phosphorus to 40 of oxygen. Sulphur, in burning, combines with oxygen in the proportion of one atom of sulphur to 2 of oxygen, $S O_2$, and as the atomic weight of sulphur is 16 the proportion by weight is 32 of sulphur to 32 of oxygen, consequently phosphorus should generate more heat in burning than sulphur.

Again, this law is modified by either the oxygen or the combustible undergoing a change of form in combining. If a substance is changed from the gaseous to the solid state, heat is evolved; if from the solid to the gaseous, heat is absorbed. Now, phosphoric acid is a solid, while sulphurous acid is a gas. Phosphorus, in burning, changes the oxygen with which it combines from the gaseous to the solid form, thus increasing the quantity of heat generated; while sulphur, in burning, is changed from the solid to the gaseous state, thus absorbing heat, and diminishing the quantity produced by the combustion.

These theoretical views have been confirmed by careful experiment. The results obtained by Andrews from his elaborate investigations were, that 1 pound of phosphorus in burning to phosphoric acid generates sufficient heat to raise the temperature of 5,747 pounds of water one deg. centrigrade; while 1 pound of sulphur, in burning, raises the tem perature of only 2,220 pounds of water 1 deg.

But it is not the quantity of heat that is to be considered in this case, but the intensity; which is in proportion to the quantity contained in a cubic inch or other given volume. This, however, only increases the difficulty, for the phosphorus flame being condensed to a solid, while that of sulphur is diffused as a gas, the intensity of heat ought to be still more in favor of the phosphorus than the quantity.

The usual explanation given for the failure of wood to ignite in a phosphorus flame is, that the surface of the wood is instantly covered by a film of phosphoric acid, which protects it from combustion. As we have no better explanation to offer, we raise no objections to this.

The products of combustion, then, in the burning of a match, are, first, phosphoric acid from the burning of the phosphorus; then sulphurous acid, from the burning of the sulphur, and, finally, carbonic acid and water from the burning of the wood.

This is far from being an exhaustive examination of the subject. The hydrogen and carbon of the wood do not combine directly with the oxygen of the air, but the wood first undergoes destructive distillation, with the production of several hydrocarbon gases, which rise in the air and produce the flame by their combustion; and after the wood is burned the ash that is left behind is made up of some sixteen elements, combined with oxygen in various proportions. The activity of the burning, also, is increased byadding to the paste some substance containing oxygen which is held by feeble affinity, and which is, therefore, readily given up to the sulphur, phosphorus, and wood. Among the substances employed for this office are saltpeter and the peroxides of lead and manganese. In a complete examination of the reactions of the combustion, the decompositions of these oxidizing agents, with the resulting compounds or elements, would demand consideration. All that might be said in relation to the burning of a friction match would fill a large volume.

TARGET TEST WITH LARGE GUNS.

Some experiments were made at Fortress Monroe on the 21st instant, which, from the data so far at hand, appear to possess some interest. The trials were made with the design of ascertaining the advantage of iron-plating as a defense to fortifications of masonry.

The guns used in the test were a 15-inch smooth-bore; and a 12-inch rifled piece, both of the Rodman patent. They had been well proved before the trial. The target was a wall of granite blocks, six feet thick, the blocks secured with iron dowels and clamps, covered with rolled plates, four inches thick, of the best iron. These were bolted directly to the face of the stone, except at one point, where a backing of six inches of sand was interposed between the plate and wall. The results, in tabular form, are these:

Gun.	Charge.	Projectile.	Initial velocity.	Penetration.	Target.
Smooth-bore.	46lbs.	432lbs.	1,155ft.	3in.	Granite.
"	"	"	1,118ft.	5½in.	Sand.
Rifle.	55lbs.	620lbs.	1,026ft.	4½in.	Granite.
"	"	"	1,079ft.	5¾in.	"
"	"	"	1,103ft.	7in.	Sand.

The experiments show that iron constitutes a defense against the penetration of shot, although the shock of the projectiles in this trial shattered the granite wall. The charges of powder used were less than it was popularly believed the 15-inch guns were capable of sustaining. The placing of the plates in close connection with the wall may be an error, as the effects of the concussion would be transmitted directly to the work itself. It would appear, from the stated initial velocity of the shots, that the powder used was the "cake," or large powder, and not that sometimes employed in tests for guns. We forbear, however, commenting on the results of this trial until we have the official record of the experiments.

HONOR TO WHOM HONOR IS DUE.

The first rail cars were mounted on four wheels, which turned on axles fixed rigidly to the body of the carriage. Mr. Richard Imlay, of Philadelphia, in 1832, invented the "vibrating plate" of car trucks and applied it, in 1834, to cars on the Germantown and Norristown Railroad. In 1837 he patented his improvement, and in 1851 secured an extension of his patent. From adequate authority it is certain he was the first, at his manufactory in Baltimore, to build cars with independent trucks, by which cars of any length now used could be run on roads with sharp curves. Mr. Imlay's invention is in general use throughout the country, and has been for many years. Indeed, no invention or improvement in railroading is of so much importance as this. He is now over eighty years of age, totally blind from cataract, with a wife who is suffering from the most acute form of cancer. The friends of this suffering family ask that the railroad corporations throughout the country shall recognize his claims, the justice of which can be fully substantiated, so that he shall not be left dependent upon charity, where he is entitled to compensation justly due.

Mr. Imlay is physically and financially incapacitated to recover for infringements and to enter into legal prosecution, and he desires, simply, that railroad companies make him a small compensation for an invention that has, more than any other, made their enterprises a success.

He is, indisputably, the originator of the independent trucks, by which long cars can be run with safety at a high rate of speed, and round, with security, curves impossible to be turned with the old fashioned car. We call the attention of railroad corporations to this case, believing that they will see, as well as we, the justice of Mr. Imlay's claim, and the duty of making a suitable return for the value of his improvement.

Mr. Imlay resides at 138 West 16th street, New York City.

POLYTECHNIC ASSOCIATION OF THE AMERICAN INSTITUTE.

The Association held its regular meeting at its room at the Cooper Institute, on Thursday evening, Sept. 28, 1866.

AN IMPROVED CAR.

Several inventions of minor note were introduced, and their merits thoroughly discussed. One, however, received with special interest, was a plan for a street car, designed to transfer the traction from the ground to the metallic bottom of the car, which thus takes the place of a rail. The wheels are mounted on a number of pedestals attached to an endless band encircling the car. This is, perhaps, the best application of the old principle of a portable track that has been invented, but its practical value remains to be tested.

BARYTES, AND ITS USES.

A recent application of sulphate of barytes has been made in preparing the so-called "perspiration-proof" paper collars, in place of white lead. It is also used for giving the fine gloss to visiting cards, and wall paper, and in England, cotton collars are made by its use, having all the appearance and finish of linen.

VENTILATION.

The regular subject being introduced, the remarks seemed to take a practical turn, and the actual necessity and means for ventilating our dwellings were dwelt upon at some length. The method of ventilating sleeping cars in use on one of our railroads was explained, where the air is made to pass through an air chamber, into which water is forced as a fine spray, thus cleansing it of any impurities. In the ice cars, used for bringing dressed meat from the West, the impure air is passed over ice, placed near the top of the car, then is conveyed to near the floor, where it again enters the car, thus keeping up a continuous current of pure air. The same principle has been used in our hospitals for fever patients with good results.

Cooper Union Free School.

The session of this school commenced Oct. 1st. The school is open every evening except Sundays, free to all. The courses of study comprehend all the useful and some ornamental branches. It offers an excellent opportunity for clerks, apprentices and others, whose means, or avocations, do not permit them to employ paid teachers, or to attend day schools. The schools are under the charge of Prof. J. G. Fox as Principal, and the department of Physics is managed by Prof. Charles S. Stone, whose reputation as a chemist and a lecturer is well known. Ladies are admitted to any of the classes of the school of science for which they are fitted.

Important to Southern Inventors.

The order promulgated from the Patent Office some time ago, that all applicants for patents from States late in rebellion must furnish certificate of allegiance, has been rescinded, and hereafter inventors from the Southern States can obtain patents on the same conditions as citizens of the Northern States.

AN accident occurred at the Naval Academy, Annapolis, a few days ago, which, but for timely aid, might have proved a most serious affair. One of the decks of the *Winnepec* having been painted with gum shellac, one of the sailors accidentally dropped a lighted lantern on it. The shellac, becoming ignited, enveloped the deck in flames. By prompt action the fire was extinguished. Rumor says there was a large quantity of powder on the vessel at the time.