Bursting of a Fly Wheel in the Tacoma Railway Company's Power House.

BY A. M'L. HAWKS, C.E.

At 1 P. M. on Sunday, July 11, an accident occurred to an engine in the power house of the Tacoma Railway Company, resulting in the bursting of the big fly wheel and the practically total destruction of the engine of which it was a part.

The initial source of the trouble was the breaking of one of the small brass arms on the governor which holds up the sliding collar. This disabled the governor, and thus the regulation of steam to the engine was destroyed, which immediately set the engine to racing. The engineer in charge of the power house ran at once to cut off the valve and attempted to shut off the steam by means of the hand wheel. When he had closed this valve about half way, finding that he had not only not reduced the speed of the engine, but that it was constantly gaining, and also being terrified by the whipping of the belt (which connected the fly wheel with the driving pulley on the line of shafting, and beneath which he had to stand to manipulate the hand wheel), which had become considerably frayed, owing to the extreme tension put upon it by the racing engine, he abandoned this task and sought safety in flight. The manager of the company and the secretary were in the office adjoining the engine room. Hearing the noise, they hastened to the engine room to attempt to aid the engineer in his task of controlling the engine. But, seeing the peril of their position, so near the wild engine, they also fled from the building. As they emerged, a report like the sound of a cannon came from the engine room. The walls immediately in front of the engine were burst outward; the roof, together with some cross arms, wires, etc., was thrown into the air, and steam, brick, iron and lime dust covered the immediate region of the engine.

The fly wheel of the engine, which was a segmental pulley, weighing 40 tons, 25 feet in diameter, 4 feet 8 inches across the face, the rim having a thickness of 2½ inches, reinforced with two ribs, 1 inch by 6, was found to have exploded into over twenty pieces. One piece, weighing about 100 pounds, was thrown a distance of over 400 feet. Several pieces, weighing from 150 to 500 pounds, were thrown more than 250 feet. Several pieces of 500 pounds weight or over were thrown directly upward through the joists and double flooring of the ceiling overhead, and the rafters and double thickness of roofing, and, returning through the same coverings, landed in the power house within 10 feet of the original fly wheel. The lower portion of the wheel seems to have flown tangentially forward, striking against the masonry surface of the wheel pit, and considerably battering the same. A few stray pieces flying through the power house destroyed the driving pulley on the line of driven shafting, and injured the dynamos to a small extent. On the hub of the fly wheel there was not left a piece of any arm longer than a foot in length; the engine shaft was torn from its bearings; one of the teeth on the clutch on the engine shaft, engaging with a smaller engine in an adjoining room, was torn out; the piston rod of the racing engine was bent near the crank pin to an angle of 30 degrees; the connecting rods to the valves were bent and twisted beyond recognition; and, practically, nothing but the steam chest remains in place.

Fortunately for the smaller engine, which was engaged on the main shaft with the one destroyed, and which for a time acted as a balance, keeping down the speed of the racing engine, one of the bolts holding down the pillow block bearing near the clutch gave way, which, in turn, brought a strain on the clutch, breaking out the tooth, and in this way it became disengaged, and no further harm was done.

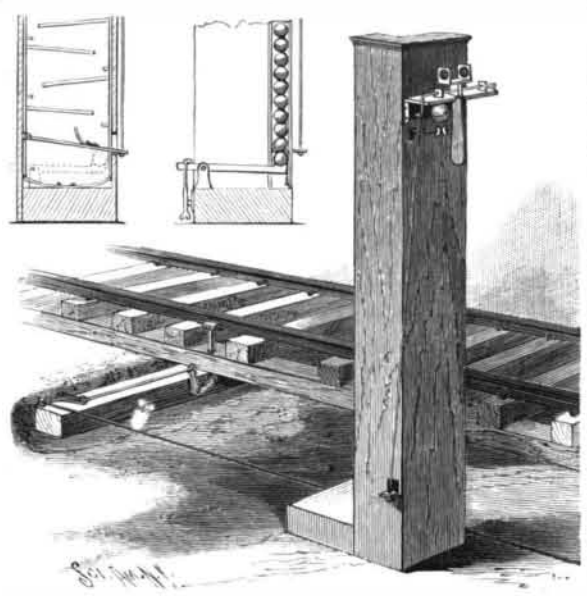
One of the curious phenomena of this explosion was the way in which the pieces traveled. Some pieces came directly through the front of the building, rising at an angle of thirty to forty-five degrees; another part rose vertically through the roof, and a third portion flew almost horizontally forward in the wheel pit. Probably not more than ninety degrees were covered by the flying missiles. The strain upon the rim of this wheel must have been very great, as, in one instance, a piece of about 2 feet of the circumference of the wheel by 4 feet 8 inches wide, coming from between the arms, not pierced by bolt holes and showing no signs of flaw, was torn out and thrown aside by itself. This piece, with its reinforcements, shows on its two faces of fracture over 300 square inches of good, clear grained cast iron. Taking the tensile strength of cast iron at 30,000 pounds per square inch, it will be seen that it must have required an energy of several million pounds to effect this destruction.

The exploded engine was one built by the Frick Engine Company, of Pennsylvania, and was rated by the builders at 750 horse power with 80 pounds of steam, but had been run at times under a load of 850 to 900 horse power. At the time of the accident it was running under a little more than normal load, due to the Sunday excursion business of suburban lines.

This accident will point out the necessity of a means of regulating such machinery, not only by the governor and the hand wheel cut-off valve, but also by some means whereby, from a safe distance from the danger of flying pieces of the engine or fraying belts, the supply of steam can be easily regulated.

AN IMPROVED RAILROAD CROSSING SIGNAL.

A device designed to signal the approach of a train by ringing a bell and exhibiting visual signals is represented in the accompanying illustration, and has been patented by William S. Woods, of Sulphur Springs, Ind. The signal box has a vertical ballway so arranged that the descent of a ball therein, as the ball strikes transversely inclined or cross partitions, as shown in one of the small views, will cause a rod at the side to be depressed to sound a bell, the length of time the bell is sounded being governed by the number of cross partitions or baffle plates. An adjacent chamber holds a column of balls resting at their lower ends on a lever, as also shown in one of the small views, the chamber discharging at its upper end into the upper end of the ballway, so that the balls are used in a circuit, each operation of the lever lifting the column of balls one step, and discharging a ball into the ballway. A detent holds up the column of balls from moving back with the lever, and a detent device at the upper end of the ball-holding chamber prevents the balls from passing out too freely. A visual signal is arranged adjacent to a shelf on which a lamp or lantern may be placed, and comprises a shaft on which are secured a semaphore or signal armand light frames carrying panes of colored glass, the signal arm swinging horizontally and the frames turning inward on opposite sides of the lantern as the signal is operated. The shaft carrying the signal arm is weighted to normally hold the arm horizontally, a position it assumes when released by a detent actuated by a descending ball, the visual signal being then exposed until the ball depresses a tilting bar at the bottom, causing the readjustment of the shaft. The lever by which the signal is actuated



WOODS' RAILROAD CROSSING SIGNAL.

may be operated in any suitable manner by an approaching train. A portion of the track may be arranged to be depressed by a moving train, and such movement of the track may be made to tilt a bell crank lever, connected through other levers and a slide rod with the lever by which the column of balls is elevated.

Photographing Rail Deflections.

In an article about the techical applications of photography by Herr Wilhelm Müller, in the Zeitschr. des Oesterr. Ing. u. Arch. Vereines for February 5, an arrangement is shown for enabling the deflections of rails, bridges, etc., under moving loads, to be photographically recorded. Briefly, says the Engineering Magazine, the apparatus consists of a camera, of which the plate holder is fitted to slide across the back by clockwork, so that a series of successive images may be taken upon one and the same plate at uniform intervals of time. The rail or beam to be observed has attached to it a brilliantly polished bead, which is photographed as a point of light, and the successive images of this point show the deflections. A second lens causes the images of a similar stationary point to be photographed upon the same plate in a line just below, thus furnishing a base line for comparison. The images are so close together that they practically form a continuous line, the deflection images giving an irregular curve showing the movements of the rail, while the spacing of the points upon the base line are clearly enough defined to enable the intervals of time to be noted.

It is, of course, essential that such an apparatus should be mounted upon a very solid foundation, as the least vibration of the camera would be fatal to the accuracy of the record; and the objective used must have great light gathering power, owing to the feebleness of the illumination. The apparatus, as installed in the Nordbahnhofe, in Vienna, is fixed upon a masonry pier, is fitted with a Zeiss anastigmat objective, and has given excellent results in practice.

Science Notes.

Some time ago Prof. Von Holst, of Chicago University, gave an account of the alleged great discovery by Prof. Von Schroen that crystals were organic substances. A letter has just been received in San Francisco from a gentleman who interviewed Prof. Von Schroen in Naples, which throws a different light on the subject. It seems that the professor is studying the process of crystallization, and has taken 2,800 photographs to show the transfer of organic into inorganic matter. It is said that his investigations will probably be of great importance in bacteriology, physics, chemistry and mineralogy.

According to Dr. A. Tschirch, resin, oil, and other secretions are never formed within the cell membrane, but in a special layer known as the resinogenous layer. The septa which occur in the vittæ of Umbelliferæ are the remains of this layer. To the substance of which this layer is composed the author applies the term "vittin." It is of a pectinaceous character, and appears to be identical with the substance of mucilage. In schizolysigenous passages, like those of the Rutaceæ, there is first a caplike formation of the resinogenous layer, followed by a dissolution of the cells and a resorption of the protoplasm.—Sitzber. 68 Versammlung Deutscher Naturforscher u. Aerzte, 1896.

The death is announced of the eminent chemist, Prof. Schutzenberger, who was born in Strasburg and studied medicine there. He began his chemical studies while working for his degree, After having been attached to the chemical laboratory at the Conservatoire des Arts et Métiers, he became assistant director at the Sorbonne Laboratory, head of the chemical department at the College du France, then in 1876 professor in chemistry at that college. In 1884 he was elected a member of the Academy of Medicine. In 1888 he succeeded Depray at the Academy of Sciences. He was the author of works on chemistry applied to animal physiology, on diagnosis and on coloring matters and fermentation.

In an interesting paper in the Transactions of the Botanical Society of Edinburgh (vol. xx, p. 534), Miss M. J. Newbigin gives a detailed account of the various coloring matters of leaves and flowers, which she divides into lipochromes and anthocyans, the former being insoluble, the latter soluble, in water. The authoress states that there is no evidence that lipochromes are in any way derivatives of chlorophyl. She groups them into two classes, eucarotins and carotinins. Anthocyans are probably derivatives of tannins. The theory that their chief purpose is to protect chlorophyl against decomposition in a strong light is scarcely in harmony with some of the conditions under which they are commonly formed, as, for example, in young shoots in spring and in autumn leaves. Etiolin is probably nearly allied to chlorophyl, these two being nearly the only pigments in the vegetable kingdom which contain nitrogen.

The Emperor of Japan has just conferred upon Prof. David P. Todd, of Amherst College, one of the highest honors within his power to bestow. The honor comes in the form of "an imperial saké cup." It is an article of small intrinsic value, but of the greatest importance when its significance is considered. It is of ordinary red lacquer and has no ornamentation, except a gilt imperial crest. In Japan, no article bearing the imperial crest can be purchased. A year ago Prof. Todd was in Japan conducting an eclipse expedition. A new school house had been built at Esashi, and the government tendered to Prof. Todd the use of the school house as a station. Prof. Todd assisted at the opening of the school on the day after the eclipse, and founded a library for the little town. It was in recognition of Prof. Todd's interest in Japanese educational affairs that the Emperor conferred the cup upon him. It is an honor which is very seldom bestowed on foreigners.

The effect of alcohol on mountain climbers is discussed by Dr. Otto Snell in No. 3 of the Mittheilungen des Deutschen und Oesterreichischen Alpenvereins. Last autumn he had a card in the same publication requesting climbers to forward their personal experiences and views to him. He received sixty communications, thirty-seven of which, or sixty-two per cent, condemn the use of liquors, wine, or beer as an impediment rather than an aid. Twelve are for a moderate use of wine, but pronounce against brandy and beer. Three believe in taking along brandy, to be used, however, not as a stimulant, but in case of need as a medicine, or to mix with glacier water. Only five of the sixty expressed their belief that alcoholic drinks are beneficial or harmless to climbers. The general conclusion drawn by Dr. Snell from these answers is that while in exceptional cases alcohol may be harmless, or possibly useful, as a rule great moderation is desirable, while the majority of experts are for total abstinence until after the climb is over, and some even strongly urge abstinence, or great moderation, on the day before the expedition. One of the correspondents expressed his conviction that the bottled drinks taken along by climbers benefit no one but the tavern keepers from whom they buy them.