is about one dollar. In waters containing from ten thousand to fifty thousand bacteria per cubic centimeter (about fifteen drops), these filters commonly remove all but fifty or seventy-five and frequently all of the bacteria. Mr. George W. Fuller, biologist of the Massachusetts State Board of Health, says of the Lawrence filters: "Out of one hundred and two analyses, fifty-eight indicated that the filtered water was absolutely sterile." An experience of the writer at the Lambertville, N. J., filter beds, showed the influence of the gelatinous growth in removing the suspended matter. When the filters were first put in operation the turbid water showed only a very slight change after passing through them. As soon, however, as this growth had taken place, the water ran from the filters clear and odorless.

All properly constructed filter beds improve with age, instead of deteriorating, but it is essential that they be so constructed that all the conditions necessary for the inception and growth of the nitrifying organism are rigidly adhered to, as otherwise undesirable bacteria will infest the beds and make the water far worse after than before filtration. The bacteria grow through the bed after the manner of mildew through a bolt of linen. A properly constructed filter bed can be compared to a well cultivated garden, in which the weeds are destroyed and the plants flourish, and a poorly constructed filter to a neglected garden, in which the weeds outgrow and dwarf all other vegetation.

The popular idea regards all bacteria as disease producing microbes. The bacteria are really a microscopic growth of the lowest order of vegetable life, and many of them are essential to our existence. Some, however, are deadly, as the typhoid, cholera and bubonic plague germ; some produce diarrhea, and others impart a very objectionable taste to water or fill the pipes with their growth. Any or all of these that may exist in the water are efficiently removed by the filter, and the immediate reduction of water-borne diseases is testified to by all communities where this method has been adopted.

Government Distribution of Seed.

In the time of Cæsar, largesses of grain were frequently distributed to the populace of Rome, in times of discontent, to smooth the course of ambitious politicians. The fact is brought to mind by the great dimensions which the business of distributing seeds by our Department of Agriculture has attained. Over 20,000,000 packages of field seed and vegetable and flower seed were thus distributed by the government the past spring. In the entire distribution nearly every variety of vegetable known to the agriculturist was distributed. There were 32 varieties of beans, 10 varieties of beets, 23 varieties of cabbage, 11 varieties of carrots, 19 varieties of sweet corn, 18 kinds of cucumbers, 30 kinds of lettuce, 19 varieties of muskmelons, 17 kinds of watermelons, and 15 varieties of onions. The entire amount of seeds distributed was sufficient to plant an area of 355 square miles, or about six times the size of the District of Columbia. The distribution of seed in 1893 amounted to 8,800 packages for each member of Congress, at a total cost of $66,548; in 1894 each Congressman got 16,000 packages, the entire cost to the government being $57,000; in 1895 the number of packages of seeds distributed was the same as in the previous year, but the total cost was reduced to $47,000. In 1896 Congressmen got 15,000 packages each, and the government paid $80,500 for the whole lot. During the past spring each member of Congress has received 40,000 packages of seeds, for which the government has paid $130,000.

THE CURVE AND CROSSINGS AT FIFTY-NINTH STREET AND EIGHTH AVENUE.

THE CIRCLE, FIFTY-NINTH STREET AND EIGHTH AVENUE, LOOKING NORTH.

CONSTRUCTION OF UNDERGROUND TROLLEY LINES IN NEW YORK CITY.

EXTENSION OF THE UNDERGROUND TROLLEY SYSTEM IN NEW YORK.

Our readers will see from the accompanying illustrations that the Metropolitan Traction Company has already commenced work on the important improvements which it is contemplating on a large portion of its lines. The work which is being done at the Circle, at the intersection of Fifty-ninth Street and Eighth Avenue, marks the commencement of a costly undertaking which involves the complete rebuilding of over forty miles of the company's lines, the horse cars and light rails being removed and replaced by electric cars and the latest type of underground trolley or conduit road. The lines which are to be immediately reconstructed on the west side of the city are the Eighth Avenue line, from the Harlem River to Fifty-ninth Street, and the Sixth Avenue line, from Fifty-ninth Street to the Battery; and on the east side the Madison Avenue and Fourth Avenue lines, between the Harlem River and the Post Office. In the present overburdened condition of street railroad travel, and particularly of that on the Broadway line, the electrical equipment of two continuous lines on each side of Broadway and Central Park will go far to relieve the congestion in north and south bound travel during the busiest hours of the day.

An important feature will be the crosstown connection at Fifty-ninth Street, on which the new system will be laid down between First and Tenth Avenues, by means of which passengers may travel from upper Madison Avenue to lower Sixth Avenue, and from Eighth Avenue to Fourth Avenue, and vice versa, without change of car. We present two illustrations of the Circle, taken during the building of the conduits and the laying down of the crossings and the connecting curves, which will give a good impression of this important meeting point, at which so many leading thoroughfares of the city intersect. In the view showing the Columbus statue the thoroughfare to the right is Eighth Avenue and that to the left is the commencement of the Boulevard. In the other view we are looking south, and the broad thoroughfare to the left is Eighth Avenue. Although the continuation of the line down Eighth Avenue is not to be undertaken immediately, the crossings are being put in at once. As soon as the work is all completed at this point the whole of the Circle will be asphalted. It should be added that the

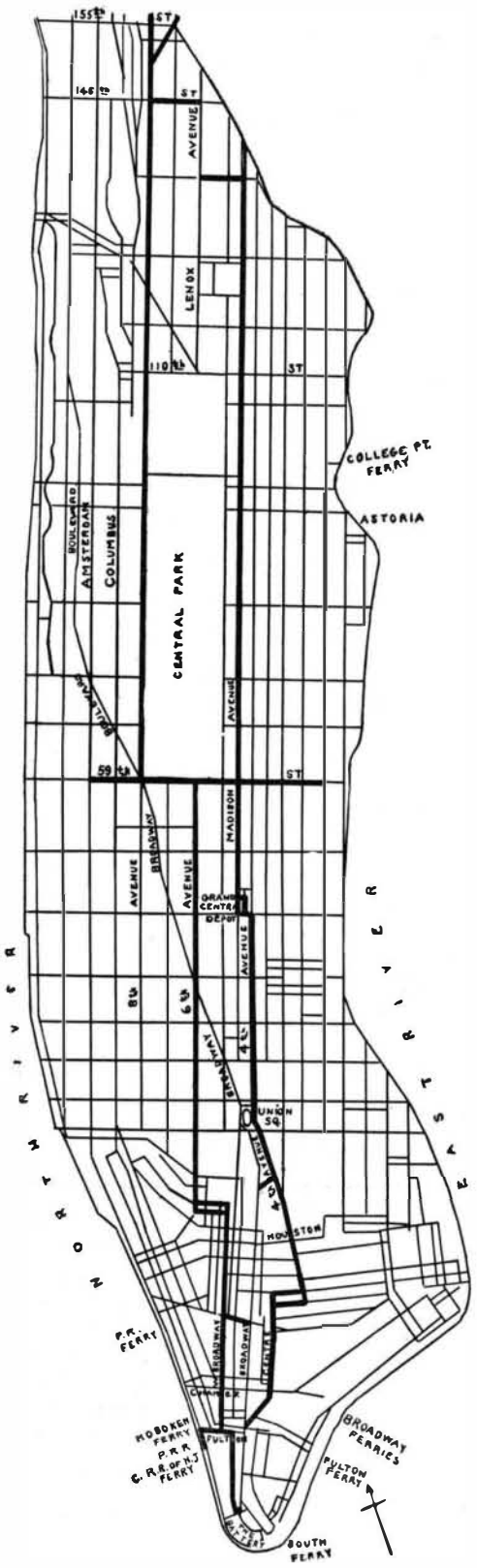
curve that swings around to the left will form the connection between the Eighth Avenue and Fifty-ninth Street lines, and will be used by the cars which will run to the lower city from this point by way of the new Fourth Avenue line.

Our readers will remember that the Metropolitan Traction Company has been operating for many months several miles of underground trolley road on a branch of its system known as the Lenox Avenue line. This was built as an experimental line from which data might be gathered for the construction of the present extensive system, and in order to be prepared for contingencies the conduit was made large enough to admit of the line being changed to a cable road, if the electric system should not give satisfaction. Since the line was first put in operation, in June, 1895, the company has always expressed itself as fully satisfied with its performance, and hence the decision to use the underground system on the new lines was not unexpected.

The new conduit, track and equipment will not differ materially from those of the Lenox Avenue line, for a full description and illustration of which the reader is referred to the SCIENTIFIC AMERICAN for February 22, 1896. The conduit, for the reason given above, will be smaller, as will be seen from the accompanying drawing. The yokes, and, indeed, all the metal work, are lighter, and contain many minor improvements in the details. The feed wires are carried in the terra cotta ducts shown adjoining the yokes on the inside of the tracks, and connection is made between them and the conductor rail on the inside of the conduit. The conductors are T-shaped and weigh 21 pounds to the yard, one of these being used for the supply current and the other for the return. The slot rails weigh 57 pounds to the yard and the track rails will be 9 inches deep and will weigh 107 pounds to the yard. This is the first time that a 9 inch rail has been used in New York City, and the rails are probably the heaviest to be found in the track of any regular street or steam railroad. The heaviest rail in extensive use on the trunk railroads of this or any country is to be found on the main line of the New York, New Haven and Hartford Railroad, between New York and New Haven, where there is a continuous stretch of 100 pound rail. This is 7 pounds lighter than the rails on the street railroad in question.

The underground contact device is similar to that of the experimental line. The plow of the car passes through the slot and supports two contact pieces which are carried on spring leaves which keep them snugly against the contact rails, the current being taken from one rail, carried up through the motor and returned by the other rail. The plow is constructed of two plates of steel, upon each of which is laid a sheet of non-conducting material. The two steel plates are fastened together with the insulating material on the inside, and between the latter are placed the strips of copper which serve to carry the current from the contacts to the motor cables. Particular attention has been paid to the question of insulation. The brackets which carry the conductor rails are provided with a heavy porcelain cap cemented into an iron cap, which latter is bolted to the yoke. There will be an insulator on every third yoke, and, judging from the experience with the Lenox Avenue line, the loss on the line will probably be very light.

As soon as the Eighth and Fourth Avenue lines, as outlined above, are completed work will be pushed on an extension through Amsterdam Avenue and on the lower Eighth Avenue line. The estimated cost of the completed system is about $6,500,000.



PROPOSED NEW YORK UNDERGROUND TROLLEY LINES.

The Abuse of Nervous Stimulants.

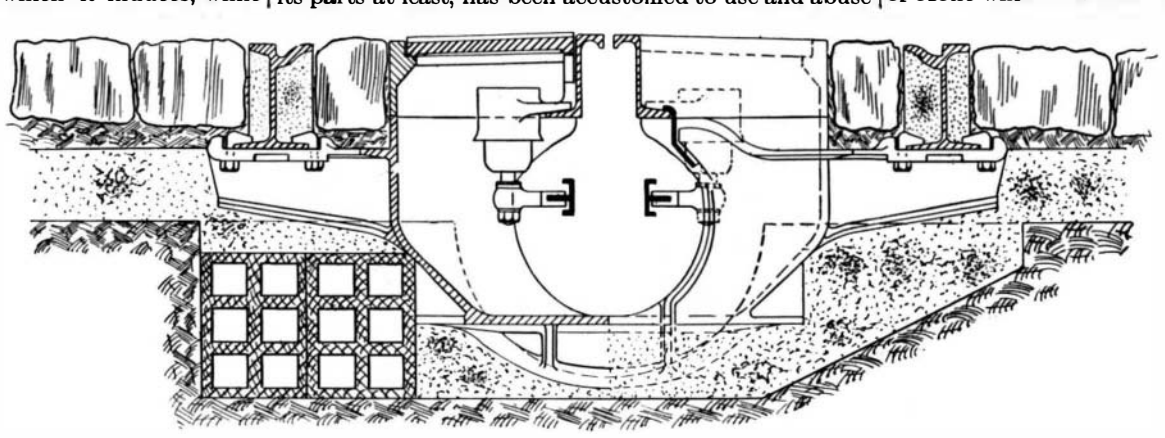
The medical profession and the laity have been accustomed for so many years to the abuse of alcohol as a nervous stimulant that some persons have become hardened to the miseries which it induces, while others have been stimulated to its excessive condemnation. As a result of this and of the general desire for stimulating foods or drugs, a very large number of persons have been led to place before the public other powerful nervous stimulants, of which both the medical profession and the laity know less than they know of alcohol, until at the present time there are almost as many consumers of nervous stimulants other than alcohol as there are of those who use alcohol to excess. Further than this, the number of these substitutes is daily increasing, and in many instances unprincipled venders are fortifying comparatively innocent and mild nervous stimulants, dispensed for common use, with so large a quantity of alcohol added that the patient really becomes addicted to the alcohol habit while thinking he is simply using an innocuous drug; he thinks he is taking coca, kola, or some similar stimulant, when in reality most of the temporary changes for the better which he notices after a dose of his favorite tipple are due to the alcohol which it contains.

It has been thought by some that the rush and dash of modern life forces a large number of persons without well balanced nervous systems to the use of stimulants to a greater extent than they were employed by our ancestors, but a careful study of this question would seem to indicate that this is untrue, and that for many hundred years the human race, in some of its parts at least, has been accustomed to use and abuse nervous stimulants, for the same purpose as we use and abuse them to-day.

Unfortunately, many physicians, in their endeavor to relieve symptoms temporarily, and ignoring the underlying causes of the affections from which their patients suffer, are too ready to employ many of the preparations we have named, not only giving them to their patients, but using them themselves. The object of this note is not, however, to direct attention to these preparations or to the evil effects which they produce, but rather to make clear the fact that all of them are but temporary makeshifts which in the end, in the vast majority of cases, materially increase the discomfort and the ill health of the person who takes them.

The abuse of these remedies by the profession is not so much the result of ignorance as of carelessness. There is no drug yet discovered, so far as we know, unless it be alcohol, which distinctly adds force to the body when it is taken. All of the so-called "strengthening remedies," which enable a man to accomplish more work when he is under their influence, do this not by adding units of force to his body, but by utilizing those units of force which he has already obtained and stored away as reserve force by the digestion of his food. Kola, coca, excessive quantities of coffee and tea, and similar substances, while they temporarily cause nervous work to seem lighter, only do so by adding to the units of force which a man ought to spend in his daily life those units which he should most sacredly preserve as his reserve fund. The condition of the individual who uses these remedies when tired and exhausted, with the object of accomplishing more work than his fatigued system could otherwise endure, is similar to that of a banker who, under the pressure of financial difficulties, draws upon his capital and reserve funds to supplement the use of those moneys which he can properly employ in carrying on his business. The result in both instances is the same. In a greater or less time the banker or the patient, as the case may be, finds that his reserve fund has disappeared and that he is a pecuniary or nervous bankrupt.

Even the advertising boards and the fences of the cities, towns and country now contain advertisements which mislead the ignorant into the idea that, by using the drugs named thereon, they will actually increase the development of their muscular power, when in reality the final result of such a course must be to decrease the nervous stamina which the would-be athlete so earnestly desires.—The Therapeutic Gazette.



CROSS SECTION OF CONDUIT—UNDERGROUND TROLLEY ROAD, NEW YORK CITY.

Atmospheric Ozone.

William Sutherland, in a recent paper in the Philosophical Magazine, deduces an important law relating to the spontaneous change of oxygen into ozone, which has important bearings on the constitution of our atmosphere. He finds, from theoretical considerations, that under very small pressure oxygen should exist entirely as ozone. As the pressure increases, the ozone changes partially into oxygen, but even at a high pressure the change is not complete. According to his figuring, the proportion of ozone in the air at the earth's surface should be about one volume in 7,000. Measurements show that the actual proportion is about one volume in a million, but Mr. Sutherland accounts for the disappearance of the rest by its chemical activity, which causes it to unite readily with metals. Above a point where the atmospheric pressure is about 0·715 millimeter of mercury, that is, where there is a practical vacuum, what oxygen there is, is completely in the form of ozone. The author says: "These deductions have some hygienic importance, and explain the reason for the current belief that the higher regions of the atmosphere and winds which come from them are richer in ozone than the surface air; they also show that there must be enough ozone in the whole atmosphere to have an important bearing on the blue color of the sky. . . . The claims of ozone to a serious share in the blueness of the sky have been rather neglected; but if it is remembered that the blueness of ozone is enormously stronger than that of oxygen under the same conditions, it becomes apparent that the quantity of ozone which has been theoretically shown to have a probable existence in the atmosphere must exercise a considerable influence on the color of the sky and the color of distant objects."

The New Register of Copyrights.

The Hon. John Russell Young, Librarian of the Congressional Library, at Washington, has appointed Thorwald Solberg, of Boston, Register of Copyrights. This, next to the Chief Assistant Librarian, is the most important place on the staff of the new library. Mr. Solberg is a native of Wisconsin and was born in 1852. Mr. Solberg has served in the Library of Congress for thirteen years, and eight years ago he was selected by the Boston Book Company to take charge of one of its important departments.

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.

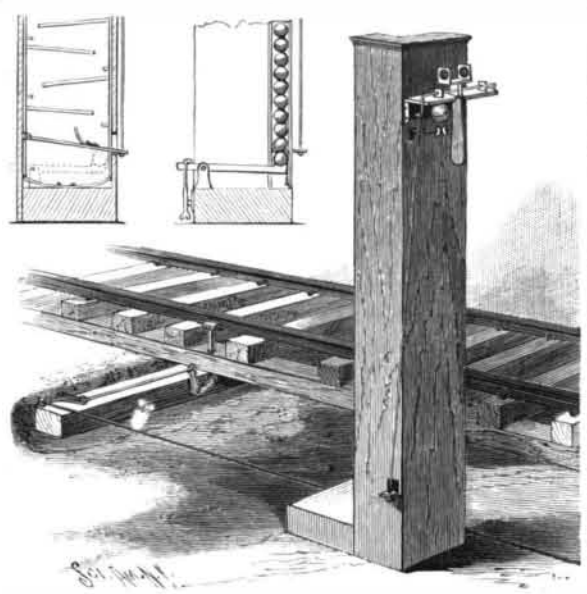
One of the curious phenomena of this explosion was the way in which the pieces traveled. Some pieces came directly through the front of the building, rising at an angle of thirty to forty-five degrees; another part rose vertically through the roof, and a third portion flew almost horizontally forward 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.