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UNION ARCH, WASHINGTON AQUEDUCT.

In its latest edition the American Cyclopædia states, under the head of masonry bridges, that there are comparatively few of any great size in the United States, and instances as perhaps the finest example the High Bridge of the Croton Aqueduct, over the Harlem River, with its eight arches of 80 feet span, and five others of 50 feet span. Probably the majority of well-informed Americans would accept the statement as correct, and few, even among engineers, would hear without some surprise, that by far the largest masonry arch in the world is in this country, and that it forms a part of one of the most important engineering achievements that have been accomplished during recent years—namely, the aqueduct by which the City of Washington is supplied with water.

Unfortunately for its own fame, this work was completed during the most exciting period of the civil war, when the security of the national capital against the assaults of the Confederate army was a matter of infinitely greater popular interest than any improvement of its water supply. Possibly, too, the inadvisability of calling the attention of the enemy to a work of such importance to the beleaguered city may have had something to do with the singular absence of information with regard to it in the popular prints of the time and in later publications. At any rate one will have to search a long time to find more than a casual mention of the work, where one would expect to find the fullest description of it. The splendid masonry arch shown in the accompanying engraving carries the aqueduct over the Cabin John Creek, with a span of 220 feet. The height of the arch is 101 feet, and the width of the structure 20 feet. The arch forms an arc of a circle, having a radius of 134·2852 feet. When the center scaffolding was removed, the arch (unlike all other works of the kind) did not settle, the keystone having been set in winter, and the center struck in summer.

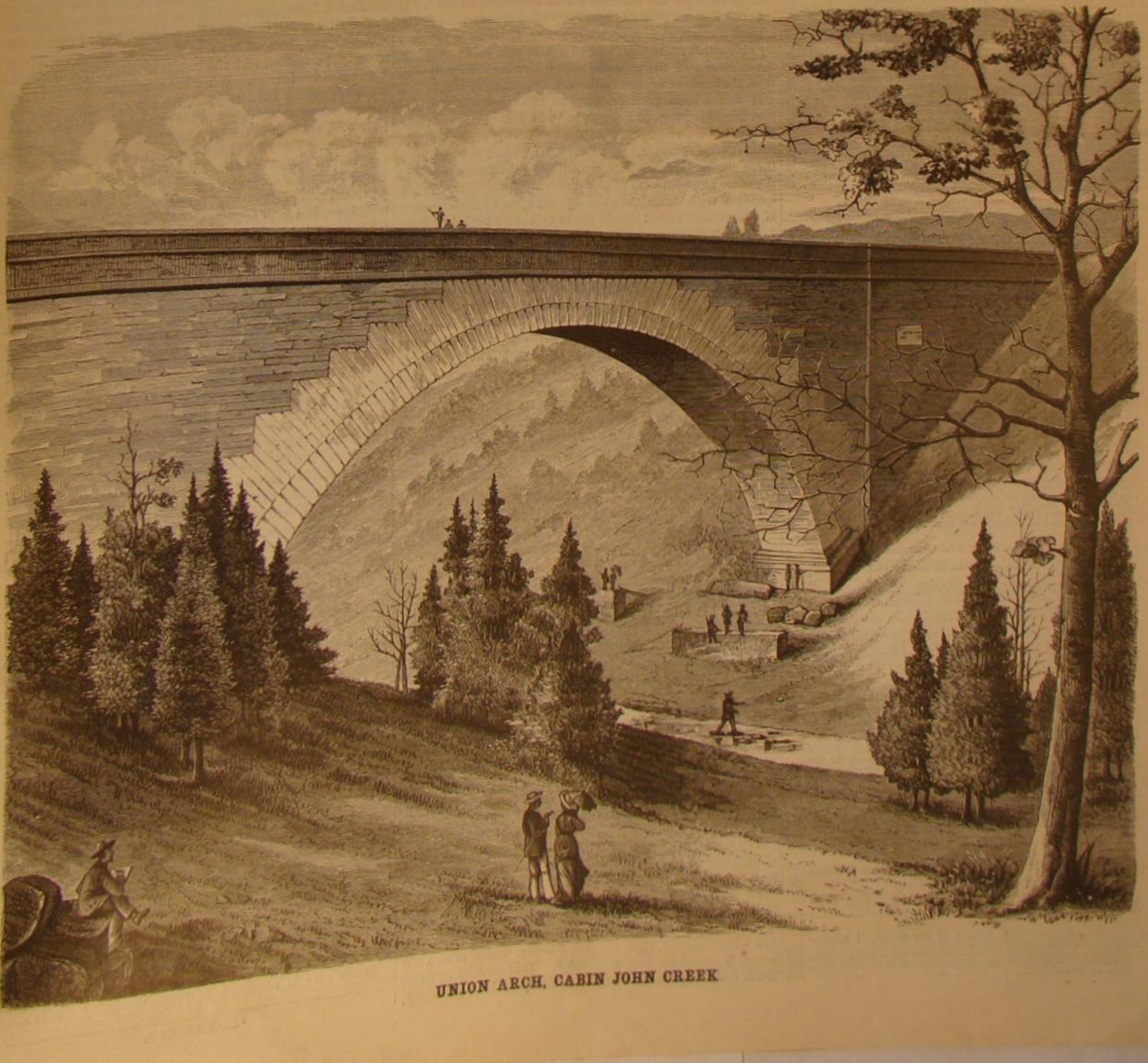
Two other remarkable structures are included in or form a part of the Washington Aqueduct. From the distributing reservoir the water is conveyed in two thirty-inch pipes. There were two streams to be crossed, College Branch and Rock Creek. Instead of building bridges and laying the pipes on them, the pipes themselves were in each instance cast in the form of an arch and constitute the bridge. The Rock Creek bridge has a span of 200 feet, with two forty-eight-inch pipes; the College Branch bridge has a span of 120 feet, with two thirty-inch pipes. The arch over Rock Creek is so strong that it is used for a roadway, continuing Pennsylvania avenue to Georgetown.

The other notable masonry arches of the world are the Chester arch across the river Dee, at Chester, England, with a span of 200 feet; the famous center arch of the new London Bridge over the Thames, with a span of 152 feet; Ponty-Prydd, over the Taff, in Wales, 140 feet; the bridge across the Seine, at Neuilly, France, with five spans each of 128 feet; the nine spans of Waterloo Bridge, London, each 120 feet; and the celebrated marble Rialto bridge in Venice, with a span of 98½ feet.

Washington Aqueduct was begun in 1853, and finished in 1863. The engineer in charge of the work was Gen. Montgomery C. Meigs.

The Japanese Fan as an Audiphone.

At a late meeting of the New York County Medical Society, Dr. Samuel Sexton read a paper on the use of the lacquered Japanese fan as an aid to hearing. The fan is constructed on the same principle as the audiphone, being composed of lacquered material that receives any ornamentation that may be desired. Its cost is from 25 cents to $1, whereas, when first presented to the public, the audiphone was a high-priced article, ranging from $5 to $25. By using the model of the human skull Dr. Sexton showed how the sounds of the human voice were transmitted to the auditory nerve, and illustrated how the instrument assisted the defective sense of hearing. He had brought a couple of deaf-mute subjects, by means of whom he gave some illustrations of the advantage of the instrument, which proved very satisfactory to the audience. The best distance for conversation was about three feet. When the distance was less the voice was too loud, and when greater it was indistinctly heard.



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Contents.

(Illustrated articles are marked with an asterisk.)

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THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 290,

For the Week ending July 23, 1881.

Price 10 cents. For sale by all newsdealers.

SEPARATION OF THE COMET.

As Professors Stone and Wilson of the Cincinnati Observatory were watching the comet, on the night of July 6, it was seen to separate into two parts. The report of the observation says that a jet was seen to proceed from the nucleus in the direction of the tail, and gradually form a separate nucleus, the division being sharply defined.

This is not the first known splitting of a comet, Biela's comet having divided, probably in a similar manner, some time between 1845 and 1846; but this is the first time that the actual separation has been observed.

This spontaneous division of the comet into two comets gives peculiar interest to certain speculations as to the identity of the present comet and the possible fate of all comets.

In a communication to the *Herald*, dated July 1, Prof. Lewis Boss, of Dudley Observatory, Albany, N. Y., discusses the striking similarity of certain elements of this comet's orbit to the corresponding elements of the orbit of the comet of 1807. That the two comets are not the same body—that is, that the comet of 1881 is not a premature return of the comet of 1807—he is quite sure; but, he asks, could these bodies have originally formed a part of the same body?

For illustration he refers to the comet discovered by Biela in 1826, whose splitting has already been mentioned. This comet was found to revolve around the sun in the comparatively short period of seven years. It was not seen again, however, until 1845, when it presented its usual appearance.

On the 12th of January, 1846, Professor Hubbard, of the Washington Observatory, on looking at the comet through his telescope, was surprised to find not one, but two distinct comets in the same field of view. The distance between the two bodies was small, but went on increasing night after night, until in March the distance apart had become 200,000 miles. At its next return in 1852 this distance had become more than a million miles. What became of the comet in subsequent years can only be conjectured, for it has never since been seen, unless an observation of a strange body by Pogson, in Madras, is held to be authentic as a view of this comet of Biela—a matter about which opinions are divided.

Professor Boss continues: "What has happened once may happen again. It is known that great forces of mutual repulsion exist in the particles which constitute a comet. It is to this that we probably owe the varied appearances in the head of a comet as it approaches to or recedes from the sun. By able astronomers this force of repulsion is held to explain the existence of the gigantic tails which are seen projected from the heads of comets on the side opposite the sun.

It would seem possible that the two comets of 1807 and 1881 may have formed a single body in distant æons of time, and that at a certain period the original body separated into two, diverging more and more widely, until now we have them, the one following nearly but not quite in the wake of the other at an interval of about seventy-four years. It is a question well worth the close examination of astronomers. If the present comet should prove to have a period of from 1,100 to 2,200 years, the reasonableness of the above conjecture will be almost demonstrated."

The observed division of the comet now in sight gives peculiar significance to these suggestions. It also shows that the natural subdivision of a comet is no longer to be considered—as the splitting of Biela's comet has been—an astronomical anomaly. And the question arises: To what extent can this process of subdivision go? The hypothesis suggested by the behavior of Biela's comet, namely, that meteoric belts or streams may be due to cometary disintegration, certainly receives additional plausibility from this repetition of (so far as positive observations go) the primary act of division. With a few more splittings the comet might entirely cease to be visible.

FULMINATING COMPOUNDS.

In answer to a number of correspondents respecting fulminating compounds and mixtures, we give the following:

A fulminating composition is one that detonates by percussion or friction. There are a large number of substances, chemical compounds and mixtures, that come within the scope of this definition, but for various reasons only a few of these have found any practical application as primers. Nitro-glycerine, nitro-cellulose (gun cotton), and the chloride and iodide of nitrogen are fulminating compounds, though not usually classed with percussion mixtures; but their detonation takes place with extreme violence, and so quickly that in many cases they do not ignite gunpowder when detonated in contact with it. Chloride of nitrogen is so exceedingly sensitive to friction or percussion, that its preparation is rarely attempted. It can only be prepared and used safely in minute quantities. The following are some of the metallic fulminating compositions:

Fulminating Antimony: Tartar emetic (tartrate of antimony and potassium), 100 parts; charcoal, finely powdered, 3 parts.

The mixture is well triturated together and put into a crucible, capable of holding one-fourth more than the charge, and covered with a layer of charcoal. The cover is then luted on and the crucible exposed to a bright red heat for three hours, then covered with clay and allowed to stand for seven hours, after which the contents is carefully transferred to a wide-mouthed, glass-stoppered bottle, where, after a few hours, it crumbles into a powder. This powder contains much metallic potassium as well as finely divided antimony, and fulminates violently when brought into contact with water, or when moistened with a drop of that liquid.

Fulminating bismuth is prepared in a similar manner from bismuth, 120 parts; cream of tartar, 60 parts; niter, 1 part.

The tartar is heated until it begins to blacken before mixing. This compound is rich in potassium and fulminates violently.

Fulminating copper is prepared by digesting precipitated copper with fulminate of silver and a little water. It explodes by percussion with a great flame. Fulminating zinc is prepared from zinc filings in a similar manner.

Gold fulminate is formed by digesting the terchloride of gold in a slight excess of aqua ammonia. It is a brownish-yellow powder, and can be safely made only in very small quantities at a time, as it explodes with great violence on the slightest friction or sudden increase of heat.

Platinum fulminate is similar to the gold salt—it may be prepared by digesting platinum sulphate with ammonia.

There are several methods by which fulminating silver may be prepared. The following is one of the best:

Dissolve 1 part of silver in 10 parts of hot nitric acid (sp. gr. 1·37), and add the solution to 20 parts of alcohol of 85°. Gradually heat the mixed liquid to the boiling point, then set it aside to cool. The fulminate of silver deposits in lustrous white crystals. They are washed with a little cold distilled water and distributed upon separate pieces of filtering paper in portions not exceeding 2 grains, and left to dry in the air. This fulminate dissolves in 36 parts of boiling water, but the solution deposits the greater portion of it on cooling. It is exploded when dry with great violence by slight percussion or friction, or by contact with a drop of sulphuric acid. When wet it is not quite so explosive, but under any circumstances it can hardly be handled or kept with safety.

Fulminate of mercury, the material now almost universally employed for the priming of gun-cartridge caps. The most convenient way of preparing this substance is as follows:

Dissolve by aid of gentle heat 1 part of mercury in 10 parts of nitric acid (sp. gr. 1·40), and pour the solution at a temperature of about 131° F. into $8\frac{1}{2}$ parts of alcohol (density 0·83), contained in a capacious glass flask—at least six times larger than is necessary to contain the volume of liquid. A few minutes after there begins at the bottom of the flask a light disengagement of gas, the quantity increasing until a quick ebullition is produced. The inflammable white vapors given off are very poisonous, hence the operations are performed with the vessels in the draught of a chimney or out of doors. When the ebullition and disengagement of vapors have stopped, the contents of the flask are turned out upon a filter, and the precipitate is washed with pure cold water until the washings have no action upon litmus paper. The filter paper containing the washed fulminate is then spread out on a copper plate, and heated by hot water or steam to about 200° F. The dry fulminate is separated into portions of about $1\frac{1}{4}$ drachms, wrapped up in soft paper, and kept in large stoppered bottles. The powder, when properly prepared, is composed of small brownish-gray crystals.

It is decomposed with flame and explodes by a shock or when heated to 370° F. The largest crystals detonate most easily. When it is mixed with thirty per cent of water it may be ground on marble without danger of explosion.

POISONOUS REFRESHMENTS.

The need of especial care in the preparation of refreshments for picnic parties and the like has been shown with painful emphasis in several instances recently.

At Decatur, Georgia, thirty-five persons are reported to have been seriously poisoned, June 21, by a salad prepared in a brass kettle. All suffered seriously; but, thanks to prompt medical service, no lives were lost.

Less fortunate were a party of 500 or more who attended a picnic at Warrensburg, Missouri, July 4. The caterer provided lemonade, so called, in which some unwholesome acid was substituted for lemon juice. A press report—possibly exaggerated—dated the following day, said that eight drinkers of the spurious lemonade had died and a hundred more were in a critical condition.

Ice cream made in a copper-bottomed boiler is similarly charged with poisoning painfully two hundred persons, near Keota, Ill., on the 4th. Possibly indiscretion on the part of the cream eaters may have occasioned serious gastric trouble without any mischievous agency on the part of the alleged copper-bottomed boiler; and similar indiscretion may have occasioned the illness charged to poisoned salad in Georgia. Still it should be borne in mind that badly prepared refreshments are a too frequent attendant of popular merry-makings, and people cannot be too careful with respect to their eating and drinking on such occasions.

THE MANUFACTURE OF CELLULOID.*

Celluloid, a complex combination formed by mixing gun-cotton and camphor, is to-day well known, as it is an industrial product. It is being manufactured in France, at Stains, near Paris, whence it is sent out ready to be worked like wood, ivory, or tortoiseshell. It can be turned, sawed, moulded, polished, etc. We have, on a previous occasion, stated that it originated in America, having been invented by the brothers Hyatt, as long ago as 1869.

Much care is necessary in preparing it. A recent com-

* *Revue Industrielle.*

munication made to the Société d'Encouragement gives us the following details in relation to the subject.

The manufacture embraces several important operations: (1) the manufacture of the nitro-cellulose or pyroxyline; (2) forming the mixture into slabs and then rolling them; (3) pressing and heating the rolled product in order to form blocks; (4) cutting the blocks into sheets of various thicknesses, according to the purpose for which they are to be used; and (5) heating the products.

The pyroxyline is obtained from cigarette paper of very good quality. This paper, in rolls 13 inches in width and 33 to 35 lb. in weight, is unrolled mechanically and immersed in a mixture of 5 parts of sulphuric acid of 66° with 2 parts of nitric acid of 42° B., kept at a temperature of about 35 degrees. The cellulose of the paper, after twelve or fifteen minutes' immersion, becomes changed into nitro-cellulose, which is soluble in a mixture of alcohol and ether. The solubility is tested by a hasty trial. The product is then removed from the acid bath, the liquid is expressed from it, and it is thrown into water. After a preliminary washing it is placed along with water in a pulp vat and triturated from two and a half to three hours in order to obtain a homogeneous paste. The pyroxyline then has to undergo bleaching, the operation being effected by the use of a solution of permanganate of potash. When contact with this reagent has been sufficiently prolonged, the excess of permanganate is eliminated by washing. Then the mass is treated with a solution of sulphurous acid in order to dissolve the oxide of manganese, and the operation is finished by a series of washings in water. The whitened pyroxyline is put into boxes lined with filtering cloths and then submitted to mechanical drying. On being taken from the hydro-extractor the material still retains about 40 per cent of water and is found to be in a state fit for the preparation of celluloid.

It is then passed through a mill having metallic runners, first alone, and afterwards mixed with the proper quantity of camphor (which has been first rolled), and with coloring matters if it be proposed to make opaque celluloid. After a dozen successive grindings, the mixture is moulded in a metal frame, by hydraulic pressure, so as to give slabs that are arranged and pressed between 10 to 12 sheets of thick bibulous paper. The water in the mixture is then gradually absorbed by the paper, the latter being renewed 12 to 15 times. The slabs thus dried and reduced to a thickness of about one-tenth of an inch are broken up between bronze cylinders armed with teeth. The pieces are allowed to macerate for about twelve hours with 25 to 35 per cent. of alcohol of 96°, and then the coloring matters soluble in alcohol are added if it be proposed to have transparent, colored celluloid. The mixture is then passed through the rolling mill, the cylinders of which are heated to about 50°.

The operations are performed upon from 20 to 28 lb. at once. The rolling takes from 25 to 35 minutes and terminates when the material has become homogeneous. There is then obtained a sheet of about half an inch in thickness, which is cut into pieces of 23½ by 31½ inches. The latter are superposed on the table of an hydraulic press in a metallic box having double sides and being tightly closed, and allowing the heating to be done by a circulation of hot water. The box is heated to 60° during the whole duration of compression, which lasts about four hours. At the end of the operation a current of cold water is passed into the box, the pressure is removed, and there is then obtained a very homogeneous block of celluloid about five inches thick. The blocks are then taken to the planing machine and shaved into sheets varying from 0·008 to 0·12 of an inch in thickness, according to the purpose for which the product is designed. These sheets are next placed in a ventilated stove, heated to 55°, where they remain for from eight days to three months, according to their nature and thickness.

In this description it has been only a question of celluloid of a uniform color, either transparent or opaque, imitating pale tortoise shell, coral, ebony, turquoise, etc. When it is desired to obtain a product to imitate amber, jade, spotted tortoise shell, etc., each of the ingredients of uniform color which is to compose the material is prepared separately, and then mixed to be afterwards united by pressure.

As the principal properties of celluloid are well known, we will not recall the numerous applications which may be made of it; but there is one, however, which has been pointed out by Colonel Goulier, that is of interest to engineers.

In passing from dryness to extreme humidity, celluloid elongates very little, and much less than the thin horn which is used in making the protractors that are occasionally employed in topography. There is every inducement, then, to make these instruments of celluloid, since they will prove less fragile than those made of horn, and more confidence can be placed in the scales and the angular divisions.

STEAM BOILER NOTES.

The dilemma with which the Philadelphia steam user is now struggling is becoming serious, while the situation occupied by the boiler inspectors is scarcely less grave and perplexing. The scare began with the Gaffney & Co. explosion, which occurred on the first day of June, 1881, and which was fully illustrated and explained in No. 2 of vol. xlv., of the SCIENTIFIC AMERICAN. It was discovered very suddenly, when this event took place, that cast iron was a dangerously treacherous material for boiler construction. This fact should have been in the possession of the designer, the maker, and the engineer, and more emphatically and above all others, the city and insurance inspectors, whose special business and duty it is to know, should have known whether or not this particular boiler was up to their standard of strength, namely, four or five times the stipulated load. And they not only should, but they do know, or have it on record, whether cast iron boiler heads of this diameter and thickness are in the habit of blowing out at the pressure stipulated in their certificates. If these inspectors now decline to pass all cast iron boiler heads at a desirable pressure they seem to stultify themselves. If they refer the matter to the city attorney, as is reported they have done, or to any other lay authority, their dilemma is complete, as they thereby acknowledge their ignorance of the whole subject. In the mean time the owners of similar boilers are in a state of mind not to be envied. If they decline to insure their boilers they take a risk that they now know less about than ever before. If they insure at the present pressure they seem to have little of the protection to their lives that is promised by insurance certificates, and they are, moreover, liable to suits at law if it can be shown that they have broken the contract. If they reduce their working pressure for the sake of insurance and safety, they will at once require additional boiler capacity, and not only that, but loss in working low steam in the engine will also follow.

The inspectors and the jury searched in vain for a defect in the broken head after rupture, when it should, if it existed, have been so plain that a runner could read it. In casting about for a plausible argument they charged the fireman with wetting the head with cold water from his quenching hose. They treated the gaping crowd at the wreck with stories of anomalous and exceptional cases of fractures that had been seen or heard of in their experience, all of which does not reassure either the owner or the workmen whose lives are daily exposed to such accidents.

Now it naturally occurs to the thoughtful practical engineer to inquire what has so suddenly brought about this state of things in a city justly noted for the number of its celebrated engineers and manufacturers. He remembers to have seen hundreds of such boilers, and he cannot believe that he has all the time been so near destruction as would now seem when in their vicinity. For forty years past cast iron, when not exposed to the direct action of fire or to a similar violence, has shown itself as reliable a structural material for boilers as for any other engineering device, and for that length of time 60 to 65 pounds of steam per square inch have been a common load for land boilers of this size. The common sense conclusion therefore is that more than the supposed load existed upon the Gaffney boiler head, or that the inspectors and experts are all deceived as to its soundness and dimensions.

The boiler in J. H. Richardson's mill, near Terrell, Texas, exploded June 20, killing two men outright and crippling four others.

An elevator boiler at Arkansas City, Ark., exploded June 6, killing John McCullough, the engineer, and seriously wounding Pat Boland, the fireman, and Amos Ramsey and Jacob Wallace, carpenters.

To all therefore a careful perusal of the report referred to above is earnestly recommended. It is a simple statement of stubborn facts, and the lesson will be obviously to take care of the safety valve and search for inevitable deterioration so that the supposed margin of safety may actually exist. Whether your boilers have cast iron heads or not these precautions are imperative.

CENTRIPETAL AND CENTRIFUGAL MOTIONS IN ANIMALS.

In a memoir published in the *Revue Scientifique*, last June, on "Writing Regarded from a Physiological Point of View," the author, M. Carl Vogt, after a lengthy discussion of centripetal writing (from right to left) and centrifugal (from left to right), drew the conclusion that the direction of the lines does not depend upon a physiological necessity, but only upon external conditions. Dr. G. Delaunay, who has for a long time been making researches on the same subject, has an article in a recent number of the same journal in which he endeavors to prove, on the contrary, that writing, as well as all motions and gestures in general, are dependent upon a physiological, and consequently an anatomical necessity.

The motions of quadrupeds can only take place horizontally or laterally; yet there are a few that perform centripetal movements—the cat, for example, which strikes with its paw by bringing the latter toward the axis of the body. Monkeys make centripetal motions mostly; but these animals hold a place between quadrupeds and man. Man alone is capable of making centrifugal motions. This physiological evolution of motions, which are successively vertical, then lateral and centripetal and then centrifugal in measure as we proceed from quadrupeds to the human species, is only the result of an anatomical evolution. According to Dr. Delaunay's researches, motions are rather centripetal than centrifugal in primitive or inferior races, and rather centrifugal than centripetal, in superior races. A centripetal motion in a primitive race becomes centrifugal in measure as that race evolutes. Sanskrit, Persian, and Greek were written from right to left before being written in the opposite direction. So our chronometers were wound up from right to left before they began to be wound in the other direction. The English, however, are behind the age in this respect, since in the screws manufactured by them the threads still run from right to left, and most of their watches, like those of our ancestors, are wound from right to left. On the other hand, the people of the United States, who are in great part transformed English, and who without doubt are more advanced in evolution than those of Europe, use watches only which are wound from left to right, and repudiate the old system still in use in England. Writing was centripetal among the ancient inferior races and is still so among those of modern times: Semitic, Phenician, Hebrew, Assyrian, Arabic, Chinese, Japanese, Negro, etc. Among the superior races not only is writing executed from left to right, but plans, sketches, shading, etc., are begun in the same manner. A circle is always drawn centrifugally, that is, in the direction of the hands of a watch. In our designs and on our monuments the symmetrical ornaments are, starting from the median line, centrifugal. To consider other motions: we turn a door knob, door key, screw, stopcock, corkscrew, as well as tools for drilling, cranks of mills, wheels, etc., from left to right. In all trades and professions work is performed in a certain direction, which is generally centrifugal. To sum up, centrifugal motions, characterizing the superior races, are a sign of superiority marking the last term of evolution. As for sex, centripetal motions characterize woman, while centrifugal motions are characteristic of man. A woman, for example, strikes with her palm, while a man gives a blow with the back of the hand. Every article of woman's clothing, from the chemise to the cloak, buttons from right to left, while man's garment's button from left to right. When a woman puts on a man's coat she buttons it with the left hand, centripetally, doubtless being unable to button with her right centrifugally.

As for age, the motions of children are centripetal rather than centrifugal, therein resembling women.

From a psychological point of view centripetal gestures mark primitive, egoistic, retrograde ideas. On the contrary, centrifugal gestures express ideas and passions which are generous, altruistic, and expansive. From a psychological as well as from other points of view then, centripetal gestures characterize inferiority, and centrifugal, superiority. As a result of his studies the author draws the conclusion that the centrifugal motions of abduction and of supination prevail in organisms most advanced in evolution, as the superior human races, men, adults, intelligent beings, etc.; while, on the contrary, the centripetal motions of adduction and pronation predominate in individuals less advanced in evolution, as the inferior human races, women, children, people of little intelligence, monkeys, quadrupeds, etc.

Finally, the physiological evolution of motions, which is a consequence of the anatomical evolution of the limbs, proceeds from the centripetal to the centrifugal. Comparative anatomy and physiology, then, explain why not only writing, but also other motions, are at first centripetal during the first phases of organic development, while the adductor muscles predominate over the abductor, and became centrifugal by very reason of the progresses of evolution which bring about the predominance of the abductors over the adductors.

Objections to Telegraph Wires in Sewers.

The Superintendent of Police and Fire Alarm Telegraph, the Chief Engineer and Surveyor, and the Chief Commissioner of Highways, of Philadelphia, under instruction from Councils, held a conference recently as to the practicability of running electric wires through the sewers of the city. The *Record* states that the three officials agreed to report adversely to Councils. One objection to the plan was that the sewers were much too small to be put to any such use, as men could not work in them with any degree of safety. It was also argued that the dampness of the sewers is so great that the wires could not be operated without insulation, which would be expensive and bulky. Another evil which was pointed out was the breaking into the sewers, which would become necessary to make connections. In their report the committee will call attention to these points, and also to the fact that the telegraph and telephone companies must make other provisions for the future, and not depend upon or expect to use the sewers as conduits for their wires, for the reason that in a few years the ordinary increase of the business of these institutions would result in the occupation of sewers to the material damage of the city's interest.

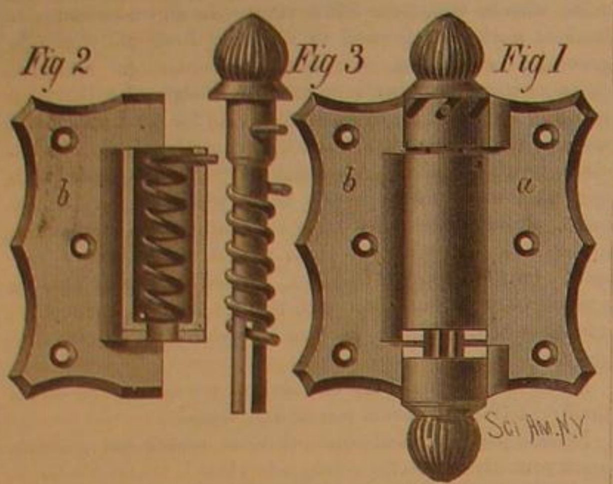
A Patent Pigeon.

The recent pigeon shooting "tournament" was varied by a special contest in which artificial pigeons were used. They were earthen projectiles sprung from a trap, and similar in shape to the clay saucers used for flower pots. The motion of this projectile is much more like that of a real pigeon as it rises from the ground than that of the gyro pigeon. When it is thrown from the trap it receives a violent rotary motion which compresses the air within its rim, and gives the "pigeon" more stability, while the convex shape causes it to sail or skim along very swiftly and settle lightly, when not hit by the shot, without breaking. The motion of this new substitute is very similar to that of an oyster or clam-shell when thrown by hand in such a manner as to skim through the air. The clay is light and brittle, and the rapid centrifugal motion causes it to fly in pieces easily when struck by the shot. There were few contestants entered in this match, but the men who did shoot and others who have practiced at this new projectile say that is the best substitute for live pigeons that they had yet seen. The pigeon and trap from which it is thrown are the invention of Mr. George Legowsky, Cincinnati.

IMPROVED SPRING HINGE.

The annexed engraving represents a new spring hinge lately patented by Mr. George M. Lane, of Asbury Park, N. J. It is adapted to blinds, shutters, screen doors, etc., and is so constructed that it may be easily and quickly adjusted to any required tension, and it admits of readily unhinging a shutter or door.

Fig. 1 shows the hinge complete; Fig. 2 is a section through the spring chamber; and Fig. 3 shows the hinge pintle. The leaf, *a*, is formed with an upper and lower knuckle, the upper knuckle having in its upper edge a series of ratchet teeth surrounding the central vertical hole through which the pintle passes. The lower knuckle is formed with a sliding surface and shoulders or stops on its upper



LANE'S SPRING HINGE.

edge and opposite each other, as shown in Fig. 1. The leaf, *b*, has a central chamber which fits between the two knuckles of the leaf, *a*, and has sufficient vertical play to permit the shoulders formed on its lower end to pass over the shoulder on the lower knuckle of the leaf, *a*, when the shutter is closed. The shoulders on the lower end of the spring chamber are arranged to correspond with those on the lower knuckle, and are locked together by the dropping of the shutter when the latter is opened. When locked in this way the shutter is held against any ordinary force of wind. The lower end of the pintle opening in the spring chamber has a shoulder on which the free end of the coil spring rests. This shoulder protects the lower end of the spring from injury and holds it in place when the shutter or door is lifted off the hinges. The pintle has a milled head by which it may be drawn out of the hinge, and on its shank near its upper end there is a pin that will engage the ratchet teeth when the head is pressed down. In the lower end of the pintle there is a longitudinal slot the inner end of which is within the spring chamber. The upper end of the coil spring is fastened to the spring chamber, and its lower end is left free and rests on the shoulder at the bottom of the chamber, as shown in Fig. 2, and is bent and received by the slot in the pintle. The pintle is retained in the hinge by its own gravity, and it may be raised or lowered or entirely removed at pleasure without affecting the position or fastenings of the coil spring.

Further information may be obtained by addressing E. L. Richards & Co., 733 Broadway, New York, or the inventor as above.

NEW MECHANICAL MOVEMENT.

The engraving shows a new mechanical movement for changing a reciprocating motion into a continuous rotary motion, the device being capable of producing rotary motion at every point in the revolution of the crank.

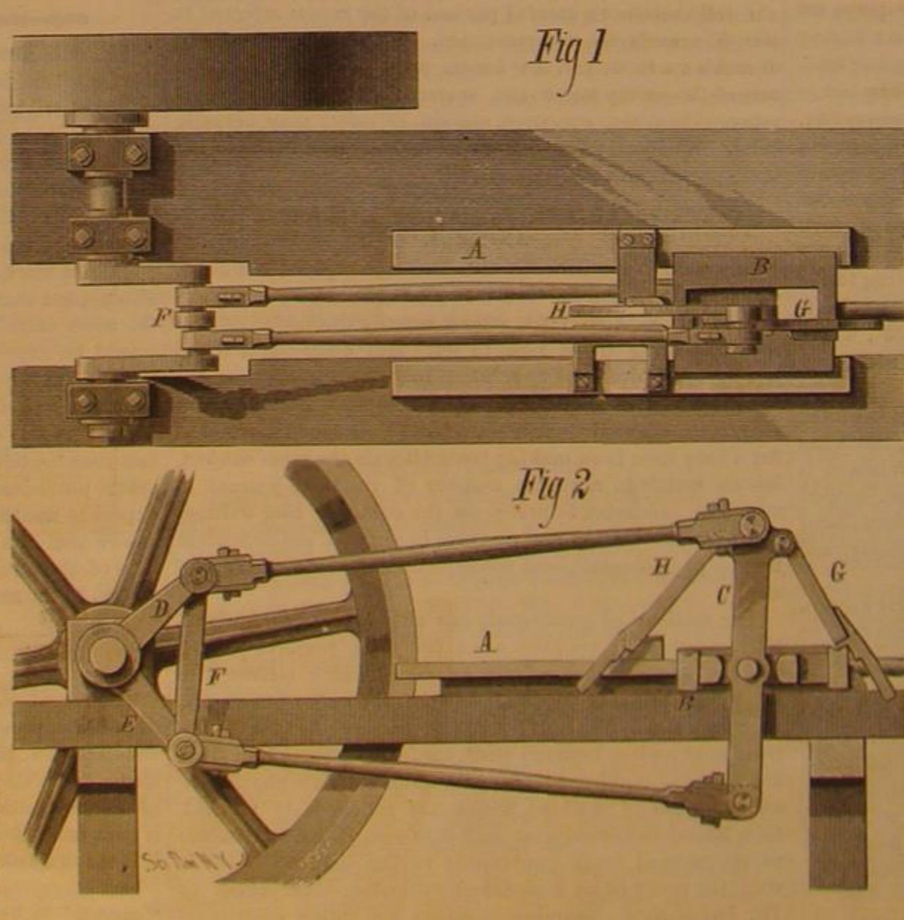
Fig. 1 is a plan view, and Fig. 2 is a side elevation, partly in section, showing the relation of the various parts. The device is represented as connecting the crosshead and crank shaft of a reciprocating steam engine, but it is capable of application to any kind of machinery in which reciprocating is converted into rotary motion. The ways, A, support the crosshead, which is attached to the piston rod of the engine and reciprocated in the usual way. The crosshead carries a lever, C, having at its ends connecting rods connected with the cranks, D E, the latter being connected together by the tie rod, F, so that they stand at right angles to each other. Pawls, G H, jointed to opposite sides of the upper end of the lever, C, are fitted to engage notches in the ends of the auxiliary crosshead, B, and are arranged so that during the stroke one of them may be engaged by an arm attached to one of the ways, A, and the other will be engaged by an arm projecting from the other way.

With the device arranged in this way the engine will turn only in one direction, but by attaching a set of pawls, G H, to the lower end of the lever, C, the engine may be made to turn in either direction, depending of course upon which set of pawls is allowed to operate.

The auxiliary crosshead is of such length relative to the length of the main crosshead that has an independent long stroke—that is, a longitudinal movement at the ends of the stroke which is independent of the movement of the main crosshead, and the ends of the auxiliary crosshead are provided with the grooves with which the notched ends of the pawls, G H, alternately engage while the crosshead is traveling the space of its independent movement. By this means the force during the independent movement of the auxiliary crosshead is transferred through the pawls, G H, to a point above the plane of reciprocation, and applied to the cranks of the shaft through the oscillating lever, C, and the connecting rods at a point above the line of dead-center It will be understood that durirg this time the main crosshead remains at rest, and that the motion of the oscillating bar is only upon its pivot.

When the main crosshead and oscillating bar begin to move, the pawls, G H, are thrown out of engagement with the notches by coming in contact with the arms or projections, which are secured in proper position for that purpose upon the ways, A, as shown in the plan view.

After sufficient motion has been obtained to carry past the dead-center, the auxiliary crosshead is brought to its short stroke by placing blocks between the crossheads or by the employment of a device actuated by a lever, which locks the two crossheads together, when they act as a single crosshead.



HARRIS' MECHANICAL MOVEMENT.

Preservation of India-rubber Tubing under Water.

Mr. Mareck relates his experience of having met with serious annual losses, in consequence of certain kinds of India-rubber tubing soon becoming brittle on exposure. After many experiments, he has adopted the plan of preserving them under water, which he renews from time to time. He found that even the thickest kind of tubing will thus remain soft and pliable without losing elasticity; nor has he found any other drawback by adopting this plan, except this, that they undergo a change in appearance. Red or brown tubing gradually fades, and becomes brownish or grayish-yellow; gray tubing becomes darker and browner externally. A section of tubing reveals the fact that about one-half of the thickness of the rubber, from the outside toward the middle, appears bleached and fatty; but the change is one which is rather of benefit for their practical use. The author adds that very thin rubber bands, with which other goods were tied, became so soft that they could be rubbed to small crumbs with the fingers.—*Dingler's Polyt. Jour.*, 239, 325.

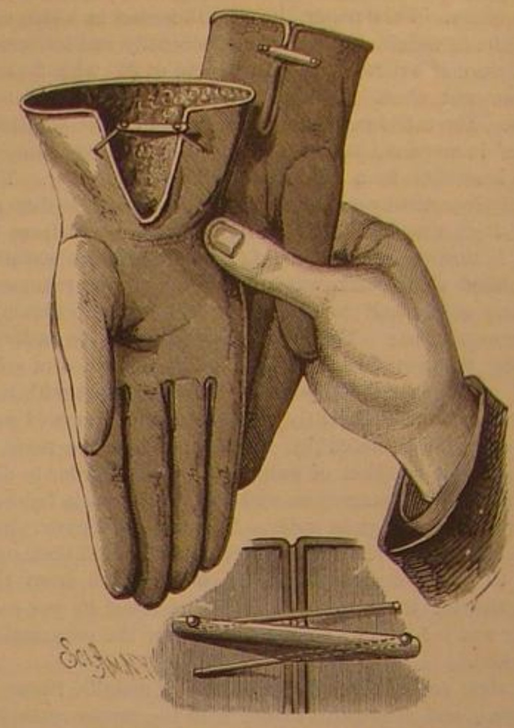
A Stray Balloon.

Mr. John W. Tobias, of the whaling brig Rosa Baker, which arrived at Boston on July 1, reports that on June 17, at noon, in latitude 27° 50', longitude 67° 30', he observed a large balloon in the westward. It was apparently about one mile in elevation and about five miles distant, and proceeding slowly in a northwesterly course. We set our colors, but could get no signal from it. The aerial traveler remained in sight until 3 P.M., when the weather became cloudy and it was hidden from our view By the aid of our glasses we could distinctly see the car that was attached to it swaying to and fro as it moved along, but could not observe any occupants. The balloon seemed to be of a white or cream color, and of large size. It was proceeding in the direction of Cape Hatteras, the nearest point of the American coast, distant upward of 600 miles.

NEW GLOVE FASTENER.

An improved glove fastener lately patented by Mr. Frederick Schramling, of Sabula, Iowa, is shown in the engraving.

The invention consists in a metal strip or plate with side lugs or flanges, connected with two wires attached to the opposite lapels of a glove or mitten, the other ends of the wire being bent and passed loosely through apertures in the ends of the strip, and are prevented from being drawn out of these apertures by knobs or buttons at the ends of these wires. The glove is closed by turning the flanged strip in



SCHRAMLING'S GLOVE FASTENER.

such a manner that the wires will be crossed longitudinally between the flanges or side lugs of this strip or plate.

Figure 1 shows one of the gloves with the fastener open, while the fastening of the other glove is closed. Figure 2 shows the fastener in detail.

When the fastener is opened it gives ample room for the insertion of the hand, and when it is closed it is self locked and holds the glove properly in place.

MECHANICAL INVENTIONS.

Mr. Frank W. Kepner, of Houlton, Me., has patented an improved mill-feeding device, the object of which is to prevent choking of the mill feed. It is impossible to clearly describe this invention without engravings.

An improved wood-sawing machine has been patented by Mr. William H. Mellott, of Ray's Hill, Pa The object of this invention is to facilitate the sawing of wood and promote convenience in operating sawing machines.

Mr. John H. Boren, of Haubstadt, Ind., has patented an improved water elevator which is so constructed that when the filled bucket is raised an empty bucket is lowered. The invention consists in a chute or gutter passing through the frame of the water elevator, and provided with a parallel rod a short distance above it, on each side, against which projections on the buckets catch, thereby tilting the buckets so that their contents will flow into the chute.

Much difficulty has been experienced in running millstones from backlash from the face of the stones getting out of relative position, and consequently irregular grinding. To overcome these difficulties Mr. Frederick Mayo, of Zanesville, Ohio, has patented a millstone driver having arms with adjustable springs, to compensate for backlash, to prevent irregularities in the running of the stone and insure the best results otherwise.

An improved table for wood-working machinery has been patented by Messrs. Michael Lally, of North Lawrence, Ohio, and John J. Kehoe, of New York city. The improvements relate to the tables of band, jig, and other saws, and the tables of other wood-working machinery upon which the material is required to be moved by hand. In this apparatus the work moves upon a series of balls adjustably supported and capable of turning freely in any direction.

An improved lathe attachment has been patented by Mr. Harry C. Barnes, of Vallejo, Cal. The object of the invention is to combine with a lathe an attachment by which teeth may be cut in gear wheels with accuracy and rapidity.

Mr. Robert Rutter, of Dillon, Montana Ter., has patented an improvement in the construction of the wagon brakes known as the "California" or "roller" brakes in such a manner that they can be reversed to bring the brake lever upon the right or left side of the wagon, according as the brake is to be "put on" by a man riding on the left-hand wheel horse or by a driver riding in the wagon.

AGRICULTURAL INVENTIONS.

A novel combination, with the seed dropping slide of a corn planter, of a pair of rimless wheels, a shaft, a series of elastic arms, and a cam, whereby provision is made for dropping the corn at regular intervals, has been patented by Messrs. Nimrod J. Curtis and W. J. T. Curtis, of Martelle, Iowa.

An improved combined harrow, seeder, and roller has been patented by Messrs. Robert Lang and James B. Lang, of Lindsay, Ontario, Canada. The object of this invention is to till or mellow the soil, sow the seed, and smooth or roll the land at one operation.

Mr. John C. Waddell, of Union City, Tenn., has patented a broadcast seed sower for sowing clover seed and other fine seeds, so constructed as to sow the seed in uniform quantities; and so stop the escape of seed automatically when the mechanism comes to a state of rest, and which can be readily adjusted for sowing any desired quantity of seed per acre, and finer or coarser seeds, as may be desired.

A New Exhilarating Substance.

Dr. Luton, of Rheims, calls attention in a French medical paper to the exhilarating properties of the tincture of ergot of rye when associated with phosphate of soda. The circumstances of the discovery were as follow: A woman of 62, at the infirmary of the *Maison de Retraite*, in Rheims, was receiving tincture of ergot of rye for disease in the knee. Fearing an unfavorable turn, the doctor thought to strengthen the action of that medicament with phosphate of soda, and accordingly combined a little of the two substances in a quarter of a glass of sweetened water. The patient, about three-quarters of an hour after taking this, surprised the inmates by bursting into loud laughter, without obvious reason, and this continued for more than an hour, with brief intervals. The laughter seemed to be associated with merry ideas, and to indicate a kind of intoxication. For some time after it died down the woman was in great spirits and good humor. Dr. Luton had not witnessed the scene, but the consequences to the patient being good, he administered the substance again, and a third time, observing the same effect. The experiments were further repeated on seven or eight women and girls with like results. In the case of men the action of the substance is less marked: it appears only in coloring of the face, giddiness, and slight headache. The effects in question have probably a common origin, it is thought, with those from eating rye bread when, in rainy years, the cereal contains as much as five per cent of ergot. A sort of intoxication is produced which the consumers by no means despise.

Increased Occupation for Women.

Mrs. Mary A. Livermore says that one evening twenty years ago a few ladies, interested in the welfare of women, discussed the employments open to women. They counted eleven and could think of no more. Recently the same ladies repeated the enumeration, and were able to point out 287 employments which women could engage in.

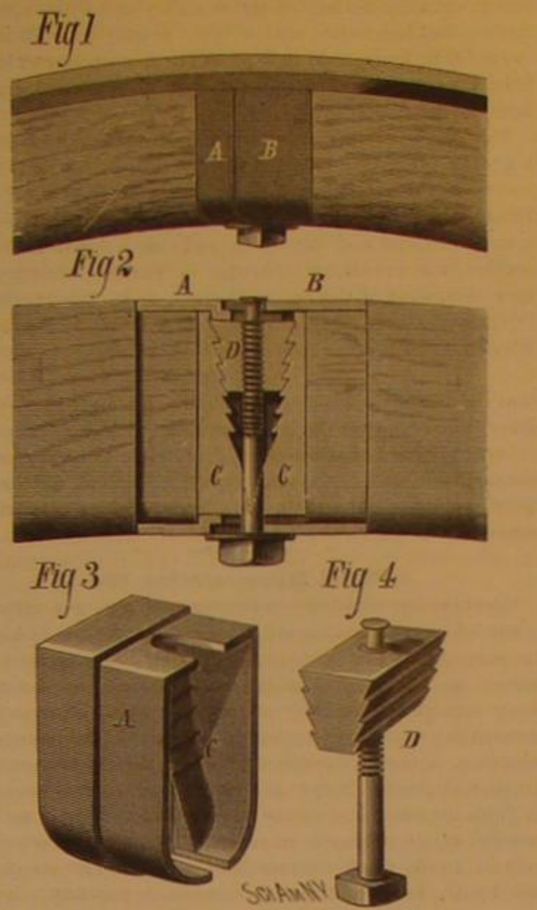
A Gift to the Museum of Natural History.

Mr. Robert L. Stuart, President of the Metropolitan Museum of Natural History in Manhattan Square, has presented to the museum the valuable "De Morgan" collection of prehistoric stone implements from the river gravels and peat beds of Northern France. The series of specimens representing the Stone Age in Denmark at the Centennial Exhibition were already in the possession of the museum; and the gap between that collection and the one just acquired is filled by the magnificent collection deposited by Mr. G. L. Feuardent, which in itself includes a series of objects belonging to the period of the river man in England, the cave man of Southern France, the latter from excavations made by the Marquis de Vibraye, from the tertiary and quaternary habitations of the Lovie Valley. The lacustrine period is fully represented in the Feuardent collection by the finds of Dr. Gross in the Swiss lakes, comprising stone implements with their original handles of stag horn, jade axes, chisels, etc., pottery of all sorts, and finally, numerous tools and ornaments of the bronze age from the same locality. This collection is completed by the ovidian implements from Greece. Prof. Spencer F. Baird, speaking of these two collections, says that no museum on this continent, the Smithsonian included, possesses anything equal to those now brought together at the Museum of Natural History. The museum is also rich in American antiquities.

Carbon tracing paper is prepared by rubbing into a suitable tissue a mixture of 6 parts of lard, 1 part of beeswax, and sufficient fine lamp-black to give it a good color. The mixture should be warm and should not be applied to excess.

NEW TIRE TIGHTENER.

The engraving represents a novel device for expanding the fellies of wagon wheels, so as to tighten the tire and prevent the wheels from being wrecked, as they frequently are when the tire becomes loose.

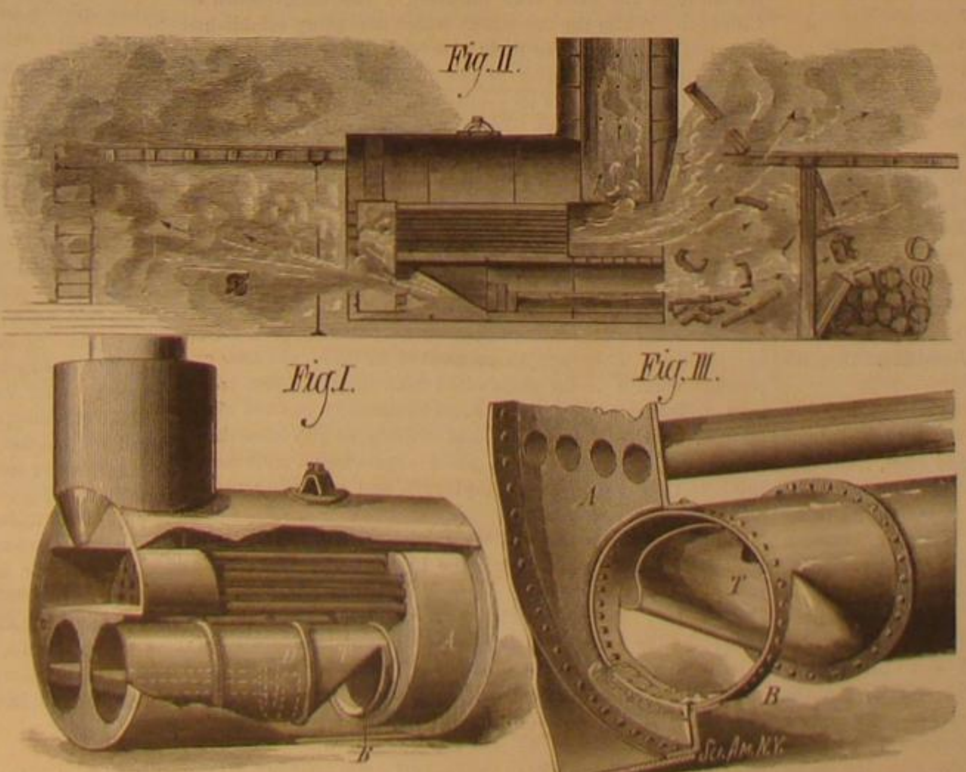


WILKIN'S TIRE TIGHTENER.

A, B, are telescoping metallic ferrules, provided with recesses, into which the ends of the felly sections are fitted. These ferrules are provided with diagonal toothed faces, C, having between them a wedge-shaped opening, when the ferrules are fitted together. An endless screw carries an elongated nut, D, having diagonal toothed edges, the inclination of which corresponds with the incline of toothed faces, C. The screw is fitted through the ferrules, as shown, so that it has a bearing in the upper plate of ferrule, B, and a projecting head on the inner side of the felly, by which the screw may be turned.

When the wheel is constructed the device is inserted at the joint with the ferrules, telescoping as far as possible, and with the nut at the top of the wedge-shaped opening. When the felly needs tightening the screw, D, is turned, and the nut, E, travels toward the head of the screw and forces the ferrules apart, and with them the felly-sections. As the nut travels along the faces, C C, of the ferrules, the teeth on its edges ride over the teeth on the faces, the teeth interlocking when the nut is stationary, so preventing it from being moved back toward the tire by jar or vibration. The expansion of the fellies caused by forcing apart the ferrules tightens the joints of the wheel and expands it so as to tightly fit the tire.

This invention was lately patented by Mr. Alfred Wilkin, of Toledo, O, who may be addressed for further information.



EXPLOSION OF THE BOILER OF THE WRECKING STEAMER B. & J. BAKER.

COLLAPSE OF A STEEL BOILER FLUE.

BY S. N. HARTWELL.

On Sunday morning, the 12th of June, 1881, one of the large flues in the boiler of the wrecking steamer B. & J. Baker collapsed while the vessel was lying at anchor off the coast of Virginia. The accident resulted in the death of three men and the scalding of one or two other men. Very little damage was done to property other than to the boiler itself. The vessel was owned and used by the wrecking firm of Baker & Co., of Norfolk, Va., but with other property of that company it is believed to have since changed owners. The vessel is described in the government certificate of inspection, which expires January 22, 1882, as a small passenger steamer, built of wood at Baltimore, in 1864, 212·67 tons register, rebuilt at Norfolk in 1870, having one low pressure (?) engine, 22 x 24 inches, and one iron and steel boiler, built in 1877, 16 feet long by 7 feet diameter, and allowed to carry 50 pounds steam pressure per square inch. There were on this boiler, according to the same authority, the usual safety appliances, namely, two safety valves, three gauge cocks, two steam gauges, and a fusible plug. This vessel is a propeller, and was used for towing and lightering.

It was a tugboat boiler, of the return tubular type, shown in Fig. 2, where the boiler is represented with its port side toward the observer, part of the shell being omitted to show the broken furnace tube. The diameter and length of the boiler are given above. It had two 27 inch round furnace tubes, straight from the boiler front to the back connection, each made of three steel plates about quarter inch thick, which were secured together by outward-turned riveted flanges. A fire-brick bridge wall in each tube at about two-thirds the length from the front, upon which the fire grates abut, divides the tubes into furnaces, ash pit, and flue leading into the back connection, whence the gases return to the up-take chamber and chimney above the furnaces through seventy-five small tubes. Cast iron doors, with door frames bolted to the front boiler head above the grate level, formed the front walls of the furnaces.

The facts contained in this report were obtained through the politeness of the owner, Mr. J. Baker, who gave the writer permission to examine the interior of the vessel and the broken boiler, which was done before anything involved in the explosion had been moved. Men and means to facilitate the examination were placed at his disposal, in the belief that something would be brought to light in explanation of the accident that came upon them so unexpectedly after having done all in their power to make the vessel safe and efficient.

Fig. 1 is a sectional view of the boiler and fire room. It is intended to explain the course of the escaping contents of the boiler, and the effect on objects in the vicinity. The engraving, by means of the arrows, sufficiently explains the direction taken by the broken objects, which consist of the boiler hatch beam, the bulkhead forward of the boiler, which separated the fire-room from the forward storage room in the hold, the cast iron doors and their frames, all burst off and broken from the front head. The bridge wall and grate bars from the port furnace, and the back connection door from the rear end of the boiler. Hatches and skylights were blown off. The whole interior of the vessel's hold bore marks of the force with which things were driven before the scalding torrent that was impelled by its contained heat with terrible velocity.

Fig. 3 is a sketch on a larger scale showing the rear end of the collapsed tube and a part of the tube head in section. Also the patch upon the lower part of the tube.

The thickness of the plate, T, at the thickest margin of the rupture where a gauge could be applied, was found to be 0·220 of an inch, near the extremity of the torn edge, about half way up the side of the tube. From there to the point, B, the lowest part, the thickness decreased, the metal having wasted by corrosion on the water side, so that after rupture it showed a ragged knife-edge. Near the edge, on the bottom, holes were corroded entirely through. On the lower exterior surface of the other tube were found broad shallow pits of irregular shape extending over a large area, indicating that this tube was thin also, but not as far gone as the port one.

The patch at C, Fig. 3, covering the lower part of the flanged seam, and the rear end of the longitudinal seam of the broken tube, is sufficient proof that the engineer had been warned by a leak that a weakness, or at least a defect, existed here, and it was his duty to have tested with proper tools the surrounding parts before applying a patch. Drilling his bolt holes in the flue should have shown him that the plate was too thin, and he should have reported the deterioration that was going on to his owners and the local inspectors. It is obvious that the man in charge of the boilers should watch for and report dangerous defects to the proper officers, otherwise how can they know of their existence and be responsible for results that may occur in the interval between regular inspections?

The *Tribune* has the following relating to this explosion: "The report of the United States local inspectors of steam vessels at Norfolk, Va., upon the accident to the wrecking steamer B. & J. Baker, was received by Superintendent Inspector-General Dumont on the 23d of June. It states that the accident was the collapse of the port flue caused by over-pressure. The evidence of one of the deck hands shows that the engineer on watch was asleep in his berth at the time of the accident, and this evidence is corroborated by the fact that his body was found in his berth. The condition of the boiler shows that all the doors were closed."

This is the whole of it; overpressure meaning a pressure *a little too great* for the weak flue. It may, however, have been within the limit of fifty pounds per square inch allowed by the certificate, which was written less than five months before, or else what good were the safety valves, which should have been automatic in their action whether the engineer was asleep or awake? No theory is therefore necessary in this case to account for the immediate cause of the accident. The remote cause from which the deterioration of a strong flue of the best quality of homogeneous metal that is known to modern engineers, arose is not so clear, although much has been written and some indirect experiments have been made by the British Admiralty Boiler Commission for the purpose of finding a remedy for the rapid deterioration of boilers in the Royal Navy, since the introduction of surface condensation. Rear Admiral C. Murray Aynsley, a member of that Commission, contributed a paper to the Journal of the Royal United Service Institution, which was printed by Van Nostrand in November, 1880. From the part of the paper in which the Admiral summarizes the report of the Commission's Ocean Plate Experiments, it appears that a set of plates of bright but not polished steel and iron, four inches square by ⅜" thick from different makers in England were sent to "men of war in the Mediterranean, West Indian, Pacific, Australian, China, Brazil, Cape, and East Indian stations, troop ships of the home and foreign service, tugs in home ports, and merchant vessels belonging to as many as forty-five of the principal steam ship companies, trading in every part of the globe." A blank form was supplied with each set of plates to be filled in by the chief engineers. The following table is made from forty-two sets of these papers, all that were available when the paper was prepared, showing the loss in grains per square foot for each ten days the plates were in the boilers. The table is rearranged, so as to be intelligible as far as may be without the balance of the paper, space for the whole of which is not now available.

The point made by the author of this paper related to the effect of the presence or absence in the boiler, used in conjunction with surface condensation, of air (gas) which would be brought in with the feed water used to make up the waste in blowing off, and by leakage. The table is arranged from his data in groups such as they were divided into by him.

	Loss in grains per square foot in 10 days.
Group (1). Those that do not change any of the water at sea, mean of 10 sets of experiments........................	66·49
Group (2). Those that change 3 inches in depth of water in the boiler in 24 hours; mean of 9 sets of experiments.........	26·49
Group (3). Those that change between 3" and 12" in 24 hours; mean of 7 sets of experiments	149·87
Group (4). Those that change more than 12" in depth of water in the boiler in 24 hours; mean of 6 sets of experiments...	323·75

From this it will appear that where the greatest amount of water was daily changed, involving the introduction of air, which contains the very active corrosive agent carbonic acid gas, then the experimental plates suffered most from corrosion.

The author of the paper states what does not appear in the table, that the plates in those boilers of group 1 that were emptied at the shortest intervals suffered more than the others in that group.

He next compares steel with iron plates as regards rapidity of corrosion, and the different brands of English steel, from which it appears that crucible steel suffered least, Bessemer next, and Siemens-Martin most under like exposures, while Staffordshire iron suffered least of all, Lowmoor ranking next to crucible steel. The extremes, however, between Staffordshire iron, 123, and soft steel, 155 grains per square foot in ten days, was not so decided as when they were exposed in boilers in connection with jet condensation, when the figures were, iron 119, and steel 179 grains.

Then fresh and sea water are compared as to their corrosive action, with the following results referring to the groups in the table. Group 2, fresh water, loss 49 grains; sea water, 102 grains; group 3, fresh, 73; sea, 166, while in the first group, no blowing off, fresh water was the most active as 28 is to 20. From all of which the author of the paper concludes that when no change of water is made sea water has the advantage, but when from 3 inches to 12 inches of the depth of the water in the boiler are daily blown out; then fresh water has the advantage. He cites a case of comparison of a boiler and a feed water heater where the loss in the heater was 93 grains, and in the boiler only 16½ grains, the air (gas) having been trapped in the heater. Without attempting to explain the corrosion that occurred on board the Baker, the writer desires to call attention to the practice that there prevailed, according to a letter recently received from her gentlemanly and obliging master, Captain Charles L. Nelson, in answer to inquiries. The substance of his answers are that the boat is fitted with a surface condenser, from which the water is returned to the boiler, entering the back head on each side a little below the center; that the habit was to blow twenty-four inches in twenty-four hours, and that when lying at anchor water was fed from the sea and passed through a heater entering the boiler at 80° to 100° Fah.

The *Norfolk Virginian* of current date printed the following: The investigation into the causes of the accident to the boiler of the wrecking steamer B. & J. Baker, off Cape Henry, on Sunday morning last, by which three colored men were killed and one white and one colored man were scalded, was concluded yesterday in Berkley, the coroner's jury consisting of George T. Hodges, J. R. Humphries, R. D. Cornick, G. W. Stell, Nathan Jones, and J. N. Etheredge, who rendered the

VERDICT

that the victims came to their deaths by an explosion of a flue of the boiler of the steamer B. & J. Baker, caused by an over pressure of steam resulting from gross neglect of the engineer, and, from the evidence elicited, we the jury fully exonerate the remaining officers and owners of said steamer.

A Model Manufacturing City.

Great manufacturing establishments are generally the result of growth from small beginnings. A shop is located in some cheap and undesirable region, the workmen find homes as best they may anywhere around, or sometimes hasty structures are erected for their occupancy, and the enterprise commences operations. There is no pretense of elegance, or taste, or comfort, either in the establishment or its surroundings. Noise, dirt, and discomfort characterize it from the start, and as the establishment grows, and the number of its employés increases, the same characteristics extend to the whole surrounding region. The streets are filled with cheap unattractive cottages or vast unwholesome tenement houses. The gutters overflow with filth, in which unwholesome children endeavor to find amusement. No spot of green grass, no bough of green tree is seen, a pall of smoke hangs over the settlement, and grime and squalor, and often disease, accompany the development of the great industrial establishments where labor finds employment and support. While it is true that there are many manufactories where the result of prosperity has been shown to some degree in the construction of excellent buildings and the adornment of the surroundings, still the vast number of our industrial works are anything but inviting to the eye, or indicative of care on the part of their proprietors for the happiness and the health of their workmen. Indeed, when a place has been started, as most manufactures are, without regard to appearances or comfort, and its growth has taken the same form, it is almost impossible ever to regenerate it.

To build up a modern manufacturing village, the work must be begun at the bottom. While there are examples in this and other countries where this has been done, there is nothing anywhere to compare, either in perfection and breadth of plan or rapidity of execution, with the new town of Pullman, which, within a few months, has sprung up on the shore of the little lake Calumet, a few miles south of Chicago. While the car works which are being established here are remarkable for their size and perfectness, it is not the manufacturing aspect of the matter of which we wish here to speak. It is in its relation to such a village or city as is here being built up by a single organization, to the army of men whom it will employ, to their families, and to society, of which they form a part, that this enterprise shows its grandest phase. Here we are to have an illustration of what a man with unlimited means, and actuated by a broad philanthropic sentiment, which at the same time is backed by an eye to business prudence, can accomplish.

The town of Pullman is not a public charity. Its workmen are not to be supported as paupers or amused as children. They are to be treated as men who can appreciate what it is for themselves and their families to be surrounded with the comforts and luxuries of modern civilization, and who are glad and willing to pay something for it, and who will show their appreciation by rendering better service to their employers, and becoming useful and self-respecting citizens.

June, 1880, the site of this model town was a broad stretch of prairie over which the high grass waved undisturbed by wheel or foot. Here Mr. George M. Pullman, President of Pullman's Palace Car Company, decided to undertake the grand work of founding a model manufacturing town, which had been for years his dream.

The work once commenced was pushed with extraordinary energy. All through the bitterly cold winter the walls were arising, when the workmen were obliged to have fires burning upon them to keep themselves from freezing, when the stone and brick had to be picked out from the drifts of snow and the packing of ice in which they were buried, and when the workmen, to the number of a thousand or more, had to be carried to and from the city a dozen miles every day. But in spite of the elements the work went on, and to-day there stands a group of vast and imposing buildings, forming a manufacturing town for workmen such as is not seen anywhere else. The houses are handsome, even elegant, brick structures with stone trimmings and slate roofs, and from one to two and three stories in height, supplied with perfect sewerage, running water, gas, baths, marble fireplaces, and many other forms of modern improvement in dwellings, equally as complete as those which a millionaire can obtain. A beautiful park adorned with trees, choice shrubs, and winding walks fronts the new city. A little lake whose bed was formed by excavating the earth for filling other portions, shines like a gem in front of the great manufactory. The railway station where the visitor gets his first impression of the place is not a dingy weather-beaten shanty, but a gothic structure of brick, itself a model of taste and elegance. There are rapidly arising a hotel 100 feet square; a market house of equal size, where various articles of food can be cheaply obtained; an arcade building, which will contain a public library, art gallery, association rooms, and some fifty stores and business offices. Plans are being devised by one of the leading educators of the country for school accommodations, and churches will quickly appear.

On the whole vast tract of some 3,500 acres owned by Pullman's Palace Car Company and the Pullman Land Association, where this great scheme of a model manufacturing city is to be worked out, not a single liquor saloon will be tolerated to corrupt the morals and deplete the pockets of the inhabitants. The character of the enterprise itself removes the excuse which is often urged for the existence of saloons—that they afford the poor man his only place of amusement and his only solace. When the day's work is over the workman will not be tempted to seek refuge in the saloon from filth and disease and discomfort at home. His home itself, the beautiful surroundings of park and lakes and shady groves, the library, the reading room, the indications all about of peace, order, cleanliness, and health, will tend to make repugnant to him the thought of the squalid saloon and its imbruted frequenters. All his surroundings will impel him to take high views of life in its possibilities and move him to set a worthy example to his children.

Before the first year shall have elapsed, not far from two millions of dollars will have been poured out in the development here of this remarkable and philanthropic scheme. At the same time it is not a Utopian enterprise. While the workingman can obtain a charming home for from $9 to $16 a month, with all the conveniences and luxuries of modern house architecture, the rental will pay a handsome interest on the cost of the building and also on the value of the land at a figure vastly enhanced over the original cost, so that in helping the thousands of workingmen and their families who will form the nucleus of this new city the projectors will at the same time receive a fair return for their financial risk and expenditure.

The result of this remarkable enterprise will be watched with great interest as inaugurating a new era in the foundation and development of manufacturing industries, in which the condition of the workingman will play a far more important part than it generally has hitherto. It will show that it is not only a kind and benevolent thing for employers to make the workingman comfortable and contented, but a profitable thing, because it makes him a better workman and removes from him the feeling of discontent and desire for change which too often characterizes our working population. The town of Pullman is an exemplification of practical philanthropy based upon business sagacity. May its leading characteristics and the motive which prompted its public spirited projector prove examples which shall have many emulators!—*Railway Age.*

A Durable Whitewash.

To the Editor of the Scientific American:

In regard to the query of C. B. C., in your last number, in relation to whitewashing, I believe I have tried every known wash. The so-called White House stucco wash is no better than any ordinary whitewash. No brick wall that ever is intended to be painted should be whitewashed. All washes absorb water, and in damp weather lose their color.

The best wash that I have ever heard of is made as follows: For one barrel of color wash—Half a bushel white lime, 3 pecks hydraulic cement, 10 pounds umber, 10 pounds ocher, 1 pound Venetian red, quarter pound lampblack.

Slake the lime; cut the lampblack with vinegar; mix well together; add the cement, and fill the barrel with water. Let it stand twelve hours before using, and stir frequently while putting it on.

This is not white, but of a light stone color, without the unpleasant glare of white. The color may be changed by adding more or less of the colors named, or other colors. This wash covers well, needing only one coat, and is superior to anything known, excepting oil paint.

I have known a rough board barn washed with this to look well for five years, and even longer, without renewing.

The cement hardens, but on a rough surface will not scale.

T. G.

Cincinnati, Ohio, July, 1881.

THE trust fund created by Professor Tyndall upon his departure from this country has accumulated sufficiently for the purpose to which he devoted it: The assistance of needy American students in physics who should show aptitude for original study and should wish to complete their education in Germany. The fund will now furnish a moderate income to two students.

RECENT INVENTIONS.

Mr. Eugene Wessells, of Peekskill, N. Y., has patented an improved automatic mechanism for feeding animals. It is designed to be operated by a heavy weight, and its movements are controlled by a clock.

An improved chamber vessel has been patented by Mr. Arthur Bird, of Jeffersonville, N. Y. The object of the improvement is to provide means for tightly sealing vessels used in sickrooms, hospitals, and other places, so as to prevent escape of gases and odors. The invention consists in swinging covers fitted for being opened and closed by hand or by movement of the seat.

Mr. Henry Eitenmüller, of Butler, Pa., has patented an improved beehive of handsome appearance, which affords ready means for the inspection of its interior, and an easy and convenient removal of the upper comb boxes and the improved comb racks in the brood chambers, means being also provided whereby the honey made in the hive shall be made more secure against marauding bees.

Mr. Samuel B Knapp, of Osceola, Iowa, has patented a device for attracting insects, which drop into a poisoned liquid in the apparatus, and are thus destroyed.

An improved billiard table on which a game can be played with two or more balls, has been patented by Mr. Edmond J. Sause, of Brooklyn, N. Y. The invention consists in a billiard table provided with the ordinary cushioned end rails, and with a central cushion attached to a stud projecting from the table.

PHOSPHORESCENT SUBSTANCES.

Phosphorescence, or the emission of light without flame or sensible elevation of temperature, is a phenomenon exhibited in a greater or lesser degree by many substances—mineral, animal, and vegetable—and is developed under a variety of conditions. In a few substances the light is developed by chemical change or a process of slow combustion, as in the case of phosphorus, from which the name phosphorescence has been derived. In others the substance suffers no appreciable change, only requiring exposure to a strong light to shine themselves when taken into the dark. The diamond and many mineral substances develop light in this way, and it is supposed that these substances have the property of absorbing light in the same way they do heat, and of slowly parting with it when taken into the dark much in the same way that hot bodies part with their heat when removed from the source of heat.

With some of these substances the application of heat causes the development of a brighter light (though for a shorter time than would be otherwise required to exhaust the supply); and again, there are some substances, such as fluorspar, that absorb light, but do not give it out until heated.

Many substances also become phosphorescent while crystallizing.

The color of the light developed by many of these substances varies with their nature and the degrees of heat to which they have been exposed. A certain scale of light and color may, therefore, be produced by grouping together different substances or samples of the same substances previously heated at different temperatures.

The following are methods for preparing some of these pyrophors:

BARIUM SULPHIDE.

Finely powdered barium sulphate, free from iron, is formed into balls with gum tragacanth; the balls are dried at a moderate temperature, then placed in a crucible with a luted cover and kept at a red heat for an hour. They are then allowed to cool slowly, and while still warm are transferred to glass stoppered bottles.

A better light is developed from the following charge:

Barium sulphate (C P.)	32 parts.
Magnesium carbonate (C. P)	1 part.
Sulphur (C. P.)	1 "
Gum tragacanth	q. s.

This is heated in the crucible as before described.

STRONTIUM SULPHIDE.

Strontium sulphate (C. P.)	22 parts.
Sulphur (C. P.)	1 part.
Gum tragacanth	q. s.

Proceed as before.

CALCIUM SULPHIDE.—(CANTON'S PHOSPHORUS.)

Calcine clean oyster shells to whiteness in a crucible, separate the clearer portions, reduce these to a fine powder, and place in layers with intermediate layers of flowers of sulphur in a crucible, cover, and heat to dull redness for about half an hour. Cover the crucible tightly and let it cool slowly in the crucible.

Another method of preparing this phosphorescent sulphide is to heat bisulphide of lime—obtained by boiling lime in a little water with twice its weight of sulphur—in a covered crucible at a low red heat for one hour.

CALCIUM AND ANTIMONY SULPHIDES.

Calcined oyster shells	3 parts.
Flowers of sulphur	10 "
Antimonic acid	1 part.

Mix intimately, in fine powder, and heat for half an hour in a covered crucible at low redness.

CHLORIDE OF CALCIUM.

Fuse chloride of calcium in a crucible and pour it out on a clean iron plate. As soon as it becomes cold enough break it into pieces and transfer to well stoppered bottles.

CALCIUM NITRATE.

Dissolve chalk or marble dust in nitric acid, evaporate to dryness, and fuse in a porcelain crucible.

These substances, when properly prepared and exposed to any strong light for a short time, exhibit phosphorescence for some time after removing to a dark place. A calcium sulphide has been prepared that, after a short exposure to sunlight, will continue to give out light for ten hours in the dark. When, by keeping in the dark, one of these substances has ceased to give out light, it may be made to give a series of fresh exhibitions by heating it first with the hand, then over a water bath, and finally on a hot stone plate.

A remarkable phosphorescence is developed in quinia and some of its salts by heat. Spread quinia or its sulphate on a sheet of paper, and spread the paper on a plate of hot metal in a dark room—a strong phosphorescent light develops at the edges and spreads to the center. A similar display is observed in sprinkling finely powdered fluorspar (calcium fluoride) over a plate of hot metal in the dark.

Boracic acid fused and allowed to cool breaks into small pieces, and along the cracks a phosphorescent light appears, which is sometimes strong enough to be visible even in daylight. Potassium sulphate fused with cream-of-tartar shows the same phenomenon.

PHOSPHORUS.

Phosphureted oil is the best means of exhibiting the luminous properties of phosphorus. A small piece of dry phosphorus, about the size of a pea, is placed in a test tube with a little pure olive oil. The test tube is held in the waterbath until the oil becomes heated and the phosphorus liquefies; it is then shaken until the oil will take up no more phosphorus, and, after allowing the oil to become clear, it is poured off into a small glass vial provided with a glass stopper. Only a small quantity of this oil in the bottom of the vial is necessary. When it is shaken about so as to coat the sides of the vessel, and the stopper is removed so as to let the air get in, the oil-coated sides of the glass become at once luminous, and continue so as long as the stopper remains out. Characters written on paper with oil thus prepared (freshly), appear in the dark very brightly.

Phosphureted ether is prepared by digesting phosphorus in ether for some days in a tightly stoppered bottle. A piece of sugar dipped into this ethereal solution and then thrown into water makes the surface of the latter appear quite luminous in the dark.

Young experimenters must remember that phosphorus is very dangerous to handle when out of water, and often inflames spontaneously when exposed dry in the air.

The Storage of Electric Energy.

Sir William Thomson, in a recent note to *Nature*, confirms the favorable results of his previous experiments with the Faure battery. He says: "I am continuing my experiments on the Faure accumulator with every-day increasing interest. I find M. Reynier's statement, that a Faure accumulator, weighing 75 kilogrammes (165 pounds), can store and give out again energy to the extent of an hour's work of one horse power (2,000,000 foot pounds), amply confirmed. I have not yet succeeded in making the complete measurements necessary to say exactly what proportion of the energy used in the charging is lost in the process of charging and discharging. If the processes are pushed on too fast there is necessarily a great loss of energy, just as there is in driving a small steam engine so fast that energy is wasted by 'wire drawing' of the steam through the steam pipes and ports. If the processes are carried on too slowly there is inevitably some loss through local action, the spongy lead becoming oxidized, and the peroxide losing some of its oxygen viciously, that is to say, without doing the proper proportion of electric work in the circuit. I have seen enough, however, to make me feel very confident that in any mode of working the accumulator not uselessly slow, the loss from local action will be very small. I think it most probable that at rates of working which would be perfectly convenient for the ordinary use of fixed accumulators in connection with electric lighting and electric transmission of power for driving machinery, large and small, the loss of energy in charging the accumulator and taking out the charge again for use will be less than 10 per cent of the whole that is spent in charging the accumulator; but to realize such dynamical economy as this prime cost in lead must not be stinted. I have quite ascertained that accumulators amounting in weight to three-quarters of a ton will suffice to work for six hours from one charge, doing work during the six hours at the uniform rate of one horse power, and with very high economy. I think it probable that the economy will be so high that as much as 90 per cent of the energy spent in the charge will be given out in the circuit external to the accumulator. When, as in the proposed application to driving tramcars, economy of weight is very important, much less perfect economy of energy must be looked for. Thus, though an eighth of a ton of accumulators would work very economically for six hours at one-sixth of a horse power, it would work much less economically for one hour at one horse power; but not so uneconomically as to be practically fatal to the proposed use. It seems indeed very probable that a tramcar arranged to take in, say, 7½ cwt. of freshly charged accumulators, on leaving headquarters for an hour's run, may be driven more economically by the electric energy operating through a dynamo-electric machine than by horses. The question of economy between accumulators carried in the tramcar, as in M. Faure's proposal, and electricity transmitted by an insulated conductor, as in the electric railway at present being tried at Berlin by the Messrs. Siemens, is one that can only be practically settled by experience. In circumstances in which the insulated conductor can be laid, Messrs. Siemens' plan will undoubtedly be the most economical, as it will save the carriage of the weight of the accumulators. But there are many cases in which the insulated conductor is impracticable, and in which M. Faure's plan may prove useful. Whether it be the electric railway or the lead-driven tramcar, there is one feature of peculiar scientific interest belonging to electro-dynamic propulsion of road carriages. Whatever work is done by gravity on the carriage going down hill will be laid up in store ready to assist afterward in drawing the carriage up the hill, provided electric accumulators be used, whether at a fixed driving station or in the carriage itself."

Electrotype of the Brain.

A brain, preserved and metallized by the galvanoplastic method, was lately presented to the French Academy of Medicine, on behalf of Dr. Oré, of Bordeaux. Dr. Oré's method (which preserves the brain entire) is briefly as follows: The brain having been so arranged that circumvolutions are well separate, by introducing cotton wicks into the fissures, and so that the preserving liquid may penetrate the ventricles, is kept about a month in alcohol at 90°, so as to acquire good consistency; the wicks are then taken out. The brain is now plunged for ten minutes in an alcoholic solution of nitrate of silver (100 gr. per liter of alcohol), and carefully drained in air. Next, it is transferred to a case in which sulphureted hydrogen is liberated, and it takes a dark hue owing to formation of a surface deposit of sulphide of silver. In about twenty minutes it is taken out, and after exposure a quarter of an hour in air, it is put in the galvanoplastic cell, where it soon assumes a fine metallic aspect.

A Boiler Water Safety Valve.

According to the *Revue Industrielle*, M. Barbe has successfully introduced a guard safety valve for steam boilers, to be brought into action only on emergencies. This valve is placed in a suitable position underneath the boiler shell, and is essentially an ordinary weighted lever safety valve turned upside down. When the valve is opened, therefore, water is blown off instead of steam. M. Barbe argues that, useful as ordinary safety valves undoubtedly are, there are occasions when a sudden and explosive evolution of steam takes place, and at such times these valves are of little service, since the steam cannot escape with speed equal to that at which it is formed, and the pressure consequently rises to the bursting point. In all such cases, in addition to what must be reckoned a possible failure of the ordinary valve for other reasons, M. Barbe's valve would be a complete safeguard, as it would instantly discharge a large quantity of water. It is known that a cubic inch of water increases in volume about 1,700 times when transformed into steam, and therefore the escape of the water would naturally be more efficacious in reducing the danger of explosion than the discharge of an equal bulk of steam. The idea, of course, is not new, but M. Barbe's apparatus for effecting the desired object is very simple and compact, although some objection might be urged against the awkward situation of the valve and the practical impossibility of examining it or keeping it in order during ordinary working; and all experience shows that fittings intended for use solely on emergencies are seldom in working condition when the event for which they are intended arrives. It is, however, stated that experiments have been made with the guard safety valve, under conditions similar to those of actual but dangerous working, and it has answered so well that many have been fixed in French factories.

Lemon Juice in Diphtheria.

Dr. J. R. Page, of Baltimore, in the New York *Medical Record*, May 7, 1881, invites the attention of the profession to the topical use of fresh lemon juice as a most efficient means for the removal of membrane from the throat, tonsils, etc., in diphtheria. In his hands (and he has heard several of his professional brethren say the same) it has proved by far the best agent he has yet tried for the purpose. He applies the juice of the lemon, by means of a camel's hair probang, to the affected parts, every two or three hours, and in eighteen cases on which he has used it the effect has been all he could wish.

Tartaric Acid in Diphtheria.

The topical use of tartaric acid in diphtheria has been successfully resorted to by M. Vidal, who, in one of the foreign medical journals, remarks upon the necessity of thus making use of topical agents against the false membrane, as it has a great tendency to spread by a sort of auto-inoculation, comparable to what occurs in certain cutaneous affections. His formula is ten parts, by weight, of tartaric acid, fifteen of glycerine, and twenty-five of mint water. The acid acts upon the false membrane, converting it into a gelatinous mass, and favors its expulsion.

The Lady Franklin Bay Expedition.

The Arctic expedition for meteorological and geographical exploration left St. Johns, Newfoundland, at noon, July 7, for the station selected for it near Lady Franklin Bay. The party will call at Disco or Upernavik, Greenland, for Esquimau hunters, dogs, clothing, etc., and then hurry on to the end of their journey. The steamer will at once return to Newfoundland. The expeditionary force is commanded by Lieut. A. W. Greely, Fifth Cavalry.

Varnish for Gelatine Negatives.

Collodion, by itself—even the ordinary porous collodion employed in negative work—answers admirably, says the *British Journal of Photography*. As a protection against damp its effect is simply marvelous; for, should the moisture penetrate it and reach the gelatine film, it possesses sufficient elasticity to withstand the strain put upon it. It exhibits little tendency to absorb silver from the damp printing paper, and in the event of actual moisture being accidentally present when in contact with the paper there is no fear of adhesion. For portraiture the film will bear working on with the pencil in retouching, though from its hardness and smooth surface it is usually desirable to use a "medium" to give a "tooth" which will take the pencil.

In preparing a special collodion for the purpose we should select a good, tough—not necessary "horny"—sample of pyroxyline, and use it of the strength of not more than four grains to the ounce, with two or three drops of castor oil. The best protective medium we have used consisted of a collodion made from celloidine, which gives a remarkably clear and structureless film, and may be used stronger than ordinary pyroxyline. Five grains of celloidine and two drops of castor oil to each ounce of solvents will answer well. There is a slight advantage in employing a small excess of ether over alcohol in dissolving—say nine parts of ether to seven of alcohol—both being as free from water as possible, and the negative very thoroughly dried before application.

ELECTRO-MASSAGE.

A large portion of electrical treatment that hitherto could only be carried out by specialists by using elaborate apparatus, by the proper use of a new mode of treatment, by employing the apparatus shown in the engraving, can be intrusted to the hands of those who are not so skilled.

By means of this simple machine the manipulator transfers the mechanical motion used in rubbing the patient into an electrical current, and the current as it is generated is transmitted through the part while being rubbed, and it fulfills the requirements of a treatment including rubbing, kneading, pounding, flexing, etc., combined with the application of the electric current.

The instrument consists of a metallic roller covered with chamois leather or other suitable material, an electro-magnet, and a permanent magnet set in a strong frame, which holds the instrument together. The roller, besides acting

DR. BUTLER'S ELECTRO-MASSAGE INSTRUMENT.

as the driving wheel of the machine, is so arranged that it also acts as one of the electrodes by which the current is transmitted, and is connected by gearing with the electro-magnet so as to cause the poles of the latter to revolve opposite those of the permanent magnet which forms the handle of the instrument. Each revolution of the roller produces twenty five revolutions of the electro-magnet, which is magnetized and demagnetized at each revolution, and thus induces a current of electricity which is ample for all purposes for which it is intended. The circuit is completed by connecting any required electrode by the binding post at the side of the instrument, the roller acting as the other electrode; both are brought into contact with the surface of the body of the patient, and as the roller is moved about over the surface, the current is established and transmitted through the part over which the roller is made to revolve.

This machine includes in itself an electric generator, a rubber, kneader, a manipulator, and a set of electrodes, all in one. Any person of ordinary intelligence can be taught to use it under the direction of the attending physician. It is portable, being quite capable of being carried in an overcoat pocket.

The inventor finds in practice that it has far exceeded his expectations, inasmuch as by its use he gets greater tonic effects than from the employment of both faradism and massage separately. It fulfills most of the requirements of the induction current in general practice and every-day cases. As the current is generated by motion, no acids or liquids of any kind are necessary. The instrument is at all times ready for use, a matter that will be appreciated by all who use electricity.

This treatment has been used with great success in cases of nervous exhaustion, debility, neuralgia, rheumatism, paralysis, etc., and we are informed that it is recommended by the medical profession generally.

This invention has recently been patented by Dr. John Butler, of New York city. Communications in regard to the instrument may be addressed to the New York Dynamo-Electric Manufacturing Company, 907 Broadway, New York city.

NEW REFLECTOR FOR SUSPENDED LAMP.

We give an engraving of an improved reflector for suspended lamps recently patented by Mr. John J. Smokey, of

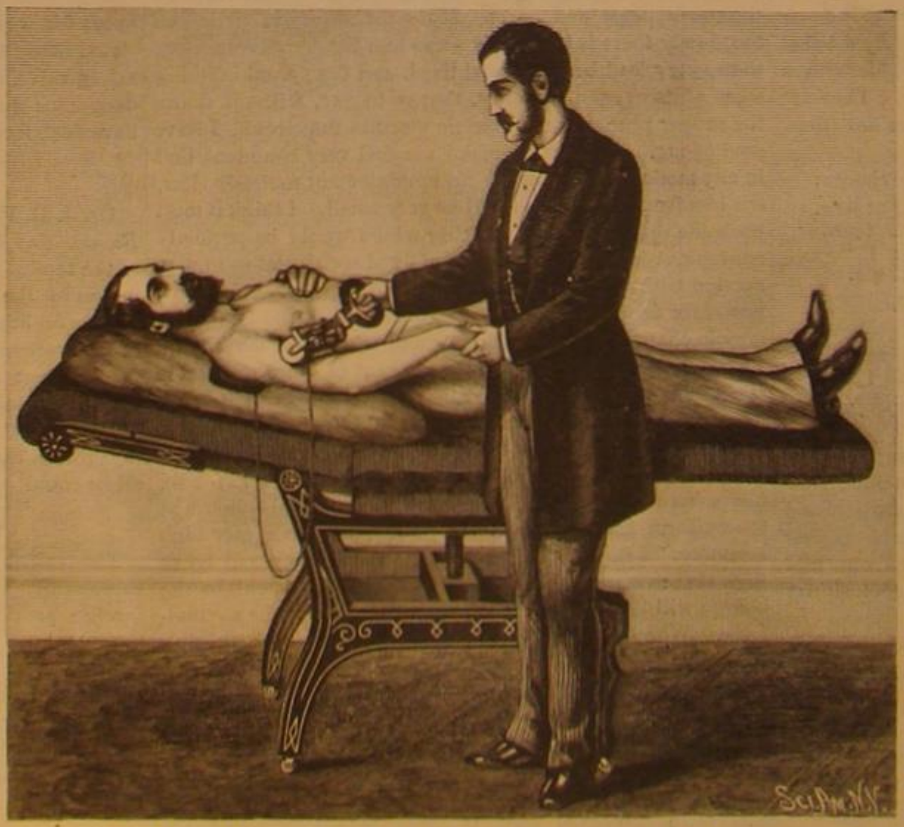
SMOKEY'S LAMP REFLECTOR.

Natchez, Miss. It is designed to increase the effectiveness of lamps by throwing down the greater portion of the light and preventing the shadow of the body of the lamp. The lamp is suspended by chains from a wire loop which also supports the reflector, and above it a small concave plate for receiving the heat that escapes through the opening in the center of the reflector.

The reflector is made in the form of a low cone from two to five feet in diameter according to the size of the room to be lighted, and is placed from nine to thirteen feet from the floor. It is made from tin, brass, or copper, and nickel plated to give it a bright and permanent reflecting surface. The device is inexpensive and adds greatly to the efficiency of the lamp.

The Bray of the Mexican Donkey.

The New Orleans *Democrat* recounts the many good qualities of the Mexican burro that has lately been introduced into that city as a child's horse, who, it seems, can banquet on splinters and scraps, carry immense loads, and is faithful, uncomplaining, docile, and tireless; but "we regret to say," continues the *Democrat*, "the burro brays. Amazing as is his strength, his stamina, his amiability, his courage, these things are as nothing compared to his bray. That such a tremendous and far-reaching sound should emanate from so small a source constitutes the eighth wonder of the world. When the little blue burro—they are nearly all blue—concludes to celebrate his scanty period of relaxation by a good, healthy, whole-souled bray—when he humps his little back, and shuts his appealing little eyes, and lets his ears lie along his back, and then gathers himself into one ecstatic note, it is enough to make one envy the sainted dead and long for the cold and silent grave. The sleepers for a mile around start up with the sweat of terror on their furrowed brows, children fall down in fits, the sick believe they have heard Gabriel's horn, and the very atmosphere shudders like a human creature. Burros don't often bray, because they haven't much time for braying; but they bray sometimes, and that is what keeps them so low in the scale of animated nature. Without his bray the burro would be little short of an angel. As he is, however, he is an animal to be admired at a distance and in the abstract."



PRACTICAL APPLICATION OF ELECTRO-MASSAGE.

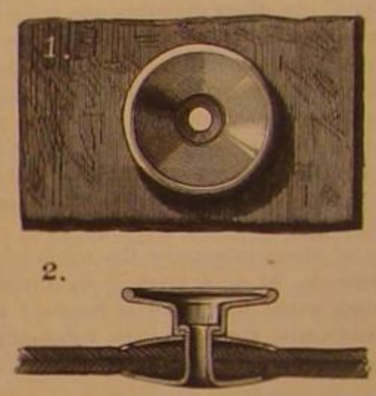
Toughened Glass.

From the results of a large number of experiments it is found that the elasticity of toughened glass is more than double that of ordinary glass, and that toughened sheets bend much more readily than ordinary sheets. Single toughened glass has a resistance 2·5 times, and demi-double toughened glass a resistance 3·1 times that of ordinary double glass. Polished toughened sheets, of thickness varying from 0·006 meter to 0·013 meter, have a resistance 3·67 times as great as that of ordinary sheets of the same thickness, and the resistance of rough toughened sheets is 5·33 times that of ordinary rough sheets.—*De la Bastie.*

IMPROVEMENT IN BUTTONS.

The annexed engraving represents an improved button recently patented by Mr. Oscar Ericsson, of Sioux Falls, Dakota Ter., and designed for various uses, but more especially for men's garments. It is strong, quickly and conveniently attached, and is inexpensive.

The head of the button has a tubular shank, which rests on a concaved and serrated clamping disk, and is clamped in place by the elongated shank of a similar disk placed on the opposite side of the fabric. This shank, as will be noticed, enters the end of the tubular portion of the button, and is set down after the manner of an eyelet upon an internal flange, holding all three of the members securely in place, and clamping tightly the cloth of which the garment is composed.



ERICSSON'S IMPROVED BUTTON.

MISCELLANEOUS INVENTIONS.

Mr. William W. Batchelder, of New York city, has patented a novel article of manufacture which he calls a "continuous match," for the reason that the entire length or body of the match is made of the explosive compositions, which are so arranged as to flash at will without continuously burning.

The same inventor has heretofore patented devices for lighting the gas in which the lighting was effected by the union of two kinds of composition arranged in sticks side by side, which would not explode when separated in bulk, but when scraped up and mixed formed a pulverulent charge, which was exploded by friction.

The present invention comprises a novel and simplified device for carrying out this principle, which is designed to utilize a peculiar continuous match, which is constructed on the above-described principle. Mr. Batchelder has applied the same device to cigar lighters. He has also devised and patented a novel attachment to be applied to a gas-burner for the purpose of lighting the gas or to be used in any other connection desired.

Mr. Charles H. Starin, of Brooklyn, N. Y., has patented an improved ash-sifter, which consists in a box with an inclined top provided at the lower end with a hinged door, and at the upper end with a chute closed by a balanced gate, through which the ashes are dropped upon an inclined sieve or grating, down which they slide, the ashes dropping into a box below the sieve and the cinders accumulating in the lower end of the box.

An improved combined ruler and rotary blotter has been patented by Mr. Arthur R. Hall, of Prompton, Pa. This invention relates to that well known class of blotters which rotate in a case and are sometimes made with a paper cutter in front and a ruler strip on the rear of casing. It consists in making the case of a strip of sheet metal extend in the rear to form a handle, and made with a straight-edge in front supported on two side flanges.

VOLUMETRIC ASSAY OF BULLION, ALLOYS, ETC.

Probably no quantitative analytical process is susceptible of a higher degree of accuracy than that by which the quantity of silver in bullion, coin, plate, etc., is now usually determined, and in point of simplicity as well as accuracy is a good illustration of the volumetric method as applied to the analysis of many other substances.

When a neutral or acid solution containing silver is brought into contact with a solution containing a sufficient quantity of sodium chloride (common table salt) the whole of the silver is precipitated as silver chloride.

A given quantity of pure salt always thus precipitates a certain definite quantity of silver (1 grain of salt corresponding to $1\frac{85}{100}$ grains, nearly, of silver.)

If one grain of salt, silver, or any other substance is dissolved in a quart of liquid, and the quart is then divided into ten, one hundred, or one thousand equal parts or volumes, each of these will contain just one-tenth, one-hundredth, or one-thousandth, as the case may be, of a grain of the dissolved substance. So that, in the case of silver, if it is known just how much salt is dissolved in a given quantity of water it is easy to calculate how much there is in any volume of the solution, and just how much dissolved silver any volume of it will precipitate.

The several pieces of apparatus necessary in preparing, standardizing, and applying this liquid measurer are shown annexed. The glass burette, A, is secured in position by the wooden clamp, B, adjustable on the iron rod of the stand, C. The ground glass stop-cock, *a*, controls the flow of the liquid from the tube. The burette is accurately graduated to one-fifth or one tenth cubic centimeter by an etched scale.

In the burette, D, the expensive glass stop-cock is dispensed with, a piece of pure gum rubber tubing and a brass wire clamp, *b*, being substituted. The small delivery neck of the burette is joined by the tubing to a small piece of glass tube drawn out at one end to a fine delivery. The wire clamp (quetchon or pinch-cock) retains the liquid by pinching the rubber tube. E and F are pipettes. In using them the lower end is dipped in the liquid, the mouth applied to the upper end, and the liquid drawn up until the tube is nearly full. The mouth is then removed, the finger quickly placed over the end, as shown at G, and a small portion of the liquid allowed to escape until the liquid fills the tube just to the containing mark, *c*. When the finger is removed the liquid runs out. The flask is used where larger quantities of the liquid are to be measured. The containing mark is at *e* on the neck.

The titration bottle, H, is of fine thin glass, the glass stopper being ground to accurately fit the neck, and terminates in a point. These bottles usually have a capacity of about 250 c.c.

In analytical work of this kind the decimal or French system of weights and measures is nearly always used, as they are much more convenient than other systems. The gramme equals $15\frac{1}{2}$ grains, nearly; the milligramme (mg.) $\frac{1}{1000}$ of a gramme; the liter about $1\frac{3}{4}$ pints; the cubic centimeter (c.c.) $\frac{1}{1000}$ of a liter.

In preparing the salt solution $5\frac{1}{2}$ grammes of chemically pure, dry salt is dissolved in a small quantity of distilled water, the solution diluted to one liter with cold distilled water, and put into a clean glass bottle labeled "*Salt No. 1.*" Fifty c.c. of this solution is drawn off with a pipette, diluted with cold distilled water to 500 c.c. (half liter), and put into another clean bottle marked "*Salt No. 2.*"

These solutions are then *standardized*—that is, tested to determine just how much silver a given measure of the liquid will precipitate.

One-half gramme of pure silver is dissolved, by aid of gentle heat, in about 3 c.c. of pure nitric acid, and the solution is then diluted to one-half liter with cold distilled water; so that 1 c.c. of the liquid contains just 1 mg. of silver. Fifty c.c. of this solution, drawn off with a pipette, is placed in the titration bottle, and the burette (A or D) is filled to zero with the salt solution No. 2. This solution is then allowed to drop from the burette into the silver solution in the bottle, the flow being discontinued from time to time and the bottle closed and agitated to facilitate the subsidence of the flocculent precipitate. A little experience enables the operator to tell when the silver solution is nearly saturated, and then the contents of the bottle is shaken and allowed to subside between the addition of every two or three drops, so that when at last the drops of salt solution fail to produce any more precipitate in the silver solution, then the total quantity or volume of salt solution used may be accurately read off on the scale of the burette. To avoid any error the test is duplicated, and the results of the two tests, when compared, should agree very closely. If it is found, for instance, that 50 c.c. of the salt solution corresponds to 50 c.c. of the silver solution, then the solution in bottle No. 2 is marked "1 *c.c.*=1 *mg. silver;*" and bottle No. 1, "1 *c.c.*=10 *mg. silver,*" as its contents contain ten times as much salt.

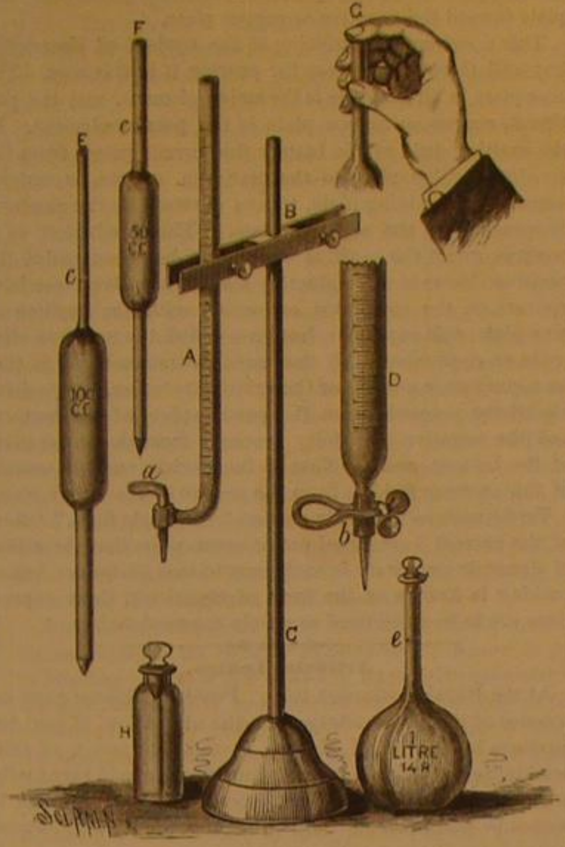
Thus standardized the salt solutions become, when properly used, accurate measures of the amount of silver in a liquid.

In the actual assay of a silver alloy from half to one gramme of the metal is weighed out, put into the titration bottle with 4 or 5 c.c. of nitric acid (of sp. gr. 1·2), and the contents heated by placing the bottle obliquely in a hot water bath. From time to time the nitrous fumes are blown out and the bottle frequently shaken to promote their expulsion. When solution is complete the bottle is removed and its contents allowed to cool. If the alloy contains gold, a small quantity of pure sulphuric acid is added, and the liquid boiled until all the gold has separated. The liquid adhering to the stopper and neck of the bottle having been rinsed down with a small jet of distilled water, salt solution No. 1 is gradually let in from a burette until the silver solution is, as before described, nearly saturated; then salt solution No. 2, from another burette, is added until the exact point of saturation is noted. The readings from the two burettes properly reduced will then indicate how much pure silver the alloy contains.

Tests of this kind should always be made in duplicate to avoid error.

In testing photographic silver baths the total quantity of bath is measured, and a clean burette is filled to the zero mark with a definite portion of it, previously diluted with distilled water to about ten times its volume, and well shaken. About 50 c.c. of standardized salt solution is mixed with just enough of a strong aqueous solution of pure potassium chromate solution to distinctly color it. Then the dilute silver solution is gradually let in from the burette, the mixture being agitated after every few drops. As long as there is an excess of salt the orange-red silver chromate formed when the drops of silver solution strike the salt liquid is quickly decomposed and decolorized. When the point of complete saturation is reached this decomposition no longer takes place, and the solution assumes a distinct orange-red color.

The quantity of silver solution required to saturate 50 c.c. of the standardized salt solution is then read off on the burette. As the quantity of silver this volume of salt solution corresponds to is known, the rest of the calculation is is easy.



VOLUMETRIC ASSAY OF BULLION, ETC.

DYNAMIC ELECTRICITY.

BY GEO. M. HOPKINS.

GENERATION OF THE ELECTRIC CURRENT.

When two dissimilar metals, such as pure copper and pure zinc, are placed in contact in acidulated water, evidences of activity immediately appear in the form of a cloud of microscopic bubbles constantly rising to the surface of the water. If the metals are individually capable of resisting the action of the acid solution, it will be noticed that on separating the metals the action ceases, but it will commence again as soon as the metals are brought into contact. The same action is noticed if the two metals are connected by a wire, which may be either wholly within or partly out of the acidulated water.

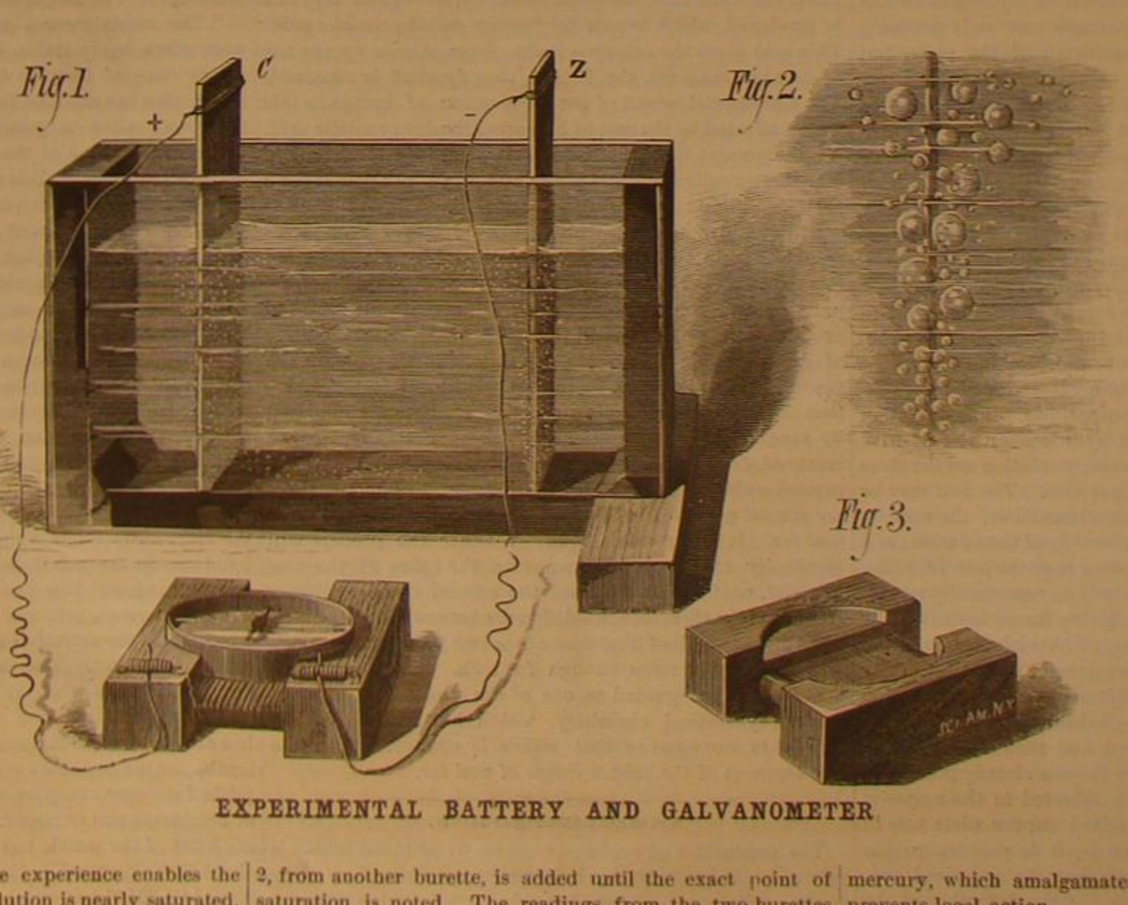
The bubbles which are noticed in this experiment are hydrogen resulting from the decomposition of the water and escape from the copper, and the oxygen resulting from the analysis unites with the zinc, forming zinc oxide.

The copper is scarcely attacked while the zinc slowly wastes away. If the wire connecting the zinc and copper be cut and the two ends placed on the tongue, a slight but peculiar biting sensation is experienced, which will not be felt when the wires are disconnected from the metals.

A piece of paper moistened with a solution of iodide of potassium and starch placed between the ends of the wires exhibits a brown spot, showing that between the ends of the wires there is a species of energy capable of effecting chemical decomposition. If a wire joining the copper and zinc is placed parallel with and near a delicately suspended magnetic needle, it will be found that it is endowed with properties capable of affecting the needle in the same manner as a magnet. This form of energy is dynamic or current electricity, generated in this case by chemical action and confined to, and following a continuous conductor, of which the two metallic elements and the acid solution form a part, the whole comprising a complete electric circuit.

For the purpose of studying the generation and behavior of dynamic electricity the elements referred to may be formed into an electric generator or battery, and the magnetic needle and conducting wire may be combined to form an electrical indicator or galvanometer.

The engraving shows convenient apparatus for making the primary experiments in dynamic electricity. The glass tank or cell is built with special reference to projecting the visible manifestations of the phenomena exhibited in the cell, upon a screen, by means of the lantern, to enable a number of persons to observe simultaneously.



EXPERIMENTAL BATTERY AND GALVANOMETER

The cell consists of two plates of transparent glass 4 by 6 inches, separated by a half inch square strip of soft rubber, which is cemented to both glasses by means of a cement composed of equal parts of pitch and gutta percha. The cell is nearly filled with the exciting liquid, consisting of dilute sulphuric acid (acid 1 part, water 15 parts), in which are placed two plates, the positive plate consisting of a strip of zinc about one-sixteenth of an inch thick, the negative plate being a strip of copper.

As commercial zinc is so impure as to be violently attacked by the exciting liquid, it is well to dip the zinc strip into the solution, and then apply to it a drop or so of mercury, which amalgamates the surface of the zinc and prevents local action.

When these two plates are brought into contact with each other in the exciting liquid, hydrogen gas is given off copiously at the copper or negative plate, while the action at the zinc or positive plate is almost unnoticeable. If the plates are connected together by a conductor outside of the solution, the same phenomenon is observed.

The plane flat surfaces of the cell offer facilities for the examination of the plates by means of the microscope, and if so examined it will be found that so long as there is no metallic connection between the electrodes they will remain unaltered, and no action is discoverable; but when the circuit is completed, the first visible indication of action is the sudden whitening of the copper plate as if it were frost-covered; the next indication of action is the formation over the entire surface of the plate of myriads of minute silvery bubbles, which grow until they become detached, when they rise to the surface and escape into the air. These bubbles may be discharged into the mouth of a small test tube, and when a sufficient quantity of gas has accumulated it may be ignited, showing that it is hydrogen.

The appearance of the negative plate when the cell is in action is shown in Fig. 2 greatly magnified. The gas bubbles formed on the surface of the copper are at first very minute, but they rapidly increase in size and begin to merge one into another, taking an upward course. When a large bubble has absorbed a large number of the smaller bubbles and becomes sufficiently buoyant to overcome its adhesion to the plate it rises to the surface and is dissipated.

The bubbles of hydrogen are very bright, appearing and acting much like globules of mercury. Often an equatorial belt of very small bubbles will be seen surrounding a larger one.

The accumulation of hydrogen on the negative plate seriously affects the strength of the current. To ascertain to what extent and at what time this happens, a

SIMPLE GALVANOMETER

like that shown in Fig. 1 will be required. This instrument consists of a common pocket compass, a wooden frame or spool, and about 20 feet of No. 32 silk covered copper wire. The wood spool (Fig. 3) has a recess cut in the top at either end to receive the compass, which is placed a short distance from the flat body of the spool, and the wire is wound evenly around the body back and forth until the spool is full. Then the terminals of the wire are connected with two spiral springs fastened to the ends of the spool and forming "binding posts" for receiving the wires from the battery.

In regard to the adjustment of the compass, it should be arranged with the line marked N S parallel with the wires of the coil, and the instrument should be turned until the N S line is exactly under the needle, then a weak current should be sent through the coil and the deflection noted. The current should then be sent in the opposite direction, when the needle will be deflected in the opposite direction. If the amount of deflection is the same in both cases the galvanometer is in condition for use; but if the deflections differ in degree, the compass must be turned in its socket until the proper adjustment is secured. The only precaution necessary in the construction of this instrument is to select a compass whose needle is delicately poised and vibrates freely.

By connecting the galvanometer with the cell as indicated in the engraving it will be noticed that after a limited time the galvanometer needle begins to fall back toward 0°, a point which it ultimately reaches if the circuit is kept closed; and the shorter the circuit the sooner the cessation of the current. This

ENFEEBLEMENT OF THE CURRENT

is principally due to three causes, one of which has already been noticed, that is, the accumulation of hydrogen on the negative plate. The film of hydrogen not only prevents contact between the exciting solution and the plate, but it actually renders the surface to a certain degree positive, and consequently in nature, although not in degree, like the positive plate. Another cause of enfeeblement of the current is the reduction on the copper, by the hydrogen, of a portion of the sulphate of zinc accumulating in the liquid. This increases the similarity of the two plates, and consequently assists in diminishing the current. The reduction of the strength of the exciting liquid of the cell and the oxidation of the zinc contribute still further toward the diminution of the current. All this results in making the two plates similar in their action, and in a consequent weakening of the current; but this chemical action cannot be avoided, as to secure any action in a galvanic cell the exciting fluid must be capable of decomposition. The oxidation of the zinc, the accumulation of hydrogen on the positive plate, and the weakening of the exciting solution are the three great causes of inconstancy in batteries. The first may be remedied in a great measure by amalgamation; the remedy for the last is obviously the strengthening of the solution; and the second, the accumulation of hydrogen on the positive plate, or the polarization of the plate, can only be remedied by removing the plate from the exciting solution for an instant, or by brushing it while in the solution, or by violently agitating the exciting solution. The galvanometer needle faithfully indicates the result of either treatment. The polarization of the electrode may be strikingly exhibited by allowing the copper plate to become polarized and then replacing the zinc with a clean copper strip like the one already polarized. The galvanometer needle will be deflected in the opposite direction, showing that the polarized copper plate acts in the same manner as the zinc; that is, it is positive to the clean copper plate. Now by removing the polarized copper plate and wiping and replacing it, the deflection of the needle will be much less, and it will not fall back to 0°, until the very slight coating of zinc which has been deposited on the copper is removed from the polarized plate by means of emery paper or otherwise. Precisely the same effect is noticed when a newly amalgamated zinc plate is opposed to an oxidized zinc plate. The oxidized plate in this case will act as the negative.

This method of showing the effect of the polarization of the plate is much more conclusive and convincing than to employ a secondary battery, or to treat the element under examination as such by connecting it with another battery, as the phenomenon attributed to the polarized plate manifests itself in an unmistakable manner while the plate remains in position and under the conditions of actual use.

Although the zinc is called the positive plate of the battery, and the copper the negative plate, the positive electricity proceeds from the copper through the external portions of the circuit toward the positive or zinc plate, and the negative electricity proceeds from the positive or zinc plate toward the negative or copper plate.

This is extremely confusing to the student of electricity, but still there is a reason for putting it in this way. The zinc plate in all batteries is the active element, and the platinum, copper, or carbon plate is the passive element. In the exciting fluid of the battery the current passes from the zinc or positive plate to the platinum, copper, or carbon, negative or receiving plate, thence outward by the conductor attached to the negative plate. This conductor, as it conveys away the positive electricity, has been called the positive electrode or conductor; and as negative electricity appears on the conductor connected with the positive or zinc plate, this conductor has been called the negative electrode or conductor. All that need be remembered is that on a conductor outside of the exciting solution, the positive electricity proceeds from the passive plate of the battery, and the negative electricity proceeds from the active plate of the battery, and the flow of the electric current outside of the exciting fluid is from the passive to the active plate.

Terms such as "electric current," "electric fluid," "flow of the current," are based on the assumption that the action of dynamic electricity is analogous to that of fluids; but as nothing is known of the form of electricity, these expressions are to be considered as purely conventional.

Artificial Indigo.

At the Royal Institution lately, Professor Roscoe gave an account of the latest advance in the utilization of coal tar products by Baeyer, of Munich, in the fabrication of artificial indigo, which the lecturer considered would eventually become of great commercial importance. At present, it cannot be said that the competition of artificial and natural indigo is at all comparable with that between alizarine and madder, by which the last named dyestuff has been driven out of the market; on the contrary, artificial indigo from coal tar is as yet dearer than the vegetable product from the East. It appears that native indigo was decomposed by Fritsche so long ago as 1840, and aniline was then obtained from it. Subsequently a crystalline substance called isatin was procured from indigo; and, later, indigo was made from isatin. The next step was the production of isatin from an independent source, and this has been done in three different ways, two of which are too costly for commercial use. Baeyer has alone carried it out in a practicable manner. He commenced with cinnamic acid obtained from oil of bitter almonds, but this was much too costly. It has been found by Dr. Caro and Mr. Perkins that cinnamic acid can be obtained from toluene, which is a product of coal tar. From cinnamic acid, however obtained, a complex acid can be produced which is now for brevity called propiolic acid. This acid gives the colorless isatin, from which, by the use of suitable reagents, the indigo blue dyestuff is obtained. The commercial aspect of the production of indigo in this way is affected by the cost of preparing the dry propiolic acid. At the present time the materal is placed in the hands of Manchester calico printers at the rate of 6s. per pound for a paste containing 25 per cent of dry acid. The acid itself is worth 50s. per kilo, of which only 68·58 per cent yields actual dye, so that the price of artificial indigo, being not less than 73s. per kilo, is more than twice the value of the pure natural color. Hence competition with the Oriental product is not possible until the makers can reduce the price of dry propiolic acid to 20s. per kilo, and also obtain the theoretical yield of dye therefrom. Still the fact remains that the artificial process is a chemical reality, only hindered by economical considerations, which may at any time be removed, from taking a good commercial position. At the present exhibition of woolen fabrics, etc., in London, there are several pieces of stuffs dyed with indigo obtained from coal tar. It is impossible to say whether the process will eventually exert much influence on the value of the raw material, or if it will supplant the natural dye. Professor Roscoe thinks there is such a difference between the characteristics and methods of treatment of the two products that there will probably be room enough for both. The new process is at least to be regarded as one of the greatest triumphs of modern synthetical chemistry, which has had no field so fruitful in successes as that which is connected with the development of the hidden riches of coal tar.

Artificial Refrigeration.

The production of cold and even ice by artificial means is now a necessity in many industrial processes. According to the continental systems of brewing, great cold is required not only during the actual brewing process, but also for months afterward while the beers are maturing in the cellars. In this country the natural production of ice is very uncertain, and some winters may pass without sufficient being formed to be worth collection, and even when ice is plentiful here we have no suitable arrangements at hand for storing and preserving it for use in warmer weather. For these reasons many ingenious contrivances have been devised for the artificial production of ice, and it may not be uninteresting to give some explanation of the theories on which these machines are founded. When a volatile liquid evaporates, a large amount of heat is necessarily absorbed by the resulting vapor, and is rendered latent or imperceptible to the senses and the thermometer. This heat is taken either from some of the remaining liquid or else from the medium in which the liquid is in contact. The cold produced by evaporation is very evident with a volatile fluid like ether; when a little of this liquid is placed in the palm of the hand an intense feeling of cold is observed; the ether, in evaporating, must absorb heat, and therefore takes it from the nearest body, which is the hand, and thus produces a corresponding reduction of temperature. The evaporation of volatile liquids is greatly assisted by a reduction of pressure; and, thus, if a little ether be placed in a shallow dish, floating on a thin layer of water, and the whole be placed under the receiver of an air-pump, there is not much difficulty in freezing the water by a rapid exhaustion of the air; in this case the vapor of ether is renewed almost as fast as it is formed, and fresh quantities of liquid ether are thus volatilized. The various ice-making and refrigerating machines are constructed so as to utilize this property possessed by all volatile fluids. If the ether be placed in a metallic vessel exposing a large surface to water or any other fluid which requires to be cooled, all the heat necessary for the volatilization of the ether must be taken from the water; the volatilization of the ether is assisted by means of an air-pump, and the ether vapor is then conveyed through pipes to another vessel also surrounded by cold water, where it gives up the same amount of heat again, and is thus converted back into a liquid. In this way a comparatively small quantity of ether will cool or even freeze an indefinite quantity of water, and the whole of the ether can be condensed again into the liquid state. Instead of ether, liquid ammonia, sulphurous acid, or other very volatile substances may be used, and a variety of complicated mechanical arrangements are introduced to assist in the volatilization, condensation, and preservation of the volatile agent used. These mechanical arrangements have been so far perfected that even water itself has been used as the evaporating agent, and ice has been successfully produced by such means. Great cold and even ice has also been produced by the expansion and contraction of atmospheric air by machines constructed on a similar principle to those we have just referred to. For brewery purposes ice is not actually required, but rather a reduction of temperature equal to about 25° F. A machine (says the *Brewers' Guardian*, from which we derive the above) that will effect this successfully and economically will probably be required in every brewery of importance before many years have elapsed.

Speed of Locomotives Then and Now.

From the comments of the Philadelphia *Ledger* on the Stephenson centenary, it appears that a greater speed than ten miles an hour for the then projected Liverpool and Manchester Railway was not to be thought of for fear of alarming the people and so defeat the charter. Such breakneck speed was "grossly in the teeth of all experience," fifty years ago. The *Ledger* says:

"The reminiscences are both interesting and curious now, when heavy trains are carried over long distances at steady rates of forty to fifty miles an hour, and when the locomotive has attained to a speed for experimental purposes of seventy miles on good tracks. It is to the steady gait of the railway engine at the forty-mile speed that we desire to invite attention. This is a regular rate on several railways radiating from Philadelphia, but for our present purpose we shall select express trains on the West Jersey Railroad. Suppose a passenger, starting at Cape May at seven o'clock in the morning for Philadelphia. He may have that delicate and accurate piece of mechanism, a chronometer watch, in his hand, and the ponderous locomotive of his train is in front of him. The watch may weigh five ounces, the locomotive thirty tons; yet the leviathan of iron is as precise in its movements and as true to time as the smaller instrument of steel, brass, platinum, and gold. As the passenger, with watch in hand, looks first at its dial, then at the watchful conductor, with his eye on his own timepiece, regulated by standard, he sees the signal to start the moment the hand on the dial shows seven o'clock. Then the engineer, with his hand on the lever, lets loose the pent-up steam, and away goes the engine. It is due at the end of the track in Camden, 81½ miles away, precisely on the moment when the same hand marks the arrival of nine o'clock. Not a minute earlier or a minute later. The engine is to go over the eighty-one and a half miles while the chronometer watch marks precisely one hundred and twenty minutes. When that time has exactly elapsed the engine is at the Camden end of the track; for the instances when this is not accurately accomplished are rare exceptions, and seem to weigh on the minds of conductor and engineer. The wheel that turns the minute hand of the watch has turned 120 times, and traversed about 180 inches, while the five foot driver of the engine has turned 27,394 times, and has traversed 430,320 feet, or 5,163,840 inches! This, as already said, is done daily with the utmost regularity, and, considering the steadiness with which it is done, and the varying load drawn by the machine, it may be considered as well a marvel of mechanical skill as an eloquent comment on the doings and sayings before that parliamentary committee when the project for the Liverpool and Manchester Railway was under consideration."

NEW INVENTIONS.

An improved monkey-wrench has been patented by Mr. Allen K. Sheppard, of Camden, N. J. It consists of a wrench in which one jaw is attached to a shank that slides within a hollow handle to which the other jaw is fastened, the handle having a cam-dog that acts upon a block resting against the sliding shank, which, with its jaw, can be locked in any desired position or released by turning the cam-dog.

An improved air compressor and faucet has been patented by Mr. Samuel A. Livingston, of East New York, N. Y. The object of the invention is to aerate beer, as well as create a pressure by forcing air up through the liquid, and also to allow a keg to be tapped without permitting the natural gases of the liquid to escape.

A simple and convenient device for preventing a door from swinging back against the wall and for holding the door open, has been patented by Mr. John J. Schlueter, of San Francisco, Cal.

An anti-freezing closet has been patented by Mr. John B. Gordon, of Cutler, Ill. The object of this invention is to furnish anti-freezing closets so constructed as to prevent the freezing in the coldest weather of canned fruits, meats, and other articles, and thus preserve them in good condition.

An improvement in wash basins has been patented by Mr. Chas. E. Robinson, of New York City, N. Y. The invention relates more particularly to that class of basins known as the "Wellington," which consist of two concentric basins, the inner one of which overflows over its top edge into the outer one, both of which discharge through a central opening at the bottom into a circular trap suspended in a circular trap-chamber, which is detachably held to the bottom of the outer basin and coupled to the waste-pipe.

A French Photographic Salon.

A handsome salon on the first floor is a fitting reception room to the studio, which of late years has attained such high reputation, both in Paris and in Milan, as that of MM. Benque et Cie. Fluted columns, draped with rich maroon curtains, are at the entrance to this apartment, into which not a ray of direct sunlight enters. All is soft and somber within. There are extensive windows, but these are hidden by loosely festooned drab silk, so that while there is plenty of illumination, it is subdued and yet refulgent. The walls are of chocolate brown, the damask, chairs, and furniture gold and black, the fittings rich and handsome. This fine carbon portrait in frame complete, standing a meter high (39 inches), is a specialty of the firm Benque et Cie., and sells for a thousand francs. These pictures on the table are what is termed the "Paris portrait," similar in height to the panel or promenade, but half an inch broader, a very attractive size, but still, to our thinking, not so elegant in its proportions as the promenade. Of cabinets, there is also a collection, not large, for we believe that there are not more than a score of photographs in the whole salon. Two or three cartes are here also, but during the past three months, our host tells us, not a single carte picture has been taken in the establishment. Here, too, we find Madame Nilsson, not in a frame, but in the flesh; she is looking at some portraits of sister artistes, after undergoing a lengthened sitting. "We have just taken one hundred clichés," our friend whispers, "and within the space of an hour and a half."

Before we walk upstairs, we are presented with a card of terms. Here it is:

12 Cartes-de-visite, 30 francs; the dozen following, 20 francs; 12 cabinet portraits, 80 francs; 6 cabinet portraits, 50 francs; the dozen following, 60 francs; 12 Paris portraits, 120 francs; 6 Paris portraits, 80 francs; the dozen following, 100 francs.

In the Benque establishment, gelatine reigns supreme. "Do you develop at once, or in the evening?" we ask. "Always in the evening—we are now so confident of our results; of those hundred clichés just taken of Madame Nilsson, not one will be developed till to-night." The development is done by artificial light, by means of a gas-burner behind ruby glass, a convenient tap permitting the photographer to heighten and lower the jet at will. The developing, too, for the most part is done mechanically. As soon as some idea has been obtained of the exposure of the plate, and the time and strength of development, half a dozen clichés are put together into a rocking tray. The developer is poured over the films, and then the tray rocks to and fro by itself, kept in motion by a heavy pendulum that swings underneath. It saves a world of trouble, our host tells us, and produces very uniform results. We always like to take the sense of photographers on the development of dry plates, and we put the question whether pyrogallic or oxalate treatment is preferred. "*Oxalate toujours—Oxalate toujours*" is the energetic reply.

The studio is large and roomy—the largest in Paris, our friend says; at any rate, it measures fifteen meters (nearly fifty feet in length). There is nothing particular to be noted about the lighting; top-light is the dominant light. The walls are of very dark brown, and we remark upon this. They are dark, admits our host; but when they are again painted, we shall color them darker still. Large plates are in general use at the Benque establishment, and large cameras. As a rule, six poses are taken on one plate. We mentioned the other day the circumstance of Madame Judic being portrayed 132 times in this studio at one sitting. She was at the atelier for two hours only, and, during that time, changed her dress four times. Twenty-two poses were taken, of each six clichés, with an exposure of about three seconds. The negatives were developed at night, and there were only two technical failures. "Elle ne voyait plus," when she went away after the ordeal, our host remarked of the fair comedienne. Certainly, such rapid work could not have been undertaken before the days of gelatine. There is no dark room adjacent to the studio; the plates in their slides are sent up a shaft from the laboratory below, and delivered close to the assistant's hand in the studio, after the manner of Messrs. Window & Grove's studio, which we described the other day. The exposures are made by means of the ordinary pneumatic-Cadett shutter.

In the enlarging-room there is one point worthy of mention. The camera is disposed pretty well as usual; but just in front of the transparency is placed a swing looking-glass or mirror, perhaps twenty inches high. This permits, in a most convenient manner, the concentration upon the transparency of light that comes through a small opening in the wall, and if the mirror is turned to its proper angle by hand, the hand being never quite steady, no partial lighting is likely to ensue.

There are two printing rooms, and MM. Benque send the negatives to one or the other, according to their density. Thus in the top printing room, which is on the roof, the denser clichés are to be found, and those which will bear strong light; while in the more subdued light of the lower printing room are located such clichés as require more delicate treatment. From 1,200 to 2,000 prints are produced here every day, for the firm has now a large publishing connection, and their portraits go to every capital in Europe. Printing to this extent would be impossible in a London atmosphere, and for this reason our big metropolitan firms have usually an establishment in the suburbs for the purpose. But in Paris they burn charcoal more than they do coal, and, moreover, when this is used, it is of a much less sooty character than that employed in this country.

Starch, prepared fresh every day, is invariably employed for mounting at the Benque establishment; where so much publishing is done it is a matter of imperative necessity that the mounting should be depended upon, especially as black mounts are largely used just now. We are glad to hear, by the way, that of late these black mounts are more satisfactory than was the case a short time ago. Numerous cases of fading were then rife, and the cause, as our reader knows, Mr. Spiller was able to trace to the presence in the mount of a considerable quantity of sodium chloride, or common salt. The test to discover this—namely, the adding of a few drops of nitrate of silver solution to water in which one of these has been steeped for some hours, and observing whether any turbidity results—is so simple that any photographer can make use of it for himself.

Besides making itself known through its publications, the firm also adopts the practice of exhibiting its works largely in Paris. The Boissy d'Anglas, although a turning out of the Faubourg St. Honoré, is not a very frequented thoroughfare, and hence visitors to Paris might well escape seeing the studio. MM. Benque et Cie. have therefore opened an exhibition in the Rue Royale, that familiar street leading from the Madeleine to the Place de la Concorde, and here a display of the firm's finest work is exhibited. A *pièce de resistance* is always present in the form of a scene from one of the Paris plays. Whatever happens to be popular on the boards for the moment is here illustrated. The boat-scene from Michael Strogoff is the present attraction, a fine enlargement from nature, measuring perhaps three feet across, and including the portraits of half a dozen favorites. Any scene is chosen in which many characters are grouped, and the photograph being well executed, it naturally draws considerable attention. A magnificent portrait of Gounod, another of Judic, and a forcible picture of that Swedish professor with the hard name who discovered the North East passage, are also attractions at the little exhibition in the Rue Royale.—*Photographic News.*

Ventilating the St. Louis Tunnel.

The annual report of the St. Louis Bridge Company has the following in regard to the ventilation of the tunnel which forms part of the western approach to the bridge:

"The increasing number of trains passing through the tunnel has rendered its ventilation a serious question, as the peculiar arrangement of grades and lateral archways makes it almost impossible for natural ventilation to take place. For some months past it has been almost impossible to keep the track gangs long enough in the tunnel to properly repair the track; and, in addition, the great quantity of smoke pouring out of the openings at St. Charles and Second streets has caused us to be threatened with numerous damage suits on account of this nuisance. There remained, therefore, but one course to pursue, to put up a shaft and mechanical ventilator, to thoroughly exhaust the gases from the tunnel, and to discharge them at a sufficient height not to annoy the public.

"Col. C. Shaler Smith has devoted a great deal of time and attention to this problem, and the very ingenious plan devised by him is now in the course of being carried out. The requisite property has been condemned and acquired, and the iron for the chimney (which is of boiler plate, and will be 15 feet in diameter and 125 feet high), is now on the ground, and the erection has begun. A 120 horse power engine is under construction, and a pneumatic screw, having a capacity of 400,000 cubic feet of air per minute, will be placed in the base of the shaft and worked by this engine. To enable the repair gangs to work continuously in the tunnel, and to silence the complaints made as to the smoke at Main and Second street bridges, a small air screw on the same principle as the large one has been put up at the St. Charles street opening, and is now exhausting the gases at the rate of 30,000 cubic feet per minute. The effect of this small model, which is only 4 feet in diameter, leaves no doubt as to the success of the large screw when it shall be placed in position. Room is being prepared in the engine house for a 16-light electric machine, should it be considered advisable to light the tunnel in this manner. No extra power will be needed, as the engine ordered will be of sufficient capacity for both fan and electric light."

A Railway Tunnel through a Volcano.

The rocks which constitute the southern island of New Zealand are for the greatest part of the archaic type, consisting principally of gneiss, granite, mica-schist, phyllite, quartzite, and felsitic rocks. They are partly covered by palæozoic strata, which are folded up into innumerable troughs and saddle-backs throughout the province of Canterbury, and which partly belong to the carboniferous period, so that there are prospects for a future discovery of coal beds. By far the greatest interest, however, is offered by the extensive volcanic phenomena of the island, and among them the extinct volcanoes upon the Banks peninsula, east of the town of Christchurch, are prominent. This peninsula, now only connected by bands of low and recent deposits with the mainland, was once a complete island, only formed by volcanoes, which rose up from the bottom of the sea. The special construction of such an extinct volcano has been made visible by a tunnel of 2,620 meters' length upon the railway between Christchurch and Littleton, which has pierced through the walls of a volcanic cone and thus has laid bare its structure of successive streams of lava and beds of scoriæ, ashes, and tufæ, which are again intersected by dikes of younger volcanic rocks. This is perhaps the first volcano through which a railway has been constructed.

Another peculiarity of New Zealand is the extremely frequent occurrence of bones of those large wingless birds, which by the aborigines were called "moa," and which belong to the family of the Dinornithidæ, of whom the largest representative, *Dinornis maximus*, has reached the considerable height of ten and a half feet; the largest deposits of these bones were found in the Point cavern and the marshes of Grenmark. There is now do doubt that these gigantic birds were contemporaneous with man, and that an early human race were moa hunters in these islands, who lived upon the flesh of these birds at a time when the glaciers extended still very much below their present boundaries, for bones, tools, and other remnants of these early moa hunters are frequently met intermingled with bones of the now extinct Dinornithidæ.

Earthworms and Anthrax.

An important report was presented to the Académie de Médecine, at its meeting on the 17th inst., by M. Villemin, in the name of a commission appointed to investigate the statements of M. Pasteur as to the presence of the germs of anthrax-bacteria in the soil, and their transportation by earthworms, statements which had been contradicted by M. Colin, of Alfort. In the investigations of the commission they first inoculated five guinea pigs with earth taken from the soil over a trench in which animals dead of anthrax had been buried twelve years previously. All the guinea pigs died, the first four from septicæmia, the fifth from well marked anthrax, and the latter presented numerous bacteria in the blood of the heart and the spleen, which organ was considerably enlarged.

A second similar series of guinea pigs were inoculated with earth from above a pit in which animals dead of the disease had been buried for three years. The first four of these also died of septicæmia, and the fifth of anthrax, with characteristic bacteria. A third series were inoculated with "virgin soil"—*i. e.*, earth from a spot in which, "within living memory," no animal dead of anthrax had been buried. All of these continued well, presenting only at the point of the inoculation a small nodosity the size of a nut, and consisting of an abscess inclosed in a pyogenic membrane. The first two of these experiments with the suspected earth were repeated, six guinea pigs in all being inoculated. Of these all died, five of septicæmia, the sixth of anthrax. Two other guinea pigs were inoculated with blood from the animals to which anthrax had been communicated in the first two series of experiments, and both died of the same disease. A drop of blood taken from the ear of one and "sown" in some decoction of fowl, reproduced pure and abundant anthrax-bacteridia.

Some worms were also taken from the earth over the pits in which the animals had been buried three and twelve years before, and their excrement (the worms being still alive) was diluted with a little distilled water, and with it three guinea pigs were inoculated. Of these two died from septicæmia, and the third from anthrax. Other three guinea pigs were inoculated with the excrement of worms taken from soil beneath which, during the Commune, human bodies had been interred. One of the guinea pigs died from septicæmia, the other two continued well. Lastly, the excrement of worms collected over the trench in which the animals had been buried for twelve years, and treated by "cultivation," gave rise to a rapid production of bacteridia, which, inoculated into two guinea pigs, caused the death of both by anthrax. The experiments and report thus give a triumphant corroboration to the assertions of M. Pasteur.—*Lancet.*

Compressed Gun Cotton.

BY M. EISSLER.

Through the systematic study of Abel, an eminent chemist, this material has now attained quite a position in England, as by means of his analytical and synthetical researches he has found the causes of the instability observed in that substance, and has traced its occasional liability to undergo spontaneous combustion to the presence of minute quantities of foreign substances of comparatively unstable character, produced by the action of nitric acid upon resinous or fatty substances retained by the cotton fibers.

Some parts of his mode of manufacture may be considered comparatively safe, as he carries it on with the material in a wet, therefore uninflammable state. His mode of converting it into a minute state of division is the main improvement which he introduced, as it allows of a more perfect cleansing, and then its conversion into highly compressed masses is the main feature of his mechanical modifications; otherwise, he admits, one has only to follow Von Lenk's plan, and adhere to his rules.

The process of manufacture, as pursued by Prentice & Co. or the Liverpool Cotton Company, is as follows:

Clean cotton, picked as free as possible from foreign matter, is brought into a uniform and open condition, by being passed through a carding engine.

The rolls thus obtained are dried in a triple cylinder, by means of a steam jacket.

When completely dried it is placed in large tins and carefully covered.

After standing in these till quite cold, the cotton is weighed out in quantities of 1 pound each, and carried by a boy to the dipping vessel. Here each pan is charged with about 12 gallons of a mixture of 3 volumes of sulphuric acid, 1·84 specific gravity, and 1 volume of the strongest nitric acid, the whole being kept cool during the action by currents of cold water, which circulate around the vessel.

In this mixture the cotton is dipped, and after it has been in about three minutes the workman lifts it on to a grating, just above the acids. Then, with a movable lever, he gently squeezes it until, roughly speaking, it retains about ten times its weight of the liquid.

Thus saturated with the acids, it is allowed to remain in well-covered earthenware pots for twenty-four hours, the pots during this time standing in a shallow trough containing water to keep down the temperature, sufficient acid being added to cover the cotton. The chemical change in the cotton is now complete, and the further processes are for washing and pressing.

First, the large excess of acid is driven off by a centrifugal machine, and the waste acid is caught by a jacket surrounding the revolving portion of the machine, and collected in a receiver. These machines are on the principle of the wringing machines employed by laundries to dry clothes (whizzer).

On leaving the centrifugal machine the gun cotton has to be washed. This operation also requires great care, because the acids which the gun cotton yet retains would give rise to a considerable development of heat if mixed slowly with water. At such an increased temperature the gun cotton would be decomposed, or "fired," as it is technically called. Therefore it has to be brought at once in contact with a large body of water.

To perfect the washing, the cotton is subjected to the action of water for one, two, or three weeks, and afterward boiled in large vats by the injection of steam. By this latter operation the less stable compounds are destroyed and extracted, and the purified gun cotton is transferred to the heating tanks.

This is a simple contrivance for converting the gun cotton into pulp. It is a machine similar to the one used in paper mills and called Hollander.

The pulp is now removed from the tank to a poacher, where it is agitated with a large quantity of water by a wheel, and here it has to be washed till it answers the heat test, which the chemist now applies.

When his report is favorable, the pulp is transferred to a vat and mixed with a small quantity of caustic soda.

The further processes of abstracting the water and moulding the pulp into cartridges or other shapes, is performed by hydraulic pressure or other pressing machines, which are very ingeniously arranged, and great credit is due to the manufacturers for the nice and elaborate machinery they have adopted for the treatment of their products.

Where the cartridges are made under light pressure they are put on perforated trays, and dried in chambers heated with hot air.

In establishments where the gun cotton is mixed with oxidizing salts, these are mixed in regular gunpowder incorporating mills, of light but very elegant pattern.

The great difference between the process of manufacture described above and that of Von Lenk consists in the introduction of the pulping operation devised by Abel. This improvement admits of very searching purification, and also of more reliable testing, and of the subsequent compression.

PROPERTIES.

Before it has been reduced to pulp, gun cotton has the same appearance as the original fiber, but it is harder to the touch; it has neither taste nor smell.

It is insoluble in water, ether, or alcohol. Dilute acids and alkalies have no action upon it, but a lower substitution product is formed by the action of nitric acid of the specific gravity, 1·45.

Strong sulphuric acid dissolves it with difficulty.

Caustic potash dissolves it.

Much uncertainty prevailed for a long time as to whether gun cotton was liable to spontaneous combustion or not. As I have shown in my former articles, it had been used in Austria for twelve years, where it underwent the severest tests, and was held by the best authorities to be perfectly safe, but it was at last rejected on account of its instability, and also that other governments abandoned it after experimenting with it extensively. Prof. Abel, in his valuable researches, ascribes the reason of its decomposition to be mainly due to impurity, generally resulting in the process of manufacture, from the action of the acids on resinous matter in the imperfectly washed cotton, and certainly the experience of the last few years speaks in favor of his theory, as no accidents from that score are on hand.

It is only in late years that the true cause of chemical instability, which belongs to the whole class of nitrated organic compounds, has been clearly defined, it being the life question of our modern high explosives.

After their nitration a certain portion of acid—sulphuric, nitric, and hyponitric—always adheres to those compounds, more or less, according to their form and structure. From a liquid explosive substance like nitro-glycerine, the acids are easily washed out by churning it with water first and then with alkaline solution. But a granular, flocky, or fibrous material, like cotton, retains the acids with far greater tenacity, particularly the nitrous and hyponitric acids, which every nitrated organic compound has a strong tendency to retain.

It is quite clear that if there is hyponitric acid present, that highly corrosive material, which attacks almost every organic compound, even at the ordinary temperature, must be removed; if not, it will slowly but surely lead to an incipient decomposition, which, acting on a nitrated substance, sets free portions of dioxide of nitrogen or hyponitric acid.

From nitro-glycerine the corrosive acid is washed out with the utmost facility, and from the moment when the importance of that operation became fully appreciated it has never been neglected. Hence the chemical stability exhibited by dynamite under all conditions of climate.

Although nitro-glycerine has exhibited, upon the whole, greater chemical stability than gun cotton, yet it acquires that superiority only after being thoroughly purified from acid at the factory. When it contains free hyponitric acid it cannot be stored at all in hot weather, and even during the course of its manufacture it has several times given rise to a decomposition, ending with explosion and loss of life. The instability of the crude article contrasts so strongly with the stability of the pure nitro-glycerine in dynamite as to remove every trace of doubt regarding the decomposing influences of the adhering acids.

FUMES.

Among the most grievous complaints of miners about modern explosives is the poisonous nature of the fumes emitted, which exposes them to most serious inconveniences.

The gaseous products of the explosion of gun cotton differ from those of nitro-glycerine, as gun cotton lacks 24·24 parts of oxygen in 100 for the complete conversion of its carbon into carbonic acid, consequently we have the following to be the percentage composition of the resulting gases:

Carbonic oxide	28·55
Carbonic acid	19·11
Marsh gas	11·17
Nitric oxide	8·83
Nitrogen	8·56
Aqueous vapors	21·93
Total	98·15

The large amount of carbonic oxide is very deleterious and even dangerous when pure gun cotton is exploded in a close place.

It is very clear to my mind why English manufacturers have adopted the admixture of oxidizing salts (saltpeter, nitrate of baryta) with gun cotton, as the oxygen contained in the salts effects a more complete combustion, rendering the resulting gases less obnoxious than those resulting from pure gun cotton.

GUN COTTON IN MINING OPERATIONS.

In the compressed form gun cotton is susceptible, like nitro-glycerine and its preparations, of explosion through the agency of an initiative detonation (cap). Compressed gun cotton may therefore be applied with the same facility as dynamite and analogous substances in all mining and blasting work. On a whole the mixture of gun cotton and salts is not as sensitive to concussion as dynamite, consequently an extra strong cap is required to detonate it. As the highest nitrated product of cellulose (trinitro) still demands 24·24 parts of oxygen for the conversion into carbonic acid of the carbon in 100 parts, it is evident that the most explosive gun cotton producible must be inferior in explosive power to nitro-glycerine, which contains a very slight excess of oxygen. Some authorities claim that, in spite of its high state of compression to which English manufacturers have brought it, its strength is much less than dynamite.

Here, also, it is clear why the English manufacturers have adopted the use of an admixture of oxidizing salts, as stated before; but the question will present itself: Is not the quickness of the explosion less rapid through this admixture than of pure cotton?

Where great local action is required, nitro-glycerine or dynamite competes advantageously with those substances. Some careful comparative experiments made by the German engineer corps, at Graudentz, with Nobel's dynamite and Abel's compressed gun cotton (made at the English government works), demonstrated that dynamite produced somewhat greater local or shattering effects than gun cotton.

The plastic condition of dynamite and similar preparations gives them an advantage over the rigid, compressed gun cotton in blasting operations, as plastic powders may be inserted more readily into rugged and uneven bore-holes, and may be made, by application of pressure, thoroughly to fill the part charged. Every miner is aware of the importance of having his charge well home in the bottom of his hole, filling the whole cavity. And this can only be accomplished with a plastic powder.

The increased effect derived from this mode of applying plastic explosives is far greater than is generally believed.

Volume for volume, it is impossible to put the same weight in a bore-hole for a certain given space; or, in other words, if one has a cartridge of dynamite, say one inch diameter and four inches long, and one of compressed gun cotton of the same size, the dynamite cartridge will weigh more; consequently one has more explosive material in the same space, owing to the higher specific gravity of dynamite, and as a consequence larger bore-holes are required when using gun-cotton, which increases the cost of mining.

The cartridges of compressed gun cotton are rigid, stiff, and every miner knows there should be no air chamber round the charge, for the expansion which it causes not only lessens the power in proportion to its dilution, but actually decreases the tension of the gas in a much greater measure. Stiff cartridges cannot be introduced into a bore-hole without leaving a considerable air chamber round the charge, particularly as bore-holes generally deviate a great deal from the circular shape.

It is difficult to calculate even approximately the relative proportions of the unoccupied space and the charge, but certainly the loss will amount to considerable. When a loose mass of gun cotton is ignited in the air it burns rapidly away without any explosive effect. But if the ignition takes place in a closed chamber, the gases first produced immediately penetrate the mass of the cotton, and the whole is instantaneously decomposed. According to some authorities gun cotton will not explode below a temperature of 280° Fah.

Gun cotton has the great advantage over dynamite that it does not freeze, and therefore needs no thawing out, which is appreciated in cold climates. It does not suffer from exudation, and when properly made has good keeping qualities.

One great advantage again of nitro-glycerine and its preparations is that they remain unaltered under water, and can be used in wet bore-holes with the same facility as in dry holes, and although compressed gun cotton, when containing 10 per cent or 15 per cent of water, can be exploded, it requires a very strong exploder or a dry primer to accomplish it, consequently for work under water dynamite is preferred.

The cost of these two materials also differs greatly; the expense of producing gun cotton must be 20 per cent or 25 per cent higher than dynamite; therefore, when the question of competition arises, the latter has the advantage.

In the last six or seven years there have been brought forward in England (since Abel perfected his system of reducing gun cotton to a fine state of division and compressing it) several special preparations of gun cotton, for which peculiar merits are claimed by their advocates. One of those preparations, manufactured by the Gun Cotton Company, is a mixture of finely divided gun cotton and saltpeter. Another, the Tonite Company, at Faversham, mixes gun cotton with nitrate of baryta. Which of these is the best practical experience alone can form the estimate.—*Mining and Scientific Press.*

ENGINEERING INVENTIONS.

An improved bridge has been patented by Mr. August W. Brenner, of Coleman, Texas. The object of this invention is to construct substantial bridges of wood adapted for long spans, and which can be put up where iron bridges would be too expensive. The invention consists in a bridge composed of arches having a central trussed portion, and ends formed as trusses that support the central portion and sustain the end thrust.

An improvement in ore washers has been patented by Mr. Burrall A. Peirce, of Mouth of Wilson, Va. The invention consists in combining guides and swinging shovels on the ends of blades, the latter arranged on the rotary shaft of an ore washer.

Ten years ago a blast furnace which would make 400 tons of metal per week on 600 tons of fuel was considered a big thing. We have blast furnaces in Pittsburg which produce 1,500 tons of metal per week on less than 1,500 tons of fuel. The old method of heating permitted the flame to pass out of the furnace stack at a temperature of 3000° F. We are now using the regenerating stoves in Pittsburg, and do not let the gases out until we have utilized all the heat except 300°.

The International Geographical Institute of Berne has put forward a project for the establishment of an international school for training travelers. The programme of study is a formidable one, and is divided into two distinct divisions. The first includes instruction in numerous branches of knowledge more or less necessary for a traveler, and the second practical training in the field.

Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

If your boiler foams, it is caused by impurities suspended upon the surface of the water. It is a foul proceeding, and can be entirely obviated by the Hotchkiss Mechanical Boiler Cleaner. 84 John St., New York.

We advise our readers to use Van Beil's "Rye and Rock" as a tonic.

Cook's Infusorial Earth. A superior quality. Apply to D. Judson Cook, Drakeville, Morris County, N. J.

Wanted—To trade territory of my patent Buggy Top for second-hand engine boiler and machinery. J. F. Fowler, Alliance, O.

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Persons having Patented Specialties they want placed on the market, address "Agency," P.O.Box 985, Prov., R.I.

Pocket Cutlery Manufacturers send address to H. Rogers, Sabula, Iowa.

Electro Gold, Silver, and Nickel Plating, Buffing, and Polishing Iron, Steel, or Brass Goods. Careful estimates given to Manufacturers of Metal Goods. S. H. Cowles & Co., 137 Elm St., New York.

Light Tramway Locomotives for wood or iron rails, Steam Street Cars. W. A. Gilday, 54th St., Phil'a, Pa.

J.J.Callow's new grainl'g and letterl'g catal'g, Clevel'd, O.

18 ft. Steam Yacht; also 2 H. P. Engine and Boiler. Geo. F. Shedd, Waltham, Mass.

Second-hand Engines, Boilers, and Machinery. Send for price list. D. Stevenson, Jr., Harrisburg, Pa.

Parties owning Patents relating to Light Hardware, that wish the goods manufactured in quantity, or have patterns made for same, will find it to their interest to address Geo. Van Sands, Lock Draw 132, Middletown, Ct.

Peck's Patent Drop Press. See adv., page 14.

Houghton's Boiler Compound contains nothing that can injure the iron, but it will remove scale and prevent its formation. Houghton & Co., 15 Hudson St., N. Y.

Tarred Roof'g, Sheath'g Felts. Wiskeman, Paterson, N.J.

Long & Allstatter Co.'s Power Punch. See adv., p. 13.

Supplement Catalogue.—Persons in pursuit of information on any special engineering, mechanical, or scientific subject, can have catalogue of contents of the SCIENTIFIC AMERICAN SUPPLEMENT sent to them free. The SUPPLEMENT contains lengthy articles embracing the whole range of engineering, mechanics, and physical science. Address Munn & Co., Publishers, New York.

Abbe Bolt Forging Machines and Palmer Power Hammers a specialty. S. C. Forsaith & Co., Manchester, N. H.

For Mill Mach'y & Mill Furnishing, see illus. adv. p.12.

List 26.—Description of 2,500 new and second-hand Machines, now ready for distribution. Send stamp for the same. S. C. Forsaith & Co., Manchester, N. H.

Combination Roll and Rubber Co., 27 Barclay St., N. Y. Wringer Rolls and Moulded Goods Specialties.

Punching Presses & Shears for Metal-workers, Power Drill Presses. $25 upward. Power & Foot Lathes. Low Prices. Peerless Punch & Shear Co., 115 S. Liberty St., N.Y.

"Rival" Steam Pumps for Hot or Cold Water; $32 and upward. The John H. McGowan Co., Cincinnati, O.

The Eureka Mower cuts a six foot swath easier than a side cut mower cuts four feet, and leaves the cut grass standing light and loose, curing in half the time. Send for circular. Eureka Mower Company, Towanda, Pa.

Saw Mill Machinery. Stearns Mfg. Co. See p. 13.

Pure Oak Leather Belting. C. W. Arny & Son, Manufacturers, Philadelphia. Correspondence solicited.

Presses & Dies. Ferracute Mach. Co., Bridgeton, N. J.

Wood-Working Machinery of Improved Design and Workmanship. Cordesman, Egan & Co., Cincinnati, O.

For Machinists' Tools, see Whitcomb's adv., p. 12.

Experts in Patent Causes and Mechanical Counsel. Park Benjamin & Bro., 50 Astor House, New York.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Malleable and Gray Iron Castings, all descriptions, by Erie Malleable Iron Company, limited. Erie, Pa.

National Steel Tube Cleaner for boiler tubes. Adjustable, durable. Chalmers-Spence Co., 10 Cortlandt St., N.Y.

Turbine Wheels; Mill Mach'y. O.J.Bollinger, York, Pa.

Corrugated Wrought Iron for Tires on Traction Engines, etc. Sole mfrs., H. Lloyd, Son & Co., Pittsb'g, Pa.

Best Oak Tanned Leather Belting. Wm. F. Forepaugh, Jr., & Bros., 531 Jefferson St., Philadelphia, Pa.

Nickel Plating.—Sole manufacturers cast nickel anodes, pure nickel salts, importers Vienna lime, crocus, etc. Hanson & Van Winkle, Newark, N. J., and 92 and 94 Liberty St., New York.

Presses, Dies, Tools for working Sheet Metals, etc. Fruit and other Can Tools. E. W. Bliss, Brooklyn, N. Y.

C. B. Rogers & Co., Norwich, Conn., Wood Working Machinery of every kind. See adv., page 414.

Clark Rubber Wheels adv. See page 28.

For Pat. Safety Elevators, Hoisting Engines, Friction Clutch Pulleys, Cut-off Coupling, see Frisbie's ad. p. 29.

Safety Boilers. See Harrison Boiler Works adv., p. 29.

Mineral Lands Prospected, Artesian Wells Bored, by Pa. Diamond Drill Co. Box 423, Pottsville, Pa. See p. 29.

Rollstone Mac. Co.'s Wood Working Mach'y ad. p. 28.

For Sequeira Water Meter, see adv. on page 30.

For best Portable Forges and Blacksmiths' Hand Blowers, address Buffalo Forge Co., Buffalo, N. Y.

Brass & Copper in sheets, wire & blanks. See ad. p. 44.

The Brown Automatic Cut-off Engine; unexcelled for workmanship, economy, and durability. Write for information. C. H. Brown & Co., Fitchburg, Mass.

Clark & Heald Machine Co. See adv., p. 413.

The Chester Steel Castings Co., office 407 Library St., Philadelphia, Pa., can prove by 15,000 Crank Shafts, and 10,000 Gear Wheels, now in use, the superiority of their Castings over all others. Circular and price list free.

Cope & Maxwell M'f'g Co.'s Pump adv., page 45.

Wren's Patent Grate Bar. See adv. page 45.

Machine Diamonds, J. Dickinson, 64 Nassau St., N. Y.

The Improved Hydraulic Jacks, Punches, and Tube Expanders. R. Dudgeon, 24 Columbia St., New York.

Eagle Anvils, 10 cents per pound. Fully warranted.

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For Shafts, Pulleys, or Hangers, call and see stock kept at 79 Liberty St., N. Y. Wm. Sellers & Co.

Tight and Slack Barrel machinery a specialty. John Greenwood & Co., Rochester, N. Y. See illus. adv. p. 45.

Houston's Sash Dovetailing Machine. See ad., p. 45.

Steam Engines; Eclipse Safety Sectional Boiler. Lambertville Iron Works, Lambertville, N. J. See ad. p. 28.

Pat. Steam Hoisting Mach'y. See illus. adv., p. 45.

New Economizer Portable Engine. See illus. adv. p. 46.

Upright Self-feeding Hand Drilling Machine. Excellent construction. Pratt & Whitney Co., Hartford, Conn.

Rue's New "Little Giant" Injector is much praised for its capacity, reliability, and long use without repairs. Rue Manufacturing Co., Philadelphia, Pa.

Rowland's Vertical Engine. Wearing parts of steel. Broad bearings. F.C.& A.E.Rowland, New Haven, Conn.

The Sweetland Chuck. See illus. adv., p. 46.

Wm. Sellers & Co., Phila., have introduced a new injector, worked by a single motion of a lever.

Machine Knives for Wood-working Machinery, Book Binders, and Paper Mills. Also manufacturers of Solomon's Parallel Vise, Taylor, Stiles & Co., Riegelsville, N.J.

Skinner's Chuck. Universal, and Eccentric. See p. 46.

Don't buy a Steam Pump until you have written Valley Machine Co., Easthampton, Mass.

Use the Vacuum Oils. The best car, lubricating, engine, and cylinder oils made. Address Vacuum Oil Co., No. 3 Rochester Savings Bank, Rochester, N. Y.

Fire Brick, Tile, and Clay Retorts, all shapes. Borgner & O'Brien, M'f'rs, 23d St., above Race, Phila., Pa.

Lightning Screw Plates and Labor-saving Tools, p. 45.

Berryman Feed Water Heater. See illus. adv., p. 46.

NEW BOOKS AND PUBLICATIONS.

THE JOURNAL OF THE AMERICAN AGRICULTURAL ASSOCIATION. Vol. I. No. 1. 75 cents. Published by the Association. Jos. H. Reall, Secretary and Editor.

Contains the proceedings and papers of the national convention in this city in 1879, the proceedings of the meetings of December, 1880, and February, 1881, with some other special contributions on subjects related to agriculture.

THE ROCKY MOUNTAIN LOCUST. By C. V. Riley. Author's edition.

Comprises that portion of the second report of the U. S. Entomological Commission in which Professor Riley sets forth the permanent courses which the Government should adopt to lessen or avert locust injury. The descriptions of the geographical, topographical, and botanical characteristics of the several areas of mountain, plateau, plains, basins, etc., have a distinct value independent of the locust question.

STATISTICAL ABSTRACT OF THE UNITED STATES. Third number. Washington: Government Printing Office. 1881.

A collection of tables in regard to finance, coinage, commerce, immigration, tonnage, and navigation, education, postal service, population, public lands, railroads, agriculture, and mining of the United States in 1880, prepared under the direction of the Secretary of the Treasury.

ON ENSILAGE. By H. R. Stevens. Published by the author. 50 cents.

In this little book the proprietor of Echo Dale Farm, Dover, Mass., recounts his very satisfactory experience with silos, and adds the confirmatory experience of twenty-five other practical farmers as given in letters to him, describing their methods of storing and feeding ensilage, and their conclusions with respect to the economy of the new method of preserving forage.

RESOURCES OF SOUTH-WEST VIRGINIA. By C. R. Boyd, E.M. New York: John Wiley & Sons. 8vo, pp. 321.

Mr. Boyd reviews, county by county, the agricultural and mineral resources of fifteen or more of the south-western counties of Virginia, his purpose being to call attention to the advantages and opportunities which that part of Virginia offers to settlers and capitalists. The mineral deposits include iron, coal, zinc, copper, and lead. This region bids fair to become one of the richest and most desirable for residence in the United States.

IMAGINARY QUANTITIES: THEIR GEOMETRICAL INTERPRETATION. Translated from the French of M. Argand. By Professor A. S. Hardy. New York: D. Van Nostrand. 50 cents.

This is No. 52 of Van Nostrand's series of scientific reprints. The work of M. Argand is notable as having presented a pretty full discussion of the theory of imaginary quantities a quarter of a century before the idea was developed by Gauss, to whom the theory is commonly accredited.

INDUCTION COILS: HOW MADE AND HOW USED. New York: D. Van Nostrand. 50 cents.

No. 54 of Van Nostrand's science series. A reprint of the eighth English edition of Dyer's compact and generally admirable manual of experimental illustration of the nature and applications of intensity currents.

LEFFEL'S CONSTRUCTION OF MILL DAMS, AND BOOKWALTER'S MILLWRIGHT AND MECHANIC. Springfield, Ohio: James Leffel & Co. Pp. 283. 50 cents.

In this handbook the publishers have presented in convenient form the two well-known and very useful works named in the title. In the first part forty or more types of mill dams are illustrated by full page engravings.

A LECTURE ON THE PROGRESS OF THE NEW IMPROVED BED OF THE DANUBE AT VIENNA. By Sir Gustave Wex. Washington: Government Printing Office. 1881.

In this lecture the chief director of the improvement of the Danube at Vienna discusses not only the work but the lessons taught by it, and adds a description of the catastrophe produced by the ice gorge of 1880.

I. COMPLETE COURSE IN GEOGRAPHY. By William Swinton. II. GRAMMAR SCHOOL GEOGRAPHY. By William Swinton. New York and Chicago: Ivison, Blakeman, Taylor & Co.

Mr. Swinton's "complete course" has been before the public for five or six years, and has won, by its practical merits, an exceptionally extensive use in common schools throughout the United States. The author's idea of the inseparableness of physical and political geography is the true one, and the prominence he gives to industrial and commercial interests is much to be commended. The maps are many and well suited to their purpose; and the numerous illustrations have evidently been inserted for purposes of instruction. The new grammar school geography is intended to mark a higher grade of school requirement, and does mark a higher if not the highest level of text book making. The book has manifestly been prepared without stint of labor or cost on the part of author and publishers, and shows throughout a clear appreciation of what is needed in the better class of schools. It is admirably adapted also for family use.

THE MERCANTILE REGISTER. Issued by McKillop, Walker & Co.: New York. 1881.

Contains a list of the banks and bankers of the United States and Canada with whom the publishers have business connection, and also a corresponding list of attorneys and their references; together with a summary of the collection laws of the different States and other information of value to merchants.

The final issue of the *Harvard Register* comprises the numbers for April, May, June, and July, 1881. The *Register* has been discontinued to avoid possible competition with the official publication which the authorities of the University have decided to issue. The publisher and editor of the *Register*, Mr. Moses King, has made it a magazine of such superior quality that its ceasing to be is a loss that will be regretted by many besides the graduates of Harvard University.

Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries do not appear after a reasonable time should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at this office. Price 10 cents each.

(1) J. M. B. asks: 1. What is papier mache and how is papier mache work made? Have been told that it is made from old postage stamps. A. Papier mache is made from paper pulp with sizing; sometimes clay, chalk, and pigments are added. 2. Is there any market to be found for old postage stamps? I have several thousand of them, and would like to find a market for them. A. See column of Business and Personal. A small advertisement inserted therein would probably put you in communication with dealers in such things.

(2) A. A. S. asks: Can you give me a reliable method of removing mildew from cotton goods of light texture, lawns, muslins, etc.? A. 1. If the goods are colored soak them for twelve hours or more in sour milk, or buttermilk, then rinse in water, and wash in strong soap suds. 2. If the goods are uncolored moisten the spots repeatedly with javelle water diluted with three volumes of cold water; a brush can sometimes be used with advantage; rinse in plenty of running water, then wash in strong soap suds, not too hot.

(3) A. B. asks: If two slabs of inch glass be ground air tight and then an air chamber be sunk between them, would the suction be stronger if the air chamber were completely exhausted than if the chamber were not there? We think not, because the square inches of atmospheric pressure are the same whether the air chamber be there or not. A. Your opinion is correct.

(4) T. D. writes: I have occasion to buy large quantities of green oak staves, and have to have them piled in the yard for about a year before they are fit to work. They are exposed to all weathers. It is not desirable to use a kiln to dry them. Do you think they would dry quicker if piled under a shed, keeping the rain and sun off, but allowing the air to circulate freely through it, all the sides being open? A. Yes.

(5) C. S. B. & S. writes: We have been making a number of heavy steel dies for hammering purposes, and have had considerable trouble in hardening them. Have used prussiate of potash and also tried them thoroughly in charcoal fire without the potash, but have not been able to make them stand. By hard use they will sink in spots just as though they were soft, but a file will not touch even the sunken spots. It must be they do not harden through. A. Probably the trouble is due either to unequal heating or unequal exposure in hardening. The heating should be done in a "dead" fire, that is, not forced by a blast; and in hardening, great care should be used, by constant agitation, that all parts may be equally exposed to the hardening liquid. It is possible your steel may not be homogeneous.

(6) E. D. asks: What becomes of the air in a boiler when steam is generated? A. It escapes with the steam, either through the engine or safety valve, as either is taking the steam from the boiler. A good engineer, when getting up steam, leaves his safety valve open to allow the air to escape when the steam is first generated.

(7) J. Y. S. asks: Is it the weight of water or the pressure from the dam and creek that runs these old kind wooden water wheels. For example, I build a wheel 20 feet in diameter, and have a waterfall 10 feet high, a box 4 feet square inside, and a flume 10 feet long and 6 feet square: would I have the same power (that is, if I would keep this box and flume as above filled with water) as if I get it direct from the dam? A. It is the weight of water that gives the power. You would have the same power in either case if the water is kept at same height.

(8) P. R. S. writes: I have an upright tubular boiler, four years old; has been unused three years. I wish to use it, and would feel safer if it was tested. Now, if I fill it full of water, heat the water till the steam gauge marks 125 lb. (the boiler is 24 inches by 6 feet, iron $\frac{3}{16}$ inch thick, and tested 160 lb. when new), will it not be safe to make steam in it at 100 lb.? A. We would not advise over 80 lb. pressure. Your proposed mode of testing is dangerous, and should only be done by a very careful and competent engineer.

(9) W. M. M. asks: 1. Will an arrow shot perpendicularly into the air attain the same force or velocity in its descent as when it left the bow? A. No; the friction of the atmosphere both in the ascent and descent will reduce it. 2. Is there any rule to compute accurately the height to which an arrow has been shot if the time of its flight is known? A. We know of none.

(10) F. & C. write: I wish to construct a Faure secondary pile, and need a little more knowledge than is contained in No. 26. Are not the plates in Fig. 1, page 406, connected for a quantity current, and therefore not suitable for electro motive use? A. They are connected for quantity, but a number of such elements may be joined for intensity. 2. Does it make any difference in charging the secondary pile whether it is connected for intensity or quantity current? A. In charging the elements should be connected for quantity. 3. Will a small magneto machine such as are used in telephone signaling, be powerful enough to charge properly? A. No; you should use two or three Bunsen elements. 4. Does the secondary pile give current of same tension until all is gone, or does it weaken at the last? A. The current gradually weakens from first to last, and of course much quicker on a circuit of low resistance than it does on a circuit having considerable resistance. 5. Are either Edison's or Swan's incandescent lamps in the market, or can they be procured? A. We believe they are not in the market yet.

(11) C. E. J. asks how to use a fast speed in reaming wagon boxes. A. You cannot use a fast speed if the boxes are hard, as they should be. A very openly grooved reamer with fine cutting edges will probably work best.

(12) A. W. G. asks how to make cement to mend a cut in the rubber tire of a bicycle. A. The rubber companies sell a cement for mending rubber. It is composed of a semi-liquid solution of gum caoutchouc in naphtha. The rubber is cut fine and digested with the naphtha, warmed, over a water bath (away from fire), with occasional agitation until it softens, swells up, and forms a smooth pasty mass. No more than is requisite should be used in the joint, and plenty of time should be allowed for the cement to get dry. See cements, SUPPLEMENT, No. 157.

[OFFICIAL.]

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Letters Patent of the United States were Granted in the Week Ending

June 21, 1881,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A printed copy of the specification and drawing of any patent in the annexed list, also of any patent issued since 1866, will be furnished from this office for one dollar. In ordering please state the number and date of the patent desired and remit to Munn & Co., 37 Park Row, New York city. We also furnish copies of patents granted prior to 1866; but at increased cost, as the specifications not being printed, must be copied by hand.

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