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(Illustrated articles are marked with an asterisk.)

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THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 290,

For the Week ending July 23, 1881.

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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 1,400 to 2,200years, 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 8½ 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 1¼ drachms, wrapped up in softpaper, 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 auther 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.