THE GATHERER.

A New Electric Marvel.

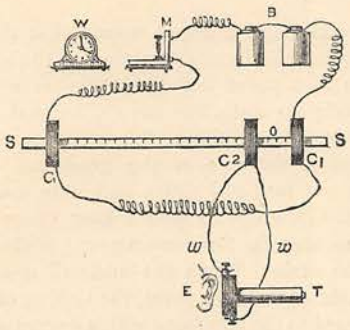
A new electrical apparatus, termed the Induction Balance, has just been invented by Professor Hughes, the well-known perfector of the microphone, and it promises to be of great and far-reaching importance to science. Professor Stokes, indeed, the distinguished Cambridge physicist, has characterised it as the most remarkable instrument of our time. Its value will lie not so much, perhaps, in its practical as in its scientific application; for it is likely to become, in the hands of the physicist, a means of throwing light on the molecular structure of bodies, and enabling him to probe the secrets of matter by help of the subtle electric current. There is no branch of science that may not profit by it, whether it be light, heat, magnetism, electricity, acoustics, or chemistry; and it may be the mainspring of a series of new discoveries.

The induction balance is another result of Professor Hughes' microphonic and telephonic researches, and it involves the use of both the microphone and the telephone (see CASSELL'S FAMILY MAGAZINE for October, 1878, and February, 1878). It is based on the fact that whenever a current of electricity is started or stopped in a wire, there will be another current set up in any wire which should happen to be near; the latter current, which is called an *induced* or "secondary" current, flowing in the reverse direction to the motive or "primary" current in the first wire. In his induction balance Professor Hughes causes a current to pass along *two* wires having a third wire placed between; and he so opposes the two wires in which the primary current is flowing that they tend to *induce* opposite currents in the mid-wire or secondary circuit. Therefore by shifting the position of the mid-wire with respect to the others, he can arrive at a point where the opposed induction currents in it exactly neutralise or "balance" each other, and the induction is zero. This will become clearer by a reference to the figure, which shows one form of the induction balance in its experimental state, a finished instrument not having yet been made. The two opposed wires are represented by two coils of fine silk-covered copper wire C and C_1, the mid-wire by the coil C_2. This being the secondary or induced circuit, a telephone T is connected into it, so that an ear E listening at the mouth of the telephone will hear the induced currents circulating in it. The current which is passed through the primary coils is obtained from a galvanic battery B, and a carbon microphone M is inserted in circuit. The little watch or "reveille" clock W ticks alongside, and acting on the microphone, transforms the current into a vibratory one corresponding to the ticking. This vibratory current traverses first one of the coils C C_1, and then the other, inducing sympathetic currents in the independent circuit C_2, so that the ticking of the clock can be heard in the telephone. It can be heard, however, only when the balance is disturbed. The extreme coils C and C_1 are so wound that they oppose each other in their inductive action on the mid-coil C_2, and there is a point between them at which there is absolutely no induction on C_2, so that when the mid-coil is placed there the telephone is silent. This point is the zero of the graduated scale S S, on which the mid-coil slides, and it is marked O on the figure. In order to give a long range of observation, the zero is, for convenience, made near one end of the scale. When the mid-coil is slid to one or other side of this zero point, the ticking of the clock can be heard in the telephone with a degree of intensity which can be measured by the graduations of the scale, for the scale indicates the amount by which the balance is disturbed.

An Electric Sonometer.—This power of the induction balance to give an accurate measure of the relative intensities of sounds obviously makes it serviceable as a sonometer; and it has already proved a most excellent audiometer, or measurer of hearing. In the hands of the aurist it will be a great boon to those afflicted with deafness, since it will enable him to examine the ear minutely, and to tell, from day to day or from hour to hour, how the hearing of his patient progresses under his treatment. He will now know what he is doing, and what the consequences of his remedies really are; whereas heretofore he has been, so to speak, groping in darkness for want of a good sonometer. Some curious results have been thus far obtained by the instrument. It is found, for instance, that very good ears, both of them hearing to the same degree, are rather a rarity, and that the hearing power varies from day to day with the weather and general state of the body. Men, too, are found, as a rule, to have more efficient ears than women, in whom this curious inferiority of the receiving organ is perhaps compensated for by the greater perfection of their articulation. We may add that the Prince and Princess of Wales have submitted their ears to the sonometer with a satisfactory result, those of the Prince, however, proving the best.

The Coin Tell-Tale.—Another important application of the balance consists in the delicate, rapid, and simple manner in which it tells a good coin from a base one, or the proportion of alloy in similar coins. For this purpose the balance as represented above is somewhat modified. Another secondary coil is added, so that there are four coils in all. These are arranged in two pairs, one pair consisting of a primary C_1 with its secondary C_2, and the other pair of the primary C with its secondary C_3 (not shown in the figure). The microphone current, as before, flows through both primaries, and in this case both secondaries are connected together and to the telephone. Now these secondaries are so adjusted with respect to each other, that the induced currents in them balance each other as they before did in the single secondary coil, so that

no ticking is heard in the telephone. When silence is thus obtained the balance is perfect, and the coils do not require to be moved with respect to each other.



The two pairs of coils, or two separate induction "pans" of the balance, as we may call them, should be kept about a yard apart, so as not to influence each other by induction. If now even a grain of metal be interposed between the primary and secondary coil (say) C_1 C_2, on one side of this electric balance, the induction equilibrium will be upset, and ticking will be heard in the telephone; and to restore the balance a similar grain of the same metal will require to be interposed between the other pair of coils C C_3. If a coin be thus interposed, the balance will only be made perfect again by means of a similar coin; and so sensitive is the instrument, that if the compensating coin be worn, or of a different alloy or temperature to the disturbing one, the balance will not quite recover itself. Tables of the proportion of alloy in gold and silver coins can by this means be made far more correctly than by any known chemical method; and a considerable saving to the Mint will very likely attend the introduction of the balance.

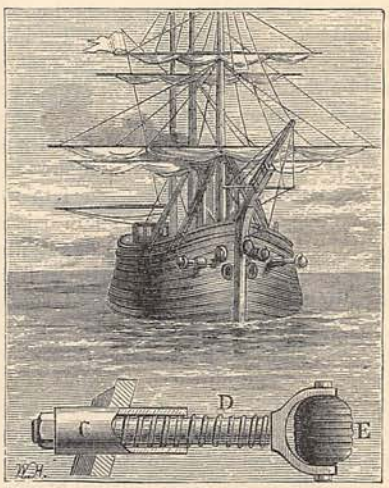
Electric clairvoyance, or second-sight, can also be performed to a certain extent by the balance. For example, let us suppose that the "pan" of the balance C_1 C_2 is in a distant place—say Edinburgh—and the other pan C C_3 (C_3 being the extra secondary coil not shown) in London; the scale being dispensed with altogether in this case. Let the telephone-wires W W be long enough to reach from Edinburgh to London, so that a person listening in the telephone at London can hear the state of the Edinburgh balance; and let the battery-wires be so long as to convey the same microphonic current through both primary coils, C_1 and C, at Edinburgh and London. Now it is clear that if the observer at London listens in the telephone he will hear the disturbance caused by inserting something in the pan of the balance at Edinburgh, and will be able to allay it by operating on the pan beside him. Indeed the apparatus can be so adjusted that if a sovereign, or a shilling, or a threepenny-piece, or a farthing, &c., be made to disturb the balance at Edinburgh, the observer at London will be able to tell what it is, since only a like coin interposed in his balance at London will produce the same disturbance on the latter.

A New Method of Raising Wrecks.

A very curious series of experiments has lately been made to develop the system of raising wrecks, such as the *Vanguard*, to which we believe the method will shortly be applied. The inventor of this novel method proposes to accomplish his task by the aid of compressed air. He surrounds the sunken vessel with an air-tight casing of woven material. This is called the "bell," and is floated above, and then lowered down upon the wreck. By forcing compressed air he displaces the water inside the bell, and from the interior of the hulk as well, bell and hulk then rising to the surface.

Safe and Silent China-Ware.

A novel set of china has recently been exhibited in Glasgow. The peculiarity of this ware is that it is prevented from scratching the polished table, and its movement is rendered perfectly noiseless, by the introduction of a strip of india-rubber riveted in a groove in the base of every article. The strip projects beyond the groove, and so the piece of china is much less likely to slip or fall from a tray when carried. But the particular feature of the exhibition is the crockery intended for use on board ship. On a rolling table of plate-glass and polished wood surface this ware is placed, and then motion is imparted to the table. The experiment is perfectly successful. Notwithstanding the rolling, the china remains steadily in its place, and its safety is secured in all ordinary weather, at least. Such an invention will no doubt prove very valuable, and for shipping wares its value is patent.



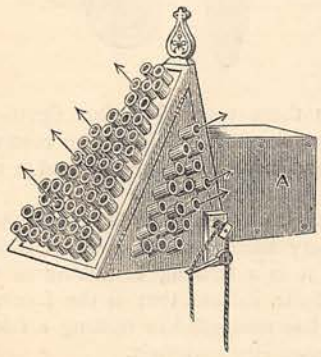
A Buffer for Ships.

We give an engraving of an ingenious fender for vessels, which has for its object the lessening of shocks in cases of collision against other ships or piers. The appliance consists of several spring-supported bars D, projecting from the bows, and carrying rollers E, that are covered with tarred rope in

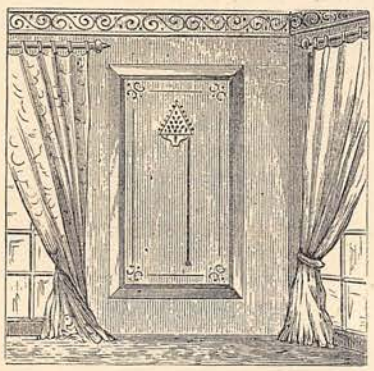
order to present a yielding surface to the opposing force. The bars D pass through strong iron sockets C, by which the buffers are to be securely fastened to the ship. It is needless to explain the action of the guards, as it must be evident from the engraving. One valuable feature in this invention is that when once it is attached to the vessel it is always attached, so that there is no chance of a smash occurring before fenders are provided to ward it off.

Improved Ventilation.

Our Family Doctor has frequently, in the course of his papers, set forth the evils of a badly ventilated



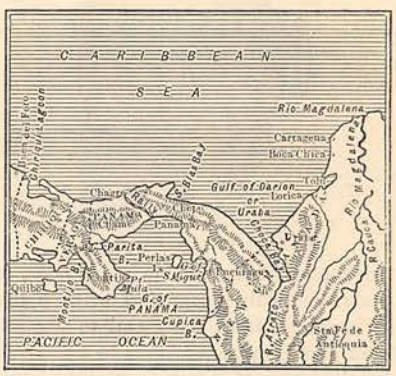
room. Now, one of the greatest obstacles to ventilation is draught, and we are often finding ourselves called upon to decide between two evils—a draught or a "stuffy" room. A clever method of ventilation lately devised, we are glad to find, has abolished both these difficulties, and by its use we are enabled to ventilate our rooms without causing a dangerous draught. The apparatus, said to be highly spoken of, is a box-like projection to be fixed in the wall, eight feet above the floor-line. It resembles in form a pyramidal box perforated with short tubelets which have an upward direction. These tubelets direct the inflowing jets of air in the same manner as the



barrel of a gun directs the projectile. The apparatus can be made to look quite pretty by fixing ornamental brackets underneath it. The air can be turned off and on or regulated to any extent. The patentees consider that each ventilator is capable of admitting sufficient air for from fifteen to twenty persons. This is a valuable invention, from the fact that the strong currents of air are made to ascend—to shoot upwards. There was an important ventilator similar in design produced in 1862, but that had not the above-mentioned improvement.

An Inter-Oceanic Canal.

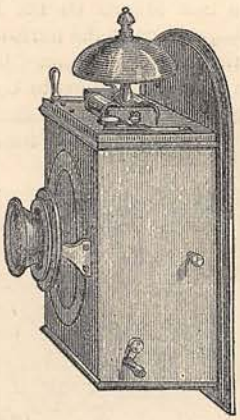
The International Congress at Paris has lately been discussing a number of schemes for the construction of a canal to unite the Pacific and Atlantic Oceans through the Isthmus of Panama. This project, however, is not novel. Many expeditions have been organised to explore the isthmus, yet none of them resulted in a practical scheme. But during the last three years a French association, in connection with the American and Central American Governments, has been actively employed upon the surveys, and several schemes have been presented to the Congress. These schemes include a level canal from Acanti on the Atlantic to San Miguel on the Pacific. Other plans—from Chagres across the narrow portion of the isthmus, from the end of Panama Gulf to San Blas Bay, and again from San Miguel to Uraba—with four or five routes, have all been suggested. The difficulties in the way are neither few nor trifling, for tunnels,



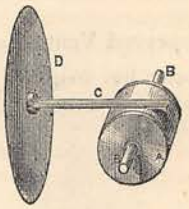
locks, and even long underground tracks have to be calculated and arranged for. The average expenditure is estimated at about 500,000,000 francs, and the yearly sum needed for repairs, &c., about 5,000,000. The time required is variously shown to be from twelve to eight years. The enormous advantages of such a channel are too obvious to need mention. The economy in time, in fuel, in insurance would be immense, and the distance saved would be, between Europe and Western America, about two-thirds that now existing. Of the two systems of canal—viz., the level canal without locks, or the canal with locks, but without a tunnel—it is probable that the former, with one or more tunnels, will be adopted, and the southern portion of the isthmus will most likely be the locality chosen for the experiment, which, if successful, will confer the greatest benefits upon the commerce of the world.

Edison's Electro-Chemical Telephone.

Mr. Edison, the famous inventor of the phonograph, has just completed a new telephone, which is perhaps the most serviceable of all those yet devised, because it speaks so loudly that not only can it be heard some yards from the instrument, but throughout a large hall. In the Bell and Gower telephones the transmitting and receiving parts of the apparatus are alike, but in the Edison telephone they are different. The transmitter is the well-known carbon telephone of Mr. Edison, in which the sound-waves set up by the voice impinge on a wafer of smoke-carbon through which a current of electricity is flowing into the telegraph wire, and, by their pressure on the carbon, regulate the strength of the current in accordance with the vibrations of the voice. The receiver is based on an electro-chemical principle discovered by the same inventor some years ago, and also applied by him to the construction of a very rapid telegraph printing instrument known as the electro-motograph. The nature of this principle is that the friction of a metal surface against another



surface moistened with certain chemicals, such as caustic soda, suddenly diminishes when a current of electricity is passed from the metal to the other surface, or *vice versâ*, and diminishes to a degree proportionate to the strength of the current. Thus, if my pen were dipped in a solution of caustic soda or potash, it would slip on the paper whenever a current of electricity was allowed to flow from it to the latter, and writing would become an easy, gliding, frictionless task. To utilise this property in his receiver, Mr. Edison takes a disc of mica D, and attaches to its centre a metal spring C, shod at its free end with a piece of platinum. The platinum point of this spring rubs against a cylinder A, rotated on an axle B B. The surface of the cylinder is composed of chalk, and is kept moistened with a solution of caustic potash and acetate of mercury. The copper pole of a small galvanic battery of two cells is connected to the spring, and the zinc pole to the cylinder; the telegraph line wire and the carbon transmitter being joined in circuit. The current, having been rendered vocal by the action of the sender's voice on the carbon wafer of the transmitter, passes from the spring to the cylinder of the receiver while the cylinder is rotating, and lessens the friction between them. The consequence is that at the passage of each vibratory current the spring slips on the chalk, and pushes the mica plate in the centre. The latter is thus thrown into vibration, and reproduces the words of the distant speaker; but since the real source of power is here the battery, and not the speaker's voice (which acts merely as a controlling agency), the sounds received may be actually

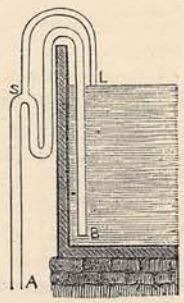


louder than those sent. The first figure represents the complete instrument, having the receiver as well as the carbon transmitter inside, and a call-bell on the top.

Recent trials of this marvellous telephone at the Royal Society have demonstrated its thorough success; and it is a striking testimony to the daring invention of Mr. Edison, that in the face of repeated failures he has succeeded in making a telephone out of such unpromising materials.

An Automatic Siphon.

Dr. William Taylor, of Edinburgh, has designed a novel form of siphon which acts as an overflow-pipe to tanks or other vessels in which a constant level of liquid is desired, without the need of any supervision. It at once carries off any excess of liquid from the bottom of the tank, without lowering the surface-level under a fixed height. This siphon consists of a waste-pipe A B, bent into the form shown, and having a hump S, about half an inch lower than the level of water required in the tank. A smaller tube, L, leads from this hump over the edge of the tank to the fixed level required. Now, on a sudden inflow of water taking place, the waste-siphon rapidly drains it off



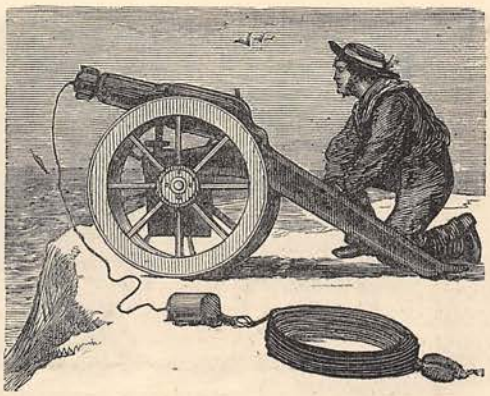
until the level stands at L. Below this point, however, the atmosphere is admitted into the small pipe at L, and A B ceases to be a true siphon, and no more liquid runs off by it until the level is again raised above the point L.

A Whistling Tree.

In the vegetable world there are many notable productions, but one of the most curious is a species of acacia, the *Acacia fistula*, which is found in Nubia, where groves of the trees may be seen over 100 square miles in extent. The Arabs call it the "soffar" (*i.e.*, flute or pipe), in allusion to a peculiar property that this acacia possesses. Owing to the inroads of the larvæ of insects, the ivory-white shoots of the tree are frequently distorted in shape and swollen at their base into a globular bladder-like gall, about one inch in diameter. After the insect has emerged from a circular hole, this thorn-like shoot becomes a kind of musical instrument upon which the wind, as it plays, discourses music in the regular sound of the flute. The natives of the Soudan, on account of the flute properties of the acacia, call it the "whistling tree."

Safe Sea-Voyages.

With all the clever contrivances that have been produced by ingenious people, one would think that such a catastrophe as a wreck would scarcely ever happen; or, if happen it did, no serious harm to the passengers would result. But though perfect safety at sea is not yet the issue of these innumerable inventions, they have, without doubt, proved of inestimable value to the navy, and have saved the lives of thousands of passengers. In addition to all the inventions of this nature previously described in "The Gatherer," we must mention a new winged projectile, which, when set in motion, shoots a rope from the shore to a vessel in danger. To this rope the passengers may attach themselves, and be drawn in to the shore. The construction of this invention is illustrated by the accompanying diagram. The projectile is made up of a tin case, having a leaden shot at one end and four wings at the other, the novelty consisting in the shot turning over immediately on leaving the muzzle, and flying over to the wreck with great rapidity, accuracy, and steadiness, carrying with it from 250 to 400 yards of line. It also uncoils the line on the shore, and carries the rope with it without breaking the line. This invention was tried at Shoeburyness the other day and found to work satisfactorily. The principle of this projectile will shortly be applied to new methods of destroying life in war, by removing the line and substituting rocket-composition, compressed gun-cotton, powder, or other inflammable material. The navy will find it of great service for countermining purposes also, so altogether the invention seems likely to become well known to, and well used by, both soldiers and sailors.



Indestructible Boot-Soles.

If the patent for a sort of stone sole for boots and shoes be found as valuable as the inventor considers it to be, what will become of the maxim that "there's nothing like leather"? for though he still proposes to utilise that product of the tanner's skill, it plays a much less considerable part in that instrument of torture known to-day, as it was generations ago, by the name of "the boot." On the well-cleaned leather sole and heel the inventor applies a kind of glue-mortar, consisting of glue insoluble in water, but flexible like leather, and of clean-washed quartz sand. Round the parts to be covered is placed a strip of sheet-lead, standing up as far as the required thickness demands. Into the enclosure thus formed the mixture is poured in a hot state, and then smoothed and made even "all over." When the glue-mortar has become cold, the strip of lead is taken off, and the cast is then allowed to settle and to dry. The use of quartz sand is said to prevent wear-and-tear, so that the nuisance of soling and heeling boots will be abolished.

Pure Air for London.

Since Dr. Richardson elaborated his model city of Hygeia, the question of rendering life in cities more healthful and lovely has been occupying many minds. Perhaps the latest plan for purifying the air of London streets is that of Mr. Gibbs, which consists in establishing very powerful air-fans like those in mines, that would suck a perpetual stream of air through the sewers from the interior of the city, and vent it along with the sewer gases at convenient points by means of tall chimney-stalks. Mr. Gibbs has already done good service in applying these fans to the drying of grain in wet harvests, and is so confident of their success in the ventilation question that he has brought the matter before the Houses of Parliament. It is undoubtedly conceivable that a city could be so constructed as to be admirably ventilated by this plan; but whether or not the latter can be practically applied to London, as at present constituted, is a point which can only be determined by experiment.

Answer to Shakespearian Acrostic on p. 447.

L orenz O
A s P
E art H
R ic E
T yrre L
E ffend I
S ahar A

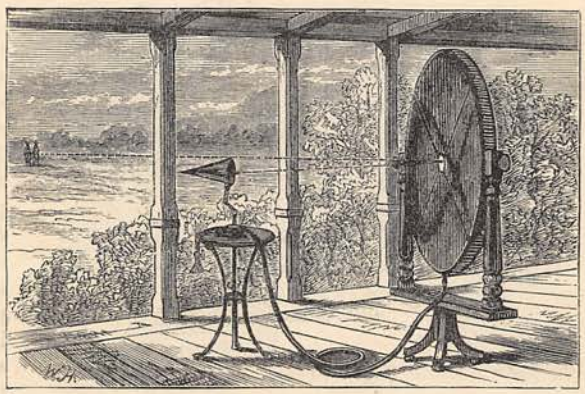
Straw-sheathed Pencils.

A process has recently been patented for covering the lead of pencils with straw instead of wood. The

straws are placed one over another until the proper diameter of pencil is attained; and the whole is then coated with "size" and consolidated. The outer straws are modelled to the required diameter by being soaked in water and then formed upon metal wires.

A Sound-Reflector.

Taking advantage of the principle that sound, like light, can be reflected, Mr. George M. Hopkins has devised a species of portable whispering-gallery, of which we give an engraving. The object of this appliance is to enable sounds that would otherwise be inaudible to reach the ear by concentrating their volume. Such an instrument must of course have a fixed focus, and is available only under certain conditions. The apparatus, it will be seen, consists of an air-tight drum, one head of which is elastic, the other rigid. This drum or reflector is mounted on pivots in a swivelled support, and is furnished with a flexible tube having a tap and mouthpiece at its free end. Across the face of the drum are stretched, at right angles to each other, two wires that, at their point of intersection, carry a small plane mirror. An ear-trumpet, which is shown on the table, is used to increase the effect of the reflector by collecting any portion of sound that the unassisted ear might fail to detect. To adjust the drum, all that is necessary is to look through the ear-trumpet towards the mirror, and to move the reflector until the source of sound becomes visible in the mirror. The reflector is then focussed by applying the mouth to the mouthpiece, to exhaust the air from behind the elastic head until the requisite degree of concavity is attained, a point that will be reached when sounds are distinctly heard in the ear-trumpet.



Curing Smoky Gardens.

Mr. Matthieu Williams, the well-known chemist, recently read a suggestive paper to the Society of Arts on a means of excluding soot-motes, or "blacks," as well as frost, from city and suburban back-gardens. A screening material is required which will stop blacks while admitting air and light; and, glass being too fragile and expensive, Mr. Williams found the desideratum in the cloth known as "wall canvas," which costs only 3½d. per yard. He proposes to erect screens of this material on a light pitch-pine framework, and calculates that a plot of 300 square feet may be thus protected at an outlay of some seventeen shillings. We may add that "wall canvas" is the material selected to protect the Houses of Parliament.

Bleaching Diamonds.

Many attempts have hitherto been made to remove the coloured tinges from diamonds, and render them pure and white like crystal, by subjecting them to heat in open crucibles. These attempts have always been more or less unsuccessful. It has now been found, however, that if the stones are heated in a *covered* crucible over a gas or charcoal furnace, such as is used in reducing the precious metals, and allowed to cool very slowly and regularly, the yellow or other tints which depreciate diamonds may be entirely got rid of, without injuring either the brilliance of the gem or the polish of its facets.

Colours from Cabbages.

The extraction of harmless pigments, which can be used for painting, printing, or dyeing, from the common red cabbage, is an important discovery which has just been made by two French chemists, MM. Savigny and Colineau. The red cabbage-leaves are first shredded fine, then boiled in water (three pounds of leaves to three litres of water) for twenty-four hours. After this they are pressed, and the expressed juices are added to the infused liquor, which is a fine blue-violet dye called "cauline," from the Latin *caulis*, a cabbage. Cauline is the base of a series of blue and green derived colours. For example, a light green dye is obtained from it by adding 2 parts of baryta to 500 parts of cauline; and a fine bronze colour is got by adding 100 parts of chloride of manganese and 5 parts of baryta to 500 parts of cauline.

The Electric Eel and the Telephone.

The muscles of the body are known to contract by a series of small movements, or jerks; and physiologists have also supposed that the electric discharge which certain animals—such as the gymnotus, or electric eel, and the torpedo—have the power of emitting is composed of a similar series of short intermittent electric currents. This conjecture has been verified recently by M. Marey, who caused the discharge to pass through a telephone. On tickling the brain of the gymnotus, he immediately heard the musical note *mi* in the telephone, thus proving that the electric discharge of the animal, which was provoked by the tickling, consisted of about 165 distinct currents succeeding each other in a second; for that note is produced by 165 separate vibrations. M. Marey also found that cold reduced alike the number of jerks in a contracting muscle and the electric impulses of the eel's discharge per second, while heat was found to raise it.