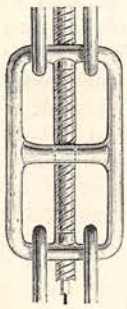
THE GATHERER.

Telegraphs to Lightships.

At the Crystal Palace Electrical Exhibition there was exhibited an ingenious means of communicating by telegraph between lightships and the shore. A model lightship was shown riding at anchor in a large tank, and by touching a press-button in the side of the tank, representing the shore, an electric bell was rung on board the ship. The current was conveyed to the ship by a cable which ran along the bottom of the tank and then up the mooring-chain to the ship. To prevent the straining of the chain damaging the cable, each link was made double and of the form shown in the figure, with the cable passing through it. The cable also passes through the mooring-swivel, and enters the ship by a revolving joint, which allows the ship to swing to the wind and tides without twisting the cable. The importance of a telegraph from lightships to the shore is apparent in case of a wreck, and it is satisfactory to learn that the Trinity House are about to try this new system on the *Sunk* lightship off Walton-on-the-Naze.



Fireproof Railway Carriages.

In the United States, where a train on fire is no uncommon occurrence, asbestos is being largely used as a lining for railway carriages. The method adopted is simply to pack three or four inches of asbestos between the floor proper and a false bottom ; and since this mineral wool is not only non-combustible, but also an excellent non-conductor, it subserves a double purpose—protecting from fire and also from cold. It has been suggested that an inch lining of asbestos on all other parts of the carriage would greatly add to their comfort, and would keep out both the cold draughts of winter and the heat of summer. Such a lining would certainly be appreciated on the English railways.

Copying Drawings in Colour.

The paper on which the copy is to be made is first dipped in a bath consisting of 30 parts of white soap, 30 of alum, 40 of English glue, 10 of albumen, 2 of glacial acetic acid, 10 of alcohol of 60° proof, and 500 of water. It is then taken out, and afterwards put into another bath which contains 50 parts of burnt umber ground in alcohol, 20 of lampblack, 10 of English glue, and 10 of bichromate of potash, in 500 of water. The paper is thus rendered sensitive to light, and must be kept in the dark. To make the copy the drawing is put into a photographic printing frame, and the paper thus sensitised is laid over it, then exposed to the light for a few minutes in such a way that the light traverses the two sheets. After exposure, the negative is developed by immersing it in water, and being a negative the drawing is seen reversed on it. The paper is next dried, and a positive is made from it by placing it on the glass of a printing frame, and laying a sheet of positively sensitised paper over it and exposing as before. The positive paper is sensitised in a bath like the first of those described, but having lampblack in it instead of burnt umber. To obtain coloured positives the black is replaced by red, blue, or other pigment.

The Centrifugal Gold Separator.

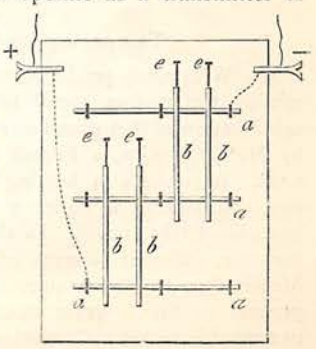
In the cradle or pan of the gold-digger the sand is washed from the gold by water, but a new apparatus has recently been devised by which the dry sand is separated from the gold by centrifugal force. The machine is about five feet in diameter, and is arranged to throw the sand by centrifugal force against a "wall" of mercury kept in position by centrifugal action. In this way every particle of gold is brought into contact with the mercury and amalgamated with it, while the sand is blown away by means of an air-blast. The machine cleans a ton of sand in twenty minutes, and is said to be so thorough in its operation that the refuse or tailings left from other washings can be worked over again at a profit.

The Microphone as a Divining-Rod.

The microphone has already been applied to the detection of earthquakes by giving notice in a telephone of very delicate earth-tremors ; and a novel use has been found for it by Count Hugo von Eugenberg, in finding hidden springs on the grounds of his estate at Tratzberg in the Tyrol. His plan is to bury microphones in the soil and connect each of them with a battery and telephone, then listen in the night-time for the murmur of underground waters. It is worthy of note that the American Indians have from time immemorial applied the naked ear to the same purpose in a similar manner.

A Simple Microphone.

A simple speaking microphone—that is to say, a microphone that will operate as a transmitter of speech when connected in circuit with a battery and telephone—can be constructed at a slight cost in the manner represented by the woodcut. A slim pinewood box is turned bottom up, and three slips of plumbago pencil or hard carbon, *a a a*, are fastened to it by brass wires passing



through holes in the bottom. Upon these rest four other strips of the carbon, *b b b b*, suspended in pairs by threads from the holes *e e e e*. The two end slips, *a a*, are connected to the battery and telephone line, and the box is slightly tilted up. On speaking to the bottom of the box the words are heard in the distant telephone.

Damp-proof Mortar.

The Hygeian Rock composition is a cement for brick walls which is entirely damp-resisting, and when melted and run hot into the middle space between two half-brick walls built half an inch apart, as shown in Fig. 1 or as in Fig. 2, it likewise increases the strength of the structure. For walls in damp places, water-tanks, and other places where moisture is to be kept back and thick walls are not required, the new cement will prove of value. We may also mention that silicate paints of different colours are now prepared for painting walls, in order to exclude the damp by filling up the pores of brick and mortar.

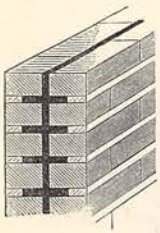


FIG. 1.

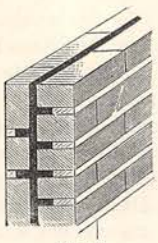


FIG. 2.

An Automatic Telephone Exchange.

Telephone exchanges are now fitted up with a complicated appliance called a "Switch," whereby an attendant can connect any two subscribers' lines together so as to enable them to converse with each other by telephone. An apparatus, however, for enabling either of the two subscribers who wish to converse to put himself in communication with the other, has been devised by Messrs. Connolly and McTighe, of New York, and is now on view in London. The device is somewhat complex in appearance, but less so in reality. It consists in idea of a set of revolving discs, each of which is set apart for a subscriber and in connection with his telephone line. By sending a current over his line, he is enabled to put his disc into communication with any of the subscribers he wishes to talk to, and thus connect both their telephone lines so that they can speak direct to one another without the assistance of an attendant.

Tempering by Pressure.

Mr. Whitworth produced very hard steel by submitting the molten metal to great pressure, and a modification of this plan has recently been introduced by M. Clémandot, a French engineer, for tempering steel. It consists in heating the steel to a cherry-red, and putting it under a strong pressure until it has completely cooled. In this way, by varying the pressure, different degrees of temper can be given. Metals thus treated acquire a great hardness, and in general so fine a grain that they can be polished to resemble nickel. Compressed steel, like steel tempered in the ordinary way, has a high "coercitive force," that is to say, it can be strongly and permanently magnetised; and M. Clémandot has applied it in the construction of magnets for Gower and Ader telephones. The best steel for such magnetic purposes is that of the Allevard Works in France, probably because it contains a small percentage of tungsten. Until quite recently we had no steel in England so well adapted for making powerful magnets as that of Allevard, but Mr. Le Neve Foster, of the India-rubber and Gutta-percha Works, Silvertown, now prepares excellent magnet steel. The proof of this is that permanent magnets made from it have been adopted at Aden instead of the powerful electro-magnets formerly employed in the working of Sir William Thomson's syphon recorder for writing the messages received on submarine cables.

Magnetism and Vibrations.

Professor Bjerknes, of Christiania, by means of little drums or tambours vibrating in a tank of water, has succeeded in imitating all the chief magnetic effects. Thus, when two drums were vibrated by means of air-pulses sent into them, they attracted or repelled one another in the water according as the vibrations were in like or unlike phase, that is to say, according as the two diaphragms of the drums approached and receded from each other, simultaneously, or chased each other to and fro as they vibrated. Mr. Augustus Stroh, with sensitive drums vibrating in the atmosphere by air-waves sent into them from a sounding-reed and bellows, also reproduces these attractions and repulsions when the drums are vibrating in like or unlike phases. His apparatus is shown in Fig. 1, where *a* and *b* are the two drums connected by pipes *e* and *d* to the bellows; the drum *b* being mounted on a swinging stand *c*, so as to be free to move by attraction or repulsion. Moreover, either of the drums will attract a neighbouring light body, such as a piece of card or paper, which is not itself vibrating. The resemblance to magnetism will at once appear if we consider the drums which vibrate in like phase to represent the opposite poles of a magnet, and those of unlike phase to represent the like poles; while the card is taken for a piece of soft, unmagnetised iron, which, as every one knows, is always attracted by a magnet, no matter what pole it is presented to. Mr. Stroh also shows that when the drums are vibrating in like phase, and therefore attracting each other, they are producing a rarefaction of the air between them, whereas, when they vibrate in unlike phase and repel

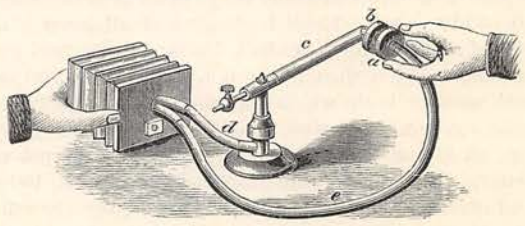


FIG. 1.

each other, they produce a condensation of the air between them. These results lead to a difference of air-pressure on the fronts and backs of the drums, and thus cause the observed attractions and repulsions of the drums. Further, Mr. Stroh has demonstrated the

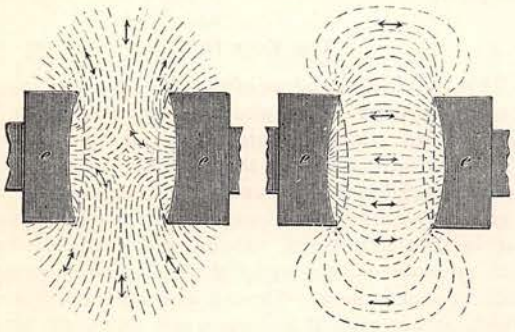


FIG. 2.

remarkable fact that the movements of the air between and around the vibrating drums is exactly similar to the well-known "lines of magnetic force" around magnets, as will be seen from Fig. 2, where *e e* are the vibrating drums, and the dotted lines show the air-movements between. The right-hand case of the figure corresponds to a like phase of the drums or to opposite magnetic poles; while the left hand corresponds to unlike phases or like magnetic poles. Thus, his experiments tend to confirm the surmise that magnetism is a disturbance of the luminiferous ether surrounding matter, set up by the vibrating molecules of magnetic substances.

A Fire-proof Door.

At the recent Building Trade Exhibition a fire-proof door made of concrete was exhibited, slag being used as a conglomerate. It was panelled and hinged like an ordinary wooden door, and moved as freely. Iron and steel Venetian blinds were also exhibited, together with revolving iron shutters which can be used for in-door partitions and safety screens in case of fire. They are arranged to drop by their own weight as soon as the brake is released. Spans up to fifty feet can be closed by a single curtain.

A Submarine Ship.

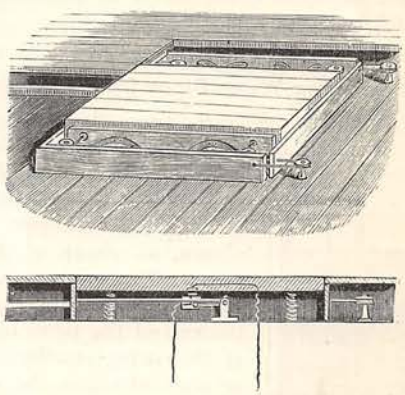
A ship that can sail for twelve hours under water at a depth between 100 and 300 feet, according to the will of the commander, is certainly a novel thing in naval architecture. Such, however, is the invention of M. Theodorescu, a Roumanian engineer; but the announcement must be taken with some reserve until we hear how the new craft acquits itself on trial. The raising and lowering of the ship are done by means of screws, and can be effected either suddenly or gradually. The progress beneath the water is noiseless and nearly as fast as that of an ordinary steamer. Enough light is supplied by electricity to enable those on board to see 130 feet ahead, and to regulate the ship's motion accordingly. Air is provided to serve for fourteen hours, and a fresh supply can be obtained if need be by putting up telescopic tubes to the surface while the vessel remains under water. To complete the duck-like qualities of this marine wonder, it can be managed on the surface of the water like any other boat. For naval experiments, and for objects such as the repair of submarine cables, the new vessel will be an acquisition.

A Weather Compass.

The ordinary barometer is a poor weather-glass by itself, because the moistness of the air and the state of the wind require to be taken into account in foretelling the weather as much as the atmospheric pressure. Professor Klinkerfues, of Gottingen, has therefore devised a combination which, in the form of a compass, gives the result of these three separate factors in the weather-problem. The needle, or indicator, of the compass is controlled by a small aneroid barometer, and a horse-hair hygrometer, while the direction of the wind is also brought to bear on the question by a very ingenious arrangement which, however, would take too much space to describe. The apparatus is very cheap, and is worthy of a fair trial.

New Burglar Alarm.

In the accompanying woodcut is represented an alarm specially devised to checkmate the burglar in the pursuit of his nefarious vocation. It has been invented for employment particularly in vaults and safes, but obviously it can be used wherever thieves may be expected to break through and steal. The *modus operandi* is exceedingly simple. It consists of a platform, supported on spiral springs, which the moment it is stepped upon operates an electric circuit; an alarm is forthwith raised at a point near or remote as may be desired. It is placed in and on a level with the floor, so that it is impossible for a



stranger to pass it without sounding the alarm. When the vault or safe is in use, movable side and end bars are moved inward by cords running over pulleys and connected with a sliding frame, which is moved by a rod reaching to some point near the platform. These bars being furnished with pins or stout pegs for supporting the platform, it will not be depressed when it

is trod upon. As soon, however, as the bars have been released, they will be carried outwards by the springs, and the platform will yield when stepped on, and complete the circuit, which was broken when the withdrawal of the bars released the lower electrical contact. The simplicity of the appliance, apart from its apparent suitability for its purpose, seems to be its strongest feature.

Glazing without Putty.

Methods of covering greenhouses with glass without the aid of putty are coming more and more into use, and two very good plans are illustrated in the figures. In Fig. 1 the pane of glass, *a*, is clamped all along its bottom edge, and the clamping metal is perforated at *b*, to allow the moisture which collects on the inside of one pane to run out on the outside of the next pane. Fig. 2 shows in section another method. In it the panes are clamped between two metal surfaces, the cap, *b*, being adjustable to prevent rattling of the glass, and the metal gutter, *c*, overlapping so as to carry the moisture from pane to pane.

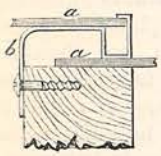


FIG. 1.

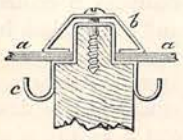


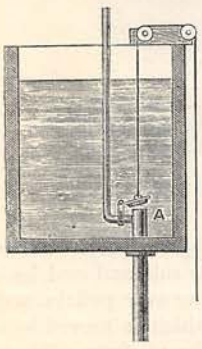
FIG. 2.

Dynamogen.

A new explosive, termed dynamogen, which is a rival to gunpowder, has been invented by M. Petri, a Viennese engineer. It is stated to contain neither sulphur, nitric acid, nor nitro-glycerine, and does not injure the gun or cartridge. The charge takes the form of a solid cylinder, which can be increased in power by pressure without any increase of bulk. The recoil, after firing a gun with it, is very slight, and as it is less costly than gunpowder, and preserves its virtues under great differences of temperature, it may be useful for blasting operations.

Preventing Water Pipes from Bursting.

An ingenious device for preventing service-pipes, in a house, from bursting during a frost, is illustrated herewith. It consists of a valve or trap-door closing the end of the main service-pipe in the cistern, as shown at A in the figure. The valve is raised or lowered, so as to open or close the end of the pipe, by means of the string attached. When severe frost comes, the valve-lid is lowered to close the end of the pipe, and then as no more water enters, the house-pipe can be emptied and thus preserved. To obtain water it is only necessary to open the valve and refill the pipes, taking care to leave them empty as before. To obviate the carelessness of servants, a simple electrical attachment is supplied, which on the temperature falling to the freezing point closes the valve automatically, at the same time cutting off the current from the electric battery to prevent waste, and also emptying the pipe.

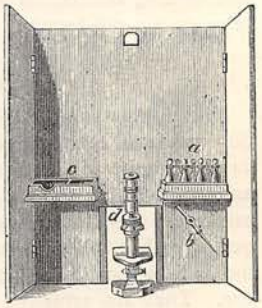


The Kola Nut.

This seed is the produce of the *Sterculia acuminata*, a native of West Africa, where the negroes use it to flavour water, which is more or less dirty or putrid. Travellers have surmised that it contains caffein, the active principle of coffee, and recent analyses by two German chemists have shown that it contains more caffein than coffee itself. Moreover the caffein is free and uncombined, not as in the coffee berry, united with an organic base. The nut also contains glycose, which is not present in cacao, and thrice as much starch as is contained in theobroma. It has no fatty matter like cocoa. The nuts are, therefore, likely to become the source of a grateful beverage. They have hitherto been employed in the cure of liver diseases amongst the dwellers in the Soudan and Western Africa, and it is expected that they will occupy a prominent place by the side of coca.

A Screen for the Microscope.

A good light and a handy method of keeping the various objects near, are both conveniences when working with the microscope; and the screen, which we illustrate herewith, is devised to give them. The screen is formed of three wooden panels, blackened inside and hinged together as shown. Two little panniers, *a c*, attached to the back-wall, carry plates and stoppered bottles, while *b* is a fine pipette hanging in a staple. The light comes through a small window, *d*, which can be obscured by ground or coloured glass if necessary.



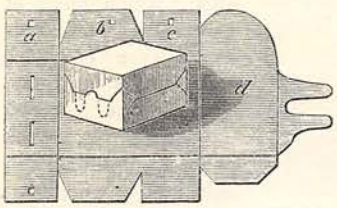
Magnetic Bricks.

It was recently noticed by Herr Hepner, of Salzburg in the Tyrol, that some old bricks there had an attractive and repellent force on the compass needle, as if they were magnets with unlike poles. Following up the hint, Herr Hepner constructed bricks from each of eight varieties of clay found in the neighbourhood and baked them. Seven out of the eight specimens were distinctly magnetic, but unbaked bricks had no such properties. Further experiments have shown that the minerals breunerite, mica-slate, chlorite, hornblende, and clayey iron-garnet become

magnetic by intense heating, and that the line between the poles is perpendicular to the bed-layers of the brick. The bearing of these results on the construction of magnetic observatories and in surveying operations will be readily seen.

A Paper Box.

The accompanying woodcut shows a handy way of preparing a folding box without paste or gum. The blank sheet of paper board is cut so as to form the flaps *a b c*, and the cover portion so as to form the flap *d*. It is then scored with a sharp edge, so that the corresponding rectangular portions form two sides of the box, the ends being formed by the folding in of the flaps. Two slits in the front of the box receive the locking flaps, and holes in the edges, as shown, receive a cord or ribbon to keep the whole together.



Removing Coffee Stains.

Stains of milk and coffee are difficult to remove, especially from light-coloured or fine fabrics. From woollen or mixed fabrics they can be obliterated by moistening them with a mixture of one part of glycerine, nine of water, and half of ammonia-water. The wash is to be applied by means of a brush repeatedly during twelve hours. The stains are then pressed between cloth and rubbed with a clean rag. Drying, or better still steaming, will generally remove the stain. In the case of delicate silk dresses, five parts of glycerine are mixed with five of water, and a quarter of ammonia added. If, however, it is found by trial that this mixture changes the colour of the cloth, no ammonia should be added. The mixture is then applied with a soft brush and allowed to remain on the stains for six or eight hours, then rubbed with a clean cloth. The remaining dry substance is then removed with a knife, the injured places brushed with clean water, and pressed between cloths and dried. Dry bread will rub away the last vestiges of the stain. The finish of the cloth may be restored by brushing it with a thin solution of gum arabic, and drying it.

An Electrical Camera Shutter.

An ingenious plan for opening the camera shutter from a distance, by means of electricity, has been devised. The shutter is ordinarily kept closed by a trigger arrangement, but this trigger is sprung by means of an electro-magnet attracting a soft iron armature when the current circulates through it. The current is produced by two small chloride of silver cells, which only weigh two ounces. These little cells are very portable and convenient for purposes where the source of electricity requires to be carried about. They are made by taking a small rod of zinc, no longer than the little finger, and a similar rod of fused chloride of silver salt. The chloride is sheathed in muslin, then placed beside the zinc with a slip of cardboard separating them. A thin strip of silver forms the positive pole of the cell, the zinc forming the negative pole. The solution is a mixture of sal-ammoniac in water, or common hartshorn.

A Telegraph Plough.

The immunity of underground telegraph lines from damage by storms or accidents is now recommending their use in preference to wires erected on poles through the air; moreover, the spread of electric lighting necessitates the employment of insulated wires buried in the earth, and it is therefore satisfactory to know that a handy machine has been constructed whereby such lines can be expeditiously interred. The telegraph or cable plough of M. Jules Bourdin cuts the trench, lays the wire in it, and closes it again all in one operation, as it is drawn over the surface of the ground by three horses at the rate of three miles per hour. The implement consists of a cutting disc which precedes the share, and severs roots or other obstructions to the share. Behind the disc comes the share, which delves a foot deep, and is provided with a bent tube through which the cable passes to the bottom of the furrow where it is laid. A drum for carrying the cable, and a roller for closing the furrow, complete the machine, which will, at least, prove useful in laying military field-telegraphs.

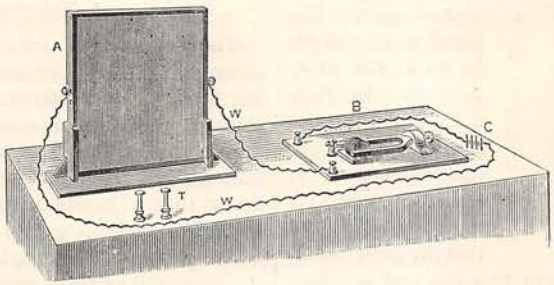
An Ingenious Bottle-Cleaner.

The engraving represents a new appliance for cleaning bottles, barrels, and receptacles of that description. As will be seen, it consists of a series of metal balls chained together, each ball being furnished with several stiff brushes. Attached to one end is a rod, by means of which the chain is inserted in, or withdrawn from, bottle or barrel. The cleansing is accomplished by shaking the chain to and fro, with water or other suitable agent. The weight of the balls carries the bristles into the tiniest nooks and corners. Of course the balls used for cleaning barrels are far heavier and stronger than those employed with bottles, weighing in the former case a quarter of a pound each.

The Inductophone.

An interesting development of the telephone has recently been made by Mr. Willoughby Smith, the well-known electrician. It has long been known that telephonic sounds could be transmitted through the air by means of "induction" from one wire to another, and, in the early days of the telephone, persons listen-

ing at a telephone connected to one telegraph line could overhear music and conversation being sent along a neighbouring wire. Mr. Smith has devised an apparatus on this principle of induction, which enables a number of persons in the same room to hear telephonic sounds by simply holding a telephone to their ears in the neighbourhood of the apparatus in question, the influence being transmitted to the telephones through the air by induction. The inductophone, as the instrument is called, consists of a wooden frame, A (see figure), in size and shape like an ordinary flat looking-glass frame. The frame is wound across in a vertical direction with very fine platinum wire covered with silk, to prevent the different turns touching each other, and short-circuiting the current of electricity, which is received from the distant station and passed through the coil. This current, which conveys the sound, is in Mr. Smith's original apparatus transmitted by a vibrating tuning-fork, B, at the distant station. The tuning-fork is placed in the circuit of a battery, C, and the line-wire W W, and at each vibration it sends a pulse of electricity into the line. These pulses traverse the wire of the inductophone at the receiving station, and in doing so produce a magnetic field around the coil which appears to extend to a considerable distance, and penetrates brick walls, glass, gutta-percha, and other non-magnetic substances. If now a telephone, T (which may have its coil removed and consist only of the iron diaphragm and magnet) is held to the ear in the neighbourhood of the coil, the magnetic changes produced in the surrounding magnetic field by the intermittent current, circulating in the fine wire, will so affect the diaphragm that the sound of the tuning-fork will be clearly audible. The skeleton telephone should be held so that the iron diaphragm *cuts* the "lines of magnetic force" in the space around the coil, otherwise if it is parallel to these lines there will be no effect. While upon this subject, we may mention that a secret telephone company has been started in New York, whereby it is rendered very difficult for any one to overhear a message except the parties concerned. For this purpose two wires far apart are used, and the message is sent piecemeal over one or other wire, alternately, by means of a rapidly-rotating contact-maker. Any one tapping a single wire can thus only hear snatches of the message. For state and business uses this arrangement may be very serviceable.



Pressed Metals.

A number of interesting experiments on the solidification of metal powders by great pressure have been made recently by Professor Walthère Spring, of Liege. He has shown that, under pressures varying from 5,000 to 7,500 atmospheres, metal filings may be united into coherent discs just as if they were solid metal held by cohesive force. Thus, zinc can be formed in this way from powder, so that it has a crystalline fracture and a density equal to that of zinc which has cooled from the molten state. Filings of lead, bismuth, tin, and cadmium, mixed in the proportions of "Wood's alloy," which melts at 63°C., are found under a pressure of 7,500 atmospheres to unite and produce an alloy melting at 70° C. Non-metallic powders also behaved in a similar manner, unless they were of an amorphous nature. Crystalline powders invariably united into solid blocks. Ground salt, for example, turned into a transparent block; and excess of pressure actually liquified some substances from the solid state. Thus, lead filings at 2,000 atmospheres became solid, and fluidified at 5,000 atmospheres. Starch under 6,000 atmospheres became as hard and petrified as alabaster. Peat was changed into a black mass like solid coal by a pressure of 6,000 atmospheres, and Professor Spring concludes that heat and pressure combined may have produced our coal supplies.

Photographing in Darkness.

A plate of rock-crystal silvered to render it opaque is nevertheless capable of allowing certain of the invisible rays of the spectrum beyond the violet to pass through it, and M. de Chardonnet recently employed such a plate to take photographs in the dark. Very white crown-glass, or even thin glass of St. Gobain, will answer instead of the rock-salt, but requires a longer exposure.

Crocodile Power.

An experiment which belongs to the curiosities of science was made quite recently at Paris by Drs. Regnard and Blanchard on a stud of ten live crocodiles which had been presented to M. Paul Bert, the late Minister of Public Instruction in France. A crocodile was fixed on a table, and its upper jaw was connected to an overhead dynamometer or power-meter by means of a rope. By startling the animal with an electric current the downward blow of the jaw was measured and found to be equal to 308 lbs. at the point, which, considering the distance of this point from the masseter muscle causing the movement, made the total contractile force of the muscle itself equivalent to 1,540 lbs. This extraordinary snapping power was that of a Saigon crocodile weighing only 120 lbs. An ordinary sporting dog gave a snap of 72 lbs. at the muzzle, corresponding to a contractile force in the muscle of 360 lbs.