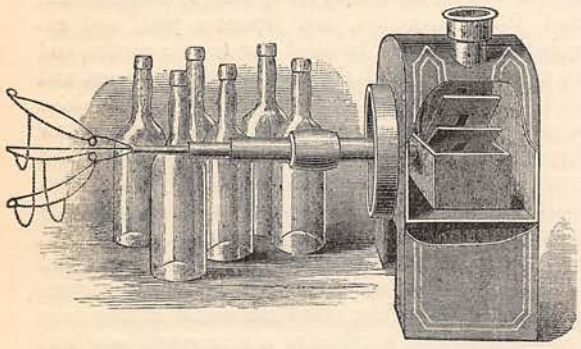
THE GATHERER.

A Frost Tell-tale.

Amateur gardeners can easily construct a frost-alarm, which will ring an electric bell when frost makes itself felt during the night in the greenhouse or conservatory. An iron wire, ten or twenty feet long, hung so that its lower end is free to contract by the cold, and in so doing complete the circuit of an electric battery in circuit with the bell, is all that is necessary, and can be readily arranged. A little more ingenuity, and the wire can be adjusted to drop a weight and strike a match, which will set fire to some light combustibles capable of defeating the rigours of the cold by the cloud of smoke which will arise.

A Machine for Washing Bottles.

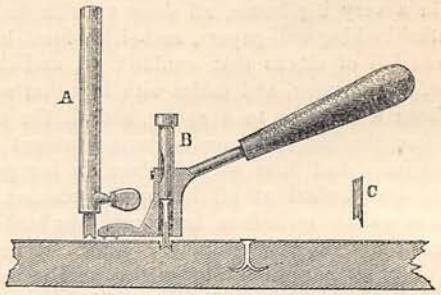
Another clever invention, of American origin, is shown in the accompanying engraving. It is a machine of a very simple character for washing bottles, tumblers, paraffin lamp chimneys, and the like. It consists of a shaft that is turned by a small water-wheel, which is driven by the force of the water as it streams from the tap. When the wheel revolves with a certain speed it shoots into the bottle wire arms, that carry some chains that are dashed against the sides of the vessel by centrifugal force. These chains not only agitate the soap and water so that the bottle



is quickly and thoroughly cleaned, but detach from the sides particles of adhering matter. A brush of convenient size may also be inserted in the bottle and worked about by the wire arms.

A Nail-Driver.

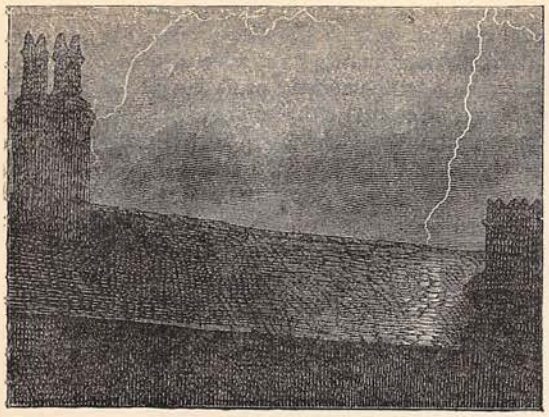
Perhaps nothing will better illustrate the inventive genius of the Americans than the appliance represented in the woodcut. It is an instrument for making a nail-hole, and for driving the nail home and clinching it when there, and is the most ingenious thing of its kind that we have seen. The part (A) of the apparatus that makes the hole has a notched end which, on being actuated by a screw, penetrates the wood and, after forming the hole, leaves a ridge in the centre at the bottom. A section of the hole made ready for the nail may be seen at C. The driving



tool, B, comprises a socket furnished with a handle, and contains a follower which rests upon the head of the nail and receives the blows of the hammer in the process of driving the nail. The nail is split for half its length, the two arms so formed being slightly separated at the point; accordingly when they meet the ridge at the bottom of the hole they are forced still further apart, clinching ultimately in the body of the wood. We should imagine that it was very difficult to extract a nail thus driven home. Whether the appliance can be made readily and cheaply available for every-day purposes we do not know, but for special work it might, we imagine, be employed with advantage.

A Mighty Lever.

A new steam-crane is nearing completion at Woolwich, which is to be the most powerful piece of mechanism in existence. It is designed to meet the necessity of raising and placing in their carriages pieces of ordnance of such enormous size as to defy all previously existing means of lifting power. Within eight pillars, by which the structure is supported, are placed the engines and other gear, and the whole travels on a circular railway of the ordinary 4 ft. 8 in. gauge with a sweep of 430 feet. To support such an immense weight, the rails themselves are one foot in breadth. Some idea of the colossal strength of this machine may be conceived when it is stated that it will be capable of lifting a weight of 1,200 tons. The work has been carried out by General Younghusband and Colonel G. Maitland from designs by Mr. Fraser, the Deputy Superintendent of the Royal Gun Factories, while Mr. Reuben Mehen has had the practical direction of its construction. The lifting carriage is seventy feet from the ground, and will with ease raise several 100-ton guns together. More than 1,800 tons of iron have been employed in the construction of this gigantic machine, which has already been upwards of four years in process of erection.

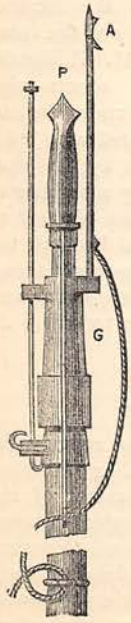


A Lightning Photograph.

We recently mentioned that Mr. Crowe had succeeded in taking some very distinct photographs of the lightning-flash, and we are now able to reproduce one of these taken during the severe thunderstorm which visited Liverpool on the night of Saturday, July 17th, last year. The camera was situated near Dingle, and the flash appeared above St. Philemon's Church, Windsor Street, at the moment the bell-tower was shattered to pieces. The flash is remarkably distinct, and exactly resembles the spark from a large induction coil. Its actual diameter is calculated by Mr. S. Higgs to be about fifty-one inches.

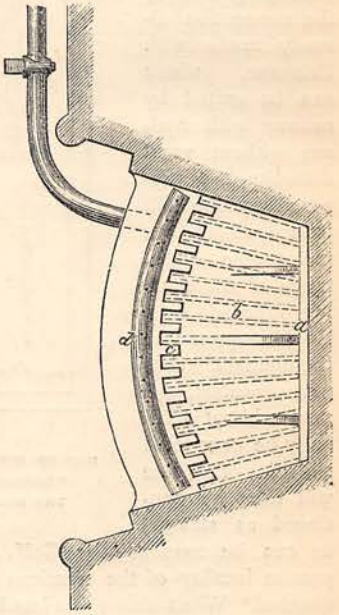
Explosive Harpoons.

Some of the new appliances for killing whales are not very well known; one of these is the bomb-lance of Mr. Pierce, New Bedford, Mass., which consists, as shown in the figure, of a lance-shaft, carrying at its end a small gun, G, which is charged with powder and loaded with the lance-point, P, which enters the animal. The lance is thrown by the harpooner at the whale, and the shock of striking it ignites a fuse, which fires the gun and shoots the pointed lance into the whale's body. The point carries a line with it, and the lance is also provided with an arrow-head, A, to pierce the whale and prevent the glancing of the stroke. Another weapon for the same purpose is the javelin-bomb of Mr. Voy, San Francisco, which differs from the bomb-lance in being actually shot from a gun held by the harpooner. It consists of a short stem, terminated by a conical bomb with a sharp point, which on entering the whale explodes, and at the same time liberates a barb which catches in the flesh. A line is connected to the shaft and fired with it. With this arm it is possible to strike a whale nearly 100 yards from the hunting-boat.



An Improved Smokeless Grate.

Dr. C. W. Siemens has further improved upon his smokeless grate, so as to enable existing grates to be altered to the smokeless form at a less expense than was necessary in the form described by us in the GATHERER of the January number. The new grate is shown in the accompanying plan, and only two parts require to be added to an ordinary grate to make it smokeless, viz., the gas-pipe *d*, with holes $\frac{1}{10}$ inch in diameter, placed $1\frac{1}{2}$ inches apart along the upper side, inclining forward: and an angular plate *a*, of either cast or wrought iron, with projecting ribs *b*, extending from front to back on its under side, either cast with or riveted to the plate, so as to present a considerable area and serve the double purpose of supporting the additional part on the existing grate, and of providing the heating surface produced by the copper plate and frill-work in the form of grate we have already described. In using iron instead of copper it is necessary, however, to increase the thickness of these plates and ribs in the inverse ratio of the conducting power of these two metals, and to make the iron plate $\frac{5}{8}$ inch thick instead of $\frac{1}{4}$, as in the case of copper. A bent plate fastened to the lowest grate-bar, to direct the incoming air on the heating surfaces, renders the arrangement more perfect. The niches, *c*, in the front plate are to allow the small quantity of ashes formed by the combustion of the anthracite or coke in the front part of the grate to discharge themselves into an open ash-pan placed upon the hearth.

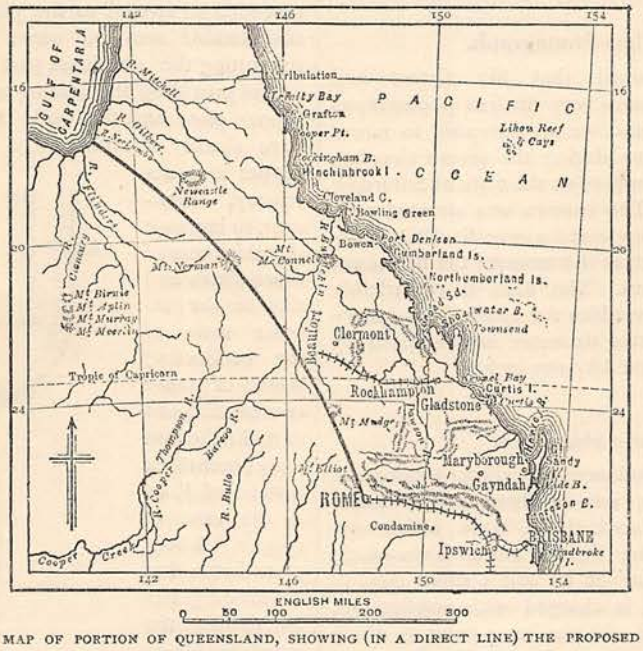


The Ellipsograph.

Boys and girls often find it necessary in their school exercises to draw an ellipse. They know how to "strike" a tolerably correct circle, but they are not so handy at drawing a presentable ellipse. The Ellipsograph, then, is an appliance that would enable them to do this in a neat and satisfactory manner. It is constructed so that it may be adjusted to describe ovals of various sizes, with parallel curves, without disturbing the pivots on which the "guide" works.

A Trans-Australian Railway.

For many years past, the idea of a railway across Australia has occupied the minds of our colonial brethren. This long-cherished hope is at length in a fair way to become realised. The line first proposed was to follow the telegraph from Adelaide in an almost direct northerly direction to Palmerston in Arnhem Land (North Territory), but an alternative route has been proposed and lately adopted, by which a considerable saving in distance and in railway connections will be effected. From Brisbane to Rome, as will be seen upon the accompanying map, the railroad is already completed. From the latter town to the nearest point on the Gulf of Carpentaria is in a direct line, and, calculating in round numbers, 850 miles—against the 1,400 miles of the former route suggested. Besides the advantage gained by the connection already made with Brisbane, which can be united by railway with Sydney without great difficulty, the proposed new line will pass within a measurable distance of the existing railroad from Rockhampton to the mining districts near Beaufort, and may without difficulty be connected with it. The line will then be continued as straight as can be towards the Gulf of Carpentaria—the precise locality of the terminus not having yet been decided. When this route has been completed there will be continuous railway communication from north and south, and through the most settled districts. The northern coasts, being geographically nearest to England, will then be within thirty days of us, though at present they are the most distant. The Queensland Government has already authorised the work.



MAP OF PORTION OF QUEENSLAND, SHOWING (IN A DIRECT LINE) THE PROPOSED TRANS-AUSTRALIAN RAILWAY FROM BRISBANE TO THE NEAREST POINT OF THE GULF OF CARPENTARIA.

The Radiophone.

In prosecuting his researches on the photophone, Professor Graham Bell found that thin discs of every substance he tried—wood, leather, glass, india-rubber, metal, and so on—emitted a musical note when held in the path of a beam of light which was rapidly intermitted or broken up by interposing a rotating screen perforated with a circle of holes. Each hole allowed a flash of light to pass through it, and these flashes falling successively on the disc produced a vibration in it which was audible as a musical tone, of a pitch determined by the number of flashes per second, and a *timbre* dependent on the nature of the disc. Recent experiments of M. Mercadier, a French physicist, seem to refer the effect to heat rather than light, and prove it to be caused by the rapid expansion and contraction of the disc, as the heat-rays fall upon it or are stopped by the screen. To illustrate his theory he has constructed an apparatus which he calls a radiophone, consisting of a copper plate, which he heats red-hot, and a rotating screen with holes to intercept the heat-rays periodically. When the discs of Professor Bell are held in the path of the heat-rays from the copper plate, a musical note is heard, which diminishes in strength as the copper gradually cools. M. Mercadier's experiment is interesting, but not conclusive, for Professor Bell's effect may be the joint result of light and heat-rays acting together.

Heating Railway Cars by Steam.

The railway carriages on all the Government lines in Sweden are now heated by steam from the locomotive, on the plan of M. Lilliehök. The steam-pipe runs under the carriage in a wooden box, which is perforated with holes to admit the cold air which is heated by the pipe, whose radiating surface is increased by a number of attached discs. The heated air is then allowed to enter the compartment by valves placed beneath the seats, and under the control of the passengers themselves. Thus the temperature can be regulated, and since the hot air enters from below, the travellers do not suffer from cold feet.

A Cure for Snake-Bites.

"Guaco" is affirmed to be a certain remedy for snake-bites by a correspondent residing in New Granada, and writing home to the Director of the Royal Gardens, Kew. There are many plants known under the common name of guaco in South America, and all more or less possessed of the antidotal property in question, but the *Mikania guaco* is a variety of powerful efficacy. The writer of the letter asserts that when

properly and promptly administered the guaco is a sure remedy for even the most deadly snake-bite. It should be taken internally, in the form of an infusion or a tincture of the leaves, and hot poultices of the bruised foliage and stems should be applied to the wound.

Safety-Cheques.

A useful suggestion for making cheques which cannot be tampered with is offered by Mr. A. Nesbit, F.C.S. He points out that in order to erase writing-ink, either an acid or an alkaline solution must be used, and he therefore proposes to tint the cheques with a dye which is discoloured either by acids or alkalies. As a further safeguard against the restoration of the colour by subsequent immersion in alkaline or acid solutions, he would print the design and lettering of the cheque partly in acid and partly in alkaline inks.

Arctic Observatories.

The days of individual attempts to reach the Pole are almost over, and organised observatories within the Arctic Circle are likely to take their place. From such headquarters the country around could be leisurely and thoroughly explored, and valuable observations made, while more venturesome expeditions to the highest latitudes could be attempted as occasion offered. At the second International Polar Conference held recently at Berne, all the leading nations of Europe except England were represented, and it was definitely decided to establish scientific posts at various points in a great ring round the Arctic Circle. Austria has undertaken to erect a station in Northern Nova Zembla; Denmark, one at Upernivik in Greenland; Germany, one in Jan Mayen for the Arctic, and one in New Georgia for the Antarctic; Norway, Bossekop in Finmark; Holland, the south-east of Nova Zembla; Russia, the mouth of the Lena and the New Siberian Islands. Switzerland hopes to take part in the movement by establishing a post at Mossel Bay in Spitzbergen, and it is to be hoped that England will complete the ring by posts in Davis Straits, or on the Mackenzie River, North America.

Colour Relations of Metals.

Mr. T. Bayley has discovered some noteworthy relations between the colours of metallic solutions. It appears, for example, that iron, cobalt, and copper form a natural colour group; for if solutions of their sulphates be mixed together in the proportions of twenty parts of copper, seven parts of iron, and six of cobalt, the resulting liquid is free from colour, but is greyish and opaque. It therefore follows by the laws of colour that a mixture of any two of these elements is complementary to the third if the above proportions be maintained. Thus a solution of cobalt, which is pink in hue, is complementary to a mixture of iron and copper which is bluish-green. A solution of iron (yellow) is complementary to a mixture of copper and cobalt (violet); and a solution of copper (blue) to a mixture of iron and cobalt (red). Mr. Bayley further shows that a solution of copper is exactly complementary to the red reflection from copper; and a polished plate of this metal viewed through a solution of copper-salt of a certain thickness is silver-white. Hence it follows that a mixture of seven parts iron and six parts copper is identical in colour with a plate of copper. The resemblance, indeed, is so striking that a silver surface covered to the proper depth with the solution appears like copper.

The Colours of Flowers and Leaves.

We have generally supposed that the colours of flowers are due to a variety of matters—each colour in fact being a distinct chemical combination. But Professor Schnetzler, of the Vaudois Society of Natural Science, has proved, by experiment, that by putting spirits of wine and adding an alkaline acid to an isolated colour of a plant, all the colours which flowers present may be obtained. For instance, a peony flower will with alcohol give a reddish-violet fluid. Add salt of sorrel and it becomes a pure red; and by the addition of soda this red will change into a violet, a blue, or a green shade according to the quantity of the alkali used. The green colouring matter in the leaves of plants is called chlorophyll, and the professor supposes that this is the only original colouring matter in plants; but being modified by certain agents—for in all plants there are acid or alkaline matters—or by transmitted light, this chlorophyll furnishes all tints of flowers and leaves. It has been ascertained that tannin with chlorophyll changes the colours of the green leaves in autumn into red. Professor Schnetzler himself changed peony sepals from green to red with salt of sorrel; and the green liquid solution of soda with the peony blossom and alcohol became red when he transmitted light through it. He therefore concludes that chlorophyll is the only source of colour in plants, the others being merely the results of atmospheric or alkaline action upon that colouring matter.

Mica Soles.

The flaky, transparent substance known as mica, has been applied by an ingenious American to keep the damp away from the feet, by fashioning it into a middle sole for boots and shoes. Sheets of it are covered with thin coatings of cement to hold to the leather, and inserted between the upper and under layers of the sole.

A Speaking Condenser.

Another important development of the telephone has been made by a French *savant*, M. Dunand. This consists in employing the instrument known to all students of electricity as the "condenser" for a receiving telephone, like that of Mr. Bell, and getting speech from it so loud as to be heard when the ear is held a yard away. To hear Bell's telephone properly, or even the improved form of it devised

by Mr. Gower, which has been adopted by the Government Postal Telegraphs for the new telephonic business they have opened up since the recent telephone case was decided in their favour, it is necessary

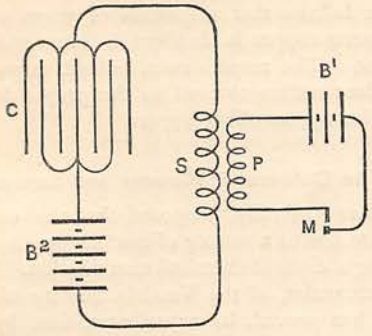


FIG. 1.

to keep the ear more or less close to the instrument; so that the higher tones of the new apparatus will be an advantage which Mr. Edison's "loud-speaking" telephone fails to supply, owing to the practical drawback of having to turn a handle all the while the speech is being delivered. A condenser is simply a set of parallel leaves of tin-foil electrically insulated from each other and connected together alternately—that is, the first, third, fifth, and so on, together, as shown in Fig. 1 at C; while the second, fourth, sixth, and so on, also go together. It has long been known that the intermittent currents of a musical telephone would make such a condenser give out a musical note or "hum" if they were caused to electrify the latter. But to M. Dunand attaches the honour of having made the vocal currents of a microphone transmitter reproduce articulate speech when allowed to charge the condenser. He has succeeded in doing this by means of an "induction

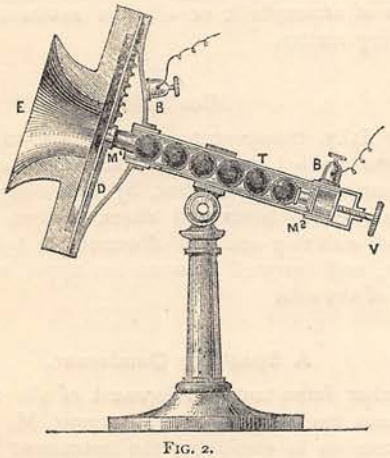


FIG. 2.

coil" and two voltaic batteries. A microphone, M, is placed in the "primary" or *exciting* circuit, P, of the induction coil, with a battery, B^1, to supply the electric current; and a condenser is connected by its two poles in the "secondary" or *excited* circuit, S, of the coil, together with a second battery, B^2, stronger than the first, and connected between one end of the secondary coil and one pole of the condenser, C. Under these conditions, the voice of a person speaking into the microphone transmitter generates vocal currents in the primary coil, which *induce* corresponding vocal currents in the secondary coil, and these passing into the condenser, which is already charged by the stronger battery, B^2, make the plates of tin-foil vibrate so powerfully and sympathetically as to give out an imitation of the original speech. With regard to the battery power needful, M. Dunand finds that ten Leclanché elements in the secondary circuit and two in the primary of an induction coil about four inches long will give quite a strong voice. If carefully applied to practical uses, this discovery should prove a great assistance to telephony and a convenience to public business. A very convenient form of microphone for telephonic purposes has been devised by M. Boudet of Paris. It is represented in Fig. 2, where E is the mouthpiece for speaking into, fixed at the extremity of a glass tube, T, mounted on a jointed stand, which allows the mouthpiece to be adjusted to any convenient angle for the speaker. An ebonite disc, D, which vibrates under the speaker's voice, carries a copper plug, M, fixed to its back, and this plug presses against the first of a series of six pellets of retort-carbon contained in the glass tube. By means of the thumb-screw, V, and the plug, M^2, at the other end of the tube, the pressure of the microphone contacts between the carbon balls can be regulated to give the best effect. The electric current enters and leaves the instrument by the terminals, B B. The purity of the speech as transmitted by this form of microphone is very striking, and the practical convenience of the instrument is considerable.

Roasting Meat by Hot Water.

Not long ago the American Society of Civil Engineers were entertained at a dinner which was cooked throughout by superheated water. The repast gave general satisfaction. Most people being familiar with boiling water as usually seen in the ordinary vessels, and as water under atmospheric pressure can be heated only as high as 212°—which is much below a roasting temperature—they may find it difficult to understand how bread can be baked or meat roasted in this novel manner. There is, however, no limit to the temperature to which water can be raised when it is confined, excepting only the weakness or strength of the vessel in which it is contained; and in this fact lies the whole secret of the new way of cooking dinners. A company has been formed in New York with the object of supplying houses with superheated water. According to their project, they undertake to maintain a temperature of 375° in the pipes of cooking ranges, a heat that is supposed to be sufficient for all culinary purposes. The matter is at present in its experimental stage, and it will probably remain there for a very considerable period.