detached or melting, notwithstanding the temperature was so high that the paper scale at that portion of the stem to which the ice clung was charred; this was the case in one of the experiments shown at the Chemical Society. In another instance I have had a thin circular piece of ice attached to the otherwise bare bulb of the thermometer, and though this piece was very thin and no more than about 2 mm. diam., it took fully one minute or more to volatilise, notwithstanding the thermometer indicated a mean temperature of about 70° C., and the surrounding tube was very hot. If the ice were not capable of being heated above its melting-point, a piece so small as that referred to would, I think, under these circumstances have fused or volatilised almost instantaneously. If the ice be really above 80° C. it ought to melt suddenly and at once on discontinuing the heat and increasing the pressure, and this I have in one or two instances found to be the case. Thus in one experiment a beautiful rod of ice nearly six inches long and about half an inch diameter was attached to a glass rod suspended in the apparatus described above and heated very strongly with a large Bunsen's burner for several minutes; the pressure was then let in, when the ice at once fell off the rod into the mercury trough below, melting completely, and as far as could be seen even before it reached the mercury. Careful observations have also been made to see whether any cavity could be detected between the ice and the hot thermometer when the latter was only partially covered with ice, and indicated a high temperature, but such could not be seen either with ice or mercuric chloride. In both cases the substance appeared to rest in actual contact with the bulb of the thermometer, in this respect differing from camphor, which does exhibit such a space. I have however never been able to get camphor above its ordinary melting-point, though by reducing the pressure below 400 mm., it solidifies while boiling, and cannot be re-melted unless the pressure be increased.

One curious point about the ice experiments is the comparative slowness with which the ice appears to evaporate, though the surrounding tube is very strongly heated.

In conclusion, I need hardly say that it is highly desirable that my results should be confirmed by other observers. THOS. CARNELLEY

TELE-PHOTOGRAPHY

WHILE experimenting with the photophone it occurred to me that the fact that the resistance of crystalline selenium varies with the intensity of the light falling upon it might be applied in the construction of an instrument for the electrical transmission of pictures of natural objects in the manner to be described in this paper.

In order to ascertain whether my ideas could be carried out in practice, I undertook a series of experiments, and these were attended with so much success that although the pictures hitherto actually transmitted are of a very rudimentary character, I think there can be little doubt that if it were worth while to go to further expense and trouble in elaborating the apparatus excellent results might be obtained.

The nature of the process may be gathered from the following account of my first experiment. To the negative (zinc) pole of a battery was connected a flat sheet of brass, and to the positive pole a piece of stout platinum wire; a galvanometer was interposed between the battery and the brass, and a set of resistance-coils between the battery and the platinum-wire (see Fig. 1, where B is the battery, R the resistance, P the wire, M the brass plate, and G the galvanometer). A sheet of paper which had been soaked in a solution of potassium iodide was laid upon the brass, and one end of the platinum wire previously ground to a blunt point was drawn over its surface. The path of the point across the paper was marked by a brown line, due, of course, to the liberation of iodine. When the resistance was made small this line was dark and heavy; when the resistance was great the line was faint and fine; and when the circuit was broken the point made no mark at all. If we drew a series of these brown lines parallel to one another, and very close together, it is evident that by regulating their intensity and introducing gaps in the proper places any design or picture might be

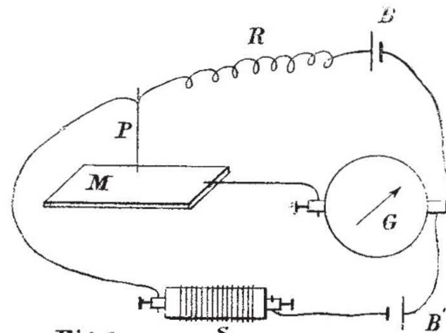

Fig. 1.

represented. This is the system adopted in Bakewell's well-known copying telegraph. To ascertain if the intensity of the lines could be varied by the action of light, I used a second battery and one of my selenium cells, made as described in NATURE, vol. xxiii. p. 58. These were arranged as shown in Fig. 1, the *negative* pole of the second battery, B′, being connected through the selenium cell S with the platinum wire P, and the positive pole with the galvanometer G. The platinum point being pressed firmly upon

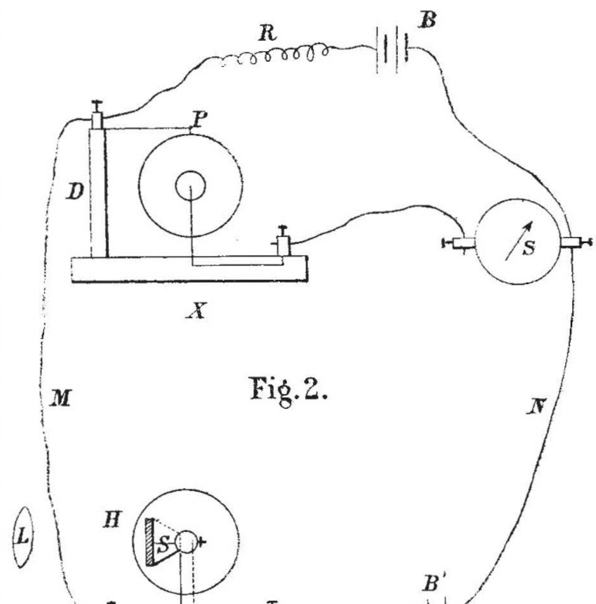

Fig. 2.

the sensitised paper and the selenium exposed to a strong light, the resistance R was varied until the galvanometer needle came to rest at zero. If the two batteries were similar this would occur when the resistance of R was made about equal to that of the selenium cell in the light. The point now made no mark when drawn over the paper. The selenium cell was then darkened, and the point immediately traced a strong brown line; a feeble light was next thrown upon the selenium, and the intensity of the line became at once diminished. Lastly, a screen of black paper, having a large pin-hole in the middle, was placed at a short distance before the selenium, and the image of a gas-flame was focussed upon the outer surface of the screen, a small portion of the light passing through the pin-hole and forming a luminous disk upon the selenium. The galvanometer was again brought to zero, and, as before, the platinum point made no mark. When however the gas-flame was shaded a firm and steady line could be drawn; and when the light was interrupted by moving the fingers before the pin-hole a broken line was produced. For this last operation a very sensitive paper was required, and it was found necessary to move the platinum point slowly.

In consequence of the very satisfactory results of these preliminary experiments I made a pair of "tele-photographic" instruments, of which the receiver was slightly modified from Bakewell's form. They are of rude construction, and I shall say nothing more about them except that on January 5 they produced a "tele-photograph" of a gas-flame, which was good enough to induce me to make the more perfect apparatus now to be described.

The transmitting instrument consists of a cylindrical brass box four inches in diameter and two inches deep, mounted axially upon a brass spindle seven inches long, and insulated from it by boxwood rings. The spindle is divided in the middle, its two halves being rigidly connected together by an insulating joint of boxwood. One of the projecting ends of the spindle has a screw cut upon it of sixty-four threads to the inch; the other end is left plain. The spindle revolves, like that of a phonograph, in two brass bearings, the distance between which is equal to twice the length of the cylinder; and one of the bearings has an inside screw corresponding to that upon the spindle. At a point midway between the two ends of the cylinder a hole a quarter of an inch in diameter is drilled, and behind this hole is fixed a selenium cell, the two terminals of which are connected respectively with the two halves of the spindle. The bearings in which the spindle turns are joined by copper wires to two binding screws on the stand of the instrument. The transmitter thus described is represented in diagrammatic section at Y (Fig. 2), where H is the hole in the cylinder and S the selenium cell.

The receiving instrument, shown at X (Fig. 2) contains another cylinder similar to that of the transmitter, and mounted upon a similar spindle, which however is not divided, nor insulated from the cylinder. An upright pillar D, fixed midway between the two bearings, and slightly higher than the cylinder, carries an elastic brass arm fitted with a platinum point P, which presses normally upon the surface of the cylinder. To the brass arm a binding screw is attached, and a second binding screw in the stand is joined by a wire to one of the brass bearings.

To prepare the instruments for work they are joined up as shown in Fig. 2, two batteries, a set of resistance coils, and a galvanometer being used, in exactly the same manner as in the preliminary experiments. The cylinder of the transmitting instrument Y is brought to its middle position, and a picture not more than two inches square is focussed upon its surface by the lens L. The pictures upon which I have operated have been mostly simple geometrical designs cut out of tinfoil and projected by a magic lantern. It is convenient to cover a portion of the cylinder with white paper to receive the image. The comparatively large opening H is covered with a piece of tin-foil, in which is pricked a hole which should be only just large enough to allow the instrument to work. [I have not been able to reduce it below one-twentieth of an inch, but with a more sensitive selenium cell it might with advantage be smaller.] The hole is then brought, by turning round the cylinder, to the brightest point of the picture, and a scrap of sensitised paper, in the same condition as that to be used, being placed under the point P of the receiver, the resistance R is adjusted so as to bring the galvanometer to zero. When this is accomplished the two cylinders are screwed back as far as they will go, the cylinder of the receiver is covered with sensitised paper, and all is ready to commence operations.

The two cylinders are caused to rotate slowly and synchronously. The pin-hole at H in the course of its spiral path will cover successively every point of the picture focussed upon the cylinder, and the amount of light falling at any moment upon the selenium cell will be proportional to the illumination of that particular spot of the projected picture which for the time being is occupied by the pin-hole. During the greater part of each revolution the point P will trace a uniform brown line; but when H happens to be passing over a bright part of the picture this line is enfeebled or broken. The spiral traced by the point is so close as to produce at a little distance the appearance of a uniformly-coloured surface, and the breaks in the continuity of the line constitute a picture which, if the instrument were perfect, would be a monochromatic counterpart of that projected upon the transmitter.

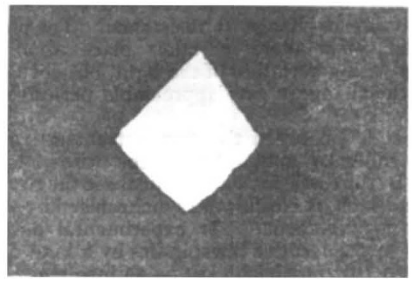

FIG. 3.—Image focussed upon Transmitter.

An example of the performance of my instrument is shown in Fig. 4, which is a very accurate representation of the manner in which a stencil of the form of Fig. 3 is reproduced when projected by a lantern upon the transmitter. I have not been able to send one of its actual productions to the engraver, for the reason that they are exceedingly evanescent. In order to render the paper sufficiently sensitive, it must be prepared with a very strong solution (equal parts of iodide and water), and when this is used the brown marks disappear completely in less than two hours after their formation. There is little doubt that a solution might be discovered which would give permanent results with equal or even greater sensitiveness, and it seems reasonable to suppose that some of the unstable compounds used in photography might be found suitable; but my efforts in this direction have not yet been successful.

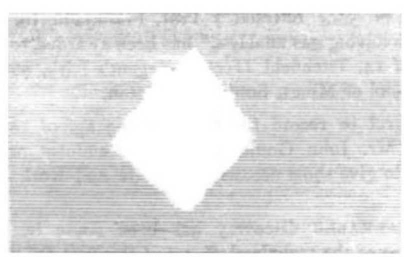

FIG. 4.—Image as reproduced by Receiver.

In case any one should wish to repeat the experiments here described a few practical hints may be useful. In order that as large a portion as possible of the current from the battery B′ (which is varied by the selenium cell) may pass through the sensitised paper, the resistance R must be high; the EMF of the battery B must therefore be great, and several cells should be used.

An electromotive force is produced by the action of the platinum point, and the metal cylinder upon the sensitised paper, and the resulting current is for many reasons very annoying. I have got rid of this by coating the surface of the cylinder with platinum foil.

Stains are apt to appear upon the under-surface of the paper, which sometimes penetrate through and spoil the picture. They may be prevented by washing the surface of the cylinder occasionally with a solution of ammonia.

Slow rotation is essential in order both that the decomposition may be properly effected and that the selenium may have time to change its resistance. The photophone shows that *some* alteration takes place almost instantaneously with a variation of the light, but for the greater part of the change a very appreciable period of time is required.

The distance between the two instruments might be a hundred miles or more, one of the wires, M, N, being replaced by the earth, and for practical use the two cylinders would be driven by clockwork, synchronised by an electromagnetic arrangement. For experimental purposes it is sufficient to connect the two spindles by a kind of Hooke's joint (some part of which must be an insulator), and drive one of them with a winch-handle.

The instrument might be greatly improved by the use of two, four, or six similar selenium cells and a corresponding number of points. If two such cells were used the transmitting cylinder would have two holes, diametrically opposite to each other, with a selenium cell behind each. A second point would press upon the under surface of the receiving cylinder, and be so adjusted that the lines traced by it would come midway between those traced by the upper point. Four or six selenium cells could be similarly used. The adjacent lines of the picture might thus be made absolutely to touch each other, and moreover the screw upon the spindles might be coarser, which for obvious reasons would be advantageous. A self-acting switch or commutator in each instrument would render additional line-wires unnecessary.

SHELFORD BIDWELL

NOTES

THE Murchison medal of the Geological Society has this year been awarded to Prof. Geikie.

THE Associateship of the Institute of Chemistry, along with the prize of 50*l.*, offered by Prof. Frankland for the "best research involving gas analysis," has been awarded to Mr. Frank Hatton, of 14, Titchfield Terrace, Regent's Park, student in the Royal School of Mines, South Kensington.

WE regret to record the death, at the age of seventy-seven years, of Mr. John Gould, F.R.S., the eminent ornithologist. We hope to give some account of his life and work in our next number.

A REMARKABLE discovery has been made by Mr. Alex. Adams, one of the technical officers of the Post Office Telegraph Department. It is the existence of electric tides in telegraph circuits. By long-continued and careful observations he has determined distinct variations of strength in those earth currents, which are invariably present on all telegraphic wires, following the different diurnal positions of the moon with respect to the earth. He will read a paper on the subject at the meeting of the Society of Telegraph Engineers to-night.

MR. JOSEPH THOMSON has, we understand, received the offer of an advantageous post under the Sultan of Zanzibar, which no doubt he is likely to accept. Mr. Thomson's work will be mainly that of geological surveying in the region of the Rovuma River, and the Sultan has offered him every facility for carrying on the work. The Sultan deserves every credit for showing such enterprise, and we have no doubt that Mr. Thomson will be able to do work of great scientific value.

AT the Royal College of Surgeons Prof. W. K. Parker, F.R.S., will give nine lectures on the Structure of the Skeleton in the Sauropsida, on Mondays, Wednesdays, and Fridays, February 11, 16, 18, 21, and 23, at 4 p.m. Prof. W. H. Flower, LL.D., F.R.S., will give nine lectures on the Anatomy, Physiology, and Zoology of the Cetacea, on Mondays, Wednesdays, and Fridays, February 28, March 2, 4, 7, 9, 11, 14, 16, and 18, at the same hour.

WE are glad to learn that the new 23-inch object-glass of Prof. C. A. Young of Princeton, N.J., is completed. Prof. Young has tested it at Cambridge, Mass., and finds it very fine; he hopes by and by to do some good stellar spectroscopic work with it. The mounting is well under way, and it is expected that the instrument will be in place next autumn.

MR. LAMONT YOUNG, the Government geologist of New South Wales, has suddenly and mysteriously disappeared, and foul play is suspected. Mr. Young arrived safely at Bermagui, 180 miles south of Sydney, and at once set out to cross the bay in a boat. No news of him came in, and two days later his boat was found jammed among the rocks of the coast, ten miles north of the point from which he had started. It was at first, and naturally, supposed that Mr. Young and his company had been drowned, and that his boat had drifted on shore. A closer examination proved that the boat had been drawn carefully up on the coast, and that the party had dined after landing. Next some bullet holes were found in the boat, and this suggested the idea that the explorers had been attacked and murdered. But not a single mark of blood or additional trace of any violent assault could be discovered. The party were five in number, and the coast has been examined for traces or tidings of them in vain. An official of the Mines Department has been assisted by detectives and by the boasted "black trackers," natives whose acuteness is seldom at fault in a case of this sort.

PROF. McK. HUGHES writes on Jannuary 27, suggesting the following scientific uses of the late severe weather:—When this frost breaks up and the frozen snow and ice begin to travel along our rivers to the sea there will be an opportunity of making observations upon several points upon which accurate information will be of use in seeking an explanation of some of the glacial and post-glacial phenomena of the British Isles, *e.g.* (1) Dimensions of the ice floes; (2) whether they consist chiefly of frozen snow or solid ice, *i.e.* an approximate estimate of their specific gravity; (3) amount of material carried by them and dimensions of larger boulders; (4) whether any of these were dropped on to the floe from cliffs of glacial drift so as to give scratched stones and *remanie* drift in modern mud; (5) how far out to sea such floes have been traced with or without earth and stones; (6) salinity of the water where the observations were made; (7) transport of shore shells, &c., by ice; (8) crumpling of mud by impinging ice; (9) grinding of ice along bridge piers, and many similar observations which it will be useful to record.

THE great annual *soirée* at the Observatory of Paris has been a great success. Almost all the Cabinet ministers and M. Gambetta were present. A plan was exhibited in the Astronomical Museum showing the present state of the Observatory, and what it will be when all the works for which credits have been voted shall be completed. A ball took place after a series of lectures and projections given in the *grande galerie*. One of the lecturers, M. Bertus, exhibited magic mirrors, and reminded those present that in 1844 M. Mouchez, then a junior officer in the French naval service, brought home with him one of these mirrors from Japan, which was presented to the Academy