

ZINC ETCHING IN RELIEF.

The object of this process is the production of a metallic *cliché*, which may be used with type in the letterpress printing press; that is, may replace the as yet generally-used woodcut. The drawing may be produced on the asphalt with chromated gelatine directly either by hand or by photography, or by transferring a fatty picture which serves to resist the etching.

In all these various cases the drawing must be strengthened, either by a special covering or in some other way before etching. The work is then almost limited to repeated rolling with ordinary lithographic rollers after each time of etching, however slight, over those parts of the metal sufficiently bitten in by the acid, in order to protect them from its further action. The further the etching proceeds the more difficult does this rolling become, because the ink must be forced as far as necessary into the hollows.

For this purpose an oven, having a cast-iron plate, is used as a table; this plate should not be made hotter than 200° C. During the rolling the zinc plate should be laid upon this hot plate. The ink then sinks because the heat makes it more fluid, and so it runs down and fills the finer hollows. The nitric acid must be used diluted at first, and for each succeeding etching it should be taken a little more concentrated. All the time the acid is etching it must be kept moving evenly, and as long as the plate lies in the etching tray the latter should be turned round regularly, either by hand or by a small steam engine.

When the first etching has gone on long enough the zinc plate is taken out of the tray and washed with a brush with benzine, turpentine, or petroleum, and a weak solution of caustic potash or caustic soda. It is then dried upon the not very hot plate of the oven and rolled, but only until the finest lines are filled with the grounding ink. It is then etched again, and one goes on alternately coating with ink and etching until the drawing stands out in sufficiently high relief. The faulty parts must then be corrected and retouched. The plate is now ready to be mounted upon wood, and printed in the letterpress printing press, where thousands of proofs may be pulled from it.

In the following paragraphs a few words will be said of Gillot's high relief etching process, which is now used in many establishments.

TYPOGRAPHIC HELIOGRAVURE.

For this process a zinc plate furnished with a coating sensitive to light is exposed under a negative. It is the quickest and cheapest process.

It is very important that good metal should be chosen; and the plates must be made *very level*, so as to lie close to the negative and to be equally rolled. The zinc also must be homogeneous in texture, so that the acid may act equally upon it. It must be very compact and have no rents, and it is well to beat it before using it, as that lessens the porosity of the metal and makes it stronger.

It is easily known whether the plate is flat enough if one look at the image of the picture as reflected in its upper surface and bounded by certain lines.

The thickness of the plate may be varied from one to three millimetres; the larger the picture and the greater the distance between the lines the thicker the plate should be. Too thin plates are often difficult to fasten down to the wood. JOSÉ JULIO RODRIGUES.

(To be concluded in our next.)

COMPOSITE PORTRAITS,

MADE BY COMBINING THOSE OF MANY DIFFERENT PERSONS INTO A SINGLE RESULTANT FIGURE.*

THE best instrument I have as yet contrived and used for optical superimposition is a "double-image prism" of Iceland spar. The latest that I have had were procured for me by Mr. Tisley, optician, 172, Brompton-road. They have a clear aperture of a square half an inch in the side, and when held at right angles to the line of sight will separate the ordinary and extraordinary images to the amount of two inches, when the object viewed is held at seventeen inches from the eye. This is quite sufficient for working with *carte-de-visite* portraits. One image is quite achromatic, the other shows a little colour. The divergence may be varied and adjusted by inclining the prism to the line of sight. By its means the ordinary image of one component is thrown upon the extraordinary image of the other, and the composite may be viewed with the naked eye or through a lens of long focus or through an opera-glass (a telescope is not so good) fitted with a sufficiently long draw-tube to see an object at that short distance with distinctness. Portraits of somewhat different sizes may be combined by placing the larger one further from the eye, and a long face may be fitted to a

* Concluded from page 253.

short one by inclining and foreshortening the former. The slight fault of focus thereby occasioned produces little or no sensible ill-effect on the appearance of the composite.

The front and profile faces of two living persons sitting side by side or one behind the other can be easily superimposed by a double-image prism. Two such prisms set one behind the other can be made to give four images of equal brightness, occupying the four corners of a rhombus, whose acute angles are 45°. Three prisms will give eight images; but this is practically not a good combination. The images fail in distinctness, and are too near together for use. Again: each lens of a stereoscope of long focus can have one or a pair of these prisms attached to it, and four or eight images may be thus combined.

FIG. 1.

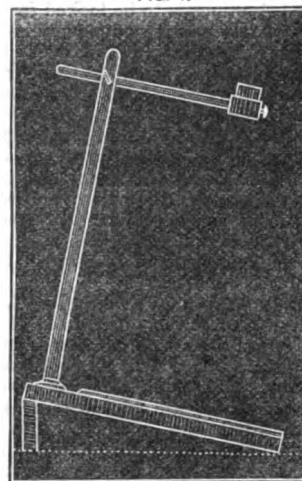
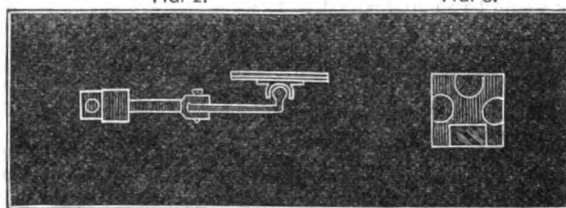


Fig. 1 shows the simple apparatus which carries the prism and on which the photograph is mounted. The former is set in a round box which can be rotated in the ring at the end of the arm and can be clamped when adjusted. The arm can be rotated, and can also be pulled out or in if desired, and clamped. The floor of the instrument is overlaid with cork covered with black cloth, on which the components can easily be fixed by drawing-pins. When using it one portrait is pinned down and the other is moved near to it, overlapping its margin if necessary, until the eye looking through the prism sees the required combination; then the second portrait is pinned down also. It may now receive its register marks from needles fixed in a hinged arm, and this is a more generally applicable method than the plan with cross threads, already described, as any desired feature—the nose, the ear, or the hand—may thus be selected for composite purposes. Let A, B, C, . . . Y, Z, be the components. A is pinned down, and B, C, . . . Y, Z, are successively combined with A, and registered. Then before removing Z take away A, and substitute any other of the already registered portraits, say B, by combining it with Z; lastly, remove Z and substitute A by com-

FIG. 2.

FIG. 3.



bing it with B, and register it. Fig. 2 shows one of three similarly-jointed arms, which clamp on to the vertical rod. Two of these carry a light frame covered with cork and cloth, and the other carries Fig. 3, which is a frame having lenses of different powers set into it, and on which, or on the third frame, a small mirror inclined at 45° may be laid. When a portrait requires foreshortening it can be pinned on one of these frames and be inclined to the line of sight. When it is smaller than its fellow it can be brought nearer to the eye and an appropriate lens interposed. When a right-sided profile has to be combined with a left-handed one it must be pinned on one of the frames, and viewed by reflection from the mirror in the other. The apparatus I have drawn is roughly made, and being chiefly of wood is rather clumsy, but it acts well.

Another instrument I have made consists of a piece of glass inclined at a very acute angle to the line of sight, and of a mirror beyond it, also inclined, but in the opposite direction to the line of sight. Two rays of light will therefore reach the eye from each point of the glass; the one has been reflected from its surface, and the other has been first reflected from the mirror and then transmitted through the glass. The glass used should be extremely thin, to avoid the blur due to double reflections; it may be a selected piece from those made to cover microscopic specimens. The principle of the instrument may be yet further developed by interposing additional pieces of glass successively less inclined to the line of sight, and each reflecting a different portrait.

I have tried many other plans; indeed, the possible methods of optically superimposing two or more images are very numerous. Thus I have used a sextant (with its telescope attached); also strips of mirrors placed at different angles and their several reflections simultaneously viewed through a telescope. I have also used a divided lens, like two stereoscopic lenses brought close together, in front of the object-glass of a telescope.

I have not yet had an opportunity of superimposing images by placing glass negatives in separate magic-lanterns, all converging upon the same screen; but this or even a simple dioramic apparatus would be very suitable for exhibiting composite effects to an audience, and if the electric light were used for illumination the effect on the screen could be photographed at once. It would also be possible to construct a camera with a long focus, and many slightly-divergent object-glasses, each throwing an image of a separate glass negative upon the same sensitised plate.

The uses of composite portraits are many. They give us typical pictures of different races of men, if derived from a large number of individuals of those races taken at random. An assurance of the truth of any of our pictorial deductions is to be looked for in their substantial agreement when different batches of components have been dealt with, this being a perfect test of truth in all statistical conclusions. Again: we may select prevalent or strongly-marked types from among the men of the same race, just as I have done with two of the types of criminals by which this memoir is illustrated.

Another use of this process is to obtain by photography a really good likeness of a living person. The inferiority of photographs to the best works of artists, so far as resemblance is concerned, lies in their catching no more than a single expression. If many photographs of a person were taken at different times, perhaps even years apart, their composite would possess that in which a single photograph is deficient. I have already pointed out the experience of Mr. Appold to this effect. The analytical tendency of the mind is so strong that out of any tangle of superimposed outlines it persists in dwelling preferably on some one of them, singling it out and taking little heed of the rest. On one occasion it will select one outline, on another a different one. Looking at the patterns of the papered walls of our room we see, whenever our fancy is active, all kinds of forms and features; we often catch some strange combination which we are unable to recal on a subsequent occasion, while later still it may suddenly flash full upon us. A composite portrait would have much of this varied suggestiveness.

A further use of the process would be to produce from many independent portraits of an historical personage the most probable likeness of him. Contemporaneous statues, medals, and gems would be very suitable for the purpose, photographs being taken of the same size, and a composite made from them. It will be borne in mind that it is perfectly easy to apportion different "weights" to the different components. Thus, if one statue be judged to be so much more worthy of reliance than another that it ought to receive double consideration in the composite, all that is necessary is to double either the time of its exposure or its illumination.

The last use of the process that I shall mention is of great interest as regards inquiries into the hereditary transmission of features, as it enables us to compare the average features of the produce with those of the parentage. A composite of all the brothers and sisters in a large family would be an approximation to what the average of the produce would probably be if the family were indefinitely increased in number, but the approximation would be closer if we also took into consideration those of the cousins who inherited the family likeness. As regards the parentage, it is by no means sufficient to take a composite of the two parents; the four grandparents and the uncles and aunts on both sides should be also included. Some statistical inquiries I published on the distribution of ability in families* give provisional data for determining the weight to be assigned in the composite to the several degrees of relationship. I should, however, not follow those figures in the present case, but would rather suggest for the earlier trials first to give equal "weights" to the male and female sides; thus the father and a brother of the male parent would count equally with the father and brother of the female parent. Secondly, I should "weight" each parent as four, and each grandparent and each uncle and aunt as one. Again, I should weight each brother and sister as four, and each of those cousins as one who inherited any part of the likeness of the family in question. The other cousins I should disregard. The weights as previously mentioned would be bestowed by giving proportionate periods of exposure.†

Composites on this principle would undoubtedly aid the breeders of animals to judge of the results of any proposed union better than they are able to do at present, and in forecasting the results of marriages between men and women they would be of singular interest and instruction. Much might be learnt merely by the frequent use of the double-image prism as described above, which enables us to combine the features of living individuals when sitting side by side into a single image.

I have as yet had few opportunities of developing the uses of the composite photographic process, it being difficult without much explanation to obtain the requisite components. Indeed, the main motive of my publishing these early results is to afford that explanation, and to enable me to procure a considerable variety of materials to work upon. I especially want sets of family photographs all as nearly as

* *Hereditary Genius*, p. 317. Column D. Macmillan, 1869.

† Example:—There are five brothers or sisters and five cousins whose portraits are available; the total period of desired exposure is 100 seconds. $5 \times 4 + 5 = 25$; $\frac{100}{25} = 4$; which gives $4 \times 4 = 16$ seconds for each brother or sister, and four seconds for each cousin ($5 \times 16 + 5 \times 4 = 100$).

possible of the same size and taken in the same attitudes. The size I would suggest for family composites is that which gives one-half of an inch interval between the pupil of the eye and the line that separates the two lips. The attitudes about which there can be no mistake are—full face, an exact profile (say), always showing the right side of the face, and an exact three-quarters, always showing the left; in this the outer edge of the right eyelid will be only just in sight. In each case the sitter should look straight before him. Such portraits as these go well into *cartes de visite*, and I trust that not a few amateur photographers may be inclined to make sets of all the members of their family, young and old and of both sexes, and to try composites of them on the principles I have described. The photographs used for that purpose need not be in the least injured, for the register marks may be made in the case into which they are slipped, and not in the photographs themselves.

FRANCIS GALTON, F.R.S.

A TRIO OF SUGGESTIONS.

OUTSIDE of the absolutely necessary paraphernalia of a photograph gallery, I would suggest as one of the most useful a good, reliable amateur printing press, with from six to a dozen, or even more, small founts of various size and styles of types. Woodcuts and electrotypes are now made very cheaply from any design furnished. Photographers can have special designs of their own always ready for printing the ends of their stereo views, backs of card-mounts, &c., in just as neat a manner as they can be executed by most practical printers, if proper care be taken. For printing envelopes, business cards, circulars, and the thousand and one things of the sort required about the gallery, it will save itself over and over again every year. A "Novelty," in use in our gallery since 1873, has not cost a penny for repairs, and still works like a charm. About twenty founts of type and as many electrotypes have accumulated. In nearly every establishment one can be found who will delight to work it.

Another very essential article, not only in the gallery but any business place, is the letter copying press, or one of the various copying books that require no press, several of which I know from practical experience do their work. Much inconvenience and annoyance is avoided by keeping copies of all letters and orders, and not unfrequently cash is saved and made.

Lastly, and to complete the trio, I would suggest, as almost indispensable, a good clothes-wringer—not to wring your pictures through ten or fifteen minutes after they came from the hypo., as I have seen recommended, for that is all bosh, but after they are thoroughly washed. Take from the water one at a time, and place on top of others till you have three or four dozen, put between two pieces of cardboard, or, better still, between one piece folded, pass through the wringer, and mount in that condition if prints have been out before toning; if not, hang up or spread out to dry. Pictures wrung out dry in half the usual time. And now, perhaps, it would be well enough to "suggest" that the writer has no interest in the sale of any of these articles, but does have an interest in the welfare of his fellow-craftsmen, and is always ready to contribute anything that may be of value to them.

W. H. TITTON.

—*Phil. Phot.*

ROYAL INSTITUTION LECTURES.

COMPOUND COLOURS.—COLOUR BLINDNESS.

LORD RAYLEIGH began his fourth and concluding lecture on Thursday, the 23rd ult., by showing that a combination of yellow and blue liquids produced green, and then explained that the result was due to the impurity of each colour, and that if they had been absolutely pure the mixture would have been colourless. Various methods of combining colours were then exhibited. Thus, with polarised light, greenish-yellow and reddish-yellow gave white. With Professor Clerk Maxwell's apparatus two or three slits produce two or three spectra, and by their overlapping definite portions of the spectra may be mixed. The colours thus formed, or the white light thus produced, may be resolved by the prism into the component parts, and do not give a continuous spectrum. Lord Rayleigh said that red and yellow might be supposed to produce orange, the colour of the spectrum between them, and Maxwell's experiments support this idea; but going upwards from the red, the intermediate colours are not always produced by mixture. Thus, purple—a combination of red and blue—is not represented in the spectrum at all. The yellow of the spectrum can be exactly imitated by mixing red and green, and with due proportions of those colours all the shades of yellow and orange; hence it is concluded that green and not yellow is a primary colour. By rotating discs with sectors of red and green a match was produced of yellow, white, and black; and his lordship obtained a yellow liquid by the mixture of chemical solutions, bichromate of potash (red), and litmus (blue). This colour, when passed through a prism, gave red and green, without yellow, on the screen. To specify any colour three elements are required—purity, depth (by black), and tint (by white). The three colours in the spectrum by which all others can be produced are red, green, and blue; but these colours,