

PHOTOGRAPHIC COMPOSITES.

BY FRANCIS GALTON, F.R.S.

YOUR request to send specimens of photographic composites as illustrations for the PHOTOGRAPHIC NEWS happened to reach me at an appropriate time. It had just been arranged by the Council of the Anthropological Institute to assign an evening to two memoirs on the race characteristics of the Jews, and to the discussion that might arise upon them, and I had already sorted out for exhibition at that meeting a few composites of Jewish faces that I made some time ago. They are, I think, the best specimens of composites I have ever produced; they were made at the suggestion of Mr. Jacobs, the author of the more important of the two valuable memoirs then about to be read at the Institute. I therefore had them in hand, and am now able to send them to you with pleasure, understanding that Mr. Jacobs will furnish you with his own views as to how far these composites succeed, in his opinion, in presenting the typical features of the modern Jewish face. On this point I will consequently abstain from saying anything, though I may mention that the individual photographs were taken with hardly any selection from among Jewish boys in the Jews' Free School, Bell Lane, which, by the way, I am informed is the largest school of any, other than Board Schools, in the United Kingdom; and to the courtesy of whose Head Master, Mr. M. Angil, I am much indebted. They were children of poor parents, dirty little fellows individually, but wonderfully beautiful, as I think, in these composites. The feature that struck me the most, as I drove through the adjacent Jewish quarter, was the cold scanning gaze of man, woman, and child, and this was no less conspicuous among the schoolboys. There was no sign of diffidence in any of their looks, nor of surprise at the unwonted intrusion. I felt, rightly or wrongly, that every one of them was coolly appraising me at market value, without the slightest interest of any other kind.

Plate I., that accompanies this article, contains full-face portraits and composites therefrom. Plate II. will follow next week, and will contain profiles. As regards Plate I., the four large ovals, A, B, C, D, are composites, and all the rest are individual portraits. A is the composite of the five individuals a_1 to a_5 . It bears strong evidence of the very dark and sharply-defined curl on the forehead of a_5 , although the intensity of the original has been reduced five times by the process. B is the composite of the five individuals b_1 to b_5 ; C is the co-composite of A and B, with the addition of three other individual portraits to increase its sharpness. The black curl of a_5 is still traceable on the open forehead of the composite, though its original intensity has now been decreased thirteen times; but it would be probably overlooked, or mistaken for some chance shade or stain, if it were not for the abruptness of its outline. Lastly, D is a composite of five adult faces, which are not given individually for want of space.

It is unnecessary to speak at length here on the principle of the process of making composites, or about the apparatus I use, as all this has been published in full in many places, and re-published in my last work.* It will probably be remembered by many of your readers that the principle consists in throwing faint images of a succession of accurately adjusted prints (or negatives) on the same part of a single sensitized plate, so that the resultant image is an aggregate of all its components, and a pictorial average of them. Also, that the apparatus I employ (made for me by Meagher) consists of the front of a camera fixed firmly on a solid board, with its back screwing out or in for purposes of focussing, and that in front of the lens there is a carriage which can be moved to and fro on a tramway along the board, and which supports a stage provided

with many adjustments, to which the print is fixed. The print can be raised or lowered, it can be moved from side to side, and it can be rotated. Consequently (within moderate limits), whatever sized print is mounted on the stage, and in whatever position it may originally have been placed there, I can produce an image of it in the camera, of any required size, and can cause that image to fall in any required position on the sensitized plate.

The required position is defined by fixed fiducial lines, to which I adapt the image by the requisite adjustments of scale and position. I cannot briefly describe the somewhat complicated and delicate arrangement that I adopt for my fiducial lines, which is fully explained in the work above referred to. Suffice it to say, that when making full-face composites, I look through an eye-hole, down upon a piece of horizontal ground glass let into the roof of the camera, and there I see two images. The one is that of delicate and bright fiducial lines, similar in shape to those in fig. 1, and the other is the image of the portrait which has been thrown upwards by a hinged

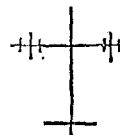


Fig. 1.

mirror that lies inside the body of the camera. While my eye is applied to the eye-hole, I have my hands free for making the adjustments. These are complete (1) when the pupils of the two eyes in the image of the print are exactly bisected by the upper of the two horizontal fiducial lines; (2) when the pupils of the eyes are equidistant laterally from the vertical line, for determining which the little cross lines give great assistance; and (3) when the parting of the lips in the image coincides with the lower of the horizontal fiducial lines. I adjust each portrait in turn in this way, and then, after capping the lens and turning the hinged mirror out of the way, I raise the dark slide. Then I withdraw the cap, give a brief exposure, and re-cap. Immediately afterwards, I close the dark slide, turn back the mirror, and remove the cap; then I am free to set to work with the next of the series of portraits, in the same way as that just described.

In taking profile portraits, I use a sloping line with two horizontal ones, as in fig. 2, and adjust the image of

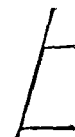


Fig. 2.

the print, so that its forehead shall be touched by the upper end of the sloping line, and that what I estimate to be the position of the front of the gums of the middle teeth in the upper jaw of the image shall be touched by the lower end of the sloping line. The line through the centre of the pupil of the eye in the profile image, and that through the parting between the lips, are then made, as before, to correspond with the upper and the lower of the two horizontal fiducial lines.

I will take this opportunity of emphasizing the value of a very simple precaution that vastly facilitates the process of reduction to a given scale, not only in making these composites, but also in other cases where reductions to scale and to position have to be made. I have not seen the plan to which I refer spoken of by others, and as I made it out for myself, I suppose it to have been hitherto overlooked, notwithstanding its simplicity. Speaking in the most general way, in every case of reduction to scale and position there are some two points (A, B) in the image

* "Inquiries into Human Faculty." F. Galton, F.R.S.—Macmillan and Co., 1883. See also PHOTOGRAPHIC NEWS, 1881, pp. 316 and 332.

of the picture, that must be made to fit two points (A', B') in a fiducial line. If the precaution, of which I am about to speak, has not been taken, the process of making the fit will consist of a set of separate and tedious attempts, until the fit proves satisfactory. At the beginning of each attempt, the picture has to be removed a step further off, or nearer, as the case may be, and there must be a fresh focussing and a fresh adjustment for position. In my plan, I arrange the fiducial line A' B' so that one or other of its two ends—say A'—corresponds exactly with the optical axis of the camera. Then, however much the portrait may be moved to or fro parallel to the optical axis, and however large may be the corresponding focussing change in the length of the body of the camera, the point A in the image of the print will remain glued, as it were, to A' in the fiducial line. After the line A B has been once superimposed on A' B' there will remain only the position of B to be attended to. In my apparatus I simultaneously work the carriage with one hand, and the focussing arrangements with the other, and the image, while retaining its sharpness, continuously waxes or wanes, as the case may be, in its size. The horizontal line that bisected the pupils at first, always continues to do so, and the vertical line still continues to stand exactly half-way between the pupils. I go on steadily screwing until the parting of the lips in the image coincides with the lower horizontal fiducial line, and then the adjustment is complete. In a solidly-made camera, it is easy to find, and mark once for all on its ground glass screen, the exact position of the intersection of the screen with the optical axis of the lens.

If we adjust the camera so that the image shall be of about the same size as the original picture, a little subsequent enlargement or reduction of the image will not require any sensible change of distance between the object and the ground glass screen. The lens can be moved to and fro a short distance, with the effect of altering the size of the image without sensibly affecting its definition. I therefore tested the position of the optical axis of my camera under these conditions. The camera and the portrait were both fixed, and as I screwed the lens in or out, the image grew smaller or larger without varying materially in sharpness, and expanded and contracted from a central radiant point, whose exact position I very soon ascertained. This being fixed, the parallelism of the tramway of the carriage to the optical axis was rectified until the to and fro movement of the carriage had no effect in causing the image A to separate from the fiducial A'. When all was satisfactorily arranged, the process of reduction to scale became swift, and very interesting to perform.

Beautiful as the adjustments of my camera are, I must honestly confess that if I had to begin quite afresh, I should employ a much more disconnected process. It would be an improvement on that which I first tried, which was merely to take prints that happened to be nearly of the same size, to adjust them under fiducial marks scratched on glass, and then to press down upon them a hinged flap, which carried two points that pricked two "register" marks in the margin of the print. The prints were successively suspended on two pins driven into the wall opposite the camera, the pins being passed through the register holes.

What I should do now would be to deal chiefly with group portraits. I formerly disparaged them for the purpose of composite portraiture as being too small and ill-defined, but they are now so frequently made on a large scale, and with good definition, and they form such useful collections of persons of the same family, profession, or race, that I should be inclined, when I have next to occupy myself with composites, to make much use of them, and to make the composites of the same size as they. Having selected portraits differing little in size, I should cut them out and paste them severally on cards, I should carefully measure the distance in each from eye line to lip line, under

a lens in good light, and I should write the measurement on the card. I should also carefully estimate and write down the proper number of units of exposure, having regard to the vigour of the portrait. Then I should adjust and attach the cards to similar frames, guided by fixed fiducial lines, regarding only the upper horizontal line in fig. 1, with its short cross marks, and its intersection, the vertical line, and disregarding the mouth line. Lastly, I should prop these frames in succession in front of the camera. The points to be attended to would be, first, that the frames should be accurately propped. This would best be done by two notches, like inverted V's (\wedge — \wedge) cut in their lower edge, each notch straddling over a stout round peg firmly fixed at right angles to the wall. The adjustment to scale would be greatly facilitated by making the composites of the same average size as the prints, because in that case, as already remarked, a slight screwing to and fro of the lens will change the size of the image without sensibly affecting its definition. I should then carefully graduate by trial the head of the focussing screw in such a way that I need only turn it until the figure that came opposite to a fixed index was the same as that of the measurement written on the card, to ensure that the image should be correct to scale. As the point of intersection of the horizontal and vertical fiducial lines would lie in the optical axis of the camera, the image would always fall into its right place. I should use a common lens for the camera, one that did not define too sharply; but I should be very particular about the goodness of its mounting and focussing screw. These hints will suffice; the details must be filled in by the reader. The fault I find with my present camera is loss of light, due to the reflection of the image upwards from an enclosed mirror, and to the necessity of viewing it through a piece of (thin plane) glass inclined at 45°, the upper surface of which reflects the illuminated fiducial lines scratched on a blackened plate that is mounted at its side with a light behind it. I also think that my camera is too much of a jack-of-all-trades, and that I should get on much better if the portraits were successively prepared at leisure, making the actual photography of them a quick and simple process. In the plan I have just mentioned, all the preparations would be gone through in good light, and without any hurry. Then the photography would be swift, and it would become feasible to make many trials, leaving out one or other of the more doubtful portraits. As it is, I find the production of even a single composite to be an anxious and fatiguing work, and if any part of the complicated process goes wrong, all has to be repeated. There is no reason why this anxiety and fatigue should not be avoided.

There is nothing respecting composites that I should more gladly hail than the invention of a simple optical method of combining many images into one, so as to judge of the effect of a photographic composite before making it. Nothing can be better for optically combining two portraits than the prism of doubly refracting spar that I have used; but I cannot make a satisfactory and simple combination of as many as six or even of four pictures. I have described most of the plans that have occurred to me, but they all fail in some respect. The last I tried was a mosaic of pieces cut in the form of equilateral triangles, vertex outwards, from the rim of a large lens, and turned and brought close together with their vertices inwards. I then viewed the properly adjusted pictures through a small fixed telescope, in front of whose object-glass the mosaic was fixed. The method fails because the outer edges of the pictures are less bright than the inner ones; consequently the images are not equally mixed up.

In conclusion, I can only express a wish that photographers will try to make ethnological or family composites. I have been much pleased to find that both Dr. Billings, Surgeon-General of the War Department of the United States, and Mr. Thompson, lately attached to the Medical Department of the University of Edinburgh, and now to

that of Cambridge, have used the method (as I also did, to illustrate a paper read at the York meeting of the British Association) to elicit the typical characteristics of the skulls of different races. It is, however, in ethnological inquiries, and in studies of hereditary and family characteristics, that I think the process would be most generally interesting.

It must be borne in mind by those who attempt to practise it, that off-hand methods will not avail. The adjustments must be made with judgment and extreme care to produce good effects. The difference between a very carefully-made composite, and one that has been combined with only moderate care, is great.

EXPLANATION OF PLATE.

In the plate published this week the composites are on the left, their respective components on the right. E is the composite of the five portraits marked with small *e*; opposite it, and similarly, F is the composite of the *f*'s opposite it. G is a co-composite of E and F reversed in position, and thus represents all the ten components on the right. H is a composite of five other older faces, which are omitted for want of room.

POSITIVES ON GELATINO-CHLORIDE OF SILVER.

BY W. M. ASHMAN AND R. OFFORD.

THIRD ARTICLE.

In the previous article, we directed attention mainly towards a clear understanding of the simple acid chloride emulsion, and its uses for certain purposes.

Those who found an opportunity to follow us by actual experiment, have doubtless felt ere this that their exertions were rewarded; we should be glad to know that such was the case, since it would bear independent testimony as to the value of our remarks, besides inciting others to test some of the capabilities of the process.

Upon the present occasion, we intend showing how a compound emulsion may be successfully prepared from materials to be found in every laboratory.

After numerous experiments with the various salts enumerated in our last article, together with others not included in that series, we have decided in favour of two compound emulsions as being satisfactory. In each case the proportions of three-fourths of a chloride emulsion to one-fourth of an organic or other emulsion, was found to yield the best result.

Mixed emulsions being always slightly washed, no very particular care need be exercised with regard to an excess of haloid, the washing waters readily adjusting the balance. As before suggested for the plain chloride emulsion, we prefer employing two chloride salts, and thus avoid crystallization or deliquescence in the finished emulsion, as instanced by the following formula:—

Gelatine	=	7	grms. diss. in 70 c. c. of dist. water.
Ammo chloride	124	"	} 20 " "
Potass. "	88	"	
Silver nitrate	6	"	

Here we have a combination by means of which the two extremes are avoided. We prefer making the silver decidedly acid, before mixing with the chlorized gelatine, and for this purpose make an addition of about ten per cent. of citric acid. The solution should be effected, and the temperature slightly raised in each case before mixing takes place.

If the quantities above given be employed, the colour-test before mentioned will not indicate the presence of uncombined silver. To mix with the above, we take either a citrate or an oxalate emulsion; the former produces a film readily toned in the ordinary gold toning bath, but possessing indifferent keeping qualities; the latter necessitates a special gold bath of the thio-cyanate form, and has

the property of retaining its whiteness for a long period. Perhaps we should rather say that it is quite possible to tone an oxalate prepared emulsion film with the ordinary borax bath, provided it be treated either before or after toning with a dilute solution of ammonium thio-cyanate.

In the first instance the following formula will form a proper proportion to blend with the above:—

Gelatine	2	gram. dis. in 30 c.c.s of dist. water
Amm. cit.	1.8	" " 6 " " "
Silver nitrate	2	" " } 10 " " "
Acid cit.	.3	" " }

The presence of citric acid helps to prevent the formation of a compound of gelatine and silver; it also hinders coagulation of the gelatine by the ammonium salt—an event which always takes place sooner or later with gelatine when citrate and some other salts are present, unless there has been so much washing that the resulting pictures are poor and thin. The colour test applied to this formula will be somewhat disappointing, notwithstanding the excess of silver salt used; nor is it really possible, when dealing with such organic compounds, to define the chemical changes that take place. On the application of potassium bichromate solution to a drop of this emulsion, no change may be apparent for a few seconds, but after a minute or so the red chromate of silver almost invariably appears. The argentic citrate is a soluble salt, but, as stated by both Roscoe and Fownes, the argentic citrate is insoluble. Besides this, there are most probably two or three salts, acid and neutral, and we are inclined to think that it is either the accidental formation of an argentic or a neutral argentic soluble salt that the colour test really indicates. This most probably only takes place upon the introduction of the chromic acid, because the addition of a chloride salt to the emulsion will not prevent the exhibition of free silver upon testing. Another argument in favour of this theory is found in the suggestion of a chemical authority to use argentic citrate as a means of getting argentic chloride by the addition of sodium-chloride. Any attempt to meet the case by successive additions of ammonium citrate will end in the apparent increase of free silver, and the ultimate separation of the gelatine from the precipitate and coagulation thereof.

Thus it appears evident that the citrate group are somewhat unstable in their behaviour when in combination with silver and its haloids, bringing about a train of complications which can only be unravelled by further experiment when the precise reactions may be chemically defined.

Having the mixed chloride and the citrate emulsions prepared, a mixture may be effected by adding one part of the latter to three parts of the former, and melting—if solidified—at as low a temperature as practicable. When the citrate emulsion is thoroughly incorporated with the chloride they should be rapidly set, thus reducing the evil effects of temperature to a minimum. Although three parts of chloride to one of citrate emulsion has been mentioned, the proportions must always remain a matter of individual taste, since printing colour is thereby affected; thus, the larger the proportion of citrate employed, the redder or browner will the printing colour be; and the less the proportion of citrate used, so will the colour tend towards the purples. When four-fifths of a chloride emulsion to one of citrate is employed, a rich violet printing colour is obtained.

After an interval has elapsed sufficiently long to ensure a firm jelly, the compound emulsion may be broken up by squeezing it through coarse wire mesh or mosquito netting into a vessel of cold water, where the thready emulsion may remain five minutes; the whole should then be thrown on a filter or fine hair sieve, and a second washing in clean water be given, the duration of each washing being five minutes only. As a general rule, the more the washing is prolonged, the better the emulsion will keep, but the resulting image will be less vigorous; for this reason we