

From the sale of this property we obtained \$20, leaving a net cost of \$32.13, to be divided among five people.

Our current supplies included, as the reader will have inferred from the preceding pages, nearly all the ordinary family groceries and a great many table luxuries also. Besides substantial provisions, such as flour, meal, sugar, coffee, tea, ham, bacon, etc., we had plentiful supplies of olives, jellies, sauces, raisins, sago, tapioca, corn-starch, cheese, dried fruits, excellent fresh butter, honey, fresh eggs, fresh fruit, and vegetables. Our meat bill covered little except sheep, of which we ate five in the course of the season. For the hire of the cow we paid \$10 a month. At first she found ample pasturage, but after we went up the mountain we gave her about a dollar's worth of barley a week. We calculated the cost of the milk at six cents a quart, which was cheap, considering the comfort we got from it. The horses fared well, foraging for themselves, until a week or two before we broke camp;

then we got a little barley for them, not more than three or four dollars' worth altogether.

We paid the cook \$1 a day. We paid the guide \$3 a day for his own services and the use of his two horses. Reckoning supplies, wages, and the rent of the cow, the living expenses of the whole party of seven, with the eight animals, amounted for sixty-eight days to \$562.31, which, divided among five, gives a cost of \$112.46 a head. Taking for the cost of the personal outfit the highest of the figures I gave above, we have the following as the expense to each person of a camping expedition of sixty-eight days:

Personal outfit.....	\$20.00
Share of general outfit.....	6.43
Current expenses	112.46
Total.....	\$138.89

Or \$2 a day. As we lived like *gourmets*, and made no great effort to economize, this, we thought, was doing pretty well.

John R. G. Hassard.

IN A DARK HOUR.

THOSE tender mothers! When such little things,
 Such helpless, fragile little things we are,—
 How they pray God for us! how they make war
 For us with death! and spread their mother-wings
 About us full of anxious quiverings,
 And spying each least peril from afar,
 With their own arms, thereto made mighty, bar
 The way from harms and smile at adder-stings,
 And brave the tigers merciless and wild,
 In their deep love for us; and by and by,
 When we are men, to strive and stand alone,
 We clasp our desperate, aching heads and moan:
 Would God my mother had left me to die!
 Would I had died a sinless little child!

Gertrude Hall.

COMPOSITE PHOTOGRAPHY.



WE are all interested in typical representations. The novelist or poet holds and gratifies us as we feel that the character which is portrayed with skillful words is the type of a class. The artist draws an ideal head, his expression of a type for which no single model will serve, and we look with satisfaction and pleasure at the product of his fancy. Both artist and author seek to sketch a face or character that has grown in their minds by the blending

of impressions gained from the observation of many individuals. The result at which they aim is a generic portrait which shall retain the typical characteristics of the class for which it stands, while the peculiarities and idiosyncrasies of the individuals are left out.

The generalized image, which the creative mind is able to seize upon and express, rises with more or less vividness in the mind of every one as the representative of the class or group of objects which is present in his thought. This image is often a vague and unsatisfactory one, and the mind, in its efforts to gain clearness, runs rapidly over the more distinct im-

ages of members of the class, and not infrequently ends in selecting some one of these to stand as the type of all. This is more apt to be the case when the group is a familiar one. When unfamiliar, the individual characteristics are for the most part unnoted on first observation, and the only distinct mental image formed as one thinks of the group is the blended one.

The individuals of a strange race at first look all alike to us; the members of a family which we see for the first time often have for us an unmistakable family resemblance, which is quite unperceived by themselves and those familiar with them. The unconscious analytical process which proceeds with longer observation soon leads us readily to distinguish the individuals of the race from each other, and to lose the vividness of impression which the family resemblance had made; so that now the generic image is called up with difficulty or not at all. In the observation of objects, it is the exceptional which most strongly impresses us, and this aids in making the mental generalization untrustworthy.

It is evident, also, in the representations of the artist, however admirable as products of artistic imagination and skill, that the personal equation cannot be wholly eliminated. Recall, in illustration of this, the dissimilarity which marks the portraits of the same person by different artists. Each painter strives to put upon his canvas the face he sees; it is the



THIRTEEN OF THE CLASS OF '83 OF SMITH COLLEGE.
(FROM NEGATIVES MADE IN JUNE, 1886.)

same face, and yet each sees it through the glass of his own individuality, and paints it with the characteristics with which this medium has tinged it. When, instead of the likeness of an individual, the aim is to produce the type of a race or family, the model for which exists only in the blended mental images of the artist, one readily sees that the difficulties in the way of truthful representation are greatly enhanced.

The typical portraits which are necessary for the study of race or family characteristics are such as will give, in form and feature, the average of the group. But the usual statistical method for obtaining averages from direct measurements cannot be here employed, for the differences in human features are too numerous and too minute. If, on the other hand, we endeavor to select a representative face from the group and reproduce it by photography, we are likely to fail as completely as the artist, and for much the same reason — our judgment in such a selection is not to be trusted.

To escape the difficulties which beset attempts to get truthful representations of a typical face, Mr. Francis Galton made the clever suggestion of blending the portraits of the individuals of a group by means of photography.

In his presidential address to the Anthropological Subsection of the British Association, in 1877, he said:



COMPOSITE OF SEVEN MEMBERS OF THE CLASS OF '84 OF SMITH COLLEGE. (FROM NEGATIVES TAKEN IN JUNE, 1886.)



FORTY-NINE MEMBERS OF THE CLASS OF '86 OF SMITH COLLEGE.* (FROM NEGATIVES MADE IN DECEMBER, 1885.)

"Having obtained drawings or photographs of several persons alike in most respects, but differing in minor details, what sure method is there of extracting the typical characteristic from them? I may mention a plan which had occurred both to Mr. Herbert Spencer and myself, the principle of which is to superimpose optically the various drawings, and to accept the aggregate result. Mr. Spencer suggested to me in conversation that the drawings reduced to the same scale might be traced on separate pieces of transparent paper and secured one upon another, and then held between the eye and the light. I have attempted this with some success. My own idea was to throw faint images of the several portraits, in succession, upon the same sensitized photographic plate."

Suppose a number of stereopticons arranged side by side so that a portrait may be projected from each upon the same part of the screen. A curious blending will take place as portrait is added to portrait on the screen and adjusted to its place, which recalls the transition period of dissolving views, but which, if the several portraits have the same aspect and are nicely adjusted to exact superposition, finally yields a face from which the individuals have disappeared, and which retains in its stronger lines only those traits which are common to all or many of the number.

If a photographic plate could take the place

of the screen, the composite picture could be made permanent. One can readily imagine a multiple photographic camera by which this might be accomplished, but as it would need as many lenses as there were portraits, it would be both expensive and awkward in manipulation, besides giving distorted images from the tubes at greatest angle with the central one.

The same result can be more easily and perfectly obtained by means of a single camera in which the portraits are photographed in succession, instead of all at once.

One might not unnaturally suppose that a process of this kind would give nothing but an indistinct blur, with faint, if any, resemblance to the human face; but the illustrations of this paper, which were all reproduced from photographs made in the way I have just indicated, show that this is far from being the case. They are somewhat shadowy in outline, to be sure, but distinctly human and attractive.

The results of this method of "pictorial statistics" will be better understood and appreciated if I give a little account of the way in which composite photographs are made, and discuss briefly some of the critical difficulties of the process.

* A reproduction of this portrait appeared in "Science" for July 30, 1886.

Mr. Galton's first results, which he submitted to the Anthropological Institute, in 1878, under the title of "Composite portraits made by combining those of many different persons into a single resultant figure," were obtained by exposing to the same sensitized plate a number of photographs in which the figures were similar in attitude and size. These photographs were hung on pins, one in front of the other,—“in such a way that the eyes of all the portraits shall be as nearly as possible superimposed.” A photographic camera was then directed upon them, and by a successive removal of the photographs from the pins, the images of all were thrown upon the same part of the sensitized plate. The object-glass of the camera was of course capped during the removals, and the interval of each exposure was the same and such that the total exposure was equal to that which under the circumstances would be necessary to give an exact photographic copy of any one of the portraits. In 1881 Mr. Galton recurs to the subject in a paper read before the Photographic Society, in which he describes at length a special apparatus for making composites and advises working directly from negatives by transmitted light.

Both of these papers—the former one in part only—are contained in an appendix to "Inquiries into Human Faculty," by the same author.

Even the simpler form of the special apparatus which Mr. Galton describes is so complex that many who might otherwise be inclined to experiment in this fascinating branch of photography are likely to hesitate and turn away. I have however found that a much less elaborate and costly apparatus is capable of giving perfectly satisfactory results. I will describe it, in the hope that some of the many amateur photographers may be induced to add composite portraiture to their accomplishments. The camera has a longer box than the ordinary form, with an opening in the top over which a piece of ground glass is fixed, and a mirror hung within at the back upper corners. This mirror—a piece of looking-glass in a

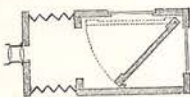
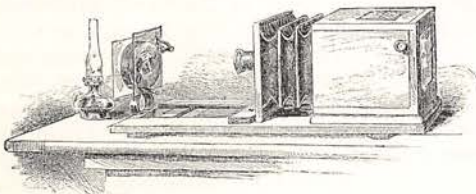


CO-COMPOSITE MADE BY COMBINING THE THREE COMPOSITES OF NUMBERS OF THE CLASSES OF '83, '84, AND '86,—A GROUP OF SIXTY-NINE.

wooden frame—is provided with a handle which projects from the side of the box and by means of which the operator can swing it into either of its two positions,—up against the top of the camera, where it is held by a spring-catch, or down to an angle of forty-five degrees, where it rests on a stop. When the mirror is in the former position, the camera is to all intents an ordinary one, and the image of the photographic object falls upon the ground glass or sensitized plate at the back; but when the mirror rests on its stop, the image is formed on the ground glass which covers the opening in the top. Both ground-glass plates must be at the same optical distance from the lens, so that an image focused on either shall be sharply defined on the sensitized plate when this is put in position. This arrangement enables one to adjust any number of successive images by means of reference lines drawn on the ground glass on top, without disturbing the sensitized plate. A very satisfactory camera of this description can be made of soft wood by any skillful carpenter at little expense.

The lens should be one of short focal distance—five or six inches—so that in making composites of about the same size as the individual portraits the apparatus need not be inconveniently lengthened. For, if the image is to be equal in size to the object, both must be distant from the lens twice the focal distance of the latter.

In front of the camera, and clamped to the edge of the table upon which it is placed, is a holder for the support of the negatives. This may be an ordinary slide-holder of a magic lan-



ARRANGEMENT OF APPARATUS FOR MAKING COMPOSITE PHOTOGRAPHS, WITH SECTION OF THE CAMERA.



TWENTY-SEVEN MEMBERS OF THE NATIONAL ACADEMY OF SCIENCES.*
(FROM PHOTOGRAPHS LENT TO THE AUTHOR BY PROFESSOR BREWER.)

tern or stereopticon, with spring clips which retain the plates securely while they allow all necessary shifting for the purpose of adjustment. The holder is backed by a piece of ground glass which serves to diffuse the light of the lamp or gas-jet used as a source of illumination. The employment of artificial light in making composites insures equality of illumination during the entire time of working, and also renders the photographic action slow. This is desirable, because the fractional exposures being longer can be more accurately timed.

The apparatus, as shown in the drawing, is arranged for making composites from negatives, for this is the best and surest way of obtaining good results.

The negatives for the purpose are taken by means of an ordinary camera and in the usual way. The sitters are placed in the same position, commonly full face or profile, and photographed under the same conditions of light and shade, and of the same size. The development of the plates should be so managed that the negatives shall be very "dense" and of uniform quality in this respect.

In making the composite three conditions must be carefully controlled if the resulting portrait is to be a faithful representation of the type of the group. In the first place, the images

which fall upon the sensitized plates must all be brought upon the same spot, and in such a way that the prominent features are accurately superposed. Carelessness in this matter of adjustment gives a composite which is all awry,—with several mouths, noses, and pairs of eyes. An inspection of the negatives from which a composite is to be made usually shows a considerable variation in the proportion of the faces, so that if, in the adjustment, the eyes are all brought on the same points, the mouths will fall on different lines, and the composite will be disfigured with a multiple mouth. If the mouths are alone considered the case is no better, and the composite will be unnatural and worthless. But if the components are adjusted in such a way that the distance from the line of the eyes to the mouth is the same in each instance, there is merely a distribution of the eyes over a short horizontal distance. This results in no disfiguring blur, but, on the contrary, gives, as it seems to me, a more truthful portrait of the type than if the eyes are accurately superposed; for, in the latter case, a deep-eyed earnestness of expression is obtained, which is in no way the average, but rather a summation, and, therefore, an exaggeration of this trait.

Hence, in order to get what may be called

* Other composites of members of the National Academy, made under the direction of Professor Pumpelly, appeared in "Science" for May 8, 1885.

a normal composite, the component images should be all adjusted so that the line passing through the corners of the eyes shall be at a constant distance from the mouth. For the purpose of adjustment, then, three lines are drawn with a fine-pointed pencil on the ground-glass focusing plate on top of the camera: two parallel lines for eyes and mouth, at a distance determined by the desired size of the portrait, and a third at right angles to them, to mark the line of the nose. To these lines the features of each component are brought as exactly as may be, by shifting the negative in its holder and enlarging or reducing the size of the image where necessary.

In the second place, the sum of the times of exposure must be equal to that necessary to make a good single photograph, and each of the exposures must be equal in length; so that, for instance, if a composite is to be made of sixty components, and sixty seconds would be required under the conditions to copy a single negative, each exposure must be for one second. If the condition of accurate timing of the successive exposures is not fulfilled, the composite will not be a true average, but the features of the longer-exposed components will predominate. When the number of components is so small that each fractional exposure is several seconds, reasonable accuracy can be attained by uncapping and capping the object-glass by hand; but in making a composite of a large group, where the exposure must be very brief, some automatic device should be employed. That which the writer has used consists of a pendulum whose rod extends above the point of suspension and has fixed to it at right angles an arm some eighteen inches in length, carrying at its extremity a little screen of cardboard or ferrotype plate. The pendulum rod is provided with sliding weights above and below the point of suspension, and by changing the position of these the time of vibration can be varied through a wide range. The proper time for each exposure is determined, and the sliding weights adjusted so that this shall be the time of the pendulum's vibration. Then, by the aid of a counterpoise opposite the arm, the little screen is brought to such position that when at rest its lower edge lies across the horizontal diameter of the camera tube. When an exposure is to be made, the screen is held down so as completely to cut off the light from the lens while the slide in front of the sensitized plate is drawn, then released, allowed to play once up and down, and stopped when it reaches its former position. With a small stop in the camera tube the exposure thus made is that of a single vibration of the pendulum.

Thirdly, the illumination of the images which fall on the photographic plate must be

in all cases equal; for the chemical action of light is more or less rapid according to its intensity, and hence a more strongly illuminated component would tend to predominate in the resulting portrait, just as one would which was exposed for more than its proper time. Indeed, as is readily seen, the conditions of time and illumination are mutually dependent, and might



FAMILY OF EIGHT—FATHER, MOTHER, FIVE BOYS, AND GIRL

be stated together by saying that the product of time of exposure by intensity of illumination must be the same for each component. If the negatives have been carefully developed to a uniform density, no change in illumination will be necessary; otherwise a slight variation will have to be made.

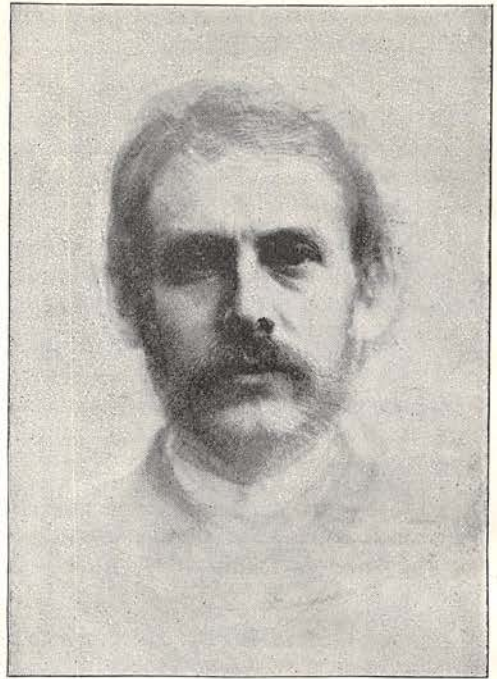
Does the order in which the components are exposed affect the result? This is a question which occurs to many who examine these composite photographs, and there seems to be a widespread notion of mysterious origin that the negative last exposed must have the greatest effect on the sensitized plate. If the order makes a difference, then the process will not give the truthful average, unless the times of exposure or the intensities of illumination are correspondingly varied. The question can be conclusively answered in the negative. Composites made from the same components taken in different orders are sensibly identical. This is the case even when the number of components is only two or three, where individual predominance, if it occurred, would be strongly

marked. There is a difficulty, however, in determining identity or dissimilarity in faces with manifold detail which makes this method of attacking the question somewhat unsatisfactory. This difficulty disappears for the most part when in lieu of faces patches of different colors are employed. Each color acts with different energy on the photographic plate, and hence, if composites of, say, three colors are made, the colors being taken each time in a different order, the results would be patches of different depths of shade, if the order of exposure affects the result; but of the same tint if the order is without influence. Experiments of this kind repeated in several different ways agree in their testimony that the order makes no difference.

The portraits, obtained by the process I have sketched, present the prevalent type of the group from which they are made with an accuracy which is undisturbed by the subjective element which is so unavoidable a factor in the results secured in any other way.

Suggestions have indeed been made of the possible prepotency of some powerfully individual or characteristic face in controlling the result, and instances have been pointed out in which this appeared to be the case—the strong resemblance to some member of the group lending color to the notion that this individual dominated all the rest and in some mysterious manner stamped the composite with his personal likeness. Unfortunately for the value of this suggestion, however, strong resemblances have as often been remarked, when the person for whose likeness the composite might well serve has not been a member of the group at all. The simple and sufficient explanation in either case is that the individual in question happens to be a close approximation to the average of the group. The very way in which the composites are made—by successive equal actions of light images on the sensitized plate—shows that in a carefully made composite there can be no question of individual prepotency. The contribution of each component of a large group is so small that the strong lines of the composite must be those in which similar lines in a majority of the components have reënforced each other, while the individual traits have almost disappeared. In a composite of a small group one can often trace the individual outlines and features, while in bolder lines the new and average face appears.

While composite portraits give pictorial averages, "they are," as Mr. Galton justly says, "much more than averages; they are rather the equivalents of those large statistical tables whose totals, divided by the number of cases and entered in the bottom line, are the averages. They are real generalizations, be-



COMPOSITE OF "MONDAY EVENING CLUB," NORTHAMPTON, MASS., OF TEN GENTLEMEN—2 CLERGYMEN, 2 PHYSICIANS, 2 LAWYERS, 3 COLLEGE PROFESSORS, AND 1 MANUFACTURER; AVERAGE AGE, 35 YEARS.

cause they include the whole of the material under consideration. The blur of their outlines, which is never great in truly generic composites, except in unimportant details, measures the tendency of individuals to deviate from the central type." Thus the shadowiness of outline, which causes some to exclaim at the composite as ghostly and uncanny, is an element of value in the result by showing the distribution of the component faces about the mean.

The most obvious application of composite photography is in the field of ethnological research, to secure types for the purpose of the comparative study of race characteristics, and which may serve as a record by means of which possible changes in type from generation to generation and from age to age can be traced. This interesting study may well be extended to sub-races and families. Mr. Galton says, "I think it [composite photography] can be turned to most interesting account in the production of family likenesses . . . the result is sure to be artistic in expression and flatteringly handsome, and would be very interesting to the members of the family. Young and old, and persons of both sexes, can be combined into one ideal face. I can well imagine a fashion setting in to have these pictures."

Composite photography gives, further, a

means for obtaining typical representations of groups illustrating health and disease, or the influence of occupation or profession.

Composites of small groups give portraits which, from the nature of the case, are of less typical value than those made from a large number of individuals. They have, however, an interest of their own which the others do not possess. A young lady, on seeing for the first time a composite of a small group of which she was a member, wrote me: "It is charming to enjoy the society of somebody who is all one's intimate friends at once."

Several persons, on examining a composite made from a few negatives, have assured me that they saw in turn most or all of the members of the group — one face fading away as a new one emerged. But this was after they had been told who the individuals of the group were. Where the imagination is strong enough to produce this effect, its possessor must find a peculiar interest in the composite of a group of friends.

Another application of the process, which has been suggested, is for the purpose of securing a more satisfactory likeness of an individual by combining several likenesses taken at different times. In this way the passing and often constrained or conscious expression, which frequently renders ordinary photographic portraits unsatisfactory, would be eliminated, and a somewhat idealized likeness be obtained. So far as I know, just this application has yet to be made; but a similar use of the method with a view to getting a more truthful portrait of an historical personage, by making a composite of such likenesses as may be in existence, has been employed in the case of Alexander the Great (Mr. Galton's first composite, from six medallions from the collection of the British Museum), and of other heads from coins and medals, of Washington,* and of Shakspeare. The great difficulty here lies in the small number of portraits in existence in which the individual is represented in approximately the same position.

It is quite possible that composite photography may be successfully applied in other ways than those already noted. Types of animal species, standards of different breeds, might be obtained, if the difficulties of securing pictures of a number of animals in the same position could be overcome.

A curious employment of the process was not long ago suggested by Dr. Persifor Frazer, of Philadelphia, by which the genuineness of a doubtful signature is tested by comparing it with a composite made from a number of signatures which are known to be genuine. Practical application of this method has already been made in court, and from the experience thus gained Dr. Frazer is of the opinion that it will, in many cases at least, prove a more trustworthy means of arriving at the truth than the testimony of even the most skillful expert.†

In the idealized features of composite portraits artists will undoubtedly find valuable suggestions, and they are, Mr. Galton believes, capable of forming the basis of a very high order of artistic work.

There are a number of ways in which a composite effect can be produced without the aid of photography. Thus, the images from magic lanterns or stereopticons may be blended on a screen, as has been already mentioned; Mr. Herbert Spencer's suggestion of superposing transparencies may be carried out with drawings on tracing-paper or photographic transparencies, carefully made, of the same aspect and size. A better method for combining two portraits is by means of a stereoscope. The two photographs or engravings must of course be selected with reference to the position of the head, though they need not be of exactly the same size. Holding one in each hand as one looks through the glasses of the instrument, one readily finds the positions in which they must be placed for the images to blend. But unless the observer's eyes are equally good, and he has the habit of using both equally, there will be in this experiment a plain case of "prepotency"; and even with good eyes there will be often noticed a curious struggle for mastery between the components.

Still another way of bringing the images of two portraits together is by means of a doubly refracting prism of Iceland spar.

All these methods are at the best imperfect, and although interesting and well worth trying, cannot for a moment compare with a process by which an indefinite number of components can be accurately combined, and which gives an objective and permanent result.

John T. Stoddard.

*A plate in "Science" for December 11, 1885, shows three composite portraits of Washington made by Mr. W. C. Taylor.

†Two papers on this subject, illustrated by a com-

posite of Washington's signatures and the components from which it was made, appeared in the "Proceedings of the American Philosophical Society" for July, 1886. The plate was reproduced in "Science" for Oct. 15, 1886.