us to form a correct judgment in regard to the mortality.

Mr. Stanley was unfortunate in the selection of several of the stations, particularly those at Vivi and Stanley Pool. They were located on high ground, and supposed to be peculiarly healthy; but at these stations the hills on the two sides of the river converge, and the cool breezes from the river and the valley blow over the stations as through the mouth of a funnel: and sickness and death are much more frequent than in low stations in the valley of the river protected from the wind by the hills or trees.

Mr. Stanley asserts, and we think he is correct, that when the sanitary conditions are better understood, and the exposures incident to the settlement of a new country overcome, proper food obtained, with temperance in eating and drinking, a man can accomplish as much work in equatorial Africa as in temperate Europe; provided, as stated on another page of *Science*, he returns home every eighteen months for a vacation of three or four months.

The death-rate is always high in new countries. In New England, and in the temperate regions of America, as well as in torrid zones, new settlements are always unhealthy, and great mortality prevails; and not until permanent settlements are made can we pronounce upon the healthiness of any climate. We believe that equatorial Africa, being nearly two thousand feet above the level of the sea, will be less unhealthy than India, or many other countries where white men live, and carry on a large and successful trade.

The association has already planted twenty-two stations up and down the valley of the Kongo, and expect to plant and maintain other stations every fifty or one hundred miles on these waters. The natives within the influence of these settlements are beginning to labor, and bring in their productions to the settlements. A small amount from each station will make a large foreign export, sufficient to support a railroad from Stanley Pool to the ocean.

The stations are now ready, but the merchants cannot successfully establish stores for trading with the natives until the railroad is built. The cost of the railroad is estimated by Mr. Stanley at $5,000,000 in the body of his book, and at $7,500,000 in the appendix.

All that equatorial Africa now requires, is the construction of the railroad from Stanley Pool to Vivi; and we trust and believe that the same good judgment, executive ability, and energy, which have won success for Mr. Stanley's other undertakings, will enable him to raise the funds for this enterprise, open the heart of Africa, and accomplish the objects of the association. GARDINER G. HUBBARD.

COMPOSITE PORTRAITURE.

THE process of composite photography has been applied to the solution of two problems: 1. Given a series of objects having in common an interesting characteristic, to find a single type which shall represent the whole group. 2. Given a series of representations of the same object, to find a single representation which shall give a superior effect by combining the strong points, and neglecting the defects, of each of the series. The latter problem is by far the simpler. The composite of six medallion heads of Alexander the Great may be taken to represent the real Alexander better than any one of the originals, because the probability of the six artists having introduced the same inaccuracy is very small. In the first problem, however, we are introducing an essentially new face, — a type representing *par excellence* the peculiar characteristic for which the originals were grouped together. In combining the portraits of criminals, the object is to get a type of criminality; in combining the portraits of national academicians, one of recognized scientific ability.

Other methods of producing a type are when the artist puts on paper the general effect of more or less unconscious observation of physical peculiarities in the class of persons represented; or when the anthropologist selects among a number of savages, for instance, one who was judged to have all the distinctive marks of his tribe in neither an exaggerated nor a deficient degree, and yet combined with them no individual eccentricities, — in short, that much-talked-of average man, whom one does not meet every day. Composite photography aims to take this process out of the hands of erring judgment and vague imagination, and reduce the art of type-getting to a mechanical one of combining photographs.

In several cases, when various images have been combined to elicit a type, it has happened that the resultant has been remarkably similar to one individual of the group represented. This was strikingly illustrated in the portraits published in *Science*, No. 118. Mr. Galton mentions, that in one such case he took a second composite, omitting the face which resembled the first composite, and the two pictures thus

obtained were practically alike. In the case of the national academicians, the gentleman referred to as representing the type was not one of the sitters at all. The explanation of this peculiarity (excluding all possibility of mechanical error in photographing) seems to be possible in two ways. It may be regarded as an example of what has been spoken of as 'prepotency,' which means that one set of features was so powerful and characteristic as to outweigh the effect of all others not in harmony with it. On the other hand, it may be said that the peculiar face is really very nearly the arithmetical mean in point of appearance of its class. For example, if we desired the average height of twenty-one men, five of whom were five feet ten inches high; five, five feet nine inches high; one, five feet eight inches; five, five feet seven inches, and five, five feet six inches, each, we might take the man of five feet eight inches as the average of the lot. This individual would then be the mean of his class, just as the one face was the mean of its class. If, now, we omit the man of just five feet eight inches in height, the average of the group is not altered in the least. So, also, in omitting the one photograph, as Mr. Galton observes, the type is not altered. This leads probably to the latter explanation.

The problem is reduced to its simplest terms in the combination of but two faces. The resultant here ought to be the exact mean between the two originals. If the composite resembles one more than the other, we must regard that one as the more powerful characteristic face; if it resembles each of the originals, they probably resemble each other; if it differs from both, they differ from each other. That is, the mean of three inches and five inches does not differ much from either, nor do they differ much from each other: the mean of one inch and seven inches is also four inches, but the differences between them and the mean are large.

I have attempted to experiment with ordinary photographs, and without the elaborate apparatus of composite photography, and give my results, in the hope of thus placing the process within the reach of every one.

The most natural method of combining two pictures is by means of the well-known Brewster stereoscope. I tried this, and was surprised at the splendid result. I went to work with all the fervor of an original discoverer, but afterwards found, on looking at Mr. Galton's article, that he had done the same. I mention this, because Mr. Galton himself, in the same place,[1] admits an independent suggestion, both of this and of composite photography, in the shape of a letter from Mr. Austin of New Zealand, to Charles Darwin.

[1] Inquiries into human faculty.

It was easy to arrange a device by which one of the two photographs could be raised or lowered, moved laterally, and also swung around its centre so as to bring its image exactly in correspondence with that of the other photograph. The only requisites are that the two pictures be approximately of the same size and position. When these requisites were not satisfied, I found other methods of combining them, as will appear below. With an ordinary stereoscope and a family album, any one has the means of an amusing and instructive study. A few of the results gotten in this way may be worth recording.

As was said before, in uniting two pictures, say of two sisters that are commonly considered to resemble each other, the composite is very much like either. Some will call it more like the one, some more like the other. By alternately closing each eye, and then opening both, the observation becomes more striking. If the pictures represent persons who are total strangers to each other, the result is often an entirely different face from either. The effect is peculiar of combining the photographs of two persons of opposite sex. The male face seems to predominate; but this is probably due to the influence of the beard, mustache, etc.; for in combining children of opposite sex, or using photographs of adults with smooth faces, the predominance disappears. Like the beard, so, too, the hair, costume, etc., are apt to lend an undesirable peculiarity to the composite. This can be partly avoided by cutting out the shape of the face proper in white paper, and attaching it with a rubber band to the photograph, thus combining the features alone. On the same principle, one can combine the upper part of one face with the lower part of another by covering with paper the suitable parts of each.

One can combine persons of different ages with good result. A young lady of twenty, combined with her mother of sixty, gives a lady of about forty years of age. A still more striking case is, when a girl and her grandmother give as a composite a middle-aged woman much more like her mother than like the girl herself, or her grandmother, although a family resemblance runs through the group.

As Mr. Galton says, the effect is often to idealize the faces. A composite of two photographs of the same person gives a composite far better than any photograph actually taken

of the individual. The combination of a photograph of a person at one age, with that of the same person at a different age, is very much like what the person looked at an intermediate age. The effect of hair, costume, etc., often spoils the result.[1]

While the combination with an ordinary stereoscope is very satisfactory, there are a few advantages in using the original form of the instrument as it was invented by Wheatstone. This consists of two mirrors set at right angles, and two bars running out perpendicularly to the faces of the mirror. Along these bars uprights, holding the photographs, can be moved. One eye looks into each mirror, and the combination of the two images takes place. Diferences in size of the photographs can be accounted for by moving the larger one farther off, and the smaller one nearer. As soon as the two images, as seen side by side, are of the same size and position, the bars are moved on their common axis until the images coalesce. The composite thus formed is even better than the Brewster stereoscope, and the arrangement lends itself to a greater variation in the experiment. Two cautions may be useful: 1°. The head must not be moved. A prong of wood attached to the instrument, and held between the teeth, will be an aid. 2°. The illumination of the two pictures must be alike, or else the more strongly illuminated will give the character to the composite.

While composite photography has always made use of photographs, there is no impossibility in making a composite directly from the original sitters. A Philadelphia photographer has been successful in producing a composite of two sisters from actual life. The method is, doubtless, more troublesome than the usual one. With the Wheatstone stereoscope, one can combine living faces by having two persons assume appropriate positions; and, as before, by guiding the movements of their heads, uniting the images in the mirrors. Both the full face and the profile give a peculiar and lifelike effect.

The most common difference in the position of photographs, as ordinarily taken, is the direction of the head; i.e., whether more of the left or the right side of the face is shown. Two photographs, looking in opposite directions, cannot be combined by any of the above methods. A simple device overcomes the difficulty. A piece of mirror is held directly in front of the face between the two eyes. The two pictures are set side by side; one is looked at directly with one eye, while the other is seen reflected, and, of course, reversed in the mirror. By moving the photograph until its reflection coincides with the other, a perfect blending takes place.

I have tried combination by means of the zöetrope. Simple figures can be satisfactorily combined; but so complicated a design as the human face, is accompanied by a vagueness of outline and detail which render the process useless. By using five or six of each of the two photographs to be combined a distinct face is seen. Even then the result is not nearly so good as in the stereoscopic combination. Besides, there is no way of accounting for small differences in the photographs. In combining several pictures, one gets nothing but a jumble of faces.

The fatal objection to all these hand-processes is, that but two photographs can be combined at once. To unite the resultant composite of two or more stereoscopes, is, perhaps, possible, but would certainly prove very troublesome. An apparatus, that, by a system of mirrors, would superimpose a series of images, suggests one method of extending the processes above described. JOSEPH JASTROW.

[1] I would suggest that this method offers a means of studying the nature of the expression of the emotions.

A COMPOSITE PORTRAIT OF THE OFFICERS OF THE ASSOCIATION.

THE accompanying photo-engraving is a composite of the photographs of the higher officers present at last year's meeting of the