

existence of a race of people who lived soon after the remote glacial epoch of Europe, and who were unacquainted with the use of metals. Their history is that of the earliest family of man of which we yet have any trace; while here, in the far north, there are tribes still living under exactly similar conditions, in a glacial country, and in a stone age. A close and careful study of this race, therefore, and more especially of any part of it which may be discovered in hitherto unexplored regions, assumes great importance, and becomes a subject of universal interest.

I ventured to hint just now that, after the arrival of the Asiatic emigrants at the "wind-loved" point, while some went south and, driving out the Norsemen, peopled Greenland; and while others remained between the forks of the great glacier, a third party may have wandered north to still more remote and now unknown shores, where the required conditions for their existence may be attainable. I believe this to be far from improbable. It is true that the "Arctic Highlanders" told Dr. Kane that they knew of no inhabitant beyond the Humboldt glacier, and this is the farthest point which was indicated by Kalahierua—*Erasmus York* (the native lad who was on board the *Assistance* for more than a year), on his wonderfully accurate charts. In like manner the Esquimaux of Upernavik knew nothing of natives north of Melville Bay until the first voyage of Sir John Ross. Yet we know that there either are or have been inhabitants north of Humboldt glacier, for Morton (Dr. Kane's steward) found the runner of a sledge, made of bone, lying on the beach on the northern side of it.* There is a tradition, too, among the Arctic Highlanders that there are herds of musk oxen far to the north on an island in an iceless sea.† Assuredly if Morton gave an accurate account of what he saw beyond the 80° of N. latitude, the Esquimaux who wandered towards the Pole would have no inducement to return south again. Open water means to them life. It means bears, seals, walrus, ducks, and otches. It means health, comfort, and abundance.

In the belief of some geographers there is a great *Polynia*, or basin of open water round the Pole.‡ Wrangell says that open water is met with north of New Siberia and Kotelnoi, and thence to the same distance off the coast between Cape Chelagskoi and Cape North.§ If this be the case the Omoki and Onkilon, who fled before Tartar or Russian invasion, had no reason to regret their change of residence. A land washed by the waves of a *Polynia* would be a good exchange for the dreary *tundra* of Arctic Siberia, where the earth is frozen for 70 feet below the surface. Dr. Petermann, and other geographers, believe that open water at all seasons, probably forming a large navigable Arctic ocean, extends along the

* Kane, i. p. 309.

† Petermann's 'Search for Franklin.'

‡ Hayes, p. 35.

§ Wrangell, p. 504.

northern coasts of Siberia, and of the Parry group. Now if these theories be anything like the truth, I think that scattered tribes will also be found far to the north. Wherever a *Polynia*, be it large or small, really exists, there men who sustain life by hunting seals and walrus may be expected to be found upon its shores. We may reasonably conclude then, if the region between Morton's farthest and the Pole bears any resemblance to the coast of Greenland, if there is a continent or a chain of islands with patches of open water near the shores, caused by ocean currents, that tribes will be found resembling the "Arctic Highlanders," who extend their wanderings to the very Pole itself. Such a people will be completely isolated, they will be living entirely on their own resources—far more so even than the "Arctic Highlanders," since the North water has been for the last forty years visited by whalers and explorers; and a full account of the habits, the mode of life, and the language of so isolated a people will be to many of us among the most valuable results of the contemplated Polar expedition.

I have thus endeavoured to point out the route which was probably taken by the ancestors of the Greenlanders, and of the supposed denizens of the Pole, in their long march from the Siberian coast. I am not in the least wedded to the theory which is propounded in this paper, but I have solicited your attention in order to point out, by a few suggestive hints, what a wide field of interesting and valuable research is waiting for investigation in the science of ethnology alone in the region of the Pole; and, be it remembered that this is but one out of many branches of knowledge which will be enriched by future North Polar explorers.

VIII.—On *Stereoscopic Maps, taken from Models of Mountainous Countries*. By FRANCIS GALTON, Esq., F.R.S.; illustrated by Specimens photographed by ROBERT CAMERON GALTON, Esq.

Read, March 13, 1865.

A LARGE amount of theory and practical skill has been directed to the art of mapping mountainous countries, on an accurate and pictorial system; but the results are far from satisfying the every-day requirements of mountaineers and other travellers. The idea obtained from the best of these maps is considerably inferior to the knowledge gained by seeing a model.

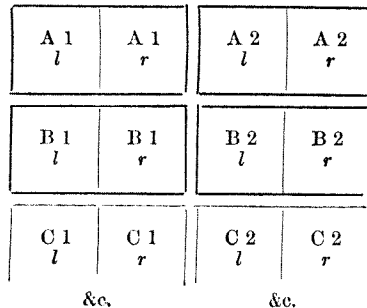
There are serious obstacles to the complete success of the map-maker in representing mountainous countries. Simple shading is too feeble an instrument to express gradations of relief, and the insertion of names interferes with the regularity of the shading. Contour maps are complete failures whenever crags and cliffs

have to be represented, for the lines then become so super-imposed as to be wholly unintelligible.

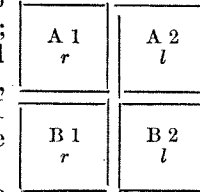
I have often had disagreeable experience of the inadequacy of maps to express the configuration of Alpine districts; and, on thinking how it could be remedied, the idea occurred to me of testing the effect of stereographs. I accordingly borrowed a few of the smaller and less delicate models from the collection of the Royal Geographical Society, and placed them in the hands of my cousin, Mr. R. Cameron Galton, who is an excellent amateur photographer, and who had kindly offered to assist me in carrying my object into effect. The result has been the production of the instructive specimens which we have exhibited to the Society.

It was not our aim to go to greater labour and expense than was necessary to show the complete feasibility of the idea. If larger models had been attacked, it would have been necessary to photograph them *in situ*, by erecting a stage above them, on which a camera could traverse in a vertical position. It would also have been necessary to have recourse to some special means of illumination. All this would have created an amount of labour and inconvenience which would, I believe, be henceforth well justified on the part of professional photographers, making stereoscopic maps for the purpose of sale, but which was in no way requisite to prove what I wished to maintain, namely, the effectiveness of this method of cartography.

It is not by any means necessary that these maps should be limited to the size of ordinary stereoscopic slides. A specimen is exhibited of the Island of St. Paul, taken in four quarters, in which the four pair of stereoscopic prints have been brought pretty closely together, both laterally and longitudinally, with good effect. If we call the upper quarters A 1, and A 2, and the lower quarters B 1, and B 2, and if we distinguish the left and right-hand halves of each stereoscope by the letters *l* and *r*, then the photographs have been pasted side by side, as in the upper part of the following diagram.



The four middle squares forming an almost continuous photographic map; as shown in the small diagram to the side; of which either the left side, by itself; or the right side, by itself; may be viewed stereoscopically. For convenience of carriage, the right and left wings of the specimen I exhibit, have been made to fold over the middle part.



Though, theoretically, the eye-glasses of the stereoscope ought to be held exactly above the centres of each stereograph, yet, I find, that no such accuracy is needed in practice. The glasses may even be held over the line that divides one stereograph from that which lies next below it; for instance, over the line that separates the A's from the B's. We might, therefore, prolong the map to any extent downwards, by annexing rows of C's below the B's; and of D's below the C's; and so on.

I also find that the glasses may be held somewhat out of their proper place, to *one side*; including, for example, a portion of A 2 *l*, and excluding a corresponding portion of A 1 *l*. It is now easy to apply the eyes to the stereoscope, in such a way (partly by withdrawing them to a trifling distance from it, and partly by not looking through the centre of the lenses) so as to limit the field of view, sufficiently to prevent the portion of A 2 that is seen by the right eye, being overlapped by anything seen through the lenses, by the left. There need be no conflict of images between A 1 and A 2. This operation is difficult to describe, but is very easy to recognise and also to effect in practice. Of the whole picture then in view, it is of course only a part that is seen by binocular vision, and therefore stereoscopically; nevertheless a stereoscopic *illusion* is insensibly conveyed to the remainder. This is exactly what occurs in ordinary vision. Only the middle belt of our ordinary field of view is seen by both eyes at the same time; as is instantly to be proved, by shutting first one eye and then the other. It will then be found that fully a sixth part of the field, on either side, has been seen by one eye alone; and that only four-sixths of the total view, have fallen within the range of binocular vision. Nevertheless, we are not conscious of any break in the stereoscopic effect. The stereoscopic illusion is carried on insensibly, principally through the medium of the perspective and shading, which remain unchanged. We are also quite unconscious of the presence of the object that limits the completeness of the true stereoscopic effect. This object is the nose, in ordinary vision; and the woodwork of the stereoscope, in the case we were describing. In either instance, the intervening object is thoroughly out of focus with the images on

which our eyes are intent; and therefore its presence is the more easily to be ignored.

Owing to these properties, we are able to deal with models of very considerable dimensions both laterally and longitudinally. When such a model has been stereoscoped in separate squares, and the prints have been carefully united, it becomes possible to view *any* part of the large map with stereoscopic effect.

Two of the models—that of the Orteles Spitze and of the Island of St. Paul—are Austrian. They are accompanied by maps, prepared with signal success by Austrian artists, that may fairly be considered to represent the most advanced stage of map-making at the present day. A comparison of the stereographs, photographed from the same models that the map-maker endeavoured to represent, cannot fail to show the infinite superiority of the stereographs over the engravings. They belong to quite another order of representation. The delicacy of their detail is far superior to the workmanship of any engraver, and the vividness of their relief is absolutely startling.

The insertion of names necessarily obliterates so much of the surface as is occupied by the strokes of the letters, but it is no hindrance to stereoscopic effect. On the contrary, it is advantageous to it, and for the following reason:—When we look at a model tinted in a perfectly uniform manner, or in purely white plaster-of-Paris, so equally illuminated as to be affected by no shadow whatever, it appears to be flat and featureless. The eyes can select no points on which to converge or to focus themselves, and therefore the stereoscopic effect is *nil*. Under circumstances of ordinary illumination there are always some spots, peaks, or ridges, picked out by the lights and shadows, and therefore there is usually some appearance of stereoscopic relief. The total effect is, however, due to the shading, rather than to the true stereoscopic effect, as is evident from the fact that, whether we look at a purely white model with two eyes or with only one, there is little difference. But as soon as names, discolorations, or marks of any kind, however delicate, are made upon its surface, the case is altered. The eyes find numerous definite points to lay hold of, and the features of the model start into saliency. In illustration of this, I may mention it is a common remark, that the height of a small room appears notably diminished, when its ceiling is painted in a pattern. The fact being, that when the ceiling is of a uniform tint, no stereoscopic data exist, to enable us to estimate its distance from our eyes. Consequently the distance is indefinite, and we think nothing about it. But as soon as the ceiling has been painted in patterns, there can be no possibility of error, nor of forgetfulness of the real height of the room.

Contour lines may be drawn on the model, and will appear on the stereograph with good effect.

The size of an ordinary stereoscopic slide is very suitable for District Maps, such as are commonly inserted in guide-books, where they occupy a single octavo page. As the stereoscopic lenses usually magnify an object twofold, the apparent scale of an ordinary stereograph and of the map that fills an octavo page, are nearly identical. The stereograph of the Orteles Spitze well represents the character of such a district map, as may be found in the Swiss guides of Baedeker and Berlepsch.

Travellers who may hereafter use stereoscopic maps, need by no means burden themselves with box stereoscopes for the purpose of viewing them. The cheap and common little instrument, used like a double eye-glass, proves a perfect substitute in a skilful hand. It consists of two stereoscopic lenses, set into a thin strip of wood, and it will go with perfect ease into the waistcoat-pocket, if the handle be shortened or made to fold.

Numerous models of the more frequented mountain districts are already in existence, on a suitable scale for photography. Many of them are large and heavy, much more important than those from which these stereographs have been taken. They are to be found in the collection of the Royal Geographical Society, in the Geological Museum in Jermyn-street, and in the South Kensington Museum, as well as in numerous other museums both in England and on the Continent. There are, in addition, a few models on a yet greater scale, that have been the labour of years to construct, and form sights that travellers delight to visit, such as that of the English lakes at Keswick, those of Switzerland at Berne, Zurich, Lucerne, and Geneva; and of the Pyrenees at Luchon. Unfortunately for the photographer, the majority of models are too highly coloured, and are placed in far too dark rooms for their convenience. But even these difficulties may be overcome when desired. So far as the models are painted in oil, they can be temporarily tinted with water-colour, to be afterwards sponged away, and the camera could be brought to bear upon them in the following manner:—A stage might be built round the models, like that erected by builders above the large works they are employed upon. A framework, holding the camera in a vertical position, looking downwards, would run laterally on a stage that itself moved longitudinally. This is precisely the same principle as that on which the builder's crane is constructed, by which it is enabled to be brought over any point that may be desired. Lines would next be drawn upon the model, dividing it into squares of a suitable size, and the camera would be brought over the centre of each of these squares in succession. The necessary illumination would be easily obtained by the magnesium light. When

have the marginal definition clear, I have used a small diaphragm, No. 3, with an opening about half-an-inch in diameter, and consequently the time of exposure has been somewhat long, varying from one and a half to three minutes. Some of the models are a good deal discoloured by age and rough treatment; and in order to obtain sufficient contrast in the different parts, I have had either to recolour them with ordinary water-colours, or to coat them over entirely with white. For the latter purpose I have used kaolin, mixed with gum and water, with the best results; it gives a very perfect dead-white surface, and can, moreover, be removed with the greatest ease.

ROBERT CAMERON GALTON.

Feb. 14, 1865.

IX.—*Water Supply in the Basin of the River Orange, or 'Gariep, South Africa.* By JAMES FOX WILSON, Esq.

Read, March 13, 1865.

A VERY noticeable physical fact, which has of late years attracted considerable attention from residents in South Africa, is the gradual drying-up of large tracts of country in the Trans-'Gariep. That great expanse of wilderness, called the Kálahári, remarkable for few inhabitants, little water, and considerable vegetation, seems to be gaining in extent, gradually swallowing up large portions of the habitable country on its confines, and slowly, but surely, assimilating their fertile character to its own sterile one. It has become matter of notoriety that springs, which a few years ago supplied a sufficient quantity of fluid to irrigate considerable breadths of garden and field, have diminished in their flow and dwindled away, causing the migration of the inhabitants to a more favourable dwelling-place; while desert sucking-places and well-filled pools, such as that of Serotli, described by Livingstone, are at present either completely dry, or afford only a small quantity of liquid after much digging, where formerly existed a large piece of water.

At Lopépe and other places on the road to Lake 'Ngami this is the case, as well as at Tunobis in Damaraland, and elsewhere; but it is most conspicuous in the territory of the Bakwain tribes, in which, as one of the many evidences of the growing desiccation of the country, streams, *e. g.* the Mahalapi River, that at Lopelóle and at Porapora Pass, are pointed out where thousands and thousands of cattle formerly drank, but in which water never now flows, and where a single herd could not find fluid for its support.*

* Livingstone, pp. 14, 150.