

answer. It may be that Rutherford was a deserter from one of those ships which, in the early days, so often visited the northern part of the island for the purpose of procuring kauri spars. Supposing this to have been the case, it would be an object of supreme importance with him that he should escape detection; and it would be a great help to him in securing this object if he could induce the natives among whom he found a home to confer upon him the honour of a tattooed face; and it would be with the same object in view that he concocted the plausible story of the capture of the "Agnes," and of his forcible detention in a distant part of the country, to account for his appearance on his emerging once more into the civilized world.

ART. LIII.—*On some Means for increasing the Scale of Photographic Lenses and the Use of Telescopic Powers in connection with an Ordinary Camera.*

By ALEXANDER MCKAY, F.G.S.

[*Read before the Wellington Philosophical Society, 13th August, 1890.*]

OCCASIONALLY notices appear in works devoted to, or incidentally treating of, advances in photographic art, by which it is evident that telescopic photography in its application to ordinary landscape views is engaging the attention of those aiming at improvements in photographic apparatus.

There seems also to be a difference of opinion as to how far mere sharpness and distinctness is a virtue in a landscape photograph. No doubt in this respect the distant parts should be rendered in due subordination to the middle and foreground parts of the picture. This matter in most cases takes care of itself, and very frequently the complaint is well founded that the distant parts of the picture are indifferently rendered. In my opinion the defects here spoken of are only too common.

Again, in approaching the outskirts of a mountainous country, such as the Southern Alps of New Zealand, or the Seaward or Inland Kaikouras in the north-east part of the South Island, there are many excellent combinations which, on account of the distance, cannot by an ordinary instrument be rendered except on a very small scale, and then totally devoid of anything like detail. This difficulty or impossibility has often been a matter of great regret to myself, since, when the mountain-range is viewed from such a distance as admits of a picture being taken on a scale sufficient to show anything

like the details, the picturesque combination first observed has vanished, and something totally different has taken its place. This must have been the experience of many amateur and professional photographers besides myself.

To meet and overcome such difficulties lenses of more than ordinary focal length might be used. Lenses of 25in. or of 30in. focal length would, no doubt, to some extent satisfy the requirements of the object in view; but, as such instruments require the use of cameras of a corresponding extension, the apparatus would prove cumbersome, unwieldy, and also unstable should the weather be at all windy.

Some of these difficulties it has been attempted to overcome by the use of an ordinary telescope attached to and placed in front of the lens; but at first sight it must be evident that this is a very doubtful improvement, involving as it does the support of the telescope and otherwise the unsteadiness of the sliding parts. Besides, the results are not what should be aimed at. The picture resulting, though sharp in detail, is of small size, and requires the after-process of enlargement, which may or may not be successfully accomplished.

Some years ago I set myself the task of producing telescopic pictures, and at first I used an ordinary achromatic telescope having positive focus; but, for the reasons already pointed out, I soon discovered that this could be of no use as applied to the purpose I had in view, and it became evident that what was wanted was a telescope of considerable power, but having a very short focal length. As meeting the requirements of the case, and serving the purpose I had in view, I made use of one tube of an opera-glass of small size. This, placed in front of the photographic objective, gave a much larger picture than that obtained by using the longer-focussed telescope with positive focus. I next mounted the lenses, the objective and eyepiece, in separate tubes, sliding one into the other, so that this part could thus be focussed, and afterwards fixed the whole to the case of a single achromatic photographic lens. With this, and by varying the power of the biconcave eyepiece-lens, I obtained pictures of different scales, varying in size from a quarter-area to that of a half-plate. At the same time I also found that, by a slight adjustment of the telescopic part, focus on the camera-screen could be obtained at any distance, from near contact with the back lens to the furthest extension the camera was capable of, and this with a corresponding increase of the scale and size of the picture as the length of the camera-screen was greater from the back lens of the instrument.

I could now produce pictures of almost any size, but they were lacking in vigour, and were not quite as sharp as I de-

sired they should be. This last defect I subsequently found was due to a dissociation of the visual and actinic foci. But I had so far succeeded in my original object, and, besides, had made two discoveries which I rightly deemed to be of considerable importance: first, that the focus on the screen of the camera-box is, by use of the optical combination described, controlled by the telescopic part, and that a very slight difference in the distance between the objective and the eyepiece shifted the position of focus in the camera-box very considerably; second, that as the power of the eyepiece was varied the size of the picture was affected, though in the case of the higher powers there was necessitated a greater length of the telescopic part.

At this stage I made use of a $1\frac{1}{4}$ in. objective lens, with an eyepiece of such power that, with the screen at a distance of 7 in. from the back lens, a picture $6\frac{1}{2}$ in. by $4\frac{3}{4}$ in. was obtained. And shortly I found that it was not necessary to use the photographic objective at all, and that the telescopic part of the combination alone was sufficient to produce a moderately sharp picture; but in using the latter I was much troubled by the introduction of both chromatic and spherical aberration. In the face of these difficulties I obtained a number of pictures which under the circumstances might be considered as very fair results.

The instrument as it then was required a very small stop to produce anything like sharpness in the photograph. I have used a stop not more than $\frac{1}{50}$ in. in diameter; and, with one of $\frac{1}{32}$ in., used to obtain results on a Wratten and Wainwright's "instantaneous plate" by giving an exposure of from five to eight seconds.

The difficulty now was that over and above the twofold optical aberration of the instrument there was such poor illumination of the screen that it scarcely sufficed for the correct focussing of the instrument; and it might be, too, that there was some slight displacement of the visual and actinic rays. To obtain more light I had to make use of an objective lens of larger aperture; and, this being of considerably longer focus, the consequences were that the two foci were dissociated to such an extent that some compensation had to be devised whereby to neutralize this effect. I overcame the difficulty by constructing an eyepiece for use in the position of the camera-screen, but which could be pushed forward into the camera-box the distance required to obtain the correct focus; and, this once determined, a stop-flange was so placed that the same distance could be again found after this part of the instrument had been withdrawn to make way for the dark slide and prepared plate.

The use of a $2\frac{1}{2}$ in. objective lens of long focus with the

same eyepiece involved the necessity of a greater length of telescopic tube in front of the camera. I found, however, that the increased scale of the objective, due to the flat curvatures of the lens, enabled me to use an eyepiece of much lower power for obtaining a picture of the same size and scale as formerly; and that, to effect this, the whole optical combination need not exceed 8 in. in length.

To overcome the chromatic and spherical aberrations above mentioned, I constructed a back combination consisting of a convexo-concave single lens, in near contact with the concave side of which a plano-convex achromatic lens was placed. This, though somewhat reducing the scale of the picture and the area of the circle of light, rendered the instrument nearly non-chromatic and perfectly rectilinear. I could now produce photographs the scale of which exceeded that of an ordinary half-plate lens, including an angle of 40° , five, ten, twenty, or even thirty diameters, simply by giving to the back lens a greater power of dispersion.

Used microscopically, I found that I could copy objects size for size at distances of 10ft. or 20ft., or more, thus admitting of the proper and effective lighting of the object to be photographed, and, in the case of spherical, cylindrical, or conic bodies, giving a representation more in accordance with the distance at which most objects are viewed; and I have no doubt that the larger forms of the instrument will within certain limits be very useful for microscopic work up to sixteen or eighteen diameters. Most of the photographic prints which I exhibit were taken with the $2\frac{1}{2}$ in. lens, having the eyepiece or back combination last described.

This instrument, although it did fairly good work, was on the whole too bulky and heavy for use in the field, and I had for field-work to devise a lighter and more handy form of the same, which, with some modifications, is before you.

In this, the optical part consists of a Ross's "rapid symmetrical lens," which, with the tube attached, is fitted to a travelling-screw, thus enabling the focussing of the instrument to be effected, if it is not desired to effect this by shifting the camera-screen. The outer photographic doublet being free from both chromatic and spherical aberration, it is not necessary to be so careful as respects the eyepiece, because aberration is not so likely to be present in that part of the instrument. Therefore the eyepiece fitted in the after-piece of the tube is a simple biconcave lens serving only the purpose of dispersing the rays at a greater angle than that at which they escape from the back combination of the rectilinear lens; otherwise it acts in the same way as the instruments I have described at greater length, with this variation only: that, if the distance between the outer combination and the eyepiece be increased

or lessened, this displaces the focus on the camera-screen only by half that distance, and an adjustment of 1in. on the tube represents about 2in. of difference in the camera.

The eyepiece taking the place of the camera-screen is adjusted to the plane of the sensitive surface of the plate in the dark slide, and is easily brought to as great a degree of exactness as the dark slides themselves will register, and if needful it may also be made to compensate any displacement of the foci that may occur through using an imperfect telescopic eyepiece. In using the screen eyepiece the picture should be first arranged, and a proper balance of focus obtained; then, throwing back or aside the screen, the eyepiece may be applied to the production of focal sharpness, which may thus be made as perfect as lies within the capacity of the lenses concerned in its production.

Such, so far, have been my experiments and discoveries, and in bringing them and the instrument under the notice of the Society I do so with a view to their publication, so that others may have the opportunity of making improvements on what I have already effected, or of suggesting something entirely new in its place.

ART. LIV.—*The Determination of the Origin of the Earthquake of the 5th December, 1881, felt at Christchurch and other Places.*

By GEORGE HOGBEN, M.A.

[Read before the Philosophical Institute of Canterbury, 2nd October, 1890.]

Plate XLI.

I BEGAN to examine into the circumstances of this earthquake in connection with the general work of determining the origins of New Zealand earthquakes, and expected to find that the source of the disturbance was situated beneath the surface of the earth somewhere in the neighbourhood of Castle Hill, or (as Professor Hutton suggested to me in conversation) between Mount Torlesse and Mount Franklin. The evidence, however, gives a different result, and yet I believe is sufficient to show that the epicentrum is at or near the same spot as that of the 1st September, 1888.

The facts on which the present notes are based are related in the *Lyttelton Times* and *Press* of the following days. Very full accounts are given, but the number of data exact enough for our purpose is small.