muscles attached to the globe which do not admit of separation into distinct parts, but completely surround the posterior half of the globe.

To trace the optic nerve through its foramen to the brain was successfully accomplished in only one dissection. After exposing the optic nerve and the eye completely, all the surrounding parts were removed, and a section made through the skull so as to exhibit a lateral view of the interior of the cranium.

The brain itself was disorganized in all the young specimens; but in the dissection just alluded to the optic nerve was seen to pass through the base of the skull, and to enter the membranes to a short distance, so that it would have been possible, if the brain had remained perfect, to trace it to its origin.

With regard to the eye itself, no difficulty was experienced in separating the iris, choroid, and lens. The other structures usually existing in the eye had been so long subjected to the influence of the alcohol that I could not determine their condition.

It must necessarily happen that many interesting observations are made in the course of an investigation like that which has been briefly described, and many minute details might have been added to this account; but it appeared to me to be desirable to limit the details, as far as possible, to those which were sufficient to establish the remarkable physiological fact that the Mole, at the time of birth, is endowed with organs of vision of considerable perfection, while in mature age it is deprived of the means of sight in consequence of certain changes which take place in the base of the skull, terminating in the destruction of the most important structures on which the enjoyment of the sense of sight depends.

II. "On an Aplanatic Searcher, and its Effects in improving High-Power Definition in the Microscope." By G. W. Royston-Pigott, M.A., M.D. Cantab., M.R.C.P., F.R.A.S., F.C.P.S., formerly Fellow of St. Peter's College, Cambridge. Communicated by Prof. Stokes, Sec. R. S. Received March 31, 1870.

(Abstract.)

The Aplanatic Searcher is intended to improve the penetration, amplify magnifying-power, intensify definition, and raise the objective somewhat further from its dangerous proximity to the delicate covering-glass indispensable to the observation of objects under very high powers.

The inquiry into the practicability of improving the performance of microscopic object-glasses of the very finest known quality was suggested by an accidental resolution in 1862 of the Podura markings into black beads. This led to a search for the cause of defective definition, if any existed. A variety of first-class objectives, from the $\frac{1}{16}$ to the $\frac{1}{4}$, failed to show the beading, although most carefully constructed by Messrs. Powell and Lealand.

Experiments having been instituted on the nature of the errors, it was found that the instrument required a better distribution of power; instead of depending upon the deepest eyepieces and most powerful objectives hitherto constructed, that better effects could be produced by regulating a more gradual bending or refraction of the excentrical rays emanating from a brilliant microscopic origin of light.

It then appeared that delusive images, which the writer has ventured to name *eidōla**, exist in close proximity to the best focal point (where the least circle of confusion finds its locus).

(I.) That these images, possessing extraordinary characters, exist principally above or below the best focal point, according as the objective spherical aberration is positive or negative.

(II.) That test-images may be formed of a high order of delicacy and accurate portraiture in *miniature*, by employing an objective of twice the focal depth, or, rather, half the focal length of the observing objective.

(III.) That such test-images (which may be obtained conveniently two thousand times less than a known original) are formed (under precautions) with a remarkable freedom from aberration, which appears to be reduced in the miniature to a *minimum*.

(IV.) The beauty or indistinctness with which they are displayed (especially on the immersion system) is a marvellous test of the correction of the observing objective, but an indifferent one of the image-forming objective used to produce the testing miniature.

These results enable the observer to compare the known with the unknown. By observing a variety of brilliant images of known objects, as gauze, lace, an ivory thermometer, and sparkles of mercury, all formed in the focus of the objective to be tested with the microscope properly adjusted so that the axes of the two objectives may be coincident, and their corrections suitably manipulated, it is practicable to compare known delusions with suspected phenomena.

It was then observed (by means of such appliances) that the aberration developed by high-power eyepieces and a lengthened tube followed a peculiar law.

A. A lengthened tube increased aberration faster than it gained power (roughly the aberration varied as v^2, while the power varied as v).

B. As the image was formed by the objective at points nearer to it than the *standard distance of nine inches*, for which the best English glasses are corrected, the writer found the aberration diminished faster than the power was lost, by shortening the body of the instrument.

C. The aberration became negatively affected, and required a positive compensation.

D. Frequent consideration of the equations for aplanatism suggested the

* From εἴδωλον, a false spectral image.

idea of searching the axis of the instrument for aplanatic foci, and that many such foci would probably be found to exist in proportion to the number of terms in the equations (involving curvatures and positions).

E. The law was then ascertained that power could be raised, and definition intensified, by positively correcting the searching lenses in proportion as they approached the objective, at the same time applying a similar correction to the observing objective.

The chief results hitherto obtained may be thus summarized.

The writer measured the distance gained by the aplanatic searcher, whilst observing with a half-inch objective with a power of seven hundred diameters, and found it *two-tenths of an inch increase*; so that optical penetration was attainable with this high power through plate-glass nearly one quarter of an inch thick, whilst *visual* focal depth was proportionably increased.

The aplanatic searcher increases the power of the microscope from two and a half to five times the usual power obtained with a third or C eyepiece of one inch focal length. The eighth thus acquires the power of a twenty-fifth, the penetration of a one-fourth. And at the same time the lowest possible eyepiece (3-inch focus) is substituted for the deep eyepiece formed of minute lenses, and guarded with a minutely perforated cap. The writer lately exhibited to Messrs. Powell and Lealand a brilliant definition, under a power of four thousand diameters, with their new "eighth immersion" lens, by means of the searcher and low eyepiece.

The traverse of the aplanatic searcher introduces remarkable chromatic corrections displayed in the unexpected colouring developed in microscopic test-objects*.

The singular properties or, rather, phenomena shown by eidola, enable the practised observer in many cases to distinguish between true and delusive appearances, especially when aided by the aberrameter applied to the objective to display excentrical aberration by cutting off excentrical rays.

Eidola are symmetrically placed on each side of the best focal point, as ascertained by the aberrameter when the compensations have attained a delicate balance of opposite corrections.

If the beading, for instance, of a test-object exists in two contiguous parallel planes, the eidola of one set is commingled with the true image of the other. But the upper or lower set may be separately displayed, either by depressing the false eidola of the lower stratum, or elevating the eidola of the upper; for when the eidola of two contiguous strata are intermingled, correct definition is impossible so long as the aperture of the objective remains considerable.

One other result accrues: when an objective, otherwise excellent, cannot

* Alluded to by Mr. Reade, F.R.S., in the 'Popular Science Review' for April 1870.

be further corrected, the component glasses being already closely screwed up together, a further correction can be applied by means of the adjustments of the aplanatic searcher itself, all of which are essentially conjugate with the actions of the objective and the variable positions of its component lenses; so that if δx be the traversing movements of the objective lenses, δv that of the searcher, F the focal distance of the image from the objective when δx vanishes, f the focal distance of the virtual image formed by the facet lenses of the objective,

$$\frac{\delta v}{\delta x}=-\left(\frac{F}{f}\right)^2.$$

The *appendix* refers to plates illustrating the mechanical arrangements for the discrimination of eidola and true images, and for traversing the lenses of the aplanatic searcher.

The plates also show the course of the optical pencils, spurious disks of residuary aberration and imperfect definition, as well as some examples of "high-power resolution" of the Podura and Lepisma beading, as well as the amount of amplification obtained by Camera-Lucida outline drawings of a given scale.

III. "On a Cause of Error in Electroscopic Experiments." By Sir Charles Wheatstone, F.R.S. Received April 26, 1870.

To arrive at accurate conclusions from the indications of an electroscope or electrometer, it is necessary to be aware of all the sources of error which may occasion these indications to be misinterpreted.

In the course of some experiments on electrical conduction and induction which I have recently resumed, I was frequently delayed by what at first appeared to be very puzzling results. Occasionally I found that I could not discharge the electrometer with my finger, or only to a certain degree, and that it was necessary, before commencing another experiment, to place myself in communication with a gas-pipe which entered the room. How I became charged I could not at that time explain; the following chain of observations and experiments, however, soon led me to the true solution.

I was sitting at a table not far from the fireplace with the electrometer (one of Peltier's construction) before me, and was engaged in experimenting with disks of various substances. To ensure that the one I had in hand, which was of tortoiseshell, should be perfectly dry, I rose and held it for a minute before the fire; returning and placing it on the plate of the electrometer, I was surprised to find that it had apparently acquired a strong charge, deflecting the index of the electrometer beyond 90°. I found that the same thing took place with every disk I thus presented to the fire, whether of metal or any other substance. My first impression was that the disk had been rendered electrical by heat, though it would have been extraordinary that, if so, such a result had not been observed before; but