LETTERS TO THE EDITOR.

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Observations of the Total Solar Eclipse in Tripoli, Barbary.

OUR eclipse took place in the midst of the fierce heat of the *Gibleh,* or Sahara sirocco; but an hour or two before totality the wind very fortunately changed, and brought skies of the highest possible optical transparency. There was no wind, and the conditions, except for the intense heat, which we momentarily feared would snap our great cameras, were the most nearly perfect imaginable at a sea-level station.

Unfortunately, on account of leaving home at very short notice, we brought no spectroscopic outfit, and our efforts were directed solely toward coronal photography with automatic and semi-automatic coronagraphs, and to exposure of plates for the slightly suspected intra-Mercurial planet. Other branches of our work related to coronal sketches, both with and without occulting discs, and to shadow band observations, both optically and photographically.

By the kindness of His Majesty's Government, represented by Mr. Alfred Dickson, Vice-Consul, the American expedition from Amherst College was permitted to establish its instruments on the terrace of the consulate, in the midst of the white city—in precisely the same spot occupied for the similar eclipse of 1900.

Many citizens of Tripoli took immediate and constant interest in our operations, and contributed very greatly to our success by their liberality in granting that service which only the chief of an expedition remote from home can fully appreciate. I am glad to mention especially Mr. W. F. Riley, Mr. W. H. Venables, Maris de Nunes Vais, the excellent photographer of the expedition, and Etim Bey, a Turkish gentleman resident in Tripoli, whose unique collection of photographic and mechanical appliances was frequently and helpfully drawn upon.

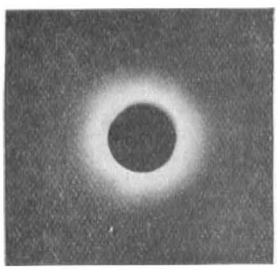

FIG. 1.—Total Solar Eclipse of August 30. Photographed at Tripoli.

The observations of shadow bands were conducted by parties organised by Mrs. Todd and Miss Todd, and will be reported to my friend Mr. Lawrence Rotch, of Blue Hill, at whose request they were made. These bands were seen as early as ten minutes before totality, and had many remarkable and pronounced peculiarities. They were wavering and narrow, moving swifter than one could walk, at right angles to the wind, their length with it, and waxing and waning five times during the eight minutes preceding totality.

The coronal sketches revealed nothing out of the ordinary. Extended rays beyond the occulting discs were looked for eagerly, but the disc (8 inches diameter at 35 feet distance) covered everything. The sky and general illumination were exceptionally bright. Totality as predicted was 3m. 9s. in duration; as observed 3m. 6s.

Our chief and largest instrument was a photographically corrected lens by Clacey, of 12 inches full aperture. To this was attached an orthochromatic screen for photographing Baily's beads, and a Burckhalter occulter as described by the writer four years ago in the *Monthly Notices.* Of the results obtained with this instrument I shall write elsewhere; about twenty exposures were made with it, and the beads are excellently shown in the accompanying photograph. The occulter was only in part successful.

Alongside it were the large Clark cameras, containing a pair of 3-inch lenses of 11 feet 4 inches focus, which took plates on which are a great number of stars, not yet fully examined. Owing to the unexpected brilliancy of the sky, the plates were exposed longer than would seem to have been wise. Everything to the eighth magnitude seems to have been caught, however.

A third instrument was a $3\frac{1}{2}$-inch Goerz doublet of about 18 inches focus, from which I removed the back lens, increasing the focal length to $33\frac{1}{2}$ inches. This was attached to one of the automatic movements used in my previous expeditions of 1896, 1900, and 1901. It was geared up to a rate of 265 photographs during the 189 seconds of totality, the exposure being about $\frac{1}{4}$ second for each. Most of these pictures are very good, and I enclose a print from one of them (Fig. 1), which does not, however, do the original negative justice. The corona was much less impressive, it strikes me, than other coronas I have seen—1878 and 1900 in clear skies, and 1887, 1889 (*b*), 1896, and 1901 in clouds; in fact, the shadow bands and Baily's beads seem to have been rather more interesting to the general observer than the corona itself.

DAVID TODD.

British Consulate, Tripoli, Barbary, August 31.

On the Class of Cubic Surfaces.

IN Salmon's "Geometry of Three Dimensions," the classes of the twenty-three different species of cubic surfaces are stated; but the process by which these results are obtained is not obvious. I therefore propose to indicate an easy method.

The class of a plane curve is equal to the number of tangents which can be drawn from a point not on the curve; hence the class of a curve is equal to the degree of its reciprocal polar. And since the line joining two points on a surface corresponds to the line of intersection of two tangent planes to the reciprocal surface, it is necessary, in order to make the theories of curves and surfaces correspond, to define the class m of a surface to be equal to the number of tangent planes which can be drawn through a given straight line. Let $(\alpha, \beta, \gamma, \delta)$ be quadriplanar coordinates referred to a tetrahedron of reference ABCD; then the equation of the tangent plane at any point (f, g, h, k) is

$$\alpha\frac{dF}{df} + \beta\frac{dF}{dg} + \gamma\frac{dF}{dh} + \delta\frac{dF}{dk} = 0 \qquad (1)$$

and if this plane passes through the line CD, we must have $dF/dh=0$, $dF/dk=0$. Hence the points of contact of the tangent planes which pass through CD are the points of intersection of the three surfaces

$$F=0, \; dF/d\gamma=0, \; dF/d\delta=0 \qquad (2)$$

and their number is equal to $n(n-1)^2$, which is the value of m for an anautotomic surface. The elimination of (α, β) between (2) will furnish a binary quantic in (γ, δ) the degree of which is equal to the class of the surface.

It is obvious from geometrical considerations that a conic node must diminish the class by 2. The equation of a cubic having a binode B_3 is $\alpha\gamma\delta + u_3 = 0$, where u_3 is a ternary cubic in (β, γ, δ). Differentiating with respect to γ and δ, and then putting $\delta = \lambda\gamma$, we obtain

$$\left.\begin{aligned} \lambda\alpha\gamma^2 + u'_3 &= 0 \\ \lambda\alpha\gamma + du'_3/d\gamma &= 0 \\ \alpha\gamma + du'_3/d\delta &= 0 \end{aligned}\right\} \qquad (3)$$

where the accents denote what the quantities become when δ is put equal to $\lambda\gamma$ after differentiation. Equations (3) are those of the sections of the cubic and the polar quadrics of C and D by *any* plane through AB; and since they intersect in three coincident points at A, $m = 12 - 3 = 9$.

The equation of a cubic having a binode B_4 at A is

$$\alpha\gamma\delta + \beta^2 v_1 + \beta v_2 + v_3 = 0 \qquad (4)$$

where v_n is a *binary* quantic in (γ, δ). Let $v'_n = dv_n/d\gamma$, $v''_n = dv_n/d\delta$. Differentiating (4) with respect to γ and δ, and eliminating α, we obtain

$$\left.\begin{aligned} \beta^2(v_1 - \gamma v'_1) + \beta(v_2 - \gamma v'_2) + v_3 - \gamma v'_3 &= 0 \\ \beta^2(v_1 - \delta v''_1) + \beta(v_2 - \delta v''_2) + v_3 - \delta v''_3 &= 0 \end{aligned}\right\} \qquad (5)$$

The eliminant of (5) is a binary octavic in (γ, δ); whence B_4 reduces the class by 4.

The classes of all the remaining species may be found by means of the eliminant of (5), or directly from their equations.

A. B. BASSET.

September 6.

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