

ellipsoid on a plane, and, lastly, of an ellipsoid of revolution on the surface of a sphere.

The object of Professor Littrow is to deduce the general properties of the three principal projections, which, though they differ from each other in no other respect than in the situation of the eye and perspective plane, with regard to the principal circles of the sphere, have hitherto been always treated as distinct and independent problems. The manner in which he accomplishes this may be easily described.

He supposes the eye to be situated at any distance above the sphere, and the plane of projection to be inclined at any angle to the straight line drawn from the eye to the centre. Having assumed x and y as the rectangular co-ordinates of any point on the map, he chooses for the axis of x the intersection of the plane passing through the eye, the centre of the sphere, and the pole with the plane of projection, and finds expressions for x and y in terms of the latitude and longitude of the corresponding point on the sphere. Two equations are thus obtained. Eliminating from these two equations the latitude, the resulting equation is that of the projection of the meridian passing through the projected point; and, by eliminating the longitude, he gets the equation of the parallel circles. He then applies this general solution to each of the three projections successively, finds in each case the equations of the projections of the meridians and parallels, and shews the cases in which they are circles, or straight lines, or any of the three conic sections. He then considers the projection of the spheroid of revolution, and gives the formulæ which express the latitude of any point on the sphere in terms of the latitude of the corresponding point on the spheroid.

The concluding part of the memoir contains some general remarks on the solutions of Gauss and Lagrange; and a demonstration that Gauss's formulæ are comprehended in those of Lagrange, the latter being only particular values of the former. The analysis is extremely neat, symmetrical, and perspicuous; and the subject, as before remarked, one of much interest.

IV. On the construction of the Hour-lines of Sun Dials. By Professor Littrow.

The remarks which Professor Littrow makes on this subject, and his method of treating it, are precisely analogous to those employed in the preceding paper. Indeed, the two subjects are closely related, as the whole theory of Dialling may be deduced from the properties of the central projection of the sphere. He begins by remarking that, though the subject has been very frequently treated of by others, the problem has not hitherto been resolved with all that generality of which it is susceptible, and which it deserves in so eminent a degree; that what regards the length of the shadows has never been satisfactorily handled; and that with regard to dials on curve surfaces, nothing complete, in point of theory, has

been done to the present time. His object, in the present paper, is to supply the deficiency.

Suppose twelve planes all to intersect in the same straight line, and to make equal angles with each other, and that one of these planes coincides with the meridian of any plane, and the line in which they intersect is parallel to the earth's axis of rotation. Then, if we also suppose the sun's diurnal motion to be uniform during a day, each of the twelve planes will successively coincide with the plane of a horary circle, and the shadow of the line of intersection will fall on the line formed by the intersection of that plane with the surface of the dial. The first question, therefore, resolves itself into this:—Trace the lines in which a given surface is intersected by planes given in position.

The second question is, that of finding the length of the shadow. It is assumed that the sun's declination does not vary sensibly during a day. The shadow of a fixed point in space, therefore, generates the surface of a cone, of which the fixed point is the vertex, and the sun's diurnal circle the base; and the path of the shadow is the intersection of the opposite cone with the surface on which the dial is traced. If, then, the dial is on a plane, the path is one of the conic sections. In any case, the question is to determine the intersection of a cone with a given surface.

M. Littrow gives the general equations of the hour-lines, and of the path of the shadow, first, when the dial is on a plane and having any inclination with respect to the equation and horizon; and then, by assigning particular values to the arbitrary quantities, he deduces the ordinary expressions for horizontal, vertical, equatorial, &c. dials. He then considers the case when the dial is in a curve surface, and points out a method of combining the equation of the hour planes and that of the given surface, so as to eliminate one of the variables, and obtain the equations of the intersections; and applies his method to the particular cases in which the dial is described on a cylinder, and on a cone with a circular base.

V. On the formulæ for the computation of precession. By M. Mattheus Valente do Conto, Director of the Observatory at Lisbon.

The object of this memoir is to correct an error into which Delambre had fallen respecting the value to be assigned to the variation of the obliquity of the ecliptic in the formulæ for the annual precession of a star in right ascension and declination.

In Vol. III. of his *Astronomy* (1814), Chapter 32, No. 19, Delambre, after having given the rigorous formulæ for the precession of a star in right ascension and declination (in which $d\omega$ does not appear), obtains the formulæ given by La Place (*Méc. Céleste* Vol. II. p. 350) without demonstration, viz.

$$\begin{aligned} dR &= dL \cos \omega - 0''.20168 + dL \sin \omega \sin R \tan D - d\omega \cos R \tan D \\ dD &= dL \sin \omega \cos R + d\omega \sin R \end{aligned}$$