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An Improved Mirror for Photography of the Whole Sky

REV. CHARLES E. DEPPERMANN, S.J.

*Director, Manila Observatory**

DR. GEORGII, of Hamburg Observatory, photographed the clouds of the whole sky by means of a contax camera fixed about a meter vertically above a large silvered globe [1]. In 1940 Dr. Georgii kindly placed one of his silvered globes at the disposal of the writer for experimental purposes. Although we found this method of photographing the whole sky to be quite simple, still it has, with practically all other methods of photographing the whole sky, a distinct disadvantage [2]: the picture near the horizon is squeezed together, and this makes it difficult to interpret properly the clouds near the horizon, which are especially important in the tropics.

The writer, therefore, has endeavored to calculate the curvature of a mirror which would reflect the whole sky into the camera as uniformly as possible. It would seem that it is probably impossible to devise a mirror of this type which can reflect the sky uniformly as if from a perfectly flat virtual image, thus bringing all the rays to perfect focus; but the writer considers that the proposed mirror is sufficiently satisfactory as to focal properties for all practical purposes. As a matter of fact, in building up the mirror curve, only the central rays, i.e., those going through the optical center of the camera lens, were used. However, the curve thus calculated is not far from that of a circle, and hence there is every reason to believe that, if the spherical mirror gives a sufficiently sharp image, our proposed mirror should also do so.

Photography of the whole sky in one picture has quite a few obvious advantages. In meteorology, the "state of the sky" is quite important, and it is often difficult to describe this properly by means of a series of pictures each containing at most one-quarter of the full view. Airports might also find it of importance to have as a record hourly pictures of the whole sky. It should be noticed that a watch and a date indicator can be placed next to the mirror and photographed at the same time as the sky. Furthermore such a mirror may have application in the photography of meteors.

* c/o 2913 Herran St., Manila, P. I.

To obtain the equation of the curvature of the mirror, the writer proceeded as follows: In the accompanying FIGURE 1, O is the lens center, P the center of the film negative, B its outer small edge. For the contax 35 mm camera, PB = b = 1 cm, whereas the focal distance OP = a = 5 cm. PO is continued to T, such that OT is 1 meter. QT is perpendicular to OT, and Q is on the continuation of straight line OB. Hence QT = 20 cm, because of similar triangles OPB and OQT. QN is the trace of the proposed mirror surface made by plane OQT, and the tangent to this curve at Q is such that light from the horizon (parallel to QT) is reflected at Q along the line QOB. Let AM be the tangent at A, AC perpendicular thereto. Light ray DA from practically infinity is reflected at A, making angle DAC = CAOW.

Our problem is to find the equation of the curve, such that, as W moves *uniformly* from B to P, ray AD rotates *uniformly* from horizon to zenith; i.e., all 10 degree zones of the sky,

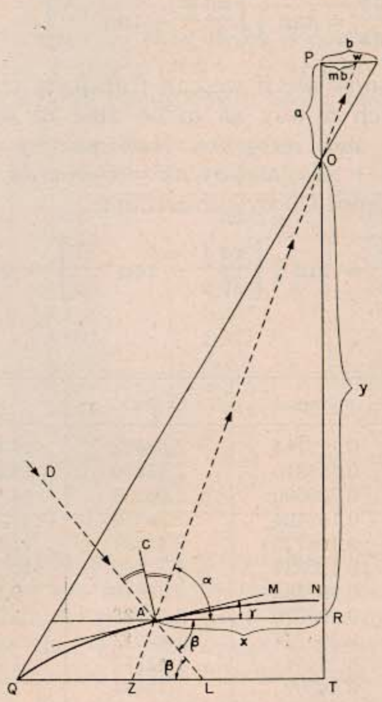

FIG. 1.