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ON THE GEODETIC APPLICATION OF A SOLAR ECLIPSE

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Although the application of solar eclipse observations to geodetic measurements has been discussed at length in several publications, there are many phases of the problem which are not readily available in the literature. We shall present here a discussion of some of these phases.

1. GENERAL CONSIDERATIONS

The instant at which a solar eclipse occurs at a given point depends upon the absolute position of the observer in space and upon the absolute positions of the sun and the moon. These absolute positions are not accurately known. Hence there will be errors in predicting the times of contacts because of these uncertainties. When an eclipse occurs in a remote area where accurate geodetic data are not available, the largest of all these errors are those of the observer's latitude and longitude. Next in importance are the errors in the distances of the observer from the centers of the earth and the moon. As far as the angular positions of the sun and the moon are concerned, the Besselian elements computed by S. GOSSNER at the U.S. Naval Observatory especially for the reduction work on the 30 June 1954 eclipse are the most accurate available. They are computed by more rigorous formulae than usual, based on revised tables for the moon, and have been corrected for irregularities in the rotation of the earth. Any errors in time which remain in the present ephemerides of the sun and the moon should be small enough to make a negligible contribution in the calculation of distances between observation sites along the path of an eclipse.

Without the observation of first or fourth contact times, a solar eclipse yields at most two observed quantities: t_0 the time of mid-totality, and $(t_{III}-t_{II})$, the duration of totality. Without this information the problem of computing the distance between observation sites becomes indeterminate. Even if we assume that the positions of the sun and the moon are precisely known, we do not have enough information to determine the absolute position of the observer. Uncertainties in the parallax of the moon and the radius of the earth still remain. But values for these are known well