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STEREOGRAPHIC MEASUREMENT.

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The problem of deducing measurements from a photograph is the inverse of that of producing a perspective drawing from the known dimensions of an object, for the image produced by the lens on a photographic plate is a true perspective if the lens be free from spherical aberration and astigmatism.

If the plate be assumed vertical then the nodal point of the lens is the point of view, the plate is the picture plane, and the focal length of the lens is the distance line. The optic axis of the lens intersects the plate in the principal point and a horizontal line drawn through this point is the horizon of the perspective. Having given the horizon line of a photograph the principal point and the distance line, that is the focal length of the lens, the problem of estimating the object in all its parts is, however, indeterminate, for we have two unknown quantities, viz., the distance of the object and its dimensions, which are dependent on each other. But if we are provided with two perspectives of the same object from suitable stations, the problem may be solved by plane table methods.

The use of photographs in surveying dates back as far as 1858 or 59, about which time Colonel Laussedat executed numerous experimental surveys with the camera, the results of which were communicated to the Academy of Sciences and received the endorsation of that body. Subsequently the method was taken up by Meydenbaur in Germany, and was used to some extent in military work during the Franco-German war, later it was exploited by Finsterwalder, Koppe, and others. It was also used in Austria, Sweden, Switzerland and Italy during the seventies and eighties. Perhaps the most extensive work by the photographic method was in the Rocky Mountain survey and the Alaska boundary delimitation (Canadian section) under Deville, Surveyor-General of Dominion Lands; this work was begun in 1888 and continued up to about 1897, and was most successful.

In all this work extending over a period of 30 or 40 years the methods employed for reduction of the photographs, though differing much in detail, were all what may be fitly termed **monocular**; that is to say, a single photograph was in itself a unit and the determination of any magnitude was arrived at by the comparison of two or more units. The various methods are all somewhat intricate and laborious, and, moreover, the identification of terrestrial details as viewed from two or more stations at different angles is often very difficult. Again, the method is not self-contained, for the camera stations and other central points must be determined by triangulation or other extraneous method.

This plan of taking a single photograph as a unit is analagous to that of a man who views an object with one eye closed and then moves to a new view point and makes a similar observation, instead of using both eyes from one station. It seems all the more remarkable that the binocular method was not introduced when the plastic properties of a stereograph were so well known, for the invention of the stereoscope dates back to 1838.

The first suggestion of utilizing stereoscopic photographs for measurement of distance by means of a comparator seems to have been made by Dr. Pulfrich, of the scientific staff of the Zeiss works, in 1901. (See "Naturwissenschaftliche Rundschau," 16, p. 589. From that time on numerous articles have appeared in scientific periodicals dealing with the problem and meantime the firm of Carl Zeiss has steadily improved the original apparatus until a permanent form of both camera and comparator have now been reached, both of which are of great perfection.

In this paper I purpose to deal with the question of measurement only, assuming that means have been used to secure accuracy in the setting of the camera.

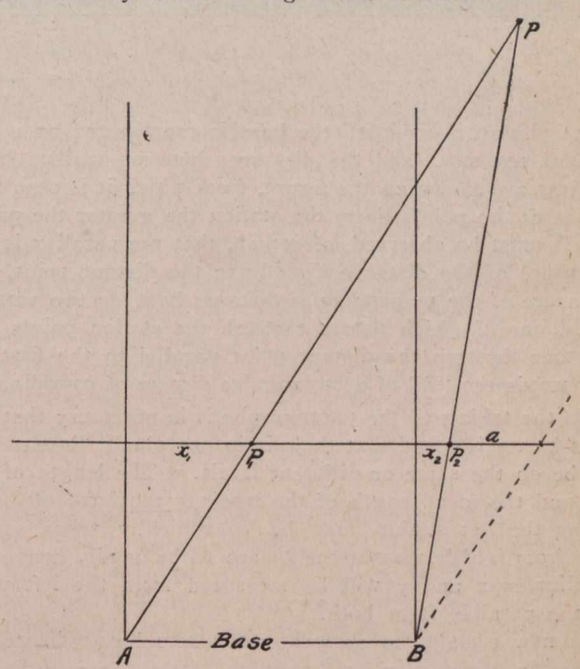

Fig. 1.

Consider a single photograph and let lines be drawn on it representing the horizon and principal line of the picture. This will divide the photograph into quadrants and the co-ordinates x and y of any point therein may be measured by means of a comparator. The actual values of these quantities cannot, however, be determined until their distances from the station are measured and this distance may be obtained from a stereoscopic pair.

The method of measuring the depth of field to any point from a stereograph requires a linear measurement of the parallax of that point. The relation between parallax and depth of field may be illustrated by the accompanying diagram, Fig. 1.