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Review

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Source: *The Mathematical Gazette*, Vol. 9, No. 138 (Jan., 1919), p. 308

Published by: The Mathematical Association

Stable URL: <http://www.jstor.org/stable/3603344>

Accessed: 11-06-2016 07:27 UTC

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REVIEW.

Principes de Géométrie Analytique. Par GASTON DARBOUX. Pp. 519. 20 frs. 1917. (Gauthier-Villars.)

This volume gives to a wider public the content of lectures delivered in Paris at various times since 1872. It assumes a fairly complete acquaintance with the elements of geometry, but no very advanced knowledge.

Its chief aim is to give an exact idea of imaginary and infinite elements in geometry. The solid foundation of the whole theory is analytical, based on Cartesian coordinates. Throughout the book each group of ideas is linked with a special set of coordinates, some of unusual type, whose use makes the development of the theory natural if not inevitable. If an algebraic equation is made homogeneous, there is no longer any need to consider specially the reduction in degree when the leading coefficient vanishes; so the use of homogeneous coordinates almost forces us to regard points at infinity as on an equal footing with finite points. A full discussion follows of tetrahedral coordinates, which leads on to cross ratio, homography, homology, and the principle of duality; a chapter on anharmonic properties of a conic concludes Livre I.

In Livre II. the definition of angle and distance plunges us into the theory of isotropic lines, with a system of complex coordinates in two and three dimensions. The imaginary generators of a sphere are used to produce the usual formulæ of spherical trigonometry. Livre III. deals with Poncelet's Theorems, with which is associated a system of coordinates based on a parametric form of the tangents to a conic. In Livre IV. Euclidean space is left behind for what Darboux calls Cayleyan geometry, in which the absolute is an arbitrary quadric, and distance is defined as the logarithm of a cross ratio; there follows the appropriate trigonometry and theory of displacements. Livre V. treats of inversion; the coordinates are pentaspherical, and the application is to cyclides, to which the last five chapters are devoted.

Geometry is treated as a whole, and not divided into watertight compartments; pure and analytical methods, in the plane and in space, are used in turn or at once, as occasion offers. Though the justification of imaginary elements is insisted upon, due account is always taken of the reality of the figures under consideration.

Much of the charm of the book arises from the connections which are shown to exist between ideas, familiar and unfamiliar, which at first sight seem to lie far apart. For example, imaginary straight lines of zero length are applied to show that the angle at the centre of a circle is twice the angle at the circumference. The style, both of wording and arrangement, is all one expects of the illustrious author, and the book is a joy and a refreshment as well as an education.

H. P. H.

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A.I.G.T. Reports, Nos. 10, 12.