

Brocard, Pierre René Jean-Baptiste Henri | Encyclopedia.com

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(*b.* Vignot, France, 12 May 1845; *d.* Bar-le-Duc, France, 16 January 1922)

mathematics, meteorology.

Henri Brocard, born in a small, unpretentious town in northeastern France, was the son of Jean Sebastien and Elizabeth Auguste Liouville Brocard. No record has been found of brothers, sisters, or other close relatives, and Brocard never married. He is now known chiefly for his work in the geometry of the triangle, but he is also remembered as a French army officer and a meteorologist.

For some time, knowledge of Brocard's life fell far short of knowledge about the Brocard configuration, on which his renown rests. This was remedied by an autobiographical account published in 1894 at Barle-Duc. It covers the first fifty years of Brocard's life and tells of his mathematical and scientific publications and activities. He sent a copy of this pamphlet to the [Smithsonian Institution](#) shortly after its publication.

Brocard received his early education at the *lycée* of Marseilles, and the *lycée* and academy of Strasbourg. He attended the École Polytechnique from 1865 to 1867, and then joined the Corps of Engineers of the French army. It is known that he was a prisoner of war at Sedan in 1870, but for the most part his army career was devoted to teaching and research rather than to active combat. He became a life member of the newly organized Société Mathématique de France in 1873, and in 1875 he was made a life member of the Association Française pour l'Avancement des Sciences and of the Société Météorologique de France. For several years after 1874 he was assigned to service in north Africa, chiefly in Algiers and Oran. He was a co-founder of the Meteorological Institute at Algiers.

As a member of the local committee for the tenth session of the Association Française pour l'Avancement des Sciences, which met in Algiers in 1881, he presented a paper entitled "Étude d'un nouveau cercle du plan du triangle." It was in this paper that he announced the discovery of the circle that is now known by his name. In 1884 he returned to Montpellier, where he had taught for a short time after his graduation from the École Polytechnique.

There followed appointments to many government commissions and many scientific honors. Brocard served with the Meteorological Commission at Montpellier, Grenoble, and Bar-le-Duc. In 1894 he became a member of the Society of Letters, Sciences, and Arts of Bar-le-Duc; and it is through the publications of this society that one can follow the activities of the last twenty-six years of his life. His scientific and mathematical publications began when he was about twenty-three, and over the years showed him to be an indefatigable correspondent with the editors of mathematical and scientific journals. Brocard contributed to *Nouvelles annales de mathématiques*, *Bulletin de la Société mathématique de France*, *Mathesis*, *Zeitschrift für mathematischen und naturwissenschaftlichen Unterricht*, *Educational Times*, *El progreso matemático*, *L'intermédiaire des mathématiciens*, and many others. In his autobiography, a brief descriptive paragraph of about three or four lines is devoted to each journal, giving the names of the editors, the dates of publication, etc. These paragraphs provide a succinct and handy source of information, particularly for journals that later ceased publication.

Brocard's most extensive publication was a large, two-part work entitled *Notes de bibliographie des courbes géométriques*, followed by *Courbes géométriques remarquables*, which appeared under the joint authorship of Brocard and T. Lemoyne. The first part of the earlier work appeared in 1897, and the second in 1899. Probably no more than about fifty copies of this work were prepared, lithographed in the printscript of the author, and privately distributed. The *Notes* may be regarded as a source book of geometric curves, with a painstakingly prepared index containing more than a thousand named curves. The text consists of brief descriptive paragraphs, with diagrams and equations of these curves. About twenty years later, Volume I of the projected three-volume work *Courbes géométriques remarquables* was published in Paris. In 1967 both Volume II and a new edition of Volume I were published in Paris. *Courbes géométriques remarquables* is described as an outgrowth of *Notes de bibliographie des courbes géométriques*.

During the latter part of his life, Brocard made his home in Bar-le-Duc. He lived completely alone and rarely had visitors. He obviously enjoyed his membership in, and his work as librarian of, the Society of Letters, Sciences, and Arts of Bar-le-Duc, although he had declined the honor of becoming president. Largely through his efforts, one of the streets of Bar-le-Duc was named for Louis Joblot, a native Barisian who was an acknowledged but almost forgotten pioneer in the field of microscopy.

When he retired from the army in 1910, Brocard was a lieutenant colonel and an officer in the Legion of Honor. In his retirement he spent much of his time making astronomical observations with a small telescope in the garden behind his house. Every fourth year he took a long trip to the meetings of the International Congress of Mathematicians.

The unit of mathematical theory identified as the Brocard configuration is founded upon two points, O and O' , in a triangle ABC such that the angles OAB , OBC , and OCA , and the angles $O'BA$, $O'CB$, and $O'AC$ are equal. Brocard readily admitted that he had no claim to priority in the discovery of the existence of these points. Yet his influence upon his contemporaries was so great that the points O and O' are now universally recognized as the Brocard points of a triangle.

Of the several solutions available for the construction of the Brocard points of a triangle, the most striking and familiar is one in which circles are drawn as follows: A circle tangent to side AB of triangle ABC at A and passing through C ; a second circle tangent to BC at B and passing through A ; and a third circle tangent to CA at C and passing through B . It is easily proved that these three circles are concurrent at a point O which satisfies the above conditions (see Figure 1). Point O' is obtained in a similar manner, after a slight modification in procedure. The angle OAB (angle W) is called the Brocard angle of triangle ABC , and it is a simple matter to prove that

$$\cot W = \cot A + \cot B + \cot C.$$

Obviously a similar relation holds for angle $O'BA$ (angle W'). Brocard's truly original contribution to the theory of the geometry of the triangle was his discovery of the circle drawn on the line segment PK as diameter, where P is the circumcenter of the triangle and K is its symmedian point. This circle, called the Brocard circle of a triangle, passes through the points O and O' and has many additional interesting geometric properties.

During the last decade of the nineteenth century several books were published about the Brocard configuration. The subject, which stirred the imagination and aroused the enthusiasm of many mathematicians in different parts of the world, has remained a pleasant and fruitful topic for discussion.

On 16 January 1922, Brocard was found dead at his desk. In accordance with his specific request, he was buried in the small cemetery at Vignot, next to his father and mother.

BIBLIOGRAPHY

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Laura Guggenbuhl