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(*b*. Nancy, France, 19 June 1771; *d*. Montpellier, France, 4 May 1859)

geometry

Gergonne's father, a painter and architect, died when Joseph was twelve years old. Joseph studied at the religious *collège* of Nancy, did some private tutoring, and in 1791 became a captain in the National Guard. In 1792 he joined the volunteers to fight the Prussians. He saw action at Valmy, and later that year went to Paris as secretary to his uncle. After a year he was in the army again, this time as secretary to the general staff of the Moselle army. In 1794, after a month at the Cahâlons artillery school, Gergonne received a commission as lieutenant. Sent to the army in the east Pyrences, he participated in the siege of Figueras in Catalonia. After the Treaty of Basel in 1795, Gergonne was sent with his regiment to Nîmes, where he obtained the chair of transcendental mathematics at the newly organized École Centrale. He then married, settled down, and began his mathematical career under the influence of Gaspard Monge, the guiding spirit of the École Polytechnique in Paris.

Not finding a regular outlet for mathematical papers in the existing journals, such as the *Mémories* of the Academy of Sciences or the *Journal de l'École polytechnique*, Gergonne began to publish (1810) the *Annales de matjhématiques pures et appliquées*, the first purely mathematical journal. It appeared regularly every month until 1832 and was known as the *Annales de Gergonne*. His colleague J.E. Thomas-Lavernède was coeditor of the journal after he had accepted, in 1816, the chair of astronomy at the University of Montpellier. In 1830 he became rector at Montpellier and discontinued publishing his *Annales* after twenty-one volumes and a section of the twenty-second had appeared. In these volumes alone he had published more than 200 papers and questions, dealing mainly with geometry but also with analysis, statics, astronomy, and optics.

By 1831 the *Annales* had ceased to be the only wholly mathematical journal. In 1825 there appeared at Brussels A. Quetelet's *Correspondance mathématique et physique (1825-1839)*, and in 1826 at Berlin A.L. Crelle's *Journal für die reine und angewandte Mathematik*. In 1836 J. Liouville continued Gergonne's work in France through his *Journal de mathématiques pures et appliqueés*. The latter tow journals are still being published.

Although Gergonne had given up his journal, he continued to teach after 1830. It is said that during the July Revolution of that year, when rebellious students began to whistle in his class, he regained their sympathy by beginning to lecture on the acoustics of the whistle. He retired in 1844, and during the last years of his life suffered from the infirmities of advanced age.

Gergonne's, *Annales* played an essential role in the creation of modern projective and algebraic geometry. It offered space for many contributors on these and other subjects. The journal contains papers by J.V. Poncelect. F. Servois, E. Bobillier, J. Steiner, J. Plücker, M. Chasles, C.J. Brianchon, C. Dupin, and G. Lamè in volume **19** (1828-1829) there is an artile by E. Galois. The geometry papers stressed polarity and duality, first mainly in connection with conics, then also with structures of higher order. Here the terms "pole," "polar," "reciprocal polars," "duality," and "class" (of a curve) were first introduced. After Poncelet, in his monumental *Traité des propriétés projectives des figures* (1822), had given the first presentation of this new geometry in book form, a priority struggle developed between Gergonne and Poncelet. The result was that Poncelet switched to other journals, including Crelle's

The discovery of the principle of duality in geometry can be said to have started with C. J. Brianchon, a pupil of Monge, who in 1806 derived by polar reciprocity, from Pascal's theorem, the theorem now named for him. This method of derivation was used by several contributors to the *Annales*, together with the polarity method typical of spherical trigonometry. In the *Traité, Poncelet stressed polar reciprocity them. In three articles in the Annales (15-17 [1824-1827]), Gergonne generalized this method into the general Principle that every theorem in the plane, connecting Points and lines, corresponds to another theorem in which Points and lines, are interchanged, provided no metrical relations are involved (géométrie de la règle).*

In his "Considérations philosophiques sur les élémens de la science de l'étendue" (*Annales*, **16** [1825-1826], 209-232) Gergonne used the term "duality" for this principle and indicated the dual theorems by the now familiar device if double columns. He applied his principle first to polygons and Polyhedrons, then to curves and surfaces; it is here that he made the now accepted distinction between Curves of degree *m* and of class *m* (instead of "order" For both). These papers led to the controversy between him and poncelet, which was partly based on the way Gergonne edited the papers for the *Annales*. In the meantime, however, A. F. Moebius had introduced duality for the plane in full generality in *Der barycentrische Calcul* (Leipzig, 1827).

One subject of contention between Gergonne and Poncelet was that Poncelet was the foremost representative Of the synthetic (i.e., the purely geometric) method, while Gergonne believed in analytic methods. True, Gergonne said, the methods of analytic geometry were often clumsy, but this was only Due to lack of *adresse*. He illustrated this point in "Recherche du cercle quien touché trios autres sur un plan" (*Annales*, **7** [1816-1817], 289-303), in which he gave an elegant analytic solution of this, the "Apollonian," tangent problem. Then, in his third article on duality (*Annales*, **17** [1826-1837], 214-252), following ideas developed by Gabriel Lamé in a study published in 1818 (*Examen des differentes méthodes employées pour résoudre les problémes de la géométrie) of which Lamé already had had an abstract* published in the *Annals* (**7** [1816-1817], 229-240), Gergonne showed the power of what we now call the "abbreviated" notation, in which, for instance, the pencil of circles in the plane is represented by $C_1+\lambda c_2=0$. This method was fully developed by J. Plücker in his *Analytisch-geometrische Entwicklungen* (1828-1831).

In 1834 Plücker solved a problem which to both Gergonne and Poncelet had seemed something of a paradox. Poncelet (*Annales*, **8** [1817-1818], 215-217) had found that from a point outside a curve of degree *m* there can be drawn *m(m-1)* tangents to the curve. Gergonne missed this fact until (*Annales*, **18** [1827-1828], 151) he corrected himself on several points and introduced for the polar reciprocal of a curve of order *m* the term "curve of class, *m*, "which is therefore of order *m(m-1)*. But the reciprocal of this curve is the original one, and this seems therefore of order *m(m-1){m(m-1)-1}*, which is greater than *m* except when *m=2*. Poncelet had already stated that the answer was to be found in the fact that the polar curve was not fully general. Plücker gave the precise answer by means of his formulas on the number of singularities of palne curve (*Journal für die reine und angewandte Mathematik*, **12** [1834], 105 ff.).

Among the many other theorems discovered by Gerogenne is the following (*Annales*, **16** [1825-1826], 209-232); If two plane curves c_m of degree *m* intersect in such a way that *mp* points of intersection are on a c_p This leads to a simple proof of Pascal's theorem by considering the six sides of the hexagon inscribed in a conic alternately as two c_3

Gergonne liked to season his papers with "philpsophic" remarks. In one such remark he said, "It is not possible to feel satisfied at having said the last Word about some theory as long as it cannot be explained in a few words to any passerby encountered in the street" (M. Chasles, *Aperçu historique* … [Paris, 1889], p. 115.).

BIBLIOGRAPHY

I. Original Works. Almost all of Gergonne's papers are in the *Annales*, and a bibliography is in Lafon (see below). The more important ones are mentioned in the text. Those on differential geometry include "Demonstration des principaux théorèmes de M. Dupin sur la courbure des surfaces," in *Annales*, **4** (1813-1814), 368-378; and "Théorie élémentaire de la courbure des lignes et des surfaces courbes, "*ibid*., **9** (1818-1819), 127-196. On statics, see "Démonstrations des deux théorémes de géométrie," *ibid*., **11** (1820-1821), 326-336. He returned to one of his old loves in an address at Lille: "Notes sur le principe de dualité en géométrie," in *Mémoirés de L'Académie des sciences et letters de Montpellier pour 1847*, Section des Sciences.

II. Secondary Literature. A. Lafon, "Gergonne, ses travaux, "*in Mémoirés de L'Acdémie de stanislas*, **1** (1860), xxv-lxxiv, includes a bibliography of Gergonne's works For further information, see E. Küotter, "Die Entwicklung der synthetischen Geometrie von Monge bis auf Staudt (1847), in *Jahresbericht der Deutschen Mathematikervereinigung*, **5** no. 2 (1901), with details on the controversy between Poncelet and Gergonne (pp. 160-167). The documents in this case were reprinted by Poncelet in his *Tralitédes propriétés projectives des figures*, II (Paris, 1866), 351-396.

See also C. B. Boyer, *History of Analytic Geometry* (New York, 1956), ch, 9; and *A History of Mathematics* (New York, 1968), ch. 24; M. Chasles, *Aperçu historique sur L'origine et le dévelopment des méthodes en géométrie* (Paris, 1837; 3rd ed., 1889); and *Rapport sur le progrés de la géométrie* (Paris, 1870), pp. 54-60; and H.de vries, *Historische Studien*, II (Groningen, 1934), 114-142.

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