Antoine Augustin COURNOT
b. 28 August 1801 - d. 30 March 1877

Summary. Unacknowledged in his own times as founder of mathematical economics, Cournot was both mathematician and philosopher. He publicised the ideas of Bienaymé on the "variability of chances", and subjected the probability calculus to a perspicacious philosophical critique.

Cournot was born at Gray, in the Franche-Comté (France); his father was a merchant descended from a long line of farmers. Antoine successfully completed his secondary studies at the Jesuit College of Gray between 1809 and 1816 with ease, thanks (as he said) to his wide reading. Among the books which he read were the *Entretiens sur la pluralité des mondes* of Fontenelle, and his *Éloges des Académiciens*, Laplace's (q.v.) *Exposition du système du monde*, the *Logique* (partly inspired by Pascal, (q.v.) of Port-Royal, the centre of the Jansenist movement in France; and the Leibniz-Clarke correspondence). In his *Souvenirs* Cournot (1913, p. 35) noted that these were the books "which had a decisive influence on all [his] subsequent ideas and studies". After four rather idle years during which he studied law out of interest, he was admitted to the Royal College of Besançon, in the special mathematics class, and later entered the École Normale in 1821 for a year, until the government closed it down on 6 September 1822. He then worked towards a licenciate degree in Science at the Sorbonne, attending the lectures of Lacroix and Hachette, and becoming friendly with Dirichlet. Thanks to Hachette, he had the opportunity of meeting Ampère and Laplace. He attended the Academy of Sciences, where he heard Poisson (q.v.), Biot, Arago, Gay-Lussac, Poinsot, Legendre (q.v.), Fourier and Cauchy deliver their papers. He was awarded his licentiate degrees in Science in 1823, and Law in 1827.

Unemployed after the closure of the École Normale, he became the tutor to Marshal Gouvion-Saint-Cyr's son, and contributed to the writing of the Marshal's memoirs, published in 1831. A contributor to Férussac's *Bulletin des sciences mathématiques*, he published numerous short notes in it from 1821 to 1831, as well as several articles from 1826 to 1831. In February 1829, he defended his doctoral thesis *Mémoire sur le mouvement d'un corps rigide soutenu par un plan fixe*, as well as a complementary thesis *De la figure des corps célestes*.

In 1834, Cournot translated and edited Sir John Herschel's *Treatise on*

Astronomy to which he made an *Addition* (Addendum), namely "Sur la distribution des orbites cométaires" which was his first important contribution to the calculus of probabilities and statistics. He also translated Kater and Lardner's *Elements of Mechanics*, appending a chapter on the measurement of forces in the work of machines. On Poisson's (q.v.) recommendation, he was appointed Professor of Analysis and Mechanics in the Faculty of Sciences at Lyons. He served there for only one year, then being appointed Rector of the Grenoble Academy, with a Chair in the Faculty of Sciences, which he occupied until 1838.

It was in 1838 that he published his *Recherches sur les principes mathématiques de la théorie des richesses*(*Œuvres Complètes*, Volume VIII). In this work, he applied the theory of undetermined functions to economics. He thus made a fundamental contribution to mathematical economics, and introduced a concept of equilibrium, later rediscovered by the mathematician J.F. Nash, who was unaware of Cournot's earlier work, in the context of game theory. Nash was awarded a Nobel Prize in Economics. Although this work of Cournot marks a fundamental advance in the history of political economy and mathematical game theory, it had no success during Cournot's lifetime, in contrast to his work on Herschel's *Treatise on Astonomy* (*Souvenirs*, p. 156). Cournot's work in economics was continued in his *Principes de la théorie des richesses* (*Œuvres Complètes*, Volume IX), published in 1863, and his *Revue sommaire des doctrines économiques* (*Œuvres Complètes*, Volume X), of 1877.

Also in 1838, Cournot published his second study in probability and statistics, entitled "Mémoire sur les applications du calcul des chances à la statistique judiciare" in Liouville's *Journal de Mathématiques pures et appliquées*.

Appointed Inspector of Education, 1836 to 1838, he was named Inspector General in 1838, a post which he held until 1854, when he became Rector of the Dijon Academy until his retirement in 1862. Meanwhile, he presided over the jury for the Agrégation (higher doctorate) in mathematics from 1839 to 1843, succeeding Poisson in this position. He retired to Paris, where he died some 15 years later.

Leaving aside the works in economics previously mentioned, as well as his pedagogical efforts, developed in his *Des Institutions d'instruction publique en France*, (*Œuvres Complètes*, Volume VII), of 1864, Cournot's opus appears to have evolved, in broad terms, in two distinct periods. Effectively, his *De l'origine et des limites de la correspondance entre l'algebre et la géométrie*

(Œuvres Complètes, Volume VI-2), of 1847, which contains the first proof of the Criticality Theorem of his friend Bienaymé (q.v.) in the theory of branching processes, concludes the series of his strictly mathematical publications, and leads on to his great philosophical works published between 1851 and 1875. It is likely that it was not only the eye disease from which he suffered after 1843 which caused this reorientation, but also Cournot's conviction that he was more creative in philosophy than in mathematics. He writes in his *Souvenirs*, p. 154, regarding Poisson's evaluation of his early papers: "he found some philosophical depth in them, in which opinion I truly think that he was not wrong; furthermore, he predicted that I would make great advances in the field of pure mathematical speculation, which was (as I always thought and never hesitated to say) one of his errors". But the chronological sequence of his two periods masks the profound unity of Cournot's thinking; Cournot the mathematician never lost sight of the philosophical implications of his research, while Cournot the philosopher found in mathematics the special expression of the power of pure reason. The guiding principle of his epistemology is that science and philosophy must necessarily intermingle, but without becoming confused, a principle which Euler had already enunciated.

The probabilistic and statistical work of Cournot consists mainly of the two studies of 1834 and 1838, previously mentioned, and the *Exposition de la théorie des chances et des probabilités* of 1843 (*Œuvres Complètes*, Volume I), copiously annotated by Bernard Bru.

The *Addition* of 1834 gave him the chance to denounce the common prejudice, according to which it was necessary in any statistical analysis " always to collect a large number of elements, although this need is often not established by either theory or experiment". It also allowed him to illustrate the fact that, just as both descriptive and theoretical astronomy serve as a model for other sciences, so also "the statistics of stars ... must one day serve as a model for all other disciplines". The publication of the "Mémoire sur les applications du calcul des chances à la statistique judiciaire" followed shortly after Poisson's *Recherches sur la probabilité des jugements* of 1837. In it he took up in a critical manner the analyses involved, which, like Poisson, he compared with the *Comptes généraux de l'administration de la justice criminelle*, published from 1825 on, without relying on the Bayesian methods of Condorcet (q.v.) and Laplace. His main objective was to introduce a conceptual clarification in this area, and show that since legislators and geometers (that is: mathematicians) must share the responsibility of taking an

overview of legal organization from a general standpoint, rather than through particular cases, both need statistics to validate their analyses.

The contents of the two previous studies were integrated into Cournot's major probabilistic and statistical work, the *Exposition de la théorie des chances* of 1843. This attempted to present more than the rules and methods of the calculus of probabilities and of statistics. As B. Bru (*Exposition*, Introduction, p.IX), points out, it offers the first global exposition of the theory of "the variability of chances" of which the elements are to be found dispersed among the works of his "excellent friend" Bienaymé.[1] But Cournot most especially proposed to submit the principles and methods of the calculus of probabilities and statistics to a critical analysis, aiming to establish precisely their significance and effective scope. Such an analysis demands making a distinction between mathematical and philosophical probabilities, and arriving at an understanding of the double meaning of mathematical probability, which is "sometimes connected to a certain measurement of our knowledge and sometimes to a measurement of the possibility of events independent of the knowledge we may have" (p. 4). In statistics too, Cournot insisted on taking into account the extent to which statistical analysis was subject to a "preliminary judgement" which depended on philosophical probabilities (p. 132), which is the crux of the continuing frequentist/Bayesian dichotomy in our time. As against the perception, still current in our day, of statistics as simply accumulation of data and its description, Cournot held that it constituted a genuine science, whose aim was to obtain "numerical results relatively independent of the anomalies of chance, and which indicate the existence of regular causes whose action is combined with that of random causes"(p. 123). Cournot argued that the question was "far less to accumulate numbers whose quantity lead to stable means, than to disentangle the chance-affected influences which are mixed together" (p. 138), the discipline of statistics thus offering a special instrument for bringing to light the mechanisms of reality.

[1]For the relationship between Cournot and Bienaymé see Heyde and Seneta (1977) and Bru, Bru, and Bienaymé (1997).

References

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