Venn, John | Encyclopedia.com

(*b*. Hull, England, 4 August 1834; *d*. Cambridge, England, 4 April 1923)

probability, logic.

Venn's family was one of a group belonging to the evangelical wing of the Church of England that was noted for its philanthropic work. This group, which included the Macaulays, Thorntons, and Wilberforces, was centered in the London suburb of Clapham and was nicknamed the "Clapham Sect." A pivotal figure was Venn's grandfather, Rev. John Venn, rector of Clapham.

After attending two London schools, at Highgate and Islington, Venn entered Gonville and Caius College, Cambridge, in 1853; took his degree in mathematics in 1857; and was elected a fellow of his college, holding the fellowship until his death. He took holy orders in 1859, but after a short interval of parochial work he returned to Cambridge as college lecturer in moral sciences and played a considerable part in the development of the newly established moral sciences tripos examination. In 1883 Venn resigned his clerical orders, being out of sympathy with orthodox Anglican dogma but remained a devout lay member of the church. He received the Cambridge Sc.D. in 1883 and in that year was elected a fellow of the Royal Society.

Besides his scientific works, Venn conducted much research into historical records and wrote books on the history of his college and on his family. He also undertook the preparation of *Alumni Cantabrigienses*, a tremendous task in which he was assisted by his son, J. A. Venn; two volumes appeared in his lifetime.

Venn's volumes on probability and logic were highly esteemed textbooks in the late nineteenth and early twentieth centuries. The historian H. T. Buckle had discussed the validity of statistical studies of human activities, and De Morgan and Boole had written on the foundations of probability theory; this work stimulated Venn to write his *Logic of Chance*. In this book he disclaimed any attempt to make extensive use of mathematical techniques; he believed that there was a need for a thorough and logical discussion of principles, and his work was an essay in that direction. British predecessors were critically discussed. Venn thought that De Morgan's *formal logic* provided a good investigation, but he was not prepared to accept his principles; he was dubious about Boole's *Laws of Thought* for he was not entirely happy with certain aspects of Boole's algebraic analysis of logic.

Venn attempted to deal with the notorious Petersburg paradox by insisting on the concept of "average gain," which is connected with his revision of the basic definition of probability. The classical definition, given in the early eighteenth century by De Moivre, considers the situation in which there are *s* successes in *m* trials and defines the probability of a success as *s*/*m*. One weakness of that definition is that if a possible ambiguity is to be evaded by specifying that the m possibilities are all equally likely, we may be led into a circular argument. Venn offered the following definition: If in a large number m of trials there are s successes (and m–s failures), the probability of a success is the limit of s/m as m tends to infinity. This definition avoids the difficulties that arise when the classical definition is applied to, say, a die with bias, but is itself not free from defects. The existence of the limit cannot be proved from the definition; Venn implicitly assumes that a unique limit must exist. In the twentieth century R. von Mises improved Venn's work by adding explicit postulates on the existence of the Venn limit that effectively restrict the nature of the possible trials. The Venn definition also has been criticized on the practical grounds that it alone cannot provide a specific numerical value for the probability and that further hypotheses must be added in order to arrive at such values.

Venn's books on logic were based on a thorough study of earlier works, of which he had a very large collection that is now in the Cambridge University Library. His writings can still be consulted with profit but are chiefly remembered for the use of logical diagrams, although *Symbolic Logic* is largely an attempt to interpret and correct Boole's is largely work. The use of geometric diagrams to represent syllogistic logic has a long history, but Leibniz was the first to use them systematically rather than as casual illustrations. "All A is B" is represented by a circle marked A placed wholly inside another circle marked B; "Some A is B" is represented by two overlapping circles; and the standard syllogisms are depicted by means of three circles. The procedure was further developed by Euler, and in the early nineteenth century many writers offered varieties of diagrammatic representation. In preparing his book Venn had made a careful survey of such writings, and his chapter discussing them is severely critical. Boole's *Laws of Thought* (1854) was the first efficient development of an algebra of logic, but he did not use diagrams.

Venn was strongly influenced by Boole's work, and in his books he clarifies some inconsistencies and ambiguities in Boole's ideas and notations; but his chief contribution to logic was his systematic explanation and development of the method of

geometrical representation. He pointed out that diagrams that merely represent the relations between two classes, or two propositions, are not sufficiently general; and he proposed a series of simple closed curves (circles or more elaborate forms) dividing the plane into compartments, such that each successive curve should intersect all the compartments already obtained. For one term, compartments x, (the negation or complement of x) are needed; for three terms, four compartments are needed; for three terms, eight; and so on. By the time five classes are under consideration, the diagram is becoming complicated to the point of uselessness. To illustrate the principles of symbolic logic, Venn deliberately provided a variety of concrete instances, often of the type now found in collections of mathematical puzzles, for he remarked that the subject is sufficiently abstract to present difficulty to the average student, who must be helped by a supply of realizable examples.

Since the null class was not then accepted as a class, Venn also had to discuss whether the diagrams represented compartments or classes–that is, whether compartments could be regarded as unoccupied. A compartment known to be unoccupied could be shown by shading it, and a universal proposition could be represented by a suitable unoccupied compartment: Thus "No A is B" could be represented by shading the area common to the two intersecting circles (or closed curves) representing A and B. Venn's treatment of the "universe of discourse" was somewhat indefinite and was criticized by C. L. Dodgson in his *Symbolic Logic* (published under the pseudonym by which he was better known, Lewis Carroll); Dodgson insisted, in Carollian style, on the use of a closed compartment enclosing the whole diagram to delimit the universe of discourse. Venn diagrams, as they are now generally called, have recently been much used in elementary mathematics to encourage logical thinking at a fairly early stage of a child's education.

BIBLIOGRAPHY

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