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IN MEMORIAM: GEORGE STEPHEN BOOLOS
1940–1996

In January 1996, a few months after his 55th birthday, George Boolos, sitting president of the Association for Symbolic Logic, was diagnosed with advanced pancreatic cancer. Treatments at first brought some results and hope; but reversals in April presaged a rapid decline. Boolos died in his home, surrounded by family, friends, students, and colleagues, on May 27, 1996.

Boolos was born on September 4, 1940 in New York City. His interest in logic and philosophy was awakened shortly after he entered Princeton University as an undergraduate. "It was Quine's *Mathematical Logic* that was responsible for my becoming a philosopher. I came upon a copy of it in the university bookstore during my freshman year" [1995, p. 282]. "I recall from undergraduate days a certain professor of mine who once remarked that the way to seduce good students into philosophy was to teach them the Frege-Russell definition of number. I was thus led astray" [1994a, p. 47].[1] After receiving his A.B. in mathematics from Princeton in 1961, he spent two years at Oxford as a Fulbright Scholar, earning the B.Phil in 1963. He received his Ph.D. from M.I.T. in 1966, the first in philosophy from that institution.

After three years as assistant professor at Columbia University, Boolos returned to the M.I.T. Philosophy Department as assistant professor in 1969, was promoted to tenure in 1975 and to full professor in 1980. In November 1996 he would have become the Rockefeller Professor of Philosophy.

Boolos had long been an active member of the Association for Symbolic Logic. He served on Executive Committee from 1979 to 1982, as Vice President from 1992 to 1995, and as Reviews editor for the *Journal of Symbolic Logic* from 1987 to 1995. His term as President had begun in 1995.

Boolos's dissertation "The hierarchy of constructible sets of integers", written under Hilary Putnam, deals with the fine structure of L. It eventuated in the seminal paper [1968] and one other publication, but Boolos did not continue working on the topic. The focus of Boolos's mathematical research soon became provability logic, of which he was one of the primary initiators. In the early 1970s, spurred by discussions with Saul Kripke, Boolos started to

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[1]The professor was Hilary Putnam.

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investigate treating the representation of provability inside formal arithmetic as a modal operator. In 1973 he found a normal form result for letterless sentences in the relevant modal logic. This work enabled him to solve the 35th problem of Friedman [1975] on the day he received the article. By choice of the editor of the *Journal of Symbolic Logic*, however, Boolos's published solution [1976] uses no terminology from modal logic.[2]

From 1975 to 1993 Boolos published a dozen research papers in provability logic, including the first treatment of the modal logic of ω-consistency, the characterization by a strengthened version of S4 of the logic of "provability and truth" (that is, when $\Box F$ is interpreted as $\mathrm{Prov}(\ulcorner F \urcorner) \,\&\, F$), and an extension of a result of Vardanian on quantified modal logic ([1980], [1980a], [1987]). Boolos was also the foremost expositor of the area. [1979] is the first book on provability logic. His later book [1993] is much expanded and altered, and surveys many of the results obtained in 1980s.

Pedagogical interests always played a prominent role in Boolos's writing and research. With Richard Jeffrey he wrote *Computability and Logic* [1974], which quickly became a highly successful textbook, and is now in its third edition. Such interests also underlay his investigation of practical examples of the dramatic increase in proof size caused by cut elimination ([1984a], [1987a]), his discernment of a curious ambiguity that can be engendered by the standard convention for forming quote-names [1995], and his formulation of a new argument for incompleteness based on Berry's paradox [1989].

In philosophy of mathematics and logic, Boolos published several articles that have become classics. In [1971]—a paper that sprang from his search for the proper way to begin a course in axiomatic set theory—he clarified the iterative conception of set, and argued that to a considerable, but not total, extent the conception can provide both philosophical and technical foundations for ZF. In a series of papers [1975], [1984], [1985], he argued *contra* Quine that first-order logic does not exhaust what is properly called logic, indeed that full second-order logic deserves the label. He went on to formulate a new construal of second-order logic that relies on no set-theoretic conceptions, but rather on a notion of plural reference. This line of thought has opened up a lively, and ongoing, debate.

In recent years, Boolos devoted considerable attention to the work of Gottlob Frege. He focused attention on what he dubbed "Frege's Theorem", namely, that classical arithmetic can be derived in second-order logic

[2]See [1991, p. 10]. Friedman's problem 35 amounts to this: is there a decision procedure (for truth) for the sentences of arithmetic obtained by starting with "$0 = 0$" and closing under truth-functions and the operation that carries a sentence F to the sentence $\mathrm{Prov}(\ulcorner F \urcorner)$, where $\mathrm{Prov}(y)$ is a standard provability predicate for arithmetic. The problem was solved independently by Bernardi and Montagna. [1991] gives an account of the first few years' development of provability logic.

amplified by a term-forming operator "the number of F's" and the principle that the number of F's = the number of G's iff F and G are equinumerous. In seven papers published from 1985 to 1995, Boolos showed how attention to the details of Frege's proofs can illuminate the philosophical significance of Frege's enterprise, provided new insight into the wellsprings of the contradiction in Frege's system, and discussed the impact that the appreciation of Frege's Theorem should have on the prospects for a revived logicism. (Four of these papers are anthologized in Demopoulos [1995].) Boolos had been awarded a Guggenheim Fellowship for 1996–97, and intended to spend the year writing a book on Frege.

Boolos was a well-known and much-beloved figure in the subject. He was soft-spoken but outgoing and sociable, possessed of great charm and a legendary dry wit that only occasionally comes through in his writings. He relished the inventive quip and imaginative wordplay, as might be inferred from the delightful [1994]. He was also a person of genuine cultivation, with a deep love of literature and, most centrally, classical music and opera, about which he was highly knowledgeable.

WARREN GOLDFARB

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