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IN MEMORIAM: RUTH BARCAN MARCUS
1921–2012

Ruth Barcan Marcus died on February 19, 2012, in New Haven. She developed the first formal systems of quantified modal logic, introducing the principle now much discussed as 'the Barcan formula'. In later work she reflected on the interpretation of names, identity, quantification, and essentialist theses in a modal setting in reply to critics of quantified modal logic. She was a notable defender of intellectual standards in professional philosophy. She served as President of the Association for Symbolic Logic for 1983–1986.

Ruth C. Barcan was born on August 2, 1921, in New York City, to first generation immigrant parents of Eastern European Jewish origin. She grew up in an intellectually lively, committed socialist household in the Bronx. She received her B.A. from New York University in 1941, majoring in mathematics and philosophy. A strong influence on her there was J. C. C. McKinsey, who gave her special tuition in logic. He was then collaborating with Tarski on algebraic and topological interpretations of modal logic, and encouraged her interest in modal logic. Since Quine at Harvard was notoriously unsympathetic to it, she went to graduate school at Yale instead to work with F. B. Fitch. Her dissertation, ***A Strict Functional Calculus***, extended some of C. I. Lewis's axiomatic systems of propositional modal logic by adding quantificational principles, with a view to later evaluating with respect to her systems Quine's charge that quantified modal logic cannot be coherently interpreted. She received her Ph.D. in philosophy from Yale in 1946.

At Fitch's encouragement, Ruth Barcan had submitted the first part of her dissertation to ***The Journal of Symbolic Logic***; Rudolf Carnap in Chicago was known to be working on quantified modal logic too, so there was no time to lose. The editor, Alonzo Church, quickly accepted her paper, *A functional calculus of first order based on strict implication*, ***JSL*** vol. 11 (1946), pp. 1–16. An article by Carnap on quantified modal logic appeared in the next issue. Unlike his, her article is austerely syntactic. She adds to Lewis's non-normal propositional modal system S2 axioms and rules for quantification, formulated in terms of strict implication rather than material implication, and derives as many quantificational principles as she can. Where the weakness of S2 is an obstacle, she shows how strengthening it to S4 would overcome the difficulty. For technical reasons, her axioms include a schema specifically

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governing the interaction of the quantifiers and modal operators: $\Diamond\exists x\, A$ strictly implies $\exists x\, \Diamond A$. That has come to be known as 'the Barcan formula' (BF). She also derives its converse (CBF) from her other principles. In the tradition of model theory for quantified modal logic initiated by Kripke, BF and CBF are valid in constant domain semantics, where all worlds in a model have the same domain of quantification, but invalid if domains are allowed to vary freely. In more metaphysical terms, the two formulas require a non-contingent ontology (a view that can be given a sustained philosophical defence). However, such characterizations are quite anachronistic for 1946, when neither Kripke-style model theory nor a metaphysical conception of modality had been developed. From a technical perspective, acceptance or rejection of BF and CBF still constitutes a crucial choice-point in the development of any system of quantified modal logic.

Two more papers based on the dissertation soon appeared: *The deduction theorem in a functional calculus based on strict implication*, ***JSL*** vol. 11 (1946), pp. 115–118, and *The identity of individuals in a strict functional calculus of second order*, ***JSL*** vol. 12 (1947), pp. 12–15. The latter is particularly significant for two reasons. First, it presents the first formal system of second-order modal logic. Second, it contains the first proof of the necessity of identity (there defined in second-order terms as indiscernibility): if things are identical, they are so non-contingently. For more than a decade, that was widely regarded as a paradox, indicative of some incoherence in the system, since it was assumed that there are contingent identities. However, it has gradually been accepted that the proof and its conclusion are correct when appropriately interpreted.

By that stage Ruth Barcan was married to the physicist Jules Marcus, whom she had met through fencing (she would have competed at the Olympics Games had World War II not caused their cancellation). Once both had their Ph.D.'s, they moved to the University of Chicago on post-doctoral fellowships. She began publishing as Ruth Barcan Marcus after she submitted another paper to ***JSL*** as Ruth C. Barcan and Church, discovering that she was married, told her to publish it under her 'legal name'. Short papers on modal logic by Ruth Barcan Marcus appeared in ***JSL*** in 1950 and 1953. In Chicago, she joined a group that met regularly in Carnap's flat. He had developed a semantic theory that validated BF and CBF. However, it relied on his method of extension and intension, which invalidated the necessity of identity by permitting individual variables to coincide in extension while diverging in intension. She sought a more straightforward interpretation of quantified modal logic, although her papers on the matter started to appear only from 1960 onwards. In those later papers, she experimented with various interpretations of quantification into modal contexts, some substitutional, some based on a fixed domain of actual concrete objects, to validate

BF and CBF. Names were treated as mere ‘tags’ for objects, in a robust rejection of descriptivist accounts, adumbrating the theory of direct reference. In response to Quine’s charge that quantified modal logic is committed to murky Aristotelian essentialism, she argued that natural science warrants the ascription of modal attributes to individuals, and that in any case quantified modal logic is committed only to the meaningfulness of non-trivial essentialist claims, not to their truth. She discussed modal theories of classes and attributes. Later developments in the field have vindicated many of the once wild-seeming positions she took long before. Her work illustrates how fruitful can be the interplay between technical and philosophical considerations in logic.

Marcus’s research was by no means confined to quantified modal logic. Her most cited paper is on moral dilemmas and consistency; it diagnoses a fallacy in the argument that a moral code is inconsistent because under some circumstances it gives rise to moral dilemmas. She also wrote on philosophical issues in doxastic logic and in deontic logic, on Spinoza’s ontological proof, on Russell’s logic, and other subjects. Altogether she published about forty papers, many of them collected in ***Modalities: Philosophical Essays*** (Oxford, 1993). At least two collections of essays have been published in her honour.

Marcus had four children. Her marriage ended in divorce. Meanwhile she pursued her research with no regular university position, although she held a Guggenheim Fellowship in 1953–1954. She became a part-time professor of philosophy at Roosevelt University, Illinois, in 1959. She was appointed the founding chair of the philosophy department at the University of Illinois, Chicago, in 1964, and built it up strongly. She moved to Northwestern University in 1970 before returning to Yale as professor of philosophy in 1973. She retired as the Reuben Post Halleck Professor in 1992 but remained on the faculty as a research scholar while taking a continuing appointment as a visiting professor at the University of California, Irvine, until 1997.

Marcus was a very active President of the Association of Symbolic Logic from 1983 to 1986, helping to negotiate tensions between mathematicians and philosophers and to secure its financial position after a period of near-bankruptcy. She was also very active in the American Philosophical Association, for example in the struggle to improve hiring practices, and served as the Chair of its Board of Officers (1976–1983). She was President of the International Institut de Philosophie (1989–1992). In 1977 she was elected a Fellow of the American Academy of Arts and Sciences. She won many awards, including a Medal of the Collège de France (1986), an honorary doctorate of the University of Illinois (1995), Yale’s Wilbur Cross Medal (2000), the APA’s Quinn Prize for service to the profession (2007), and the Lauener Prize in Analytic Philosophy (2008). Her unpublished APA Dewey Lecture

(2009) contains some memoirs; they touch on the obstacles she faced as a woman in academia in the 1940s.

Marcus became an instantly recognizable leader of the profession. Her style was tough (she could handle a cudgel as well as a rapier), combative, uncompromising, clear-cut, but also warm, funny, and inspiring. She was a supportive mentor and helped many women succeed as professional philosophers. She often served, with vigour, on visiting committees to philosophy departments, thereby propagating her influence over the profession.

Any serious history of modal logic will need to specify Ruth Barcan Marcus's contribution.

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