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Leibniz's Infinitesimals: Their Fictionality, Their Modern Implementations, And Their Foes From Berkeley To Russell And Beyond

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Many historians of the calculus deny significant continuity between infinitesimal calculus of the 17th century and 20th century developments such as Robinson's theory. Robinson's hyperreals, while providing a consistent theory of infinitesimals, require the resources of modern logic; thus many commentators are comfortable denying a historical continuity. A notable exception is Robinson himself, whose identification with the Leibnizian tradition inspired Lakatos, Laugwitz, and others to consider the history of the infinitesimal in a more favorable light. Inspite of his Leibnizian sympathies, Robinson regards Berkeley's criticisms of the infinitesimal calculus as aptly demonstrating the inconsistency of reasoning with historical infinitesimal magnitudes. We argue that Robinson, among others, overestimates the force of Berkeley's criticisms, by underestimating the mathematical and philosophical resources available to Leibniz. Leibniz's infinitesimals are fictions, not logical fictions, as Ishiguro proposed, but rather pure fictions, like imaginaries, which are not eliminable by some syncategorematic paraphrase. We argue that Leibniz's defense of infinitesimals is more firmly grounded than Berkeley's criticism thereof. We show, moreover, that Leibniz's system for differential calculus was free of logical fallacies. Our argument strengthens the conception of modern infinitesimals as a development of Leibniz's strategy of relating inassignable to assignable quantities by means of his transcendental law of homogeneity.

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