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Jenny Harrison* (harrison@math.berkeley.edu), Department of Mathematics, University of California, Berkeley, Berkeley, CA 94705. *Introduction to Operator Calculus and New Geometric Methods in Analysis and Topology.*

Axioms of calculus are presented in which continuum and discrete geometries are unified. The theory make use of a new integral and derivative, and treats highly singular domains of integration. We present new fundamental theorems underlying the generalized theorems of Stokes and Gauss. The ansatz is the existence of topological coalgebras of ‘differential chains’ that dualize to exterior algebras of differential forms, as opposed to distributions and currents, which are dual spaces of forms. A new homology theory emerges that is not equivalent to singular homology theory. The new theory is able to distinguish the sine circle from the smooth circle. Both dualize to de Rham cohomology on smooth manifolds, but our theory is equipped with a coproduct whose dual is cup product. Homology becomes primary, for cohomology can be built from it. This work marks a fundamental change in the point of view from the contravariant back to the covariant. Analytical methods are greatly simplified.

It is possible that we have in these researches the dim outlines of an operational calculus, destined to become in one or two centuries as powerful an instrument as the differential calculus has been for our predecessors and for ourselves.

Andre Weil, 1950. (Received March 03, 2009)