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Infinitely small quantities in Cauchy's textbooks

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Abstract

The fundamental role of infinitely small quantities for his teaching of the calculus was underlined by Cauchy himself in the introduction to his *Cours d'analyse* of 1821 and in the announcements of his later textbooks. First steps toward theories of such quantities which are briefly denoted as variables having zero as their limit were made by Cauchy, who represented them by sequences converging to zero (in the *Cours*) or by functions vanishing at zero (since 1823). It is shown that the famous so-called errors of Cauchy are correct theorems when interpreted with his own concepts. A few gaps in his proofs are explained by the hypothesis that he tacitly assumed continuity. No assumptions on uniformity or on nonstandard numbers are needed. Finally, some possible completions of Cauchy's rudimentary theories of infinitesimals are ventured.

Zusammenfassung

Cauchy betonte selbst die grundlegende Bedeutung unendlich kleiner Größen für seine Art, Analysis zu unterrichten, in der Einführung zum *Cours d'analyse* (1821) und den Selbstanzeigen seiner späteren Lehrbücher. Theoretische Ansätze für solche Größen, welche kurz als Variable mit Limes Null bezeichnet werden, beruhen auf der Darstellung durch Nullfolgen (im *Cours*) oder durch bei Null verschwindende Funktionen (seit 1823). Es wird gezeigt, daß Cauchys oft als falsch bezeichnete Sätze auf der Grundlage seiner eigenen Begriffe korrekt sind. Einige Beweisen werden damit erklärt, daß er stillschweigend an stetige Funktionen dachte. Historisch unzulässige Annahmen über Gleichmäßigkeit oder über Nichtstandard-Zahlen sind ebenfalls möglich. Möglichkeiten zur Vervollständigung von Cauchys Theorieansätzen werden angedeutet.

Résumé

L'importance fondamentale, pour son enseignement, des quantités infiniment petites a été soulignée par Cauchy lui-même dans son introduction à son *Cours d'analyse* de 1821 et dans les avertissements à ses traités ultérieurs. Le point de départ pour la théorie de ces quantités, qui peuvent être désignées brièvement comme des variables ayant pour limite zéro, repose sur la représentation par les suites qui convergent vers zéro (dans le *Cours*) ou par les fonctions qui tendent vers zéro (depuis 1823). On va montrer que les théorèmes soi-disant faux de Cauchy sont exacts en se basant sur ses propres notions. Des lacunes dans les démonstrations seront expliquées par le fait qu'il suppose implicitement qu'il s'agit des fonctions continues. Des hypothèses, historiquement inadmissibles, de l'uniformité ou des nombres non-standard sont superflues. On indiquera comment on peut compléter les théories de base de Cauchy.



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