From Brouwer To Hilbert The Debate On The Foundations Of Mathematics In The 1920s

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Mathematical Constructivism Routledge

The core of Volume 3 consists of lecture notes for seven sets of lectures Hilbert gave (often in collaboration with Bernays) on the foundations of mathematics between 1917 and 1926. These texts make possible for the first time a detailed reconstruction of the rapid development of Hilbert ' s foundational thought during this period, and show the increasing dominance of the metamathematical perspective in his logical work: the emergence of modern mathematical logic; the explicit raising of questions of completeness, consistency and decidability for logical systems; the investigation of the relative strengths of various logical calculi; the birth and evolution of proof theory, and the parallel emergence of Hilbert ' s finitist standpoint. The lecture notes are accompanied by numerous supplementary documents, both published and unpublished, including a complete version of Bernays ' s Habilitationschrift of 1918, the text of the first edition of Hilbert and Ackermann ' s Grundz ü ge der theoretischen Logik (1928), and several shorter lectures by Hilbert from the later 1920s. These documents, which provide the background to Hilbert and Bernays ' s monumental Grundlagen der Mathematik (1934, 1938), are essential for understanding the development of modern mathematical logic, and for reconstructing the interactions between Hilbert, Bernays, Brouwer, and Weyl in the philosophy of mathematics.

David Hilbert's Lectures on the Foundations of Arithmetic and Logic 1917-1933 Springer Science & Business Media

Hilbert's Programs & Beyond presents the foundational work of David Hilbert in a sequence of thematically organized essays. They first trace the roots of Hilbert's work to the radical transformation of mathematics in the 19th century and bring out his pivotal role in creating mathematical logic and proof theory. They then analyze techniques and results of "classical" proof theory as well as their dramatic expansion in modern proof theory. This intellectual experience finally opens horizons for reflection on the nature of mathematics in the 21st century: Sieg articulates his position of reductive structuralism and explores mathematical capacities via computational models.

The Making of Mathematics Oxford University Press on Demand

During Edmund Husserl's lifetime, modern logic and mathematics rapidly developed toward their current outlook and Husserl's writings can be fruitfully compared and contrasted with both 19th century figures (Boole, Schröder, Weierstrass) as well as the 20th century characters (Heyting, Zermelo, Gödel). Besides the more historical studies, the internal ones on Husserl alone and the external ones attempting to clarify his role in the more general context of the developing mathematics and logic, Husserl's phenomenology offers also a systematically rich but little researched area of investigation. This volume aims to establish the starting point for the development, evaluation and appraisal of the phenomenology of mathematics. It gathers the contributions of the main scholars of this emerging field into one publication for the first time. Combining both historical and systematic studies from various angles, the volume charts answers to the question "What kind of philosophy of mathematics is phenomenology?"

Philosophy of Mathematics and Mathematical Practice in the Seventeenth Century Springer

This volume tackles G ö del's two-stage project of first using Husserl's transcendental phenomenology to reconstruct and develop Leibniz' monadology, and then founding classical mathematics on the metaphysics thus obtained. The author analyses the historical and systematic aspects of that project, and then evaluates it, with an emphasis on the second stage. The book is organised around G ö del's use of Leibniz, Husserl and Brouwer. Far from considering past philosophers irrelevant to actual systematic concerns, G ö del embraced the use of historical authors to frame his own philosophical perspective. The philosophies of Leibniz and Husserl define his project, while Brouwer's intuitionism is its principal foil: the close affinities between phenomenology and intuitionism set the bar for G ö del's attempt to go far beyond intuitionism. The four central essays are `Monads and sets', `On the philosophical development of Kurt G ö del', `G ö del and intuitionism', and `Construction and constitution in mathematics'. The first analyses and criticises G ö del's attempt to justify, by an argument from analogy with the monadology, the reflection principle in set theory. It also provides further support for G ö del's idea that the monadology needs to be reconstructed phenomenologically, by showing that the unsupplemented monadology is not able to found mathematics directly. The second studies G ö del's reading of Husserl, its relation to Leibniz' monadology, and its influence on his publishe d writings. The third discusses how on various occasions Brouwer's intuitionism actually inspired G ö del's work, in particular the Dialectica Interpretation. The fourth addresses the question whether classical mathematics admits of the phenomenological foundation that G ö del envisaged, and concludes that it does not. The remaining essays provide further context. The essays collected here were written and published over the last decade. Notes have been added to record further thoughts, changes of mind, connections between the essays, and updates of references.

Postmodern Philosophy and the Scientific Turn Springer Science & Business Media

This volume offers 11 papers that cover the wide spectrum of influences on Rudolf Carnap's seminal work, Der Logische Aufbau der Welt (The Logical Structure of the World). Along the way, it covers a host of topics related to this important philosophical work, including logic, theories of order, science, hermeneutics, and mathematics in the Aufbau, as the work is commonly termed. The book uncovers the influences of such neglected figures as Gerhards, Driesch, Ziehen, and Ostwald. It also presents new evidence on influences of well-known figures in philosophy, including Husserl, Rickert, Schlick, and Neurath. In addition, the book offers comparisons of the Aufbau with the work of contemporary scientists such as Weyl and Wiener as well as features new archival findings on the early Carnap.This book will appeal to researchers and students with an interest in the history and philosophy of science, history of analytic philosophy, the philosophy of the Vienna Circle, and the philosophy in interwar Germany and Austria.

The Adventure of Reason Oxford University Press on Demand

Intuitionism is one of the main foundations for mathematics proposed in the twentieth century and its views on logic have also notably become important with the development of theoretical computer science. This book reviews and completes the historical account of intuitionism. It also presents recent philosophical work on intuitionism and gives examples of new technical advances and applications. It brings together 21 contributions from today's leading authors on intuitionism.

Proof Theory Springer Science & Business Media

This anthology reviews the programmes in the foundations of mathematics from the classical period and assesses their possible relevance for contemporary philosophy of mathematics. A special section is concerned with constructive mathematics.

From Frege to Gödel Elsevier

Gerhard Gentzen (1909–1945) is the founder of modern structural proof theory. His lasting methods, rules, and structures resulted not only in the technical mathematical discipline called "proof theory" but also in verification programs that are essential in computer science. The appearance, clarity, and elegance of Gentzen's work on natural deduction, the sequent calculus, and ordinal proof theory continue to be impressive even today. The present book gives the first comprehensive, detailed, accurate scientific biography expounding the life and work of Gerhard Gentzen, one of our greatest logicians, until his arrest and death in Prague in 1945. Particular emphasis in the book is put on the conditions of scientific research, in this case mathematical logic, in National Socialist Germany, the ideological fight for "German logic", and their mutual protagonists. Numerous hitherto unpublished sources, family documents, archival material, interviews, and letters, as well as Gentzen's lectures for the mathematical public, make this book an indispensable source of information on this important mathematician, his work, and his time. The volume is completed by two deep substantial essays by Jan von Plato and Craig Smory?ski on Gentzen's proof theory; its relation to the ideas of Hilbert, Brouwer, Weyl, and Gödel; and its development up to the present day. Smory?ski explains the Hilbert program in more than the usual slogan form and shows why consistency is important. Von Plato shows in detail the benefits of Gentzen's program. This important book is a self-contained starting point for any work on Gentzen and his logic. The book is accessible to a wide audience with different backgrounds and is suitable for general readers, researchers, students, and teachers.

Hilbert Oxford University Press

This book is about some recent work in a subject usually considered part of "logic" and the" foundations of mathematics", but also having close connec tions with philosophy and computer science. Namely, the creation and study of "formal systems for constructive mathematics". The general organization of the book is described in the" User's Manual" which follows this introduction, and the contents of the book are described in more detail in the introductions to Part One, Part Two, Part Three, and Part Four. This introduction has a different purpose; it is intended to provide the reader with a general view of the subject. This requires, to begin with, an elucidation of both the concepts mentioned in the phrase, "formal systems for constructive mathematics". "Con structive mathematics" refers to mathematics in which, when you prove that l a thing exists (having certain desired properties) you show how to find it. Proof by contradiction is the most common way of proving something exists without showing how to find it - one assumes that nothing exists with the desired properties, and derives a contradiction. It was only in the last two decades of the nineteenth century that mathematicians began to exploit this method of proof in ways that nobody had previously done; that was partly made possible by the creation and development of set theory by Georg Cantor and Richard Dedekind.

Foundations of Constructive Mathematics Springer

Paolo Mancosu presents a series of innovative studies in the history and the philosophy of logic and mathematics in the first half of the twentieth century. The Adventure of Reason is divided into five main sections: history of logic (from Russell to Tarski); foundational issues (Hilbert's program, constructivity, Wittgenstein, Gödel); mathematics and phenomenology (Weyl, Becker, Mahnke); nominalism (Quine, Tarski); semantics (Tarski, Carnap, Neurath). Mancosu exploits extensive untapped archival sources to make available a wealth of new material that deepens in significant ways our understanding of these fascinating areas of modern intellectual history. At the same time, the book is a contribution to recent philosophical debates, in particular on the prospects for a successful nominalist reconstruction of mathematics, the nature of finitist intuition, the viability of alternative definitions of logical consequence, and the extent to which phenomenology can hope to account for the exact sciences.

The Hilbert Challenge Springer Science & Business Media

Please note that the content of this book primarily consists of articles available from Wikipedia or other free sources online. Pages: 39. Chapters: Intuitionism, Constructivism, Ultrafinitism, Intuitionistic logic, Heyting algebra, Brouwer-Hilbert controversy, Criticism of non-standard analysis, Modulus of continuity, Intuitionistic type theory, Constructive set theory, Brouwer-Heyting-Kolmogorov interpretation, Constructive analysis, Primitive recursive arithmetic, Constructive proof, Choice sequence, Markov's principle, Realizability, Church's thesis, Harrop formula, Apartness relation, Diaconescu's theorem, Inhabited set, Friedman translation, Indecomposability, Disjunction and existence properties, Pseudo-order, Axiom schema of predicative separation, Heyting arithmetic, Minimal logic, Modulus of convergence, Bar induction, Computable analysis, Computable model theory, Subcountability, Heyting field. Excerpt: In mathematics, a Heyting algebra, named after Arend Heyting, is a bounded lattice equipped with a binary operation a b of implication such that (a b) a b, and moreover a b is the greatest such in the sense that if c a b then c a b. From a logical standpoint, A B is by this definition the weakest proposition for which modus ponens, the inference rule A B, A B, is sound. Equivalently a Heyting algebra is a residuated lattice whose monoid operation a b is a b; yet another definition is as a posetal cartesian closed category with all finite sums. Like Boolean algebras, Heyting algebras form a variety axiomatizable with finitely many equations. As lattices, Heyting algebras can be shown to be distributive. Every Boolean algebra is a Heyting algebra when a b is defined as usual as -a b, as is every complete distributive lattice when a b is taken to be the supremum of the set of all c for which a c b. The open sets of a topological space form a complete distributive lattice and hence a Heyting algebra....

Gnomes in the Fog Oxford University Press

The significance of foundational debate in mathematics that took place in the 1920s seems to have been recognized only in circles of mathematicians and philosophers. A period in the history of mathematics when mathematics and philosophy, usually so far away from each other, seemed to meet. The foundational debate is presented with all its brilliant contributions and its shortcomings, its new ideas and its misunderstandings.

Contradictory Woolf Birkhäuser

This two-volume work brings together a comprehensive selection of mathematical works from the period 1707-1930. During this time the foundations of modern mathematics were laid, and From Kant to Hilbert provides an overview of the foundational work in each of the main branches of mathmeatics with narratives showing how they were linked. Now available as a separate volume.

David Hilbert's Lectures on the Foundations of Arithmetic and Logic 1917-1933 Springer

Most contemporary work in the foundations of mathematics takes its start from the groundbreaking contributions of, among others, Hilbert, Brouwer, Bernays, and Weyl. This book offers an introduction to the debate on the foundations of mathematics during the 1920s and presents the English reader with a selection of twenty five articles central to the debate which have not been previously translated. It is an ideal text for undergraduate and graduate courses in the philosophy of mathematics.

Models of Simon Springer-Verlag

The seventeenth century saw dramatic advances in mathematical theory and practice than any era before or since. With the recovery of many of the classical Greek mathematical texts, new techniques were introduced, and within 100 years, analytic geometry, the geometry of indivisibles, the arithmetic of infinites, and the calculus had been developed. Although many technical studies have been devoted to these innovations, Paolo Mancosu provides the first comprehensive account of the relationship between mathematical advances of the seventeenth century and the philosophy of mathematics of the period. Beginning with the Renaissance debates on the certainty of mathematics, Mancosu leads the reader through the foundational issues raised by the emergence of these new mathematical techniques, including the influence of the Aristotelian conception of science in Cavalieri and Guldin, the foundational relevance of Descartes' Geometrie, the relationship between empiricist epistemology and infinitistic theorems in geometry, and the debates concerning the foundations of the Leibnizian calculus In the process Mancosu draws a sophisticated picture of the subtle dependencies between technical development and philosophical reflection in seventeenth century mathematics.

L. E. J. Brouwer Collected Works Harvard University Press

The papers presented in this volume examine topics of central interest in contemporary philosophy of logic. They include reflections on the nature of logic and its relevance for philosophy today, and explore in depth developments in informal logic and the relation of informal to symbolic logic, mathematical metatheory and the limiting metatheorems, modal logic, many-valued logic, relevance and paraconsistent logic, free logics, extensional v. intensional logics, the logic of fiction, epistemic logic, formal logical and semantic paradoxes, the concept of truth, the formal theory of entailment, objectual and substitutional interpretation of the quantifiers, infinity and domain constraints, the Löwenheim-Skolem theorem and Skolem paradox, vagueness, modal realism v. actualism, counterfactuals and the logic of causation, applications of logic and mathematics to the physical sciences, logically possible worlds and counterpart semantics, and the legacy of Hilbert's program and logicism. The handbook is meant to be both a compendium of new work in symbolic logic and an authoritative resource for students and researchers, a book to be consulted for specific information about recent developments in logic and to be read with pleasure for its technical acumen and philosophical insights. - Written by leading logicians and philosophers - Comprehensive authoritative coverage of all major areas of contemporary research in symbolic logic - Clear, in-depth expositions of technical detail - Progressive organization from general considerations to informal to symbolic logic to nonclassical logics - Presents current work in symbolic logic within a unified framework - Accessible to students, engaging for experts and professionals - Insightful philosophical discussions of all aspects of logic - Useful bibliographies in every chapter

Internal Logic Springer Science & Business Media

Few problems in mathematics have had the status of those posed by David Hilbert in 1900. Mathematicians have made their reputations by solving some of them like Fermat's last theorem, but several remain unsolved including the Riemann Hypotheses, which has eluded all the great minds of this century. A hundred years later, this book takes a fresh look at the problems, the man who set them, and the reasons for their lasting impact on the mathematics of the twentieth century. In this fascinating book, the authors consider what makes this the pre-eminent collection of problems in mathematics, what they tell us about what drives mathematicians, and the nature of reputation, influence and power in the world of modern mathematics. It is written in a clear and entertaining style and will appeal to anyone with interest in mathematics or those mathematicians willing to try their hand at these problems.

Phenomenology and Mathematics Oxford University Press

There is an urgent need in philosophy of mathematics for new approaches which pay closer attention to mathematical practice. This book will blaze the trail: it offers philosophical analyses of important characteristics of contemporary mathematics and of many aspects of mathematical activity which escape purely formal logical treatment.

One Hundred Years of Intuitionism (1907-2007) Oxford University Press

Mainstream philosophy of mathematics, namely the philosophy of mathematics that has prevailed for the past century, claims that the philosophy of mathematics cannot concern itself with the making of mathematics, in particular discovery, but only with finished mathematics, namely mathematics presented in finished form. On this basis, mainstream philosophy of mathematics argues that mathematics is theorem proving by the axiomatic method. This, however, is untenable because it is incompatible with Godels incompleteness theorems, and cannot account for many features of mathematics. This book offers an alternative approach, heuristic philosophy of mathematics, according to which the philosophy of mathematics can concern itself with the making of mathematics, in particular discovery. On this basis, the book argues that mathematics is problem solving by the analytic method, and that this can account for all the main features of mathematics: mathematical method, objects, demonstrations, definitions, diagrams, notations, explanations, beauty, applicability, and knowledge.

Essays on Gödel's Reception of Leibniz, Husserl, and Brouwer University-Press.org

Internal logic is the logic of content. The content is here arithmetic and the emphasis is on a constructive logic of arithmetic (arithmetical logic). Kronecker's general arithmetic of forms (polynomials) together with Fermat's infinite descent is put to use in an internal consistency proof. The view is developed in the context of a radical arithmetization of mathematics and logic and covers the many-faceted heritage of Kronecker's work, which includes not only Hilbert, but also Frege, Cantor, Dedekind, Husserl and Brouwer. The book will be of primary interest to logicians, philosophers and mathematicians interested in the foundations of mathematics and the philosophical implications of constructivist mathematics. It may also be of interest to historians, since it covers a fifty-year period, from 1880 to 1930, which has been crucial in the foundational debates and their repercussions on the contemporary scene.