E.W. Beth als logicus
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Abstract

E.W. Beth as a logician

The subject of this dissertation is the logical work of E.W. Beth. In addition, there is a short biography and an introduction to some of Beth’s methodological and philosophical ideas.

Evert Willem Beth (1908–1964) was born in Almelo, a small town near the Dutch-German border. He was the son of H.J.E. Beth and H. de Groot. His father studied mathematics and physics at the University of Amsterdam, where he received his Ph.D. in mathematics, thereafter working as teacher in mathematics and physics in secondary schools. E.W. Beth studied mathematics and physics at the University of Utrecht, followed by a study in philosophy and psychology. Evert Beth’s Ph.D. (1935) was in philosophy (faculty of arts), because the borderland between philosophy and mathematics did not yet exist as an academic discipline in the faculty of science at that time.

In 1946 Beth became in Amsterdam the first professor of logic and foundations of mathematics in the Netherlands. He held this position in Amsterdam until his death in 1964. He also held two positions outside Holland: in 1951 as research assistant of A. Tarski in Berkeley (UC) and in 1957 as professor of methodology at Johns Hopkins University in Baltimore.

The aim of this study is to show the diversity of Beth’s logical systems and what binds them (both systematically and historically) together. Beth’s main contributions to logic were the definition theorem, semantic tableaux and the Beth models. The foundation of his work was Gentzen’s extended Hauptsatz, the subformula theorem and an extensive use of (Tarskian) model theory.

Beth’s work was a combination of syntactical and semantical components. The definition theorem (1953) is a counterpart of deductive completeness. Beth’s proof is primarily syntactic: he uses the midsequent, topology and reduced logic.

With his Definition Theorem and his non-normal valuations, Beth created the tools for the next stage in his development, the semantic tableaux (1954–1955). With the semantic tableaux Beth explored different areas: classical logic, modal logic and intuitionistic logic. The semantic tableaux give a rapid decision procedure, their basis is a binary splitting tree. In combination with his
semantic tableaux Beth made a proof-theoretic variant: the deductive tableaux.

During his entire professional career Beth was interested in intuitionistic logic, but he was himself not an intuitionist and disliked intuitionistic philosophy. Beth combined his semantic tableaux with trees and choice sequence, thus creating the Beth models (1956). With the application (and in his case duplication) of Brouwer's fundamental theorem he avoided non-intuitionistic mathematics in his intuitionistic semantics and completeness proof.

Another area was the use of his earlier developed non-standard valuations: in combination with his so-called help (subordinate) tableaux and valuations it was possible to study intuitionistic and modal logic as in Kripke world semantics.

During the last period of his life (1960-1964) Beth tried to make his logical research subservient to a diverse range of applications: the study of language, theorem proving, mathematical heuristics and translation methods in natural languages.

Beth had considerable influence in international organisations. He foresaw their importance as early as the 1940s. In Europe, directly after World War II, there was no supportive climate for the studies in formal methods: no money, no professors and a scientific community, which disliked logic and the philosophy of science. So, he tried to set up international networks and organised congresses to get the recognition he needed for money and jobs. He understood that getting recognition in the Netherlands was only possible with international support. But there was also an idealistic component in the motives underlying his efforts: he wanted not only to improve the Dutch situation, but also to further the theories of logic on a world scale. Nor did he limit himself to only pure logic. In Holland he worked towards a combination of formal philosophy, philosophy of science, pure logic and foundations of mathematics. He was the first to bring these several studies together. Nowadays logic is an internationally recognized scientific discipline. As I show in the biography, we owe a lot of that to Beth.

Beth had ideas about philosophy, methodology and the philosophy of science as well. His aim was to create what he called a scientific philosophy, i.e. philosophy without speculation. He was furious at those modern philosophical movements like existentialism and the like. He thought of philosophy as not monolithic and static, but as changing in time. In this dissertation there is a small part devoted to this subject: Beth's wishes for pure philosophy and the philosophy of mathematics. Finally, I give a short impression of Beth's methodology (logic) for classical and quantum mechanics.