Boole's Elimination Summation Problem: an Overlooked Breakthrough

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Before the time of George Boole(1815-1864), logic restricted itself very largely to determining the validity and invalidity of arguments taken from a limited class. Boole is noted for having expanded this class to include arguments whose "categorical" propositions involved arbitrarily large numbers of terms in "Boolean combinations", rather than just two. Boole is not noted for an equally important innovation that may have contributed more towards altering the course of the development of logic: Boole set radically different types of problems for logic to treat. Previously logic treated problems of the following type: given a set of premises and a conclusion, to determine whether or not the premise set implies the conclusion. In sharp contrast Boole proposed several new problem classes one of which is *Boole's elimination summation problem class* composed of problems of the following type: given a set of propositions involving a certain set of non-logical terms, given an arbitrary subset of these terms, to find a proposition that (1) follows from the given set, that (2) contains only terms from the given subset and that (3) "summarizes" all of the consequences of the given set involving only these terms, i.e. that implies every consequence of the given set involving only the terms from the given subset. In other words, Boole's problem was to find a proposition which is a summation of all the consequences of the given set expressible using only the given subset of terms. This paper discusses Boole's treatment of these problems, their importance in the history of logic, and the current status of the general problem. Examples are given from modern equational logic, first-order logic, and higher-order logic.

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