A. A. Fraenkel's Philosophy of Religion: A Translation of "Beliefs and Opinions in Light of the Natural Sciences" [1]

By: M. ZELCER

Introductory Essay

1 – Life

Abraham Adolf Halevi Fraenkel is best known to mathematicians and philosophers as one of the founders of modern set theory. From the late 1800s through the 1930s, modern logic and set theory emerged as part of the new program to establish reliable and secure foundations for mathematics. Logicians and set theorists were then devising the methodology that would shape the way mathematics is currently practiced. Mathematicians and philosophers like Georg Cantor, Gottlob Frege, David Hilbert, Bertrand Russell, Alfred N. Whitehead, Richard Dedekind, Ernst Zermelo, and Kurt Gödel were making fundamental contributions to the foundations of mathematics. Though his early mathematical work was in the field of algebra, Fraenkel's most notable contribution was in the theory of sets. He and Ernst Zermelo formulated a set theory that should be not susceptible to the famous paradox of Russell, or the Burali-Forti

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[1] המאמר הזה הוא לז"נ סבי, ר' ירחמיאל זעלצער ז"ל.

Thanks to Shaul Katz for bringing Fraenkel's article to my attention many years ago in a discussion about the history of the Hebrew University; Heshey Zelcer for his assistance with the translation; Dahlia Kozlowsky for stylistic comments; and Noson Yanofsky for many valuable suggestions; a few footnotes are due entirely to him. Also, thanks to Tina Weiss at the HUC library for help tracking down some of Fraenkel's essays.

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paradox.[2] The set theory he helped develop is the most popular and is known as Zermelo-Fraenkel set theory, or ZFC. To understand the relevance of ZFC consider that the vast majority of modern mathematics can be formulated with, and be seen as being built upon, sets and ZFC's few simple axioms is their foundation. Most working mathematicians usually do not think about the axioms, nor do they care if their work can be put into the language of ZFC. Nevertheless, with enough effort, their work can be stated within the language of ZFC. From this important position, the axioms of ZFC can be seen as the axioms of all of mathematics and hence the axioms of exact reasoning itself.[3]

Fraenkel was born in Munich in 1891 to a fairly well known Orthodox Jewish German family whose lineage includes people such as his great-grandfather B. H. Auerbach, the publisher of the (now infamous) *Sefer ha-Eshkol*.[4] Like many German students, he studied in various universities, including the universities of Berlin, Munich, Marburg, and Breslau before receiving his PhD in mathematics. He served as a German soldier, mostly in a medical capacity, for 50 months in WWI. During that period he met many kinds of Jews and developed the Jewish world-view that would stick with him for the rest of his life. Shortly after returning from war, he met Wilhelmina Malka A. Prins who was studying German at the time. They married in 1920. He thought their partnership was ideal be-

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2 The paradoxes that show that Cantor's original set theory is inconsistent. Russell's paradox from 1902 (first discovered by Zermelo) is similar to the "Barber Paradox." If there is a lone barber in an isolated town who shaves all and only those people who do not shave themselves, who shaves the barber? If he shaves himself, then he doesn't shave himself, and if he doesn't, then he does. In set theory, you can have a "barber set" that is made up of those kinds of elements that cause analogous problems. The Burali-Forti paradox (1897) is more complicated and involves the largest ordinal number in the set of ordinal numbers.

3 The discussion of ZFC is loosely adapted from Noson Yanofsky's forthcoming *The Outer Limits of Reason*.

4 (Fraenkel 1967, 13) fails to mention the controversy over this work. It is possible Fraenkel was not aware that it might have been a forgery. See Mark B. Shapiro's note for more on the provenance of *Sefer ha-Eshkol*: <http://seforim.traditiononline.org/index.cfm/Besamim%20Rosh>.