

Richard L. Epstein (with the assistance and collaboration of Walter A. Carnielli, Itala M. L. D'Ottaviano, Stanislaw Krajewski, and Roger D. Maddux), *The Semantic Foundations of Logic, Vol. 1: Propositional Logics*, 2nd ed., New York, Oxford University Press, 1995. xxvi + 480 pp.

Reviewed by

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Joseph Rosenstein opened the preface of his book *Linear Orderings* with the questions: "A book about linear orderings? You mean total orderings? What can you possibly say about them? After all, besides the natural numbers, the integers, the rationals, and the reals, what linear orderings are there?" One might have a similar initial reaction to Richard Epstein's nearly 500 pages on propositional logic. Sure, we need Boolean connectives, but how much can be said about them? If we want logic to sink our teeth into, we look to quantifiers, don't we? But just as *Linear Orderings* showed just how rich its subject actually is, so does *Propositional Logics* portray both the breadth and depths to be found in this aspect of logic, too easily taken for granted. Certainly the propositional calculi of classical, modal, intuitionistic, and many-valued  $\&$  not to mention paraconsistent  $\&$  logics bear their own individual traits. Epstein not only discusses these and several other logics, he also develops.

Here's a one-paragraph sketch of the template: A mapping assigns a set to every proposition. The truth value of a compound proposition depends solely on the truth values of its components *and* on whether or not certain relations hold among the sets assigned to the components. The underlying idea is that the set assigned to a proposition represents its "contents", those aspects of the proposition (beyond truth-value) that the logic purports to deal with.

For example, classical propositional logic deems "A implies B" true, even when A and B have no bearing on each other at all, as long as they possess the right truth-values. But by taking contents into account, one can impose the additional requirement that A and B be appropriately connected. One can, say, call "A implies B" false whenever the respective content sets assigned to A and B are disjoint, or maybe even whenever B's set contains an element not already in A's. About 20 years ago, Epstein formulated his relatedness and dependence logics on the basis of such considerations. Those logics suggested the general framework developed in *Propositional Logics* and form some of its most natural applications. However, the book also

shows how to put this framework to use in other contexts, like modal or intuitionistic logics, by strategies such as taking a proposition's "content set" to be the set of Kripkean possible worlds in which it holds.

In addition, Epstein emphasizes the common ground that the various logics share by giving parallel treatments of several key topics (syntactic axiomatizations, completeness theorems, deduction theorems) in the different settings. On the other hand, he thoroughly explores byways peculiar to each individual kind of logic. Ultimately, the capstone chapter "Translations Between Logics" methodically explores the extent to which one can or cannot model one logic within another.

Despite the variety of logics considered, the unifying thrust of the material could risk imposing a certain monochromaticity on the book. But Epstein helps counter this tendency by addressing himself to a diverse readership. *Propositional Logics* contains something for the mathematicians and something for the philosophers, something for the novices and something for the more experienced. The exercises in particular exemplify this breadth as they range from review questions (such as "What is a truth-functional connective?") to open problems (concerning, for example, Gentzen's classical-into-intuitionistic translation). And many of the exercises are interesting in an offbeat way, such as "Formalize two theorems (principles) from a mathematics textbook, a biology textbook, a psychology textbook, and an economics textbook" and "Give an example of a possible world not accessible to our own under the relation of physical necessity. What makes you think your description is consistent?"

As for flaws, *Propositional Logics* contains a moderate number of typos and grammatical errors. (Particularly annoying are certain recurrent mistakes æ multiple uses of "it's" as a possessive, "criteria" as a singular, and "schema" as a plural.) More significantly, errors occasionally creep into the technical content, although for the most part these glitches are minor.

But such drawbacks are merely things that keep a worthwhile book from being even better. On the whole, Epstein writes well, in a relaxed style. His unifying perspective of propositional logic, discussions of individual logics, and often thought-provoking exercises all make for an interesting and insightful volume. And for those who still miss quantifiers, there's *Predicate Logics*, the second volume in Epstein's *Semantic Foundations* series.