do so. But I can imagine some of the intended audience ending up somewhat disoriented — "Didn't we already do that? Or did we? Is there any real difference between those theorems, or is this just tinkering?" The danger in a spiral construction for a book is that some readers may feel that it just goes around in circles.

Another possible source of disorientation is the nonuniform labeling of results. For example, pages 57–64 feature, in order: Theorem G, Theorem A, Theorem B, Theorem 1, Lemma 1, Corollary, Theorem 1°, Lemma ω, Theorem 2, Theorem 3, Theorem 3°, Theorem A′, Lemma 2, and Theorem A*. And there is no index of theorem names to help the reader keep track of this motley collection.

The book also contains several glitches that should have been caught at the copy-editing/proofreading stages. These range from the merely annoying (e.g., the occasional scrambled sentence) to the potentially more serious (e.g., the disjunctions in the statement of Theorem 3 on page 94 should be conjunctions.)

The pluses much outweigh the minuses, though, and *Gödel's Incompleteness Theorems* is well worth reading — and even obtaining for one's own (unlike many other of the publisher's monographs, this one is not unduly expensive.) Although it contains many exercises, the book seems to be written more for self-study than for use as a classroom text, and it serves that purpose well. In addition, besides providing an excellent introduction to incompleteness and giving old hands at logic some food for thought, Smullyan has another aim. Quoting from the Preface one last time, "this volume...was also intended as a preparation for our sequel, *Recursion Theory for Metamathematics*, in which we explore in depth the fascinating interrelations between incompleteness and recursive unsolvability." I am eagerly awaiting the sequel's appearance.

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Katalin G. Havas, *Thought, Language and Reality in Logic*, Budapest, Akadémiai Kiadó, 1992. Translation by J. Kovács & M. Gulyás, revised by B. Dajka, of *Gondolkodas, nyelv, valóság a logikában*, Budapest, Akadémiai Kiadó, 1983.

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This is a work in philosophy of logic. Its purpose is to answer some philosophical questions about the relationships between three seemingly disparate definitions of logic and to thereby define and delineate logic. The three definitions considered are based on the objects which logic as said to study. This also includes a discussion of the relationship between formal logic and dialectical logic which follows traditional and well-documented lines. The three foci are presented as: (1) "logic is the study of reasoning, or more generally, of the forms and laws of thought;" (2) "Logic deals with the rules concerning the usage of language;" and (3) "logic treats the entities of reality and their general laws." The three conceptions are analyzed by way of a distinction between mathematical logic and philosophical logic, the latter being used ambiguously to include philosophy of logic, non-classical formal logics (e.g. modal logic, paraconsistent logic) and dialectical logic. The analysis suggests that these three conceptions of the proper sphere of logic can be synthesized into a unified conception of logic. Along the way, the author defends the traditional conception of the relationship between dialectical logic and formal logic and rejects the recent attempts to formalize dialectical logic.

The English is stylistically awkward, and in places the translation leads to more questions and ambiguity than could have been intended by the author. When Havas says (pp. 30–31) that "Today, a great number of logicians, far from rejecting philosophy as nonsensical, would rather renew and improve by employing recent developments in logic," we might assume that this is a translator's error and that Havas was actually saying, or trying to say, that contemporary philosophers have been willing to accept the tools of mathematical logic for dealing with problems of philosophical logic. This interpretation would be in consonance with the author's concept, stated on p. 31 and developed in the pages that follow, that mathematical logic has become an important tool for dealing with problems in the philosophy of logic, such as exploring the role of abstract entities in thought and reasoning and the question of their existence; explaining or defining concepts such as *object*, *predicate*, *truth*, etc., that are used in logic; deciding how one selects the axioms of one's system; or understanding the philosophical importance and meaning Gödel's incompleteness theorems, for example. But this is not an entirely accurate way to read the sentence in question, because much of the context in which it occurs also suggests that she could as easily have meant to say that many logicians are willing to accept the help of philosophy in understanding and elaborating questions in philosophy of logic.

More serious than stylistic problems, the author's account of the history of logic, when not actually false, is inaccurate to the extent that it is incomplete, and therefore misleading to those who begin with only a rudimentary knowledge of the subject. Here is just one example of a single sentence in which several problems occur: on p. 14, we read that 'The "father" of modern logic, Leibniz, as well as, preceeding him, Bacon, Hume and Descartes, wanted to make logic a tool for the sciences, which at the time had begun to progress quite rapidly.' The errors in this one sentence, immediately evident to historians of logic, include: (1) Hume belonged to the eighteenth century (and so could hardly have preceded Leibniz), and though his some of his comments are relevant to inductive logic and others are of interest to philosophers of mathematics, he has had made no lasting or relevant contributions to formal deductive logic;* (2) placing Bacon and Descartes in the same category as Leibniz ignores the distinction, first made by Bocheński (*Spitzfindigkeit*, in *Festgabe an die Schweitzerkatholiken* (Freiburg, Universitätsverlag, 1954), 334–352) and reiterated by van Heijenoort in his review of Bocheński's *Spitzfindigkeit* article (Journal of Symbolic Logic 22 (1957), 382), between logicians who, like Leibniz, had *Spitzfindigkeit*, and those, like Descartes and the Port-Royalists, who did not; (3) Bacon's concern was (principally, if not exclusively) experimental, rather than logical; (4) if by progress Havas is referring to the elaboration and development of the Leibniz program, then it certainly was not until after symbolical algebra had been sufficiently developed, mainly in England in the first part of the nineteenth century, that Boole, De Morgan and their colleagues were able to make serious, sustained and successful progress in developing the mathematical logic, in its early guise as algebra of logic, that Leibniz articulated and attempted. There are other examples of similar infelicities that readers may detect, but there is no need to list them all here. Whether these historical problems arise because of errors of the author or of the translators, I am unable to say, since I do not have a basis for comparing the Hungarian text with this translation.

Moreover, some of the author's non-historical comments are debatable, if not false. I find rather strange that, shortly after defining logical semantics as having to do with "questions on the relation between symbolic signs and their references, as well as on the relation of of these systems to everyday thinking (as expressed in terms of ordinary language) and to the world" (p. 29), the author could assert that Gödel's "Über formal unentscheidbare Sätze der *Principia Mathematica* und verwandter Systeme" "made a significant contribution to the development of semantic investigations" when this work, as Havas explains, "demonstrated that there exist sentences (in the language of first order Peano arithmetic), true in relational systems $(w, \neq, ..., 0, 1)$, which are unprovable in Peano arithmetic [and] thus, there exist sentences (of the same language) which are undecidable in terms of the Peano arithmetic" (p. 29). Perhaps I have failed to understand Havas's definition of "semantics"? I don't think so, however, because she gives Wittgenstein's picture-theoretic semantics from the *Tractatus logico-philosophicus*, in which the logical structure of the world is mirrored in the logical structure (syntax) of language, as the first attempt at a logical semantics. Here too, I cannot say whether these sorts of questions arise because of errors of the author or of the translators.

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*The idea that the identity of numbers can be defined in terms of one-to-one correlation, now known as "Hume's Principle," is admittedly present in Hume's *A Treatise of Human Nature* (I, iii, §I), but it was left undeveloped until picked up and used by Cantor and then by Frege.

Finally, the work itself is out-dated: by the time the Hungarian original of this book was published, the vast majority of the references cited in the bibliography were already at least a decade old. The value of this work, therefore, is that it gives those who do not read Hungarian a first glimpse into the work and views of Hungarian dialectical-materialist philosophers of logic.