such hierarchies is the problem of definability (it is considered for hierarchies based on founded systems of notations though the unfounded hierarchies are also mentioned and discussed). The last section of Chapter 5 is devoted to Burge's hierarchies, i.e., to Burge's semantics for Tarski's hierarchies which lie between the hierarchies described and studied earlier in this chapter and type-free semantics *à la* Kripke.

In Chapters 6, 7 and 8 type free theories of truth are considered, i.e., theories in which the notion of truth for the language $\mathcal{L}$ can be also applied to expressions of the language $\mathcal{L}_T$, hence to expressions in which the notion T occurrs. In this languages the distinction between the object language and the metalanguage is not valued any longer. In particular, semantics of Kripke are considered in Chapter 7 and in Chapter 8 some results of Friedman and Sheard as well as of Halbach are presented.

The book is closed by Chapter 9 devoted to some philosophical considerations connected with theories of truth. One finds here the discussion of the problem of compositionality, some remarks on the role and meaning of reflection principles and of the paradoxes as well as considerations on the ontological reductions.

The book is supplemented by a list of references and by an index of persons and subjects.

Concluding, I would like to say that the book under review is a really interesting contribution to the logical theory of truth. It provides a well written overview of basic axiomatic theories of truth developed in logic. All results are stated very precisely, proofs are given in details. Moreover the reader will find here not only the technical results but also philosophical considerations clarifying the motivations lying behind various theories. It is only a pity that no index of symbols was included (which is standard in mathematical and logical books and would be a great help for the reader) and that there are so many printer's errors (fortunately they appear mainly in the normal text, not in formulas, and therefore have no negative influence on the understanding of the book).

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C. HOWSON, **Logic with Trees**, Routledge, London and New York, 1997, US $18.95 (pbk), pp. xiii + 197, ISBN 0-415-13341-6 (hbk), 0-415-13342-4 (pbk).

When writing a logic textbook, one has to make numerous choices concerning the exposition of the logic. What choice of vocabulary/symbolism should one make; how, exactly, to formulate the semantics; what proof theory to use? There are a number of ways of doing all these things. For the experienced logician, the differences may not be terribly important, but for the novice, who is being exposed to the ideas for first time, they can affect the difficulty of the subject crucially. Of these choices, perhaps it is the proof theory that is the most important. Few people, at least in philosophy and computer science classes, would now use axiom systems. This leaves natural deduction, sequent calculi, and semantic tableaux. Each of these has its advantages and disadvantages compared with the other two. The disadvantage of tableaux, compared with the first two, is that it divorces logic from its primary home: constructing arguments by chaining together inferences. The advantages are that it makes constructing proofs algorithmic, and that it delivers completeness proofs in a particularly simple way. Since these are two areas in which new students (at least outside mathematics departments) often find difficulties, the use of tableaux is pedagogically attractive.

It is, at any rate, the choice made by Colin Howson in this book. There are already a number of excellent books that use tableaux, notably, Wilfred Hodges' *Logic*, Richard Jeffrey's *Formal Logic: its Scope and its Limits* and Raymond Smullyan's *First Order Logic* (which is clearly a strong influence on Howson). Hodges' book, which pays more attention to the connection between formal and natural languages than does Howson's, but which contains very little metatheory, would be my choice for an introductory text in a philosophy department. Smullyan's book, which is much more demanding mathematically than Howson's, and covers more technical ground, is a good choice for maths students.

Howson and Jeffrey hold the middle ground. Both of these are primarily expositions of the standard metatheory of first order logic; neither expects the reader to be too sophisticated mathematically. Jeffrey is set out in an attractive pedagogical manner, and also covers issues relating to decidability, which Howson does not. It is, however, frustratingly elusive sometimes when it comes to nitty-gritty details. Howson, by contrast, provides all the details — and his rigor never turns into *rigor mortis*. His explanations are admirably clear, and directed to points that students find difficult. I particularly liked the fact that he takes time to explain proof by recursion, something that philosophy students often find a hurdle. Howson also treats topics that Jeffrey does not, notably, logical machinery that goes beyond first (and second) order logic, such as modality and conditionality, together with a discussion of some of the philosophical issues that these raise.

In more detail, the contents of Howson's book are as follows. The first four chapters take us through classical propositional logic and standard results in its metatheory: soundness, completeness, normal forms, etc. The next four do the same for classical first-order logic (including compactness and the downward Löwenheim-Skolem theorem). The next chapter deals with identity and function symbols. The treatment here is somewhat unorthodox. Howson prefers to take identity as a non-logical notion, making inferences concerning identity enthymematic, the suppressed premises being $\forall x\, x = x$, and the schema of substitutivity of identicals. Since there is an infinite number of instances of this schema, the approach has the disadvantage of forcing an infinitude of premises upon us. (Compactness assures us that the infinitude is never necessary, but this is not much practical help if we do not know in advance which ones are required.) These features could, in fact, be avoided without loss of generality, by simply requiring substitutivity in *atomic* contexts only (both in terms of the axioms and the tableaux rules). The others follow. A standard bit of metatheory is also omitted: the completeness theorem for first order logic with identity.

The last three chapters of the book give us glimpses beyond this material. The treatments are rather swift, but suffice to indicate to the student further riches of logic. One chapter surveys alternative proof theories, and, in the context of natural deduction, introduces the student to intuitionism. Another, called 'First Order Theories', surveys formal arithmetic, the Gödel incompleteness theorems, set theory and the transfinite, and theories with a truth predicate (including a discussion of the liar paradox). The final chapter contains a swift introduction to modal logic, conditional logic (the latter, slightly awkwardly, coming before the former) and a discussion of some of the philosophical issues concerning the material conditional. Each chapter has a good supply of exercises, and the solutions to a number of these are given at the end of the book, which is also well indexed.

An unfortunate feature of the book is that it has a large number of typographical and other minor errors. (More than I could list here). Most of these are not such as to throw an experienced teacher, but a number of them could well confuse a student. Doubtless, these will be corrected in the second edition. In the meantime, a list of corrections can be obtained from Howson (Department of Philosophy, London School of Economics, C.Howson@lse.ac.uk), and students would be well advised to correct their text before use.

Howson's proofs are usually deft, clear and reliable, though the teacher needs to watch out for a few of oversights. On p. 52, Howson argues that every tableau for propositional logic terminates. In fact, the argument establishes only that every branch is finite. It requires an appeal to König's Lemma to complete the job. In the proof of the Completeness Theorem on p. 60, you do not need the fact that **B** is an open branch to define the interpretation τ, but to show that all littorals on the branch are true in τ. Most importantly, Howson neither states nor proves the lemma that a formula

$A(a)$ is true in an interpretation, iff $A(x)$ is true relative to that assignment of denotations to variables which assigns x the denotation of a. But this fact is appealed to a couple of times in the Soundness proof on p. 108, and in Lemma 1 immediately after it; a similar fact is also required to verify the soundness of the substitutivity axioms for identity on p. 117.

Philosophically, the book is rather conservative. Howson doesn't have a great deal of sympathy with anything beyond simple first-order logic — second order logic, languages with truth predicates, modal logic, non-material conditionals, are all dismissed — indeed, the chapter on the last two of these is entitled 'Beyond the Fringe'. Students can add a little balance to this aspect of the book by augmenting it with Stephen Read's *Thinking about Logic*.

I also found the criticism of some of the more novel developments in logic a bit thin sometimes. For example, Howson suggests that we do not need special counter-factual conditionals: a material conditional can be taken as a counter-factual when it may be deduced from the laws of nature (p. 164). But this doesn't seem right. Since it is a law of nature that light travels at a constant speed, the following counterfactual would be true: if light were not to travel a constant speed, it would travel at a constant speed. Still, this sort of criticism is a somewhat harsh: the book does not pretend to be one of philosophical logic, and at least Howson raises philosophical issues and problems that many formal logic texts do not even mention.

There is a multitude of elementary logic books for the beginner. There are also many advanced logic books for the more sophisticated mathematical student. But books in the middle ground, where one wants to cover non-trivial mathematical results in classical logic, but at a level that does not entirely alienate non-mathematics students, are fairly hard to find. Despite the shortcomings of Howson's book that I have noted, I think that it fills this slot admirably.

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I. GRATTAN-GUINNESS and G. BORNET (eds.), **George Boole: Selected Manuscripts on Logic and its Philosophy**, Birkhäuser, Basel–Boston–Berlin, 1997, DM 58, pp. lxiv + 236, ISBN 3-7643-5456-9.

George Boole (1815-1864) wrote on the differential calculus and on logic. He was, perhaps, better known in his lifetime for his contributions to the former; but it is for his contributions to the latter that he is now mainly remembered. His work on "algebraicising" logic, first published in his short