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REVIEWS

The Association for Symbolic Logic publishes analytical reviews of selected books and articles in the field of symbolic logic. The reviews were published in ***The Journal of Symbolic Logic*** from the founding of the JOURNAL in 1936 until the end of 1999. The Association moved the reviews to this BULLETIN, beginning in 2000.

The Reviews Section is edited by Alasdair Urquhart (Managing Editor), Steve Awodey, John Baldwin, Lev Beklemishev, Mirna Džamonja, David Evans, Erich Grädel, Denis Hirschfeldt, Roger Maddux, Grigori Mints, Luke Ong, Volker Peckhaus, and Sławomir Solecki. Authors and publishers are requested to send, for review, copies of books to *ASL, Box 742, Vassar College, 124 Raymond Avenue, Poughkeepsie, NY 12604, USA.*

In a review, a reference "JSL XLIII 148," for example, refers either to the publication reviewed on page 148 of volume 43 of the JOURNAL, or to the review itself (which contains full bibliographical information for the reviewed publication). Analogously, a reference "BSL VII 376" refers to the review beginning on page 376 in volume 7 of this BULLETIN, or to the publication there reviewed. "JSL LV 347" refers to one of the reviews or one of the publications reviewed or listed on page 347 of volume 55 of the JOURNAL, with reliance on the context to show which one is meant. The reference "JSL LIII 318(3)" is to the third item on page 318 of volume 53 of the JOURNAL, that is, to van Heijenoort's *Frege and vagueness*, and "JSL LX 684(8)" refers to the eighth item on page 684 of volume 60 of the JOURNAL, that is, to Tarski's *Truth and proof*.

References such as 49***5*** or 280***1*** are to entries so numbered in *A bibliography of symbolic logic* (the JOURNAL, vol. 1, pp. 121–218).

SHAWN HEDMAN. ***A first course in logic: an introduction to model theory, proof theory, computability, and complexity.*** Oxford Texts in Logic 1. Oxford University Press, 2004, xx + 431 pp.

In spite of its title, this textbook covers a lot of ground, particularly in the area of model theory. It includes not just the usual introductory material in logic, but also a great deal that is usually covered in more advanced texts, such as the excellent and widely used book by Boolos and Jeffrey—now in a fourth edition thoroughly revised by John Burgess (BSL IX 520).

The first chapter is an efficient introduction to propositional logic, going as far as proofs of completeness and compactness. Unusual features here are, first, the inclusion of the resolution method and secondly, a proof that the satisfiability problem for Horn formulas is solvable in polynomial time. Completeness is proved by reduction to conjunctive normal form, together with a proof of completeness for the resolution rule. General compactness is proved by König's Lemma.

Chapter 2 covers structures and the semantics of first order logic, with numerous useful examples, including relational databases. Embeddings and the method of diagrams are introduced. Chapter 3 covers proof theory from a somewhat unusual angle, since the viewpoint here is closer to that of automated theorem proving than to the conventional logical approaches. Skolem normal form, Herbrand universes, unification and resolution for first

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order logic make up the bulk of the chapter, which concludes with a brief discussion of the programming language Prolog.

Chapter 4 begins with a proof of completeness for countable languages, following the method of Henkin. The general theorem for arbitrary languages is proved later, by a transfinite Henkin construction; as preparation, a brief introduction to set theory and cardinal arithmetic is included. This chapter (amounting to a crash course in introductory model theory) also includes the upward and downward Löwenheim-Skolem theorems, the compactness theorem, the simplest preservation theorems and the Robinson joint consistency theorem.

Chapter 5 continues the model-theoretic vein begun in Chapter 4, including the characterization of countably categorical theories—the countable random graph appears here as a significant example. Quantifier elimination, model-completeness and minimal theories are also discussed. Chapter 6 completes the mini-course in model theory provided by Chapters 4, 5 and 6. Readers are given an introduction to the idea of types, atomic models, homogeneous models, prime models, countable saturated models and monster models. A very brief sketch of stability theory concludes the chapter.

Chapter 7 expounds the theory of computability and complexity. Primitive recursive functions are introduced, and general recursive functions are then defined by employing an unbounded search operator. As a computing model, register machines (called "turnip machines" here) are employed. Kleene's recursion theorem is proved, followed by the undecidability of the halting problem. The chapter concludes with an exposition of basic complexity theory, including NP-completeness and the P =? NP question.

Chapter 8 is devoted to the incompleteness theorems. The first incompleteness theorem is first established using the ideas of George Boolos (*A new proof of the Gödel incompleteness theorem*, ***Notices of the American Mathematical Society***, vol. 36 (1989), pp. 388–390 and 676), whose proof is modeled on Berry's paradox, rather than the Liar paradox, as in Gödel's original proof. A more conventional treatment of the encoding of syntax follows, with a proof of the first and second incompleteness theorems in the original style of Gödel. The chapter concludes with a discussion of Goodstein sequences, and a statement (without proof) of Kirby and Paris's proof of incompleteness using these.

Chapter 9 gives brief introductions to extensions of first-order logic, including second-order logic with its pathological behaviour, infinitary logics and fixed-point logics. An unusual feature here is a complete proof of Lindström's theorem characterizing first-order logic.

Chapter 10 concludes the book with a discussion of finite model theory, including Ehrenfeucht–Fraïssé games, Trakhtenbrot's theorem and the failure of classical model-theoretic results in the finite case. Descriptive complexity is used as a lead-in to a discussion of questions in complexity theory, including the P =? NP question (left as an open problem for the reader).

As this summary of the book should make clear, Hedman covers an enormous quantity of material in his text—the coverage of model theory in particular is unusually broad. There are a large number of generally well chosen exercises that round out a challenging textbook.

The reviewer used Hedman's text in a course in which he covered parts of Chapters 1, 2, 3, 4, 7 and 8. The students had varied backgrounds, some with good mathematical training, others with only an introductory course in logic. Even covering a small fraction of the material was difficult for the less well trained students, though the more mathematically sophisticated students did better. Nevertheless, Hedman's text might be a good resource for mathematically mature students who would like a broad survey that also includes some deeper material.

Since it is a first edition, the book contains numerous typographical and other errors; for example, "Löwenheim" is persistently mis-spelled as "Löwenhiem." As for substantive errors, the reviewer noticed at least one: contrary to the assertion on p. 349, the algorithm for conversion to conjunctive normal form given in Chapter 1 does not run in polynomial time. Oddly enough, Exercise 1.21 on p. 50 points out the problem very clearly.

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RICHARD L. EPSTEIN. ***Classical mathematical logic. The semantic foundations of logic.*** With contributions by Lesław W. Szczerba. Princeton University Press, Princeton and Oxford, 2006, xxii + 522 pp.

This book is the third one in the author's series, "The semantic foundations of logic." The first was ***Propositional logics***, published in 1990 by Kluwer (JSL LVI 1499), with a second edition in 1995 from Oxford University Press, and most recently in 2001 from Wadsworth. The second book was ***Predicate logic***, published in 1994 by Oxford University Press, and most recently in 2001 by Wadsworth.

From the first of these, the volume under review takes fifty or so pages on propositional logic. But, in keeping with the word "classical" in its title, it leaves behind the material on relevance logic, modal logic, intuitionism, many-valued logic, paraconsistent logic, and the like.

From the second book in the series, the present volume takes about 140 pages on first-order logic, and a chapter on second-order logic. It leaves behind material on formalizing ordinary-language reasoning.

On this base, the author constructs a "self-contained textbook" (p. xviii) of some 500 pages. It can be viewed as consisting of three parts: First, there is a large part on propositional and predicate logic, going as far as the Gödel completeness theorem (in Chapter X). Secondly, there is a large part on formalizing various theories within logical systems. In particular, theories of groups, linear orderings, natural numbers, rational numbers, real numbers, and geometry are treated in this way. The chapters on geometry were written in collaboration with Lesław Szczerba. Thirdly, there is a smaller part on special topics (translations, free logic, the liar paradox, and such).

In the first part, the presentation of semantics for predicate logic (in Chapter IV) involves "realizations" (assigning meanings to symbols), "semi-formal language," "predications," and "interpretations." Somewhat later (in Chapter IX), this is compared (and contrasted) to concepts based on "classical mathematical models" consisting of a nonempty universe and some relations. "It is not clear that a notion of set divorced from that of the extension of a linguistic predicate can be used in defining models and still yield a good formalization of the the notion of validity" (p. 165). That is, someone not committed to a realist viewpoint might distinguish between truth in all structures $\langle A, R\rangle$ and truth under all possible meanings of the symbols.

In the second part, the chapter on formalizing the theory of linear orderings includes a bit of beginning model theory, such as the Łoś–Vaught theorem. There is a chapter here on second-order logic, taken from the author's 1994 book. The chapter on formalizing the theory of the natural numbers includes the Gödel incompleteness theorems. The exposition relies on Church's Thesis, in the form, "The computable/recursive functions are exactly those that can be represented in Q" (p. 273). The reader is referred to the author's 1989 book with Walter Carnielli, ***Computability*** (a second edition was published in 2000 by Wadsworth, see BSL VIII 101) for supporting background.

Being a textbook, the book contains exercises for the reader. Many of these ask for a discussion or an explanation, instead of merely asking for an objective answer. The material in the book ranges from points in the philosophy of mathematics to ordered divisible groups.

This breadth can be viewed as its strength or its weakness, depending on the sort of textbook one is seeking. To its credit, the book has an extensive index.

The book is composed in "the font QLogicPS created by the author" and is printed from his camera-ready copy. The reader needs to adjust to the fact that, for example, roman type is used for constant symbols, while variables are in italics.

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Graham Priest. ***Doubt truth to be a liar.*** Oxford University Press, 2006, xii + 226 pp.

This book is the latest episode of Graham Priest's attempt to elucidate and defend *dialetheism*, the view that some contradictions are true. His campaign has been going strong since the late 1970s, with little sign of slowing down. This book is published at the same time as the second edition of ***In Contradiction*** (Oxford University Press, 2006), his most detailed attempt to argue for dialetheism. In ***Doubt Truth to be a Liar***, Priest's stated goal is not to argue for dialetheism, but to give a dialetheic treatment of some central philosophical topics, in particular, truth, negation, rationality, and logic (1–2). Of course, these topics were chosen because their very intelligibility seems to require consistency; thus, the traditional understanding of them poses a substantial obstacle to endorsing dialetheism. Priest wants to show that we can have perfectly acceptable accounts of truth, negation, rationality, and logic even though some contradictions are true. As such, the book has four main parts.

Part one, on truth, begins with a long and tedious discussion of Aristotle's attempt to justify the law of non-contradiction (LNC). The law of non-contradiction (as stated by Priest) is: it is impossible that there is a proposition p such that p and $\neg p$ (8). Priest argues that all of the arguments Aristotle offers are either unsound or circular. The rest of part one is dedicated to showing that dialetheism is compatible with most of the popular views on the nature of truth (e.g., deflationism, the correspondence theory, etc.), and that trivialism, the view that everything is true (and false), is unacceptable. That is, although Priest thinks that some contradictions are true, he does not think that all of them are true. Priest's criticism of trivialism involves the claim that the observable world is consistent, but if trivialism were correct, then it would be inconsistent (63). Presumably, that means Priest is a dialetheist only about theoretical, but not observable matters.

In part two, Priest discusses negation; he focuses on the distinction between De Morgan negation and Boolean negation. Priest claims that only the former is "coherent" (88). It is defined by LNC and the law of excluded middle (LEM) so that it is a contradictory-forming operator, but not one that satisfies what Priest calls "explosion" (more commonly known as *ex falso quodlibet*). Explosion is the principle that anything follows from a contradiction. Obviously, since Priest is a dialetheist, but not a trivialist, he cannot endorse explosion. Boolean negation, on the other hand, obeys LNC, LEM, and explosion. Priest argues at length that there is no such thing as Boolean negation. Again, his argument is that there is no non-circular way to show that Boolean negation is a real connective; thus, anyone who accepts that there is such a thing begs the question against the dialetheist.

It might seem odd that after spending so much time arguing against Aristotle's defense of LNC, Priest accepts De Morgan negation, which obeys LNC. This illustrates a confusion on Priest's part—one that infects much of his work on dialetheism. On the one hand, he claims that Aristotle's defense of LNC is "the only major critique of dialetheism," and he argues that there is no non-circular argument for LNC (2). On the other hand, dialetheism implies that LNC is true (and false); thus, Priest actually accepts LNC (at least the formulation relevant to his discussion of Aristotle). It is unclear whether there is a version of LNC that he rejects; either way, his tendency to conflate dialetheism with rejection of LNC is a persistent problem.

Priest's discussion of negation highlights another problem with the book. Here and elsewhere, his major critical tool is to argue that objections to dialetheism beg the question. However, anyone familiar with philosophical work on logic knows that there is a long standing problem with non-circular justifications of logical principles. For example, it seems impossible to justify the inference rules one endorses without using any of these inference rules. So the fact that there are no non-circular justifications of LNC should not surprise anyone who has even a passing acquaintance with these issues. Nor should it come as a shock that Boolean negation is used in attempts to justify the legitimacy of Boolean negation. Priest does not seem to realize that the problems he points out are general problems. He cannot give non-circular justifications of the logical principles and connectives he accepts either. We are all in the same boat, but it does not follow that LNC is false or that there is no such thing as Boolean negation. The irony, of course, is that if Priest is a dialetheist, then he should accept LNC, since his logic deems it true.

Priest closes part two with a discussion of negation, denial, and rejection. This discussion is intended to reply to the many critics who claim that a dialetheist has trouble expressing disagreement. For example, in a discussion with a dialetheist, I assert that grass is green, and the dialetheist wants to disagree with me. It will not help for the dialetheist to assert that grass is not green, since he might accept that grass is green and grass is not green. To allay these concerns, Priest distinguishes between assertion and denial (two speech acts) and between acceptance and rejection (two propositional attitudes). The traditional view is that to deny something is just to assert its negation (likewise for rejection). For Priest, there is a big difference between asserting $\neg p$ and denying p, because one can accept both p and $\neg p$. The dialetheist can disagree with someone by denying what that person has said (instead of the more traditional way of asserting its negation). These distinctions are important not just for dialetheism, but also for anyone who thinks that there are truth-value gaps (i.e., sentences that are neither true nor false); Priest's discussion is a strong contribution to this topic. However, I would have liked to see some empirical evidence that people actually perform these two different speech acts and have these two different kinds of propositional attitudes.

Part three of the book focuses on rationality. Priest argues that a theory's consistency is just one of many possible cognitive virtues it might have, and that it might be more rational to accept an inconsistent theory than a consistent rival. Thus, Priest not only accepts that there are some true contradictions, but that it is sometimes rational to believe contradictions. He also focuses on belief-revision, in particular the AGM theory of belief-revision, which has been very influential. AGM theory, of course, presupposes that a rational agent's beliefs should be consistent and that if an inconsistency is discovered, the belief set should be revised to eliminate it. Priest formulates a theory of belief-revision on which one assigns a rationality index to each of the ways of revising a belief set, and a rational agent should adopt the revision with the highest rationality index. What Priest has to say about the rationality of belief revision is of interest independently of dialetheism; however, his suggestion is not really novel (which he admits) and does not add much to the discussion of belief-revision. It would have been much more interesting to see a more general discussion of formal epistemology (Bayesianism, decision theory, confirmation theory, etc.) from a dialetheic point of view.

Priest ends part three with a discussion of inconsistent theories in the empirical sciences. Here he argues that an inconsistent empirical theory might be acceptable (not just provisionally) so long as it does not have inconsistent observational consequences and allows adjunction (i.e., the rule that a conjunction follows from its two conjuncts).

The final part of the book concerns logic. Priest endorses a paraconsistent logic (i.e., one that rejects explosion) to go along with his dialetheism, but it is not the focus of this part. Instead, Priest discusses several important topics in philosophy of logic. I found much of this part tacked on, having little to do with dialetheism, especially the last chapter on logical pluralism. However, there is much of interest in this part. Priest offers a general account of logic as a theory of validity and then a general theory of validity as truth preservation in all situations. The theory of validity purports to be acceptable whether one is a classical logician, intuitionist, relevantist, dialetheist, or whatever. It is also intended to cover both deductive and inductive validity. Again, Priest's view is not very novel, but it does suggest that a dialetheist can still accept a plausible account of validity.

The final chapter is on logical pluralism (i.e., the view that there is no single logic that is correct for every discourse). Priest argues that there is no interesting and correct version of logical pluralism. He agrees that in different domains different logics are appropriate, but he does not take this to be a point for pluralism. Instead, he explains it by saying that in domains where stronger logics are appropriate, there is additional information that can be used as premises in reasoning. For example, it might be that paraconsistent logic is the one correct logic for all domains, but in certain situations, one is permitted to reason classically since one has the additional information that these situations are consistent. However, as Priest acknowledges in ***In Contradiction*** (ch. 16), legitimizing classical reasoning in a paraconsistent logic cannot be a matter of adding more premises, because an inconsistent context might very well validate the claim that it is a consistent situation. Instead, a new logic is required, which Priest calls minimally inconsistent logic of paradox (LPm). Thus, Priest's alternative to logical pluralism is incompatible with his views on legitimizing classical reasoning by way of LPm. As far as I can tell, Priest does not address this problem at all.

Throughout part four, Priest emphasizes that logic is an empirical theory of how people ought to reason (176). He writes, "we have intuitions about the validity of particular inferences. ... These act like the data in an empirical science: if the theory gives the wrong results about them, then this is a black mark against it," (182). Of course, if we extend this view to soundness (i.e., truth and validity), it is hard to imagine a worse theory than dialetheism in this regard. Only a handful of people in the Western tradition have the intuition that an argument whose conclusion is a contradiction can be sound. This point raises the issue of whether dialetheism is supposed to be a descriptive theory (one that purports to describe our actual practice) or a revisionary one (one that purports to describe how our practice should be changed). As a descriptive theory, it seems to fail miserably since almost no one explicitly accepts contradictions, thinks that contradictions can be conclusions of sound arguments, or thinks that asserting the negation of a proposition is not a way of expressing disagreement. However, it does not seem to fare any better as a revisionary theory because it does not seem possible to convince anyone that it should be adopted; any argument whose conclusion is a contradiction will be treated by almost everyone as a *reductio*, instead of as an argument that some contradiction is true. Moreover, since it is difficult to imagine a more entrenched belief than the belief that no contradictions are true, adopting dialetheism would be such a huge change that almost any other change would be preferable to it.

Overall, the book is lucid, wide-ranging, and thought-provoking, but I was bothered by something throughout reading it. Since Priest claims to be a dialetheist, and I take him at his word, it is difficult to know how to interpret what he writes. For example, on p. 63, he writes that the observable world is consistent. But, of course, that is compatible with his believing that it is inconsistent. Even if he says 'the observable world is consistent, and furthermore, I do not think that it is also inconsistent', that does not help. He might believe that ((the observable world is consistent and it is not inconsistent) and it is not the case that (the observable world is consistent and it is not inconsistent)). So, how can Priest ever convince us that he believes something and not both it and its negation? I do not see any way for this to happen. So, there is a pragmatic slide from treating someone as a dialetheist to treating that person as a trivialist. That is, once you begin treating someone as a dialetheist, nothing they say can convince you that they are not a trivialist. Thus, although dialetheism does not imply trivialism (at least in the logic the dialetheist claims to honor), treating someone as a dialetheist leads to treating them as a trivialist. Once one begins treating another as a dialetheist, it does not seem that one should ever trust anything they say.

Priest would probably say that this is just the problem that the dialetheist has in expressing disagreement—you can trust the dialetheist when he asserts something and denies its negation. After all, he will not both assert and deny something even though he might assert a contradiction. Of course, the problem then is: how can you tell that a dialetheist is denying something instead of asserting something? Well, he could tell you that he is denying something. But that again could just be an assertion and so it is not unreasonable to think that he might also assert that he is not denying it. Perhaps Priest accepts that one should not both accept and reject the same proposition and he accepts that one may do so. Or maybe he accepts and rejects that one should not both accept and reject the same proposition. Who knows? This just illustrates the slide problem. Again, it seems that you should not trust anything a dialetheist says. I would love to find a good basis for a discussion between dialetheists and non-dialetheists, but I have yet to see one, and Priest does not even seem to recognize the problem.

Most people react to dialetheism by denying that the view even makes sense. This book goes a long way toward showing that it does (although I still have some doubts); that in itself is a major accomplishment and a good reason for anyone interested in these topics to read it. Before reading this book (and ***In Contradiction***), I would not have guessed that dialetheism could be made to sound so intelligible. It is a Herculean effort, and Priest he has done us all a great service in making us reflect on why we are not dialetheists.

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ROSS BRADY. ***Universal logic.*** CSLI Lecture Notes, vol. 109. CSLI Publications, Stanford, 2006, xii + 346 pp.

This solid volume with the ominous black cover and eerie glowing disc lettered with inscrutable strings of characters such as "$\mathrm{DN}^d\mathrm{Q}$," "LSDJ^d," and "$\mathrm{L_2LDJQ}^{\pm}$" is the fruit of over 30 years of Ross Brady's logical labours. And it is worth the wait.

Since the early 1970s, Brady has been interested in strong theories of sets, in which the comprehension axiom, to the effect that every open sentence $\phi(x)$ (in the language of first order logic with the binary predicate '$\in$' for membership) determines some set. That is, theories in which the comprehension axiom (CA)

$$(\exists y)(\forall x)(x \in y \leftrightarrow \phi(x))$$

holds completely unrestrictedly. This means that according to such theories, there is a universal set (take $\phi(x)$ to be $x = x$, or perhaps $(\exists z)(x \in z)$ if we have no identity in the language) and each set a has a complement (take $\phi(x)$ to be $x \notin a$). This is not a cumulative hierarchy of sets familiar to us in set theories in the vicinity of ZF. This is Frege's (and our) naïve notion of sets, where every "property" determines an extension. This causes *trouble* as is well known from the paradoxes of Burali-Forti, Russell and Curry. We can form troublesome extensions: (CA) assures us that there is is a set of all non-selfmembered sets (take $\phi(x)$ to be $x \notin x$). Is such a set a member of itself or not? (CA) tells us that it is a member of itself if and only if it is not. Now, for most of us, this is enough to reject (CA). Not so for some. For some, the problem lies not with this axiom, but with the underlying logic. This is a minority view, but it has had its place in the literature from the pioneering work of Chang (*Infinite Valued Logic as a Basis for Set Theory*, in Y. Bar-Hillel, ed., ***Logic, Methodology and Philosophy of Science***, North-Holland, Amsterdam, 1965.). The motivation for this minority tradition is not hard to find. The paradoxes are genuinely puzzling and it seems that *every* option concerning them is worth exploring. We tend to treat proper classes as governed by the comprehension axiom in its unrestricted form, and in mathematical practice it is by no means clear that class talk is eliminable as a façon de parler. But once we treat classes as genuine members of the mathematical universe, they should be treated as members of classes in the same way as every other entity. So lies the way toward accepting (CA) *despite* the logical difficulties involved.

Those logical difficulties are not for the faint hearted. Fashioning one's logic in order to render a theory of comprehension non-trivial in the face of the paradoxes is not a straightforward matter. Or, rather, it is hard to do this and have a theory in which one can reconstruct mathematical reasoning. It is well-understood that moving to a three-valued logic such as Kleene's (in which we admit a 'gap' value, which is undesignated) or Priest's (with a 'glut' value, which is designated) renders the theory non-trivial. In the case of a Kleene-based theory, if r is the Russell class, $r \in r$ is neither true nor false (it takes the gap value) while with Priest, it is both true and false. However, I speak too swiftly, for this is not literally correct in the case of Kleene or Priest—for in these simple three-valued logics, the comprehension axiom is unstatable. These logics have no conditional or biconditional with which one can state (CA) and prove consequences form it. If we were to define $A \supset B$ as $\neg A \vee B$ in the usual manner, then in the case of Kleene's logic, $A \supset A$ is not valid (let A take the gap value), and in the case of Priest's, *modus ponens* for $\supset$ has counterexamples ($A \supset B$ and A may both be designated while B is not—let A be both true and false, and B be simply false). So, to have a recognisable conditional with which to represent the comprehension *axiom*, we must work harder. Curry's paradox (take for $\phi(x)$, $x \in x \rightarrow C$ where C is some statement we reject) shows us that any conditional present in a theory containing (CA) must reject inference principles such as *contraction* (from $p \rightarrow (p \rightarrow q)$ to infer $p \rightarrow q$) and an axiom form of *modus ponens* $(((p \rightarrow q) \wedge p) \rightarrow q)$. Such logics are not easy to find. One such logic is Łukasiewicz's infinitely valued logic, but it is now known that although (CA) is consistent in this logic, adding extensionality renders the theory inconsistent (see R. White *The Consistency o the Axiom of Comprehension in the Infinite Valued Predicate Logic of Łukasiewicz*, ***Journal of Philosophical Logic***, vol. 8, (1979)).

Where do we find Brady's work in this tradition? He has set himself a simple task: to craft a logical system appropriate for (CA) with extensionality, to motivate the logic, to *prove* that (CA) with extensionality may live happily with in it, and then to go on to show that one can recover much of classical set theoretical reasoning *despite* the weakness of the underlying logic. The task may be simple, but the accomplishment of it is no mean feat—it is to single-handedly paint a comprehensive position diametrically opposed to the orthodoxy of the bulk of the last century's work on set theory. And somehow, in this book, Brady manages to just about pull it all off.

The book divides into ten chapters. The first four concern Brady's target logical system, $\mathrm{DJ}^d\mathrm{Q}$, a quantified *depth-relevant* logic. Brady is in the tradition in *relevant* logic stemming from the work of Ackermann, Anderson and Belnap. As an Australian, Brady's immediate ancestors are Robert K. Meyer, and especially, Richard Sylvan (formerly, Richard Routley). With Sylvan, Brady shows a deep and settled preference for very *weak* logical systems: in $\mathrm{DJ}^d\mathrm{Q}$, the conditional connective '$\rightarrow$' expresses a notion of *entailment*, and not mere contingent conditionality. Relevance considerations rule out claims such as $p \rightarrow (q \rightarrow q)$, since whether or not p is the case has nothing to do with the truth of $q \rightarrow q$, in general. The conditional $p \rightarrow (q \rightarrow q)$ is *irrelevant*, as there need be no content shared between the antecedent p and the consequent $q \rightarrow q$. Brady's concerns are not merely with *relevance*, but with a stricter condition, *depth* relevance. The inference from $p \rightarrow (p \rightarrow q)$ to $p \rightarrow q$ cannot be faulted on grounds of everyday irrelevance: the 'subject matter' is shared between the premise and the conclusion. However, Brady notices a difference: the premise contains q to a different *depth* than the conclusion. The q in $p \rightarrow (p \rightarrow q)$ appears at depth 2, since it is under *two* conditionals. In the consequent, it occurs at a different depth. In the axiom of *modus ponens*: $((p \to q) \wedge p) \to q$, notice that q occurs in the antecedent at depth 1, while in the consequent, it is at the depth 0—the surface. So, it fails to be *depth relevant*. In fact, depth relevance considerations rule out all the principles known to cause havoc in the face of the paradoxes. If we look out for depth relevance, when we find it, we have the bonus of paradox tolerance. What does the resulting logic look like? Not all implicational principles fail the criteria of depth relevance. Principles such as

$$(p \to q) \wedge (q \to r) \to p \to r$$
$$(p \to q) \wedge (p \to r) \to p \to (q \wedge r) \quad (p \to r) \wedge (q \to r) \to (p \vee q) \to r$$

pass the test, and these principles form the basis of Brady's depth relevant logic $\mathrm{DJ}^d\mathrm{Q}$: it is a logic in the relevant family, extending distributive lattice principles for $\wedge$ and $\vee$ with a de Morgan negation, with the aforementioned entailment connective '$\to$', and with quantifiers with standard properties. In the first four chapters, Brady motivates and presents the logic, not with the usual ternary relational semantics, familiar in the model theory of relevant logics, but with Brady's own favoured 'content' semantics, intended to cash out the way in which the *content* of the consequent of a true entailment is to be found in the content of the antecedent, and to motivate $\mathrm{DJ}^d\mathrm{Q}$ as the one true logic of 'meaning containment.' This motivating account is, to my mind, the weakest aspect of the initial chapters of ***Universal Logic***. The argument that considerations of 'meaning containment' pin down just *this* relevant logic is weak. It depends on unreflective intuitions to the effect this meaning is contained in that one, and that this other meaning is not contained in that. In the absence of at least the hint of a theory of what a meaning might *be*, it is hard to judge this kind of argument as anything more than a sketch of how one account of meaning containment might go. As a decisive motivation of *this* logic rather than any other, it is lacking. I found most unsatisfactory the short argument in footnote 12 on page 18, intended to show that the distribution principle $(p \wedge (q \vee r) \to (p \vee q) \wedge (p \vee r))$ is motivated on grounds of meaning containment to be quite unhelpful. It is one thing to simply prefer logics with distribution over those without it, and even to argue that it is necessary in developing a theory of sets. It is another to think that you have a good *argument* ruling out non-distributive logics as an account of meaning containment. Brady doesn't give us a good argument, but he does give us an explanation of why he prefers to take the path that he does. That is enough to motivate the reader to at least consider the journey down that road.

These quibbles are merely a minor matter—the highlight of this book is not the motivation of $\mathrm{DJ}^d\mathrm{Q}$, and neither is it the detailed exposition of the properties of this logic. The highlight is found in the middle of the book, and it is the demonstration that in $\mathrm{DJ}^d\mathrm{Q}$, (CA) with extensionality is consistent. Brady's argument is a tour de force. In fact, Brady proves more. He shows that a *generalised* comprehension axiom is consistent. (GCA) is the stronger axiom

$$(\exists y)(\forall x)(x \in y \leftrightarrow \phi(x, y))$$

where now ϕ can contain not only x free but also the variable y. This axiom has nowhere near the intuitive support as does (CA), but the fact that Brady's model construction allows us to interpret (GCA) as well as (CA) is striking. The construction is the usual kind of fixed point matter, familiar to many from the work of Kripke (see his "Outline of a Theory of Truth," ***Journal of Philosophy***, vol. 72, 1975), but earlier discovered by Gilmore ("The Consistency of Partial Set Theory without Extensionality," in ***Axiomatic Set Theory***, *Proc. of Symp. in Pure Math.*, AMS, 1974; based on a presentation given at the Summer Institute on Axiomatic Set Theory in Los Angeles in 1967.) We construct an interpretation in stages, defining the status of $a \in \{x : \phi(x)\}$ at stage $\alpha + 1$ in terms of the status $\phi(a)$ at stage α.[1] We must fiddle at limit

[1]For (GCA), we define the status of $a \in \{xy : \phi(x, y)\}$ at α in terms of $\phi(a, \{xy : \phi(x, y)\})$. This is no trouble than the case for (CA).

stages, and we must fiddle even more to make sure that we interpret the conditional aright, since it has no straightforward truth-functional interpretation. With those finer points dealt with, we find a fixed point, at which the successor stage delivers no more an no less than what we already had, and this is our model—a model in which $a \in \{x : \phi(x)\}$ has the same semantic value as $\phi(x)$. Fixed points in the construction of a model allow us to model a theory in which every propositional function has a fixed point.[2]

Brady doesn't stop with the model construction. He defends a set-class distinction, in which (GCA) defines *classes*, and then we take *sets* to satisfy the traditional cumulative conception. The empty set is the empty class, and membership in this is unproblematically consistent and complete (everything is *not* a member). This means that classical reasoning applies here: we have no paradoxical funny business concerning $\emptyset$. It is plausible to think that classical reasoning applies also to those things constructed from $\emptyset$—at the very least the hereditarily finite sets, but perhaps also to all sets of the cumulative hierarchy. In this way, Brady paints a picture of a well-behaved classical domain of the cumulative hierarchy living inside the wilds of the non-classically structured universe of classes. One can have ones cake ((GCA) and its consequences), and follow along with traditional ZFC set theory too.

What are we to make of this program, and the way that Brady has executed it? Without a doubt, it is the most well-worked out non-classical theory of general proper classes. This very difficult territory to navigate and Brady has the patience and eye for detail to carve out amazing theorems from unpromising material. The non-triviality proof is a marvel. It is a mindboggling marvel that is not easy to take in at a single glance, but it is a marvel nonetheless. The result is a theory with a unique take on foundational issues in set theory, with something to say both of the naïve conception which takes (CA) as the ground of the concept of collecting this together in a class, and the *classical* concept in the cumulative hierarchy. Nothing else in this field has quite the scope of Brady's project.

What my caveats about Brady's execution of this program? It is merely in the motivation for the position. The motivating ideas are not going to be to everyone's taste. They are not to mine. I agree that relevance is important and depth-relevance is intriguing. However, in the absence of a genuine theory of content, gestures concerning concept containment can only hint at why $\mathrm{DJ}^d\mathrm{Q}$ is the right logic for content containment, and a lot more should be done to connect this concern to the concept of logical consequence if we are to say that this is the One True Logic, with Universal application in the way that Brady takes it to be.

Regardless. you don't need *those* ideas to motivate the book. $\mathrm{DJ}^d\mathrm{Q}$ has defence enough when you see that with this contraption you can build the mighty and intriguing edifice of Brady's set/class theory. That is more than enough reason to be interested. All those interested in tackling the paradoxes at the limits of class theory would do well to invest some time and energy grappling with the results of this fine work.

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K. SIGMUND, J. DAWSON, AND K. MÜHLBERGER. ***Kurt Gödel: Das Album. The Album.*** Vieweg, Wiesbaden 2006, 225 pp.

The book under review is opened by a preface written by the German poet Hans Magnus Enzensberger. He writes: "It is not only mathematicians who recognise that Kurt Gödel was the greatest logician of the twentieth century. This view has spread slowly, but surely over the decades. Gödel has been compared to Aristotle, the founder of classical logic." Enzensberger does not remain silent concerning the difficulties of Gödel's work given "a

[2]The fixed point for negation is the statement $r \in r$, where r is $\{x : x \notin x\}$, since we have $r \in r \leftrightarrow \neg(r \in r)$. This generalises to any propositional function: we have $\{x : F(x \in x)\} \in \{x : F(x \in x)\} \leftrightarrow F(\{x : F(x \in x)\} \in \{x : F(x \in x)\})$ for any propositional function F.

civilization with hardly any notion of pure mathematical research." Everyone who has ever strived through his 1931 landmark paper must have realized that something decisive had happened, but Gödel "would probably have protested against the far reaching conclusions that non-mathematicians have derived from his investigations." However, Enzensberger asks "And is it not an indication of Gödel's greatness that his ideas have infiltrated philosophical discourse thoughout the world?" This process of infiltration led to "methodological impurities, misunderstandings and diverging interpretations" quite similar to the fate of the theories of Darwin and Einstein. Enzensberger pleads for standing such developments: "There is no science without risks and side-effects. And who knows, maybe they do not only cause harm. They may even turn out to be productive" (p. 7). Enzensberger's preface gives a fine motivation for this popular book on the legendary genius Gödel. Although *Time Magazine* has listed him among the hundred most important persons of the twentieth century, little information about his life has entered public consciousness.

The volume under review does not attempt to contribute to the educated discourse about Gödel's incompleteness theorem, but has a "more modest aim". The authors write that "it hopes to give a simple intuitive and easily digestible introduction, meant for readers interested in the human and cultural aspects of science" (p. 12). It constitutes the catalog of the exhibition "Gödel's Jahrhundert" presented at the 2006 Vienna congress on the occasion of Gödel's 100th birthday.

The album contains numerous pictures, small in size, but excellent in quality, accompanied by bi-lingual texts in German and English, giving related information. The material contains private and official photographs, personal documents, pieces of correspondences and documents from official files, in particular in university matters. Further documents give impressions of "Gödel's world", the political, social and cultural circumstances of his life.

The material is organised in three sections: "Gödel's Life", "Gödel's Work", and "Gödel's Vienna". The first section is the longest one. It presents family documents from Gödel's childhood, and his school and university studies. It also allows interesting insights into the context of his scientific breakthrough, the role of the Vienna Circle and Karl Menger's Mathematical Colloquium. The authors spend special attention to Gödel's fate in the 1930s which saw him at the Institute of Advanced Studies, Princeton, for two times. During the second stay in 1935 he suffered there from a severe psychic crisis. The murder of Hans Hahn in 1936, the national socialist coordination of Austria in 1938 and the problems to get his teaching allowance after his return from a third stay in USA in summer 1939 drove him into emigration. Secret documents from NS officials and from the university attest him that he "had moved in liberal-Jewish circles", in a time when mathematics was under strong Jewish influence ("stark verjuded"). Gödel was said to have "hardly a deeply-felt relationship with National Socialism" and seemed to be completely apolitical. Further documents illustrate his life as a permanent member of the Institute of Advanced Studies, and his tragic end: he died on 14 January 1978 of exhaustion and malnutrition.

In the second section Gödel's work is set into its scientific context. His foundational studies are connected to Hilbert's program. The impact of Gödel's first presentation of his incompleteness results during the conference at Königsberg in September 1930 is illustrated. Connections to the continuum hypothesis and the theory of computation are drawn. Further parts of this section are devoted to his friendship with Albert Einstein, his own cosmological studies on rotating universes and time travels. His philosophical considerations are described. A reproduction of Gödel's ontological proof of the existence of God is among the documents.

The last section gives a vivid impression of the scientific atmosphere in Vienna in the first decades of the 20th century, at least in circles devoted to mathematics and philosophy of science. Topics are Hans Hahn's Mathematics Institute and Karl Menger's Mathematical Colloquium. Other colleagues and important persons in mathematics, physics, and philosophy are mentioned. The Vienna Circle and related persons like Wittgenstein and Popper are treated, as well as writers with some affinity to mathematical topics like Robert Musil and Hermann Broch, and finally Hans Magnus Enzensberger, who unsuccessfully tried to interview Gödel in 1974. The volume is closed by two texts, Gödel's synopsis of his incompleteness results first published in 1931, and Karl Menger's 1932 lecture on the new logic.

This inspiring volume goes far beyond an album illustrating the life of a famous person. It deals in a very intuitive way with the birth of modern philosophy of science and foundational studies, Gödel being the focus point, but never the exclusive target. The album thereby leads to a very broad picture of an exciting development.

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JONATHAN BARNES. ***Truth, etc.*** Oxford University Press, Oxford, New York, 2007, viii + 568 pp.

As the role of formal methods in philosophy is increasingly discussed and disputed, it is interesting to learn that even that question dates back a couple of millennia. The status of logic, or its ancient counterpart, syllogistic, was a constituent part of much of Stoic philosophy, but altogether repudiated by Epicurus. It was held either as a part of philosophy (Stoics), as a tool for philosophy (Aristotle's followers), or as both a part of philosophy but also of instrumental value (Academics such as Plato). If it was regarded as merely a tool for philosophy, some took this to mean that much of the syllogistic is useless. All this we may learn from Jonathan Barnes' *Truth, etc.* (pp. 452–457). And not only that. *Truth, etc.* consists of six chapters that are revised and enlarged versions of the six John Locke lectures Barnes gave in Oxford in the summer of 2004. Contrary to what the title of the book might suggest, *Truth, etc.*, is about ancient logic with Aristotle as the main character. Before discussing the status and the use of logic in ancient philosophy in the final chapter, Barnes provides us with chapters on truth, predicates and subjects, connectors, forms of argument, and the science of logic, each with lengthy explanations of issues of translation (the original Greek quotes are included in the footnotes), references to ancient commentaries, all written with a witty and erudite elan.

The chapter entitled 'Truth' does not discuss theories of truth as we know them but questions raised by Cicero's report that 'Chrysippus strains every sinew in order to persuade us that every assertible is either true or false'. According to Barnes, the principle in question differs from the Principle of Bivalence as we know it in three ways: first, in assuming an exclusive 'or' (this is odd; is this just another way to say that the logic in question was not truth-functional?); second, Chrysippus talks about assertibles (ἀξίομα, the transcription of the term would give 'an axiom') whereas the modern principle is about propositions; and third, in ancient logic truth-values are generally timed. Much of the chapter then focuses on times and tenses in ancient logic. In particular, the assertibles that deal with future contingencies are neither true nor false, and thus offer a counter example against bivalence. Chrysippus defended his principle primarily against Epicurus who denied it in order to avoid fatalism. Barnes's discussion of the various aspects of the debate reveals that the notion of truth in question is related to causes, i.e., that the future truth is related to a present cause whereby something will be the case in the future. Hence, the ancient principle of bivalence is a fatalistic principle about physics rather than a principle of logic. Some comparison to modern theories of truth and, perhaps, to intuitionists' rejection of the law of the excluded middle would have made the chapter even more interesting.

The second chapter deals with predicates and subjects, beginning with an examination whether they are originally logical or grammatical categories. According to Barnes, their home is in Aristotelian logic, and they have nothing to do with grammar, ancient nor mediaeval. The Stoics and with them Dionysius Thrax are an exception to the rule: they took certain grammatical notions to signify types of predicates and thus established a link between grammar and logic (p. 103). Likewise, it seems that in the simplest sentences of Aristotelian logic consisting of a name and a verb, the name corresponds to the subject and apparently the verbs and the predicates are conflated (pp. 112–113). What then are the predicates and subjects? Words? Thoughts? Things? According to Barnes, the Porphyrean account, defining predicates as expressions that signify thoughts, was generally accepted in late antiquity. To what extent, though, is this view faithful to Aristotle? According to Barnes, the view together with the homogeneity requirement of the Aristotelian syllogistic (i.e., "any item which is a predicate may also be a subject, any item which is a subject may also be a predicate"(p. 118)) is "at least as good as any other account" of what Aristotle really meant to say or ought to have said (p. 123). Barnes goes on to reflect on whether subjects and predicates must literally be parts of the sentences of which they are subjects and predicates (the answer is 'no'), and then to the problem that sentences admit multiple analyses (not however generally recognized by ancient logicians). Then he discusses the styles of predication (i.e., A, E, I, and O), transitivity of predication, and singular predication. It is often thought that singular sentences pose a problem for Aristotelian logic, but Barnes shows that Aristotle held that individuals or singular terms may be subjects, and according to the homogeneity requirement, they could function as predicates as well. Hence there is a good reason to think that singular propositions could appear as components of Aristotelian syllogisms. But the problem is that singular terms may not feature in any of the four styles of predication, and the syllogisms use only quantified propositions. Barnes's way out of the dilemma is to claim that singular sentences should be construed as universally quantified sentences. And that, according to Barnes, is Aristotle's view too. The chapter is rather long and technical, and its philosophical significance remains unclear. For example, Barnes presents ancient predicates as two-placed relations. One would wish to hear at least some explanation and elaboration of the significance of this view.

The third chapter, 95 pages in length, dives into subtleties of the ancient counterpart of the sentential connectives, for which Barnes uses the word 'connector'. To Aristotle a connector is a non-significant expression that takes two or more significant expressions and produces a significant expression (p. 177). One consequence of the definition is that negation is not a connector. Connectors do not unite only sentences but significant expressions of any length into an expression. According to the Stoics, however, connectors connect parts of sayings, and almost all Greek or Latin grammarians follow the Stoics on this point. Somewhat surprisingly prepositions, copula, and modal adverbs were also sometimes considered to be connectors. The lengthy discussion on the grammar of the connectors is somewhat exhausting, certainly quite exhaustive. The end of the chapter has more appeal to the present reader, including discussion whether connectors should or should not be likened to glue or pitch, and the ensuing discussion of the meanings of the connectors. Apollonius (2nd century AD, Alexandrian scholar) for example, came close to the context principle (pp. 247–249).

Another 95-pager is then devoted to syllogisms. With an interesting exception of Galen and possibly some others, most ancients believed that there are two species of syllogisms: Greek categorical, i.e., predicative syllogisms, and Stoic hypothetical syllogisms. In the former the validity turns on the properties of the predication, in the latter on the logical properties of conditionals, disjunctions and conjunctions. Galen's third species consists of relational syllogisms. From the various divisions of syllogisms Barnes moves to explore in what sense syllogisms were formal and to what extent they were symbolic. Some interesting philosophical issues are touched upon here, such as what is meant by 'formal logic' and what by 'symbolic logic' and how the two are connected. In the ancient logic, the syllogistic forms were presented in two fashions: by circumscription and schematically. Circumscriptions are informal descriptions of argument forms. The schematic representations are used to add clarity to the informal descriptions. This takes us to a discussion of the subsyllogistic (i.e., derivable) ways of expressing syllogisms, Stoic and Peripatetic uses of symbols. There are many interesting remarks here such as a discussion of Aristotle's use of syllogistic letters, and whether the letters should be construed as variables or not.

In the fifth chapter Barnes gives a beautiful account of Aristotelian view of logic as an axiomatic system. According to Aristotle, science is concerned with a single class of things (like geometry or zoology) and it argues about the objects in this single class of things from first principles, that is, from axioms. Dialectic is not a science, but what about syllogistic? Even if Alexander thought that Aristotle's syllogistic was not a science, it had the structure of an axiomatized deductive science: Aristotle's (non-modal) predicative syllogistic contains 'perfect' and imperfect' syllogisms. The four perfect syllogisms are the four canonical syllogisms of the first figure: Barbara, Celarent, Darii, Ferio. The syllogisms in the second and the third figure are all imperfect. Aristotle shows imperfect syllogisms to be valid by reducing them to the perfect syllogisms. Barnes shows explicitly how this is done. Contrary to the common claim that Aristotle's syllogistic was a finite system embracing fourteen to twenty-four argument forms, Barnes establishes that the syllogistic includes infinitely many theorems. Strictly speaking, according to Barnes, Aristotelian predicative syllogistic assumes an axiomatic structure such that Barbara and Celarent are the only axiomatic syllogisms (i.e., axioms) to which the other syllogisms can be reduced. In addition the Aristotelian proofs depend on certain principles of conversion and subordination, a principle of reduction to the impossible, and a rule of exposition or ecthesis. Among the theorems there are certain derived principles of conversion and subordination, and an infinite number of syllogisms. The reader remains a bit unclear about the inference rules as opposed to axioms, but in general the point is well taken.

What then is the status of the axioms? In what sense are they perfect, unproved or unprovable, and primary? After an involved elaboration we find out that the unproveds are unproved in so far as their validity is evident, that is to say, they are perfect (p. 382). According to Barnes, Aristotle's view of evidence is based on the *Dictum de omni et nullo*, that is to say, on *Prior Analytics* 24b25–30, where Aristotle writes: "For one thing to be in another as in a whole and for the other to be predicated of all of the one is the same thing. We say that it is predicated of every when you can't take anything of which the other will not be said. And in the same way for of none." According to Barnes, the principle is used to explain or justify the perfect syllogisms. The validity of a perfect syllogism is evident inasmuch as it is underwritten by the *dictum de omni et nullo* (p. 393). The dictum articulates the sense of the words "every" and "no", and hence renders the perfect syllogisms evident by virtue of the meanings of the terms involved. Barnes then goes on to discuss a similar solution for hypothetical syllogisms. Barnes construes two dicta for the unproveds in the Stoic logic, which he names as *dictum de si* and *dictum de aut*. The Stoics did not appeal to these dicta the way in which Aristotle appealed to the *dictum de omni*, but according to Barnes they could have done so (p. 399). The chapter ends with an interesting discussion of Galen's metatheorem: "Syllogisms owe their force to the universal axioms to which they are subordinated"(p. 419).

The chapter gives a beautiful answer to the question of justification of syllogistic logic. But it also makes clear how one-sided Barnes' approach is. The dialectic between different kinds of philosophical approaches is silenced to death and the matter of axiomatics is dealt with as if Aristotle was the only one with anything interesting to say on the topic. Barnes's discussion of evidence is as short as possible, and few remarks about intuition are prejudiced. The problem is that Aristotelian solution does not help us if we shift our focus of interest from logic to mathematics. Had the chapter been written from the point of view of justifying the exact sciences, it would have looked entirely different, with much more room for Plato and Euclid, and the commentators inspired by these figures.

Something of the sort can almost be found in the final chapter which starts with a brief allusion to Plotinus' account of logic and its role in philosophy. But most of the chapter is then devoted to discussing Aristotle's view that syllogistic has instrumental value in its contribution to the production of scientific proofs. Whether or not Aristotle meant that logic has only instrumental utility, in his footsteps Alexander and Galen then adopted what Barnes calls a "utilitarian view of logic", a view that makes syllogisms tools and not objects of study. Barnes then goes on to discuss the philosophical ramifications of this view. According to Barnes, this led Galen to reject modal syllogisms as superfluous because he noticed that the sciences do not use modal propositions. Likewise Galen held that argument forms that are not useful for proofs are not syllogisms.

In the Preface, Barnes laconically states that 'Ancient logic lacks sex appeal' (p. vii). Here are two observations in response: First, Barnes certainly does a superb job in presenting ancient logic with language and examples that more than once leave the reader smiling. However, for the actual content of the book it would have been more beneficial, had Barnes been less in love with his own text and edited it into two thirds of its current length. Second, sex appeal is to some extent in the eye of the beholder. To Barnes ancient logic is an Aristotelian technique which he discusses with the eye of the modern logician. But to him, modern logic amounts to the contents of an ordinary Intro to Logic course and he assumes a consensus as to what logic really is. Logic is an undisputed technique to him, and the philosophical assumptions do not much figure in one's take on logic. It seems that to Barnes there are no philosophically interesting questions related to the modern logic and this shows in his approach to the ancient logic. Instead of presenting the development of ancient logic as a dialogue involving different kinds of philosophical points of view, Barnes focuses on details of Aristotelian syllogistic. Thus Barnes reaches a conclusion that is a major let-down: "we are all better at logic than Galen was—we are better at logic than Chrysippus was, and than Aristotle was" writes Barnes. So why bother? In his view of ancient logic as a philosophically neutral technique together with his somewhat naïve attitude towards modern logic, Barnes misses an opportunity to find ways in which we could learn something from the ancients in the philosophical matters related to logic.

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