Handbook of the history of logic, edited by Dov M. Gabbay and John Woods, Volume 1: Greek, Indian and Arabic logic. Elsevier, Amsterdam, 2004, viii + 618 pp.—therein:

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This is the first book in a series of several large volumes on the history of logic. This series adresses " ... members of the research communities in logic, history of logic and philosophy of logic, as well as those in kindred areas such as computer science, artificial intelligence, cognitive psychology, argumentation theory and history of ideas ... The ***Handbook of the history of logic*** aims at being a definitive research work for any member of the relevant research communities" (from the Preface). — The first volume has, in accordance with its title, three main areas: Greek Logic (Aristotelian logic, Stoic logic — five articles, 437 pages), Arabic logic (two articles, 83 pages), Indian logic (one article of 85 pages). Thus this ***Handbook*** continues with a tradition, which was begun by *Bocheński*, of including a certain amount of discussion on non-European logic. Indian and Arabian logic are very different in this respect: Whilst Arabian logic is a direct offspring of Greek logic and, since the Middle ages, has entered the main stream of European logic once again, Indian logic is considered to have grown up independently of the Greek tradition. Let us remark that this volume of the ***Handbook of the history of logic*** does not contain any information on the only logic which is based on a non-Indo-European language: Chinese logic. We will return to this point later on.

There are inherent obstacles impeding our understanding of the achievements of our logical ancestors. The work of many a great logician suffered from serious interpretative faults of posterity. Aristotelian Logic has been the main target for misleading interpretational attacks for more than 2000 years, and Stoic logic has undergone a continuous maltreatment almost up to the present day. Concerning the Stoics, O'Toole and Jennings, in their masterful chapter in the book under review, point to the problematic role of historians of logic like Prantl and Zeller who had not enough formal background and interest to enable them to differentiate between the Aristotelian logic of terms and the Stoic logic of propositions. Today, in the age of mathematical logic, we frequently meet another kind of misinterpretation of ancient logics, committed even by outstanding logicians (and historians!) like Łukasiewicz and Bocheński: It is not that we know too little of formal and symbolic systems, but, on the contrary, " ... that there is a danger that the historian of logic possessing this requisite of mathematical logic may allow his or her familiarity with the discipline to obscure, or even distort, the historical enterprise" (p. 398). Thus, O'Toole and Jennings try to " ... attempt an interpretation of Stoic logic less coloured by a reverence for modern formal systems, and more in harmony with what the texts seem to indicate as being the place of logic in the Stoic system as a whole" (p. 400). This statement could serve as a motto for the whole handbook series!

The first chapter by J. Moravcsik, "Logic before Aristotle: Development or Birth?" gives some answers to the question "was there logic before Aristotle in Western Culture?" The author traces the development of what was a necessary background for logic as a formal discipline, relying on the work of Bruno Snell, under the general headline "from myth to logic". The paper concentrates on a discussion of concepts and vocabulary presupposed by logic (Chapter 1), gives an account of the links between logic and definition (Chapter 2) and, in the last chapter, elaborates on the differences between Plato's Method of Division and

Aristotle's logical deduction. The summary of the paper contains the following sentences: "Our main point is that the rise of logic is both a matter of development and the matter of instantaneous creation. The required vocabulary must have a historical process preceding it. Once that is in place, the possibility of constructing a logic is there" (p. 21).

In the second chapter, "Aristotle's Early Logic", John Woods and Andrew Irvine focus on Aristotle's works ***Topics*** and ***On Sophistical refutations***. They assert " ... that the logical theory of the ***Analytica Priora*** presupposes Aristotle's theory of syllogisms ... These theories appear implicitly in the ***Topics*** and ***On Sophistical refutation***" (p. 34). The authors consider the works within the ***Organon***, the ***Categories*** and ***On interpretation***, not to be about logic at all, so it is only consequent that they exclude them from discussion within their paper on Aristotle's Early Logic. Let me just remark that only few experts in the field would ascribe to this point of view; however, we cannot step into the details here. (See the review of David Hitchcock, which is to appear in ***Argumentation*** vol. 18 (2004), regarding John Woods book ***Aristotle's earlier logic***, Oxford: Hermes Science, 2001, from which significiant parts of the chapter are drawn).

The third chapter by George Boger, "Aristotle's Underlying Logic", is the central one on Aristotle's logic within this volume. Boger says "Our concern here is to present Aristotle's system of logic while also revealing the mathematical sophistication of his logical investigations" (p. 113) which shows that his work belongs to the line of research begun by Łukasiewicz and continued by Smiley and Corcoran. Boger neither overemphasizes the value of symbolic representation of his findings nor restricts himself too much to a pure philological inquiry into Aristotle's works. — The chapter begins with a presentation of Aristotle's early work, the ***Categories***, ***On interpretation***, and ***Metaphysics*** which are the very basis for everything Aristotle writes on the subject of logic later on in his ***Prior analytics***. The basic concepts comprise the two types of declarative sentence, namely, *kataphasis* and *apophasis*, their connection to the four categorial sentence patterns (*problêmata*) , and the notions of contradiction and contraries (*hai antiphaseis* and *ta enantia*). Let us note that Boger's presentation does not completely solve the problem of the exact relation of Aristotle's ***Categories*** to the ***Prior analytics***: Whilst, in the ***Categories***, the roles of subject and predicates in a proposition are by no means symmetrical, the whole formalism of the syllogistic relies on the interchangeability of the subject and predicate of a proposition. Thus, there is no "smooth transition" from the early works of Aristotle to the formal system of the ***Analytica Priora***, and this certainly requires further research efforts. — The next subsection deals with the semantics of Aristotelian logic, and the following main part of the chapter is concerned with Aristotle's formal system of deduction, comprising — in addition to the elements already mentioned — three conversion rules, 14 syllogism rules, and two kinds (direct and indirect) of deduction. Boger presents his investigations into Aristotle's system within a kind of a system of natural deduction, thus following the "deductionist" way of interpretation, begun by Smiley and Corcoran in the 1970's. This interpretation accords much more to the text of the ***Prior analytics*** than Łukasiewicz' "axiomatic" formalism, published in his groundbreaking book from 1950. — Boger then describes the processes of completion (*teleiousthai*), which Aristotle utilizes in order to show that 10 of the 14 categorical syllogistic rules are — in modern terms — *derived rules* in the sense that they can be shown to be valid by deducing them from the four "basic" syllogisms of the first figure. This set of four basic syllogisms shrinks further (Pr. An. A 7) by Aristotle's proof that two of the syllogism rules of the first figure, *Darii* and *Ferio*, can also be completed — indirectly (by *reductio ad absurdum*) — to *Barbara* and *Celarent*. Boger emphasises the differences between the processes of completion, reduction, and analysis, however, his lines of distinction would deserve a detailled discussion which cannot be given here. This holds especially for his relatively short description of the process of "analysis", a concept which we believe can only be fully understood by diving deeper into Book B of the ***Prior analytics***. The chapter also contains a detailed section on

Aristotle's method of showing the inconcludence of "patterns not resulting in a syllogism". Boger's tables on this subject (pp. 198, 199, 200) will probably become the standard reference to this part of Aristotle's logic. – The whole chapter will be of interest to a wide audience, and its careful style of examination may be considered as a prototype for a thorough research on an ancient logic and as a solid basis for further research.

Fred Johnson's chapter on "Aristotle's Modal Syllogisms" is the continuation of a line of formal interpretation of Aristotle's logic which was begun by Łukasiewicz. Johnson starts by presenting Łukasiewicz's formal system for assertoric syllogistics, and he then explains his theory of rejection. The main part of the chapter is concerned with the syntax and semantics of modern modal systems which are more or less capable of reproducing Aristotle's results on modal syllogisms (Johnson introduces an "index of Aristotelicity" of a formal system). Whilst this chapter — in particular the extensive occupation with semantics — is of eminent value for researchers in the field of mathematical methods in modal logic, historians of Aristotle's logic, however, will probably not feel satisfied. Johnson's approach shares all the disadvantages of Łukasiewicz' method, which does not aim to conform as much as possible to the classical text but to invent an axiomatic system which produces as many classical theorems as possible. Thus Johnson's interesting chapter is more a contribution to the history and theory of modern formal interpretation of Aristotle's modal system than an article on Aristotle's modal system itself.

Chapter five contains the sole article on non-European logic within this volume, and, as it seems, within the whole series. J. Ganeri's chapter, entitled "Indian Logic" thus covers an immense amount of material, ranging from ancient Nyāya logic of some centuries B.C. until the Navya Nyāya of the middle ages (about 1300 AD). This is a project which, from the very concept, could not, and, in fact, did not succeed. Indian logic is not just an appendix to European logic, and it is not adequate to add an Indian fig leaf to a western-oriented "History of Logic". One should be aware of the fact that the Indian rooted logic provides us with formal logic systems which are not based on the Greek tradition, and this should be considered as an opportunity to critically reflect on our own tradition and the self-conception of our logic. However, this would require a careful discussion of the historical and philosophical background of Indian logic. In contrast to this, Ganeri's chapter "Indian Logic" is an attempt to provide a Western reader with a set of highlights of Indian logic and to show how these topics can be framed into certain systems of formal symbolic logical environments. Section 1 is on argumentation and debate, containing the "five-membered Indian syllogism", Section 2 on the Buddhist *trairūpya* theory and Dińnāga's 'wheel of reasons' (*hetucakra*), Section 3 on Jaina logic, and Section 4 on logic in Navya–Nyāya. Within each section, Ganeri utilises a different system of symbolic logic in order to make the Indian ideas understandable to Western readers: He uses standard predicate logic in Section 1, the theory of classes in Section 2, a kind of "assertion logic" in Section 3, and a graph-theoretical formalism in Section 4. While this appears to be helpful for a reader who is experiencing his first contact with Indian logic, one should always be aware of the danger of imputing ideas from our own modern logic into an ancient system. — It is certainly not possible to do justice to Ganeri's chapter on Indian logic within this overall review. Nevertheless, I will add three critical remarks regarding the content of the paper. The first one is on Ganeri's formalisation of the "five-step schema" of the Nyāyasūtra. Quite in the tradition of St. Schayer, Ganeri speaks of the schema as "five-step proof" (p. 324), thus taking for granted that the Naiyāyikas disposed of a concept of a deductive system like we have today. In addition, Ganeri makes no mention about the discrepancy between his own interpretation on pp. 324–6 and Schayer's interpretation on p. 327, which is radically different with respect to the meaning of the fourth step (application, *upanaya*). — The second remark concerns subsection 2.1. Here the author employs a notational system which is not precise: He does not make a distinction between symbols for classes (or sets) and properties which define these classes. On p. 343, he writes

about a "property S", and some lines below he writes "A reason property for S is any member of the class $\{X: X \cap \neq \emptyset \ \ \& \ \ X \cap \text{non}S = \emptyset\}$." Thus, we have a property, a class, and members of this class, but there is no precise notational differentiation between these types. The third remark concerns Diṅnāga's *hetucakra* in Section 2. Here Ganeri does not utilise symbolic methods which would have been of some help. The *hetucakra* is one of the few examples in Indian logic where there is a very clear formal structure which cries out for a symbolic representation. However, I do not blame Ganeri for not having employed symbolic tools, but for having given an incomplete representation of the content of the *hetucakra*: In his Figure 3 on p. 346, a complete column is missing. This column should contain, in rows 4–9, Diṅnāga's six examples for which h (*hetu*) is missing, but s (*sādhya*) is present: space – space – space – space – lightning – atom (see Chatterji's translation of the *hetucakra*, cited in the bibliography of the article under review).

"The Megarians and the Stoics" by Robert R. O'Toole and Raymond E. Jennings is one of the central chapters of this handbook. To be precise, the essay is concerned mainly with the logical doctrines of the Early Stoa (Zeno, Kleanthes, and Chrysippus). The authors begin with comments on the history of misunderstandings and misconceptions of Stoic logic by historians like Prantl and Zeller as well as by Łukasiewicz, Mates, Bocheński, the Kneales and others. "The obstacle for both the later and earlier writers, it seems to us, is that they have allowed their preconceptions to obscure their understanding" (p. 399). One of the main assertions of the authors is that " ... it is surely false that the logical connectives which appear in the Stoic syllogisms were in general defined as binary connectives" (p. 398). O'Toole and Jennings show meticulously how the edifice of Stoic logic is founded on Stoic ethics, epistemology, ontology and their understanding of semantics and inference. The authors go deep into a discussion of the role of *lekta, pragma* and *axiōmata* as a prerequisite for the understanding of the building blocks of Stoic formal logic. It is impossible, at this point, to review this chapter of the handbook — it certainly deserves a separate review. This article will probably become the standard reference for anyone interested in Stoic logic.

The last two chapters of the Handbook are devoted to Arabic logic. Tony Street's chapter "Arabic Logic" should, in the words of the author (p. 526), more precisely be titled as "Peripatetic logical writings in Arabic produced in the realms of Islam between 750 and 1350, with special reference to the syllogistic." The chapter contains sections on "The Translation of the Organon", "Alfarabi and Avicenna", "Logic and the Islamic Disciplines" and "Logic after Avicenna". Besides an extensive Biibliography, there are appendices A: "Avicenna's Modals", B: "Later Modal Logic", and C: "Bibliographical Notes". This chapter is an excellent introduction into the subject and a starting point for further research.

Charles Burnett's short (10 pages) interesting chapter titled "The Translation of Arabic Works on Logic into Latin in the Middle Ages and Renaissance" gives answers to the question: Why was there any need to translate the texts of the ***Organon*** from Arabic into Latin during the twelfth and thirteenth century, given that Latin scholars " ... already had good translations of at least the first half of the ***Organon*** ... , made by Boethius in the early sixth century. And, when they wished to complete the ***Organon***, they were able to do so by translating the texts directly from the Greek" (p. 597)?

Let me add some remarks concerning the concept and realization of this Volume 1 of the "Handbook". In their short Preface, the editors write about the freedom given to the authors " ... to develop their own interpretation of things." It goes without saying that such a liberal approach has not only advantages. Concerning the subject of "Indian Logic", this approach was not successful, as we tried to show in our review of the corresponding chapter. Indian logic, together with its offsprings based on Buddhist logic in Tibet and China, is such a vast subject that it would deserve a volume of its own. Alternatively, an article comparable in scope and style to the one on Stoic logic would have been an appropriate choice. — Considering the fact that "Arabic Logic", in this Volume of the Handbook, has as

the subject "Aristotelian syllogistic in Arabic writings between 750 and 1350", it is not clear why "Arabic Logic" was included in the title of the book or why the articles on this subject are not published in their appropriate historical context. Was this just an attempt to "sex up" the title?

In addition to my remark on the absence of a chapter on China at the beginning of this review, I want to make a short comment on the importance of Chinese logic. It is well known that, long before Buddhist logic came from India, there existed also an indigenous Chinese logic of the later Mohists around the 3rd century B.C. An introduction into this subject as well as into the later Chinese Buddhist logic is given by Joseph Needham and Christoph Harbsmeier, ***Science and civilisation in China, volume 7***, Part I, Language and Logic in Traditional China. Cambridge University Press: Cambridge, 1998. We agree with Harbsmeier, who writes on p. xxi of that book: "The history of logic reflection in China is therefore [because of its being based on a non-Indo-European language; K.G.] of extraordinary interest for any global history of logic and hence for any global history of the foundations of science." The absence of a chapter on Chinese logic in the ***Handbook on the history of logic*** must be considered as a lost opportunity which is not due to a lack of literature on this subject (see also A. C. Graham, ***Later Mohist logic, ethics and science***. The Chinese University Press, Hong Kong, 1978).

The volume under review has an Index which is of limited value because references to the chapters on Indian Logic, Stoic logic and on the last chapter are missing. Some chapters (e.g., Boger's article) are troubled by typesetting errors which are too numerous to report here. On p. 372, items 1–4 of a list are missing. An entertaining type of error occurs repeatedly in the chapter on Stoic logic: "$\alpha\nu\delta\ \alpha\nu o\tau\eta\varepsilon\rho\ \tau\iota\mu\varepsilon\ \alpha\gamma\alpha\iota\nu\sigma\tau\ \iota\tau\ \ldots$ " (p. 413, see also pp. 411, 413, 415, and others), is not Greek, but English: "and another time against it ... ".

Notwithstanding these critical remarks, this Volume 1 of the "Handbook of the History of Logic" is of value due to the excellent chapters by George Boger on Aristotle's syllogistic logic, by Robert R. O'Toole and Raymond E. Jennings on Stoic logic, and because of the two chapters on Arabic Logic by Tony Street and Charles Burnett.

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