J. MACNAMARA, *A border dispute. The place of logic in psychology*. Cambridge, Mass. and London: M. I. T. Press. 1986. xviii + 212 pp. £22.50.

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Cognitive science rests on the idea that there is a natural kind—call it *thinking* or *cognition*—capable of being investigated independently of any specific realization in (for example) a human brain. Most cognitive scientists are, it turns out, wedded to the assumption that this same natural kind can be realized also in suitably programmed computers. Hence cognitive scientists tend to concentrate on those aspects of thinking which bear promise of yielding models of a computational sort. The present work, in contrast, is a contribution to the science of human cognitive performances on their own terms. More precisely, it looks at the cognitive *competences* which make such performances possible, and seeks to defend a conception of logic as a science of competence in thinking, as psychology is a science of performance. This of course leads immediately to the idea that the author must in some way be guilty of psychologism. He strives, however, to avoid this charge by pointing out that even the most extreme logical Platonist must admit that logical structures are in some way realized in our minds, and then the 'logic' with which he is here concerned relates precisely to this mental realization.

The mind, we are to assume, applies the principles of a 'basic mental logic'. This comprises (1) linguistic resources in the mind sufficient to express propositions, (2) the ability to understand sentences formed with these linguistic resources, and (3) the ability to grasp inferences among such sentences.

Basic mental logic is unlearned, and logic is in this sense contrasted with other disciplines such as group theory or geology. We can however learn about basic logic by studying the ways in which logic first manifests itself in the thinking of the infant. Much of the present work is accordingly devoted to consideration of the acquisition of logically relevant parts of natural language, or with the ways in which infants acquire the facility to operate with terms like 'and', 'or', 'not', 'is', 'same', 'true', and so on.

Basic mental logic is unlearned in the sense that when we teach logic to the novice we must appeal constantly to prior intuitions on his part in order to bring him to recognise the presence or absence of validity, and these intuitions are themselves of a logical nature. They cannot themselves be taught by means of further arguments at some deeper level (so that, as Lewis Carroll showed, children cannot learn that *modus ponens* is a valid rule of inference). Hence, too, basic mental logic cannot be an empirical generalization, and this the author sees as one principal outcome of the debate on psychologism.

Talk of basic mental logic is of course, like all talk of competence, both an abstraction and an idealization. We must abstract from errors of grammar and of reasoning and from all matters of style and rhetorical force and we must concern

ourselves with an ideal speaker-listener. As the geometer deals not with this or that actual triangle but with idealized figures, so the logician deals not with these and those actual dispositional properties which constitute the basic mental logic of Tom or Dick, but with a system of dispositional properties conceived *in specie*.

The components of basic mental logic, as Macnamara understands it, are (capacities or competences associated with our use of) the basic logical connectives and quantifiers, names, demonstratives, sortals, indexicals, identity, and pronouns (especially 'I' and 'me'). The author is interested particularly in the special role of sortal terms like *dog, animal, person* in the infant's linguistic repertoire. Above all, he lays grest stress on the distinction between predicates and sortals, a distinction which orthodox logic ignores but which is crucial from the point of view of the cognitive and developmental psychologist. Not only 'and' and 'not' but also 'is a member of kind . . .' and 'is the same as . . .' are unlearned expressions in the language of thought. He shows how the learning and use of sortals is bound up intimately with the learning and use of proper names and of expressions for identity, as also with the development of a framework enabling us to track identicals in different ways through time. It is as if the interlocking structures associated with *and, or, truth, kind, same*, etc., are built into the mind from the very start. This does not mean that basic logic (or any other kind of logic) is available at birth. We have to talk, rather, in terms of dispositions. Thus it is a natural property of the human mind to have these and those logical resources available to it (to be able to acquire and use associated expressions), just as being brittle is a natural property of glass.

Macnamara pays insufficient attention to a number of distinctions which one might have thought would have been central to a consideration of the relation between logic and psychology. Thus he neglects distinctions such as that between logic and metalogic and between both of these and philosophical logic (which, as will now be clear, forms the actual topic of the work). Above all, he does not sufficiently deal with the issue of the normativity of logic, of the sense in which logical laws are not merely abstracted from actual cognitive competences and performances but somehow serve as measure or standard for these (in a way which seems impossible to account for if basic mental logic is simply the reflection of certain 'natural dispositions').

Macnamara's thesis seems to be that it is certain relations among meanings which account for this normativity. Thus much of the work is devoted to demonstrations of the dependence of one sort of linguistic usuage on another, so that the former cannot be learned except in the presence of the latter. Frege, too, caught glimpses of the idea that the normativity of logic is derived from certain constraints on meaning. Thus for example he held that, even though language is a human creation, still, mankind shapes language 'in conformity with the logical disposition that is alive in it' (*Posthumous writings*, p. 269). It was however Husserl, as Macnamara points out, who provided the most thorough treatment of these issues. Logic is, according to Husserl in the *Logical Investigations*, the 'science of meanings'. In that capacity it studies the pure 'laws of thought', which express *a priori* connections between the categorical forms of meaning and their objectivity or truth. Logical truth is revealed when 'we take the trouble to detach the ideal essence of meanings from their

psychological and transient and grammatical connections'. For only some of the emptily possible meaning-combinations are capable of forming the content of, say, a judgment. In this way our thinking and speaking is constrained by logic: the latter is normative in relation to the former.

There is, nevertheless, much in Macnamara's account that is to be praised. Above all he deals in an original and fertile way with issues relating to our actual thinkings and inferrings, issues which are normally neglected in books on logic.

G. LOLLI, *La macchina e le dimostrazioni*. Bologna: il Mulino, 1987. 157 pp. L. 15.000.

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The rise of mathematical logic at the beginning of the century led to heated discussions about formalization. For example, Poincaré objected that formal derivations are long, meaningless and unreliable. The dispute never died out completely, and it has been reactivated by recent developments in computer science involving a more extended use of logic. This book outlines the main aspects of the debate.

Chapter 1 ('That fabulous Chicago machine') provides an exposition of Poincaré's criticism, showing that the latter was much helped by the naiveté of his opponents. The title of the chapter refers to Poincaré's comparison of Hilbert's aim in axiomatizing geometry with that fabulous Chicago machine transforming living pigs into sausages.

Chapter 2 ('Frege's and Peano's ideographies') discusses the justifications of formalization provided by Frege, Peano and Russell. While Frege intended to establish a philosophical thesis, i.e. that arithmetic can be founded on the laws of thought only, Peano's aim was more empirical, i.e. to improve existing mathematical theories.

Chapter 3 ('Mathematical formalism') analyzes the formalistic views of Couturat, Hilbert, Curry and Bourbaki, showing a variety of aims within the formalistic camp. Such views on formalization are sharply opposed to Frege's and Peano's contentual views.

Chapter 4 ('Formalization in computer science') discusses various attempts to use formalization in establishing properties of programs. A typical example is provided by correctness: the aim of the correctness school is to prove *a priori* that programs satisfy their specifications.

Chapter 5 ('Automated deduction') outlines the main stages in the development of automated deduction and automated theorem proving from M. Davis's implementation of the Presburger's algorithm for addition arithmetic to the Boyer-Moore theorem prover.

Chapter 6 ('Proof on a paper napkin') analyzes the argument that the discovery of the exponential intractability of basic mathematical theories and the suspected intractability of first-order logic raises serious doubts as to the practical use of logic.