

Truth and Assertibility

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TRUTH AND ASSERTIBILITY *

THE question I will try to answer in this paper is: What role should the study of the truth conditions of sentences play in our attempt to understand the phenomenon of language? In contemporary philosophy of language there are two major opposing schools of thought on this issue. On the one hand, a tradition influenced by Frege, Russell, Wittgenstein of the *Tractatus*, Tarski, and Carnap takes truth to be the basic concept in terms of which a theory of meaning, and hence a theory of language, is to be developed. According to this view, the essential feature of language is its capacity to represent the way things are. Understanding this function in detail is thus a matter of describing the conditions under which particular sentences *truly* represent the way things are. Formal semantics, the study of the truth conditions of sentences of various sorts of discourse, is the natural expression of this point of view. On the other hand, there is an approach to language, shared by Dewey and the later Wittgenstein, which attributes little or no importance to the notion of truth. According to this view, language is best thought of as a set of social practices. In order to understand how language works, we must attend to the *uses* to which its sentences are put and the circumstances in which they are used. Dewey claimed that everything useful that could be said about language with the notion of truth could also be said with a more general and methodologically unproblematic notion of justified utterance or "warranted assertibility." He argued further that the notion of truth should be discarded, since, insofar as it cannot be so reconstructed, its use in a theory of language leads to confusions and pointless unanswerable questions.¹ One of the

* I would like to thank Richard Rorty, David Lewis, and Bruce Kuklick for valuable comments on earlier drafts of this paper.

¹ John Dewey, *Logic: The Theory of Inquiry* (New York: Holt, 1938); see especially chs. 1, 6, and 25. See also Dewey's response to Russell in P. A. Schilpp, ed., *Philosophy of John Dewey* (New York: Tudor, 1951).

striking features of Wittgenstein's mature thought is the replacement of his earlier question "What are the facts?" by the question "What are we entitled to say?" The notion of truth plays no role whatsoever in his comments on language-use (it is mentioned only in passing in the *Investigations*, by way of criticizing his earlier views).²

I

It is not immediately obvious why stressing the kinship of language-use to other social practices should lead to the de-emphasis of the notion of truth; so let us look a little more closely at the sort of picture with which this approach presents us. The use of a particular language by a population consists in the conformity of that population to a great many regularities. There are regularities involving pronunciation, the form of utterances, the physical and social circumstances of utterance, responses to utterances, and so on. The object of a theory of that language is the characterization and explanation of those regularities conformity to which is a criterion of membership in the linguistic community. We want, among other things, to associate with each sentence of the language a set—the assertibility conditions of that sentence—which determines the regularities of usage a speaker must conform to for a given sentence. (The elements of the sets associated with sentences might be patterns of retinal irradiations, possible worlds, or sets of beliefs of the speaker; for my present purposes we can abstract from the question of what sorts of elements to choose.) Now it is clear that no regularity of appropriate utterance which a speaker learns to conform to and which is reconstructed by a hypothetical theory of assertibility conditions for a language can amount to requiring that all utterances be true, for that would make infallibility a prerequisite for learning the language. It is thus clear that many of the utterances of any population will be, as we should say, assertible but not true, or true but not assertible.

But—to return to the question raised above in connection with Dewey and Wittgenstein—what is the significance of this observation for understanding the language studied? Presumably some of the utterances are guttural or nine-worded or spoken in the sun and not assertible, or are assertible and not guttural, nine-worded,

² Ludwig Wittgenstein, *Blue and Brown Books* (New York: Barnes & Noble, 1958), pp. 67–68; *Philosophical Investigations* (New York: Macmillan, 1953), part I, secs. 22, 23; see also secs. 136, 137 for the only use of truth.

or spoken in the sun. Why should the notion of truth be more important to the theory of this language than these other notions? Of course we *can* describe the linguistic behavior in terms of truth if we like, but the redundancy characteristics of our truth predicate assure us that we *can* involve that notion in any description we like, even where nothing like language is being discussed. We want to know what work is to be done by that notion. Notice that it is of no particular use to point out that in some language being studied not all warranted assertions of the presence of a deer result in venison dinners (even when nothing concrete goes wrong with the hunt, such as a badly thrown spear). For this is just to say that even if all members of the group are on their best behavior, each intending to conform to all the traditional regularities of linguistic conduct, asserting things only when appropriate and always responding appropriately, and even if everyone succeeds in these intentions, sometimes things go well and sometimes not so well. And this is surely true of their other social practices of child-rearing, planting, and propitiating the gods as well. If no notion of truth is required to explain the occasional and otherwise random failures of a certain generally successful child-rearing practice, what is it about the linguistic practices which does enforce this notion?

Approaching language primarily as a social practice or "form of life" thus presents a challenge to anyone who thinks that truth and the truth conditions studied by semantics ought to play a central role in our account of language. In the rest of this paper I will develop a precise sense in which the representationalist's concern with truth conditions can be generated within the project of the assertibility theorists.

II

Two recent authors who have recognized the challenge presented by the two points of view we have outlined, and have made explicit attempts to reconcile them are Wilfrid Sellars³ and David Lewis.⁴ I will not draw upon their efforts here, though the resolution I will propose is similar in some respects to each of their proposals. The suggestion I will develop as to the proper role of truth in explaining language-use is that of Michael Dummett⁵:

³ *Science and Metaphysics* (New York: Humanities, 1968), chs. 4 and 5.

⁴ "Languages and Language," forthcoming in the *Minnesota Studies*; also his *Convention* (Cambridge, Mass.: Harvard, 1969), ch. 5, sec. 4. I believe that the view Lewis puts forward is, with minor changes, compatible with the more detailed position developed in this essay.

⁵ *Frege: Philosophy of Language* (New York: Harper & Row, 1973), p. 451.

... the notion of truth is born in the first place out of less specific modes of commendation of an assertoric utterance, from the necessity to distinguish between it and the epistemic notion of justifiability; and this necessity is in turn imposed by the requirements for understanding certain kinds of compound sentence (451).

“Epistemic justifiability” is a part of what we have called the “assertibility conditions” of an utterance. Dummett offers an example:

If future-tense sentences could not come within the scope of sentential operators, there would be no place for such a distinction between justification and truth. We should, for example, have no basis for distinguishing between an expression of intention and a statement of intention, that is, between the forms ‘I am going to marry Jane’ and ‘I intend to marry Jane’, which differ, not in respect of the circumstances in which their utterance is justified, but solely in their truth-conditions. This distinction has to do solely with the different behavior of the two forms as constituents of more complex sentences, and, particularly, as antecedents of conditionals (450).

Dummett is thus claiming that

(1) I am going to marry Jane.

and

(2) I intend to marry Jane.

have the same assertibility conditions.

(3) If I am going to marry Jane, then I will no longer be a bachelor.

and

(4) If I intend to marry Jane, then I will no longer be a bachelor.

however, have different assertibility conditions, because within the context of the conditional the different *truth* conditions of (1) and (2) become significant. If we want to explain the assertibility conditions of (3) and (4), we must consider not just the assertibility conditions of the embedded sentences, but also their truth conditions. Unfortunately, Dummett does not say anything about the class of sentential contexts that require us to discriminate between truth and assertibility, save that the conditional is one. Moreover, (1) and (2) do not in fact have the same assertibility conditions. I might be justified in believing that I will marry Jane on the basis of some inductive inference or because of a religious prophecy with great authority in my community, without its being appropriate to say that I *intend* to do what I believe I will do. We must try to overcome these difficulties in developing Dummett’s suggestion.

Consider a language generated from a finite set $a_1 \dots a_n$ of atomic sentences by the possibly iterated application of a finite set $F_1 \dots F_m$ of one-place sentential operators (we lose no generality by the restriction to one-place operators). One way to formulate a theory of what a speaker knows when he can use all the sentences of such a language is to associate with each sentence s a set $A(s)$ of *assertibility conditions*, such that, within the context of the theory, $A(s)$ determines the concrete occasions of appropriate use of s . A finitely specifiable theory of the use of such a potentially infinite language⁶ cannot merely associate a set with each sentence, but must generate the assertibility conditions of complex sentences by some recursion on their complexity. In the ideal case each compounding operator would be *assertibility-explicable*; i.e., for each operator F_i there would be a function which, given only the assertibility conditions of the component sentence, would generate the assertibility conditions of the compound containing it:

$$(F1) \quad \forall i \leq m \exists g \forall s \in L (A(F_i s) = gA(s))$$

Dummett claims that (F1) is false of English.⁷ For he claims that:

$$(F2) \quad \exists i \exists s, s^* \in L ((A(s) = A(s^*)) \& (A(F_i s) \neq A(F_i s^*)))$$

offering two sentences supposed to have identical assertibility conditions, but which generate compounds with non-identical assertibility conditions.⁸ And this indeed shows:

$$(F3) \quad \exists i \sim \exists g \forall s \in L (A(F_i s) = gA(s))$$

We will see below how to adapt Dummett's example so as to make this argument stand up. Thus in English the contribution a sentence makes to the assertibility conditions of compound sentences containing it is not exhausted by the assertibility conditions

⁶ In the sense that there is a uniform procedure for generating a further sentence of the language from any finite set of its sentences. I believe that something like this property ought to be used to distinguish *logical* connectives from others, but a discussion of quantification is beyond the scope of this paper, so I cannot argue the point.

⁷ There are, of course, languages that are assertibility-explicable. Intuitionistic mathematics is formulated in such a way that the assertibility conditions of compounds depend only upon the assertibility conditions of the components. Dummett discusses the significance of this point for the general dispute between those who view language primarily as a means of representing reality and those who view it as a social practice, in the concluding sections of "Truth," *Proceedings of the Aristotelian Society*, LIX (1958/9): 141–162.

⁸ Adapting Dummett's example to our language of one-place sentential functions, we take the functor to be "If ..., then I will no longer be a bachelor," rather than the ordinary two-place conditional "If ..., then _____."

of the component sentence. Let us introduce an auxiliary notion B such that we *can* generate the assertibility conditions of a compound sentence from the assertibility conditions *and the B -conditions* of the embedded sentence. Two requirements must be satisfied:

$$(F4) \quad \forall i \exists g \forall s \in L (A(F_i s) = g(A(s), B(s)))$$

$$(F5) \quad \forall i \exists f \forall s \in L (B(F_i s) = f(B(s), A(s)))$$

In the context of this machinery, we may take Dummett to be suggesting that, in order to generate in a uniform way the assertibility conditions of compound sentences, we need to look not only at the assertibility conditions of the embedded sentences, but also at their *truth* conditions. Truth is to play the role of the auxiliary B above. In what follows I shall try to show that there is a class of compounding devices in English which are *truth-inducing sentential contexts* (TISCs). Whatever auxiliary notion a particular theory invokes to explicate (in the technical sense of F4) just those sentences generated by means of these devices will be the truth concept employed by that theory. I am not, of course, offering this as a suggestion about the origins of the uses of the everyday notion of truth, though I hope to illuminate such uses by considering a special technical project.

III

With this project in mind, I suggest that the following serve Dummett's purpose:

- (5) I will marry Jane.
- (6) I foresee that I will marry Jane.

'Foresee' is little enough used in our ordinary conversation so that we can stipulate that it is to be taken as including whatever could justify one in asserting that one will marry Jane.⁹ Thus one is justified in asserting (5) under just the same circumstances in which one is justified in asserting (6).¹⁰ Whatever slight damage we must do to the sense of (6) in order to identify its assertibility conditions with those of (5) obviously does not affect the difference between:

⁹ David Lewis suggested this use of 'foresee'.

¹⁰ This is a much weaker statement than the (false) claim that (5) and (6) have the same *meaning*. For if (speaker) meaning is, plausibly, whatever it is that the speaker must be said to "know" when he can use the sentence properly, then that meaning includes on our account not just the assertibility conditions of the sentence, but also the contribution the sentence makes to the assertibility conditions of compound sentences containing it. In any language containing TISCs, *truth* conditions will thus also be a part of the meaning of every sentence that can appear embedded in such a TISC.

(7) If I will marry Jane, then I will no longer be a bachelor.

and

(8) If I foresee that I will marry Jane, then I will no longer be a bachelor.

(7) is presumably assertible whenever it is conversationally germane; (8) is assertible only under very special conditions of knowledge concerning how good at foreseeing I am.

According to our formal analysis, then, exhibiting (5)–(8) is sufficient to establish that English is not assertibility-explicable. So some auxiliary notion must be introduced to generate the assertibility conditions of compound sentences. Dummett's suggestion as we have reformulated it is that the conditional is one of the compounding devices in English which require truth as an auxiliary for their explication. Other such devices exist:

- (9) Waldo believes that I will marry Jane.
- (10) Waldo believes that I foresee that I will marry Jane.
- (11) It is possible that I will marry Jane.
- (12) It is possible that I foresee that I will marry Jane.
- (13) It will be the case that I will marry Jane.
- (14) It will be the case that I foresee that I will marry Jane.

It is clear that, for the compounding devices illustrated in these pairs as well, a difference in the truth conditions of the embedded component is sufficient to ensure a difference of assertibility conditions for the compound, regardless of the identity of assertibility conditions of the embedded component.¹¹

Can we give a general characterization of truth-inducing sentential contexts? We might in fact get the right class of compounds for English by using the straightforward condition that any compound whose assertibility conditions are different depending upon whether it has (5) or (6) as a component, is a TISC. This would be an accidental and unilluminating way of characterizing the desired class, however. For we can imagine extending English by adding a one-place sentential compound F' such that, for any sentence p of

¹¹ As far as I can see, there is no direct way to test whether the compounding devices of (7)–(14) would yield co-assertible sentences in the event that we substituted for the components (5) and (6) a pair of sentences with identical assertibility conditions *and* identical truth conditions. For there simply are no such sentences. What would be the point of such redundancy in a natural language? I conclude that the requirement of F4 that identity of assertibility conditions and truth conditions of embedded sentences must be sufficient for identity of assertibility conditions of the compound TISC-generated sentence, offers no barrier to our taking the constructions of (7)–(14) to be TISCs.

English, $F'p$ is assertible just in case it has an odd number of words. Since no pair constructed by the device of (5) and (6) will have two elements *both* of which have an odd number of words, F' would discriminate between them in the required fashion. Yet nothing about truth is intuitively required to explicate F' ; so it should not be taken to be a TISC. Accordingly, in generalizing from the examples we have considered, we must find a class of pairs of sentences which can play the role that (5) and (6) played with respect to the compounds we have discussed and whose selection is sufficiently motivated by its connection with ordinary notions of truth so that it will not violate our intuitions concerning manufactured connectives.

The characteristic of (5) and (6) on which I want to focus in defining TISCs is, roughly, that there is a state of the speaker which (5) expresses and which (6) states to be expressed. Sometimes there will be in the language a state-attributing term—e.g., ‘asserts-that- p ’ or ‘believes-that- p ’—such that, according to the regularities governing its application, the production of an utterance in a particular situation is sufficient to license the attribution of that state to the utterer. In such a case I shall call the pair consisting of the original utterance and the statement that attributes the appropriate state to the issuer of that utterance an *expression-statement pair* (ESP).¹² A TISC, then, can be defined as any sentential compounding device F such that, if the ordered pair (p, p') is an ESP, then $A(Fp) \neq A(Fp')$. That is, TISCs are those compounding devices such that it is a sufficient condition for a compound to discriminate in its assertibility conditions between elements of a pair of sentences that that pair be an ESP, let the assertibility conditions, word length, sonority, or what have you of the components fall where they may.¹³ Elements of an ESP need not have the same assertibility conditions, but, if they do, they are discriminated anyway.

This definition requires that all the ESPs have elements which differ in their truth conditions and which are accordingly discriminated by the firm examples of TISCs. By the nature of the

¹² Where the regularities are very close to invariable association of state with utterance, the utterance that attributes the state to oneself and the original utterance will have very nearly identical assertibility conditions. Where there are divergences, as with the attribution of belief states, assertibility conditions will exhibit similar divergence.

¹³ In generalizing to multi-place functors we will identify ESPs by requiring that there be ways of filling all but one of the places of the functor so that, when the elements of the pair are sequentially substituted into the remaining place, different assertibility conditions result,

case I cannot survey all the TISCs and ESPs of English to demonstrate that these conditions are met without serious counterexample.¹⁴ By way of persuasion, however, we may consider a type of ESP very different from those we have attended to thus far:

- (15) Is Waldo going to the library?
- (16) I am asking whether Waldo is going to the library.
- (17) Waldo, open the door!
- (18) I am commanding Waldo to open the door.

The pairs (15), (16) and (17), (18) are ESPs, for the second element of each pair attributes to the speaker that state of asking or commanding which is expressed by the first element. The first element does not yield a grammatical sentence when embedded in our paradigm TISCs, but the second does:

- (19) Wanda believes is Waldo going to the library.
- (20) Wanda believes I am asking whether Waldo is going to the library.
- (21) If Waldo, open the door, then the door will be opened.
- (22) If I am commanding Waldo to open the door, then the door will be opened.

The first elements of these pairs have, roughly, no assertibility conditions at all, but the second elements do. The TISCs thus discriminate all the ESPs appropriately. But notice further that we can explain the deviance of (19) and (21) intuitively by the fact that (15) and (17) have no truth conditions, where (16) and (18) do. The difference in assertibility conditions of the compounds is plausibly attributed to the difference in truth conditions, just as our theory says it ought (even though this situation is very different from those we began with). And this would still be true if (15) and (16), or (17) and (18) had identical assertibility conditions. According to the view I am urging, of course, the anomalous behavior of (15) and (16) as components of TISCs is the reason they have no truth conditions.

IV

The results we have arrived at concern the relation of a study of the truth conditions of sentences to a more general investigation of language use. We thus consider only that aspect of the ordinary

¹⁴ I believe, though it is no part of my present project to argue for the claim, that *every* sentential compounding device of English is a TISC. This would have the important result that the *only* auxiliary device needed to explicate sentential compounding is truth. That this is not the only coherent possibility is clear from fn 7 above.

notion of truth which is relevant for a particular sort of technical project. It is worth pointing out, then, that the notion of truth that results from a consideration of ESPs and TISCs has an intuitive connection with traditional views about the nature of truth. Representationalists like Russell, arguing for the necessity of a language-transcendent notion of truth, have claimed as against truth-as-assertibility theorists like Dewey that the very essence of the notion of truth lies in the contrast it enables and enforces between how things are and how they are thought to be, believed to be, or desired to be by any person or group of people. If you have this distinction, you have a notion of truth: if you fail to make this distinction, you are simply talking about something else.¹⁵ Although the primary orientation of this paper has been squarely within the language-as-social-practice tradition of those who give pride of place to assertibility, we have seized on just that distinction which according to the representationalists generates the notion of truth. For on our account it is precisely the explication of compounds (TISCs) that systematically discriminate between the content of an utterance (how it says things are) and any state of the utterer (what he is entitled to say, what he believes or desires) that may be associated with it, which requires the introduction of truth as an auxiliary notion in carrying forward the project of generating assertibility conditions describing the use of the language. A leading idea of the traditional view of truth is thus incorporated in our assertibility-generated treatment of truth.

We have presented an account of what facts it is about the use of a language in virtue of which the sentences of that language have a *content* distinct from the set of circumstances under which they may be appropriately used. For the purposes of semantics, whatever auxiliary notion explicates the TISCs is the truth concept of the language and assigns to each sentence of the language that can appear in the appropriate sort of compound a set: the truth conditions of that sentence. The theory then provides, for each sort of compounding device, a uniform way of generating the assertibility conditions of the compound sentences from the assertibility conditions and the truth conditions of its components. The contemporary discipline of semantics takes only part of this generation as its project, namely, the construction of truth conditions for all

¹⁵ Indeed, thinking about this contrast is supposed to lead one to think of language as *re-presenting* the way things are. See pp. 145–154 in Schilpp, *op. cit.*, and ch. 23 of Russell's *Inquiry into Meaning and Truth* (New York: Norton, 1962).

the sentences of the language and the generation of the truth conditions of compound sentences from the truth conditions of their embedded components. Since in natural languages multiple nesting of sentential operators is common, the primary project (from our point of view) of generating assertibility conditions will require for multiply compound sentences that the truth conditions of embedded compounds be generated (as in formula F5 above). Semantics as such never considers the final step of generating assertibility conditions, given the truth conditions of components. For some sorts of compounding devices—the conditional, negation, tensing, modal operators, and some others—it happens to be possible to generate the truth conditions of compounds from the truth conditions of components in relatively simple ways, as formal semantics has shown us. For other sorts of compounds, notoriously for analogues of “Waldo believes that . . .,” it appears that not only the truth conditions of components are needed, but also the assertibility conditions. If so, then the theory of truth conditions will not be able to insulate itself as a self-contained part of the project of giving assertibility conditions in treating these compounds.¹⁶ Be this as it may, we see from our account both how semantics can be a semi-autonomous discipline, abstracting from the more immediate concern with assertibility, and also how that semi-autonomous discipline serves a useful purpose in a general theory of how languages work.

It is clear from our previous discussion that the role we have ascribed to the notion of truth in a theory of the use of a language underdetermines the actual truth conditions of sentences. There may be many candidate sets of truth conditions which result in the same assertibility conditions for compound sentences. In theorizing about the use of some language we will pick among rival

¹⁶ It is interesting to note that Quine's suggestion that we restrict ourselves to extensional constructions in order to make truth conditions behave is undercut by this approach. According to our definition, the second element of an ESP attributes a state to a speaker on the basis of his utterance and its circumstances. We should not be surprised, therefore, that all the ESPs we have identified above involve nonextensional constructions. For the state-attributing construction of the second element of an ESP to be extensional would be for the attribution of the state to depend only on the truth value of the utterance which is the first element. The only states like *that* are “speaking truly,” “speaking falsely,” and their trivial variants (like “speaking truly and not being a neutrino”). And we may not simply restrict ourselves to these ESPs in defining TISCs on pain of circularity. It follows that the existence of nonextensional constructions in a language is a necessary condition for the employment of truth conditions as auxiliaries in an account of the use of the language.

forms of truth conditions by considering the resulting theory with regard to all the mundane criteria applicable anywhere else in science—ease of coupling with other theories (particularly psychological and physiological theories about how human beings work), power, elegance, intuitive acceptability, exhibition of general principles, and so on. Our approach prepares us to discover that, even within a single language, in view of the *very* different sorts of things that would count as ESPs, for example, in mathematical talk, fictional talk, and ethical talk, different sorts of things might best be taken to be truth conditions of sentences of the different kinds of discourse. From the point of view of the technical project of generating assertibility conditions, the notions of truth and of truth conditions are theoretical auxiliaries, to be cut and pasted in whatever ways give us the nicest account of the assertibility conditions.

It is a striking fact that, as we have seen, we can be fairly precise about the *point* of a theory of truth conditions for a certain kind of theory of the use of language before we know the details of the best theory of any language. As our treatment of the various examples shows, we have pretty good intuitions concerning the role of truth in explicating the assertibility conditions of compounds in English even though we know nothing about such crucial matters as what sort of thing the elements of sets of assertibility conditions or truth conditions are best taken to be and even though we can exhibit no single example of a sentence for which we can write down assertibility conditions. The explicatory task that we have attributed to truth conditions arises equally for languages that contain no analogue of a truth predicate as for those languages, like English, which do (so long as the language is not assertibility-explicable in the sense of F1, and has TISCs). Nonetheless, the way in which we employed our intuitions concerning the everyday notion of truth at key places in the development of our characterization of that explicatory role shows that the ordinary English notion of truth in fact plays that role. We began by asking what point the notion of truth has for understanding the use of a language, since it seemed that everything we could be interested in about the use of a language could be accounted for solely in terms of assertibility. We have answered that question by showing that the association of truth conditions with sentences performs an essential function in characterizing the use of any language that meets a few easily specifiable conditions. To show the point of the ordinary no-

tion of truth for a certain technical project is not, however, to show the point of the notion of truth as such. We saw above that the technical purpose of generating assertibility conditions could in principle be fulfilled by many alternative "truth notions" (choices of specific sets as truth conditions). In view of the many and various projects that have enlisted the aid of the word 'true' and its cognates in the history of thought, we should not expect that *every* role played by that notion would be equally well played by any concept that happened to suffice for the generation of the assertibility conditions of certain compound sentence types. The aspect of the ordinary notion of truth which we have exhibited, however, is of great importance for the appreciation of the *point* of the study of semantics, and provides a general framework within which specific proposals and disputes may be placed and evaluated.

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BOOK REVIEWS

Logic and Arithmetic. DAVID BOSTOCK. New York: Oxford, 1974. vii, 216 p. \$19.25.

Legend has it that logicism foundered on the question "What counts as logic?" and on various technical difficulties with proposed reductions of mathematics to logic. This book tries to salvage the wreck with a reformulation of the philosophy and new technical machinery for the reduction. Logic is taken to investigate the relation between the structure of propositions and their truth values. Numbers are construed as quantifiers. Along lines developed by Ludwig Borkowski,¹ the author constructs a formal system accommodating quantification over quantifiers and delivering at least Peano arithmetic. His presentation is marred by frequent elementary confusions (of quotation with quasi-quotation, schematic constants with variables) and obscuring informality (an interpretation of the formal language is never presented). The philosophical motives behind the work remain nebulous. It offers us arithmetic served in a novel way, adding to the previous embeddings of that science in set theory, type theory, combinatorial logic, infinitary logic, and modal logic.

¹ "Reduction of Arithmetic to Logic Based on the Theory of Types without the Axioms of Infinity and the Typical Ambiguity of Arithmetic Constants," *Studia Logica*, VIII (1958): 283-295.