Bar-Hillel,Yehoshua

Yehoshua Bar-Hillel (1915-1975) was an Israeli logician and philosopher of language who made significant contributions in a number of linguistic fields: formal and algebraic linguistics, logical aspects of natural language, and computational linguistics, in particular machine translation and information retrieval. His principal essays are included in two collections *Language and Information* and *Aspects of Language*.

In most of his writings, Bar-Hillel's aim was to bridge the "disastrous" gap between logic and linguistics, believing that linguists (particularly semanticists) had ignored logic to their detriment; and that logicians had ignored linguistics by creating a formal system devoid of any relevance to natural language in actual use. He sought to extend the logical syntax of his mentor Rudolf Carnap, which he believed could serve as "a methodological and terminological basis for structural linguistics", by describing a formalism for relating lexical items to the specific entities (objects, persons, etc.) they refer to in particular contexts, both in natural and in artificial languages; in this, he anticipated the logical and natural language semantics of Richard Montague. With Carnap he explored the possibilities of a theory of 'semantic information', an extension of inductive and probabilistic logic to the semantics of communication. He also saw logic as a kind of 'universal semantics', providing the framework for expressing relationships among linguistic entities whatever the language (including artificial languages) – in contrast to a linguistics-based 'general semantics'.

Much of his work in the early 1950s was influenced by Norbert Wiener's cybernetics and by the possibilities of the newly invented digital computers to test speculations and theories about logic and language. In May 1951 he was appointed to a position in the MIT Research Laboratory of Electronics, with the task of investigating the application of computers to linguistic work, and specifically MT and information retrieval. He visited all the US groups, wrote the first survey (1951), and convened the first conference (June 1952). The conference was a major factor in launching substantial MT research in the following years. There, Bar-Hillel often expressed "naïve optimism", which he later regretted; however, he was never a believer in the full automation of translation. For practical reasons, he advocated the collaboration of man and machine, the use of editors to revise MT output, the use of restricted (unambiguous) forms of natural language, and the use of subject-specific dictionaries.

His major contribution to algebraic linguistics was categorial grammar, a "decision procedure" for identifying constituents in grammatically well-formed sentences, based on the logic of Kazimierz Ajdukiewicz – a further example of bringing logic and linguistics closer. His 1953 essay is recognised as a pioneer article in the field, and he made a number of important contributions to the theory of formal grammar, much under the influence of Noam Chomsky – a close friend from the 1950s to his death. His theory of categorial grammar was first presented at the MT conference in 1952 as a way of dealing with the syntax of natural language – a topic neglected by most linguists at the time. Later, Bar-Hillel demonstrated that categorial grammar was formally equivalent to context-free grammars, and as such (following Chomsky) inadequate for the description of natural language; he had long recognised

its weakness in dealing with discontinuous elements. Consequently (1962) he argued forcefully that MT researchers and computational linguists should base parsers and grammars on Chomsky's type of 'transformational grammar' (i.e. with rules for transforming active sentences into passive, or for showing that *look* and *up* in, e.g. *He looked the word up in the dictionary* form a single unit 'look up'). However, after his death, the renewed interest in non-transformational grammars has shown that categorial grammars can be extended to overcome the deficiencies (cf. Wood 1993), and Bar-Hillel's pioneer work remains influential.

Although a firm supporter of Chomsky's formal grammar theory, he was not uncritical. He disliked the confusing and overworked use of 'theory' for different conceptions and philosophies in linguistics, and he argued for the development of grammars of linguistic performance (language in use) – i.e. parallel to his extension of logic to deal with actual communication. And he was a trenchant critic of the semantic theories of Jerrold Katz and Jerry Fodor, dismissing as simply false their thesis that meaning rules could be exhaustively presented in the form of dictionary entries plus rules of combination, since they had ignored the need for inference rules and for mechanisms to relate words and their external referents.

By the late 1950s, Bar-Hillel's confidence in computational linguistics was waning. He wrote a report for the sponsors of MT research (published 1960), which was highly critical of nearly all current projects. He was particularly critical of those groups adopting statistics-based analyses to 'discover' grammars for computer programs, of those investigating interlinguas (i.e. intermediary language-neutral representations), indeed of any that did not keep to modest and realistic objectives. He was opposed to interlinguas not just in practice (they did not lead to economies of programming) but even more in theory: only a logical semantics could form a sound basis in his view.

His main criticism, however, was directed to the assumption that the goal of MT should be fully automatic high quality translation, and he included a 'proof' that such a goal was non-feasible, not just in practice but in principle – arguing that no amount of data (linguistic, encyclopedic, inferential, referential) could ever be sufficient to resolve all ambiguities in texts and to choose the best translations in context. This article was perhaps the single most influential publication in the early history of MT, convincing many outside the field that MT was a misguided activity, and it continues today to be cited as 'evidence' of the impossibility of MT.

Later (1962) he lost his belief that even the man-machine partnership in MT could be cost-effective, and the last vestiges of his earlier enthusiasm for cybernetics went with the realization that the idea of a 'learning machine' was a delusion, since "all attempts at formalising… inference have completely failed". On the other hand, later still (1971), he withdrew his harsh judgement about the future of practical MT, conceding that quality in MT could not be an absolute and that, in practice, it varied according to recipients and uses.

Bar-Hillel accepted that he often "trod on … toes", and he did not, in fact, like the role of devil's advocate, which he often found himself taking. In truth, his criticisms were often expressed forcefully (even bluntly) but they were always pertinent, well-argued, and enlightening.

Biography

Yehoshua Bar-Hillel was born in Vienna on September 8, 1915. He moved to Palestine in 1933, and attended Hebrew University from 1935. He received his MA in 'The antinomies of logic' in 1938, and a PhD on 'Theory of syntactic categories' in 1939-1945 (interrupted by four years in Jewish Brigade Group, British Army). He worked as a teacher in high school in 1945-1947, and fought in the Israeli War of Independence in 1947-1949. He was a research fellow at Hebrew University in 1949-1953, and received a visiting fellowship to USA in 1950-51. Bar-Hillel was appointed research associate in the Research Laboratory of Electronics (RLE), Massachusetts Institute of Technology (MIT) in 1951-1952, and convened first MT conference (at MIT) in June 1952. He was a senior lecturer in Philosophy at Hebrew University in 1953-1958, and held further appointment at RLE, MIT, 1955-56. He returned to Hebrew University in 1956 and conducted a study tour of the United States (funded by US Office of Naval Research) in 1957-1960. He was Associate Professor of Philosophy at Hebrew University in 1958-1961, and visiting professor at the University of California at Berkeley in 1960-1961, and then again at RLE, MIT in 1961. He was Professor of Logic and Philosophy of Science, Hebrew University, 1961-1975; a member of the Israel Academy of Sciences and Humanities in 1963-1975; secretary and organiser of the third International Congress for Logic, Methodology and Philosophy of Science, Jerusalem, in 1964; visiting professor, University of Michigan, 1965; visiting professor, University of Southern California, La Jolla, in 1966-67; president, Division of Logic, Methodology and Philosophy of Science of the International Union of History and Philosophy of Science in 1966-1968; president, International Union of History and Philosophy of Science in 1967; visiting professor, University of Konstanz in 1971; and visiting professor, University of Berlin in 1972. He died in Jerusalem on September 25, 1975.

References

Bar-Hillel, Yehoshua. 1950. On syntactic categories. Journal of Symbolic Logic 15, 1-16.

— 1951. The present state of research on mechanical translation. American Documentation 2 (4), 229-237.

— 1953. A quasi-arithmetical notation for syntactic description. Language 29, 47-58.

— 1960. The present status of automatic translation of languages. Advances in Computers 1, 91-163.

— 1966. Four lectures on algebraic linguistics and machine translation. Automatic translation of languages, papers presented at NATO Summer School held in Venice, July 1962, 1-26. Oxford: Pergamon Press.

— 1964. Language and information: selected essays on their theory and application. Reading, MA.: Addison-Wesley.

— 1970. Aspects of language: essays in philosophy of language, linguistic philosophy, and methodology of linguistics. Jerusalem: Magnes Press, and Amsterdam: North-Holland.

— 1971. Some reflections on the present outlook for high-quality machine translation. Feasibility study on fully automatic high quality translation, ed. by Winfred P. Lehmann and Rolf Stachowitz, 4pp. Griffiss Air Force Base, NY: Rome Air Development Center, Air Force Systems Command. (RADC-TR-71-295)

Bar-Hillel, J.Malino and A.Margalit. 1974. On logic and theoretical linguistics. Current trends in linguistics, ed. by T.A.Sebeok, vol.12: Linguistics and adjacent arts and sciences, pt.1: 37-101. The Hague: Mouton.

Carnap, Rudolf. 1934. Logische Syntax der Sprache. Wien: Springer. (The logical syntax of language. London: Routledge, 1937.)

Hutchins, John. 2000. Yehoshua Bar-Hillel: a philosopher's contribution to machine translation. Early years in machine translation: memoirs and biographies of pioneers, ed. W. John Hutchins, 299-312. Amsterdam: John Benjamins.

Kasher, Asa (ed.) 1976. Language in focus: foundations, methods and systems: essays in memory of Yehoshua Bar-Hillel. Dordrecht: Reidel. (Boston Studies in the Philosophy of Science, 43) [Includes substantial bibliography of Bar-Hillel's publications.]

Koppel, Moshe and Shamir, Eli (eds.) 1996. Proceedings [of] the Fourth Bar-Ilan Symposium on Foundations of Artificial Intelligence, June 20-22, 1995, Ramat Gan and Jerusalem, Israel. Menlo Park: American Association for Artificial Intelligence. [Conference dedicated to Bar-Hillel and his ideas.]

Wood, Mary McGee. 1993. Categorial grammars. London: Routledge.

W. JOHN HUTCHINS