Milestones in machine translation

No. 6 *in the series*

by John Hutchins

Bar-Hillel and the nonfeasibility of FAHQT

John Hutchins is probably the world's leading historian of machine translation, and a prominent figure in the International Association of Machine Translation. His books include: Machine Translation: past, present, future (1986) and (with H.L. Somers) An introduction to machine translation.

During the latter end of 1958 and early 1959, Yehoshua Bar-Hillel was charged by the US Office of Naval Research to make a critical assessment of current machine translation (MT) activity in the United States and Great Britain. Agencies of the US government were funding research on a large and increasing scale. Bar-Hillel had been the first person appointed full-time to work on MT at the Massachusetts Institute of Technology in 1951, and had produced a survey of MT activity in preparation for the MT conference which he organised in the following year [see Milestones no.4]. As an independent scholar with no close ties to any particular project but familiar with the issues and problems, he was the ideal person. He visited most MT groups in the US during October 1958, and obtained information about others in the following months. His report appeared in February 1959, was circulated widely in the MT community, and caused immediate consternation. He had been particularly critical of many of the teams of researchers, and had questioned the very goals and expectations of the whole field of MT research.

While the report was read only within MT circles, its impact was relatively unnoticed. But in 1960, Bar-Hillel revised it for the newly founded journal *Advances in Computers*,* which aimed to provide authoritative reviews of computing and computer applications. At this time, MT was at the forefront of non-numerical computing - indeed, it was almost the only focus for natural language processing - and, moreover, the level of its funding was envied by many in the field of computing. Any authoritative review could expect to receive great attention, and Bar-Hillel was certainly well known for his previous enthusiasm for MT.

For his revision, Bar-Hillel added a substantial section on developments in the Soviet Union, based on Russian reports and books and on recent visits by prominent American MT researchers such as Anthony Oettinger of Harvard University. As far as the US groups was concerned, however, the article was still a description of the situation in late 1958, and he had not changed the wording of his criticisms in any way.

His basic contention was that MT research - now a "multimillion dollar affair", as he pointed out - was, with few exceptions, set on a mistaken and unattainable goal, namely, fully automatic translation of a quality equal to that of a good human translator. This he held to be utterly unrealistic, and in his view resources were being wasted which could be more fruitfully devoted to the development of less ambitious and more practical computer aids for translators.

The argument was essentially a theoretical one; as a logician and philosopher, he argued from basic principles, and his report included no examples of actual MT-produced translations. Indeed, it would have been difficult to find many, since at the date of his survey very few of the MT groups had been active for more than two years. The large Georgetown group had been formed only in 1956, the teams at Harvard and Cambridge (UK) had received their first grants only in 1956, the RAND groups had been set up in 1957, and research at National Bureau of Standards, IBM, University of California (Berkeley), Wayne State University and Texas University, had not started until 1958 itself. The only relatively long established groups were the two at MIT and at the University of Washington (Seattle). The situation was much the same in the Soviet Union: only two groups had been active for more than two years. Since he could not report actual implementations, Bar-Hillel concentrated therefore primarily on statements of declared aims and proposed methodologies.

Bar-Hillel had become convinced that 'fully automatic high quality translation' (FAHQT), as he called it, was unattainable "not only in the near future but altogether". He had in fact expressed this view in his 1951 review [Milestones no.3] before most MT projects had even been thought of. Now he felt able to give a 'proof' in an appendix to the report "A demonstration of the non-feasibility of fully automatic, high quality translation", which has achieved 'definitive' status for all those opposed to MT research right to the present day.

The argument was based on discussion of the sentence "The box was in the pen" in a context such as: *Little John was looking for his toy box. Finally he found*

it. The box was in the pen. Since the word *pen* can have two meanings (at least), a 'writing utensil' and an 'enclosure where small children play', there are in theory two interpretations for the sentence. However, only one is plausible given our knowledge of "the relative sizes of pens, in the sense of writing implements, toy boxes, and pens, in the sense of playpens." This knowledge was "not at the disposal of the electronic computer." In Bar-Hillel's view, to put such information in a MT system would mean that "a translation machine should not only be supplied with a dictionary but also with a universal encyclopedia", and for Bar-Hillel such a requirement was "utterly chimerical and hardly deserves any further discussion."

He did, of course, concede that some ambiguities of this nature could be resolved by the use of specialised glossaries and the use of contextual clues, but he thought their effectiveness could only be very limited - and resolution of some but not all ambiguities would not be good enough if the aim is 'high quality' translation.

Although there has subsequently been much research on the use of special-purpose 'knowledge bases', on computational inferencing, on the restriction of texts for translation to specific domains, and on more sophisticated use of contextual information, Bar-Hillel's basic argument remains powerful: the full resolution of all ambiguities demands human-like understanding of reality; human quality translation is not a realistic goal for MT research, even perhaps as a 'futuristic' long-term project.

Given this conviction, Bar-Hillel was highly critical of any MT group that declared (or implied) FAHQT its long-term aim. He attributed such aspirations to the early initial successes in MT. In the first few years there had been "a considerable amount of progress" in solving many linguistic and computational problems. Translations had been produced that, crude as they were, could be understood by expert readers in the subject domain. This progress had convinced many that "a working system [was] just around the corner." However, most groups had realised that the problems solved were "just the simplest ones" and that "the 'few' remaining problems were the harder ones - very hard indeed."

In his assessment of current MT projects, Bar-Hillel was particular critical of those who took an 'empirical' approach, by which he meant those who distrusted existing linguistic resources and believed that MT had to build its dictionaries and grammars from scratch, usually on the basis of statistical analyses of large text corpora. Despite his emphasis on practicality, he believed that faith in the power of statistics was unfounded - it derived from earlier overestimations of the value of the statistical theories of communication or 'information theory' in the processing of natural language. He believed there was no reason to reject traditional (normative) grammars and well researched dictionaries, as they "are already based... upon actual texts of incomparably larger extension than those that serve as a basis for the new compilers." In recent years, it may be noted, MT has returned to statistical analyses of text corpora (with a considerable measure of success), made possible of course by the ready availability of very large electronic databases. Unlike their predecessors, today's MT researchers do not have to laboriously convert printed texts onto punched cards.

The other trend Bar-Hillel had little sympathy with was the so-called 'interlingual' approach. A number of MT groups (in Italy, Britain and Russia) believed that the best route for high quality translation would be via a 'universal language' or 'language-independent' representation. Bar-Hillel conceded that with modern achievements in mathematical logic there might be more success than achieved by predecessors in the seventeenth century, but he thought the whole approach mistaken. The 'economic' argument for multilingual systems was based on the belief that it would be easier to develop programs for translating into and out of an interlingua than to develop programs for translating directly from one natural language into another. Bar-Hillel insisted that there was no reason to believe translation into a 'logical' interlingua would be any simpler than translation into a natural language.

Bar-Hillel did not condemn basic theoretical research as such, since he was confident that it should lead to theoretical insights into the nature of language which would be of great benefit (even if not directly to the task of translation.) What he insisted upon was that those aiming for practical MT systems had to sacrifice aspirations of high quality output. Either they had to develop low quality products for automatic 'translations' that were acceptable in certain circumstances - he mentions the use by people interested only in extracting the general content or in locating particular items of information, and he may not be concerned about lexical, grammatical and stylistic imperfections - or they had to develop systems where good quality translations could be achieved only after extensive revision ('post-editing'). In his view, the latter was the most fruitful line: partially automatic MT, commercially competitive with human translation, which could be gradually improved and refined with more and more of the 'post-editing' operations carried out automatically. In this regard, Bar-Hillel was undoubtedly on the right lines. The failure of US research groups to see the validity of his argument meant a continuation of unrealistic aims until they were brought to an end in the ALPAC report six years later. ■

* Bar-Hillel, Y. 'The present status of automatic translation of languages', *Advances in Computers* 1 (1), 1960, pp. 91-163.