control would jump to the instruction at location x, where x is a number stored in another part of the alarm clock. At location x, a subroutine would start which would reset parameters, including those in the alarm clock.

The general effect of having alarm clocks would be that work done in counting out loops would be done in parallel with the rest of the calculation by means of additional circuitry, so that we would be trading circuitry for time. Part of this extra circuitry is the extra digitry. In a serial machine, the three extra digits per word would involve a proportional loss of time of $3/\omega$ in all machine programs, so that the case for alarm-clock instructions is better for parallel machines.

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Book Review

Automatic Language Translation, by A. G. OETTINGER (Harvard), 380 pages, price not given.

Automatic Translation, by D. YU. PANOV (Pergamon), 73 pages, 21s.

The best chapters of Dr. Oettinger's book are those describing the practical work done under his direction over the past few years. The Harvard group decided that a pre-requisite for automatic translation research was a thoroughly reliable automatic dictionary, to which reference would be made by the program for syntactic and other information about the words of an input text; they felt that, in the experimental stages of a translation program, so many unforeseen troubles would arise that progress would be almost impossible unless the researcher could have complete confidence in the reference stage of his program. In particular, since, in common with most groups in the U.S.A., they were proposing to work on Russian, it was necessary to develop very reliable methods for removing the endings of inflected Russian words, which could then be used with confidence that no unexpected anomalies would arise. In order to achieve this, the Harvard group were obliged to set up a new classification of Russian words, of such precision that the paradigm could be worked out exactly and not merely roughly from a knowledge of the classification of a word. The full paradigm was then produced mechanically, and each member of it subjected to the ending-removal algorithm. When each word was processed it was then possible to make an exhaustive test for failures and anomalies, and then to remove or note any that arose. All this work is thoroughly described, and anyone proposing to work in problems of mechanized linguistics would do well to study the Harvard experience at an early stage.

I am not so clear as to the usefulness of the remainder of the book. For instance, the chapter on the structure of signs concludes with an interesting discussion of the Cyrillic Unityper used at Harvard. Is it necessary to discuss set-theory, isomorphisms, use-mention, the identity of indiscernibles, the nature of models, the type-token distinction, and other such topics of college philosophy courses in order to understand this device, or indeed the program as a whole? While I would not deny that topics like these may come up in the ultimate analysis of language, Dr. Oettinger does not reach a point where they emerge and, in a work subtitled "Lexical and Technical Aspects," there would be no reason to expect him to refer to them. Why, therefore, was the material put in?

Professor Panov's book is the reverse of Dr. Oettinger's in almost every way. It describes the work on automatic translation, mostly English–Russian, done at the Institute of Precise Mechanics and Computing Technique and the Institute of Scientific Information of the USSR Academy of Sciences since 1955. It also discusses experiments now under way on the automatic translation of Chinese to Russian. Professor Panov starts with a discussion of the mechanism of ordinary (human) translation, and goes on to show how his workers have tried to represent in a program the various stages he describes.

In working from English, he had much fewer inflectional problems to deal with than Dr. Oettinger, and the dictionary compilation and reference methods are accordingly simpler. He has, however, to extract information about case in order to be able to construct the Russian output, and case information is not easily obtainable from English, which expresses it mostly by prepositions and word-order rules. His analytic procedures are all expressed very neatly as choice structures. For example, in the choice structure for English nouns, we find "5(6, 13) Test preceding word for 'let'."

This means that this is test 5; with a positive answer we proceed to test 6, with a negative answer to test 13. Words which have more than one Russian equivalent are given, as part of their dictionary entry, a special choice structure for selecting the right rendering. In effect, the dictionary contains a special subroutine for each recalcitrant word. This suggests that Panov believes that such words are something of a rarity; I cannot believe that this is so, and I fear that the program may become overburdened with large, rarely used choice structures. However, when the program has been extensively tested the answer will be known.

Professor Panov's book has been well translated, and is, probably on account of its short length and absence of frills, easier to understand than most accounts of experimental automatic translation programs.

Neither of these books should be omitted from the library of any computing laboratory where linguistic applications of computers are carried on or contemplated.

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