

Mr. E. H. Ullrich (*communicated*): Mechanical translation will surely come, and I welcome the attempts at it now being made. I feel, however, that most of the workers in this field underestimate by a factor of ten the difficulty of producing a useful and truthful translation as opposed to a novelty for amusement only. They appear to think that dictionaries and grammars together contain substantially all that is required for the purpose. In serious matters this is usually not so. Before the war, I lived for a number of years in Paris and found the standard of translation in the Press poor. Perhaps the popular Press is the most attractive outlet for mechanical translations, because it does not really matter whether these are right or wrong, and amusing versions such as 'the ghost wills but the meat is feeble' might make mechanical translation into a daily feature as indispensable as the cross-word puzzle. To the best of my recollection it was the rule, not the exception, that, on serious subjects, quotations in the Press of the one country differed from the original text in the Press of the other in some very material particular. The disturbing fact from the computer standpoint is that this original text could usually bear the new interpretation, as far as grammar and dictionary were concerned. A person who used the language of the original as his mother-tongue, however, understood correctly what was meant. The ambiguity was resolved for him by his local knowledge.

I cannot remember actual word-for-word cases at this length of time. Let me, however, reconstruct an example. If we consider the two sentences, 'Field-Marshal Montgomery disposed of a million men' and 'Premier Stalin disposed of a hundred Communist leaders', a knowledge of the personalities is necessary for translation.

Experience shows that technical translations are not worth reading unless the translators have a good knowledge, not only of the two languages, but also of the specialized branch of engineering involved. To make a correct translation of an article on microwave valves, therefore, a computer will have to be provided with substantially the same amount of information as is stored in the head of a microwave valve engineer. Alternatively, the computer will have to work with a technical expert in the same way as a non-specialized translator does, i.e. by submitting a tentative translation sentence by sentence or paragraph by paragraph for acceptance or rejection by the expert. In other words, translation of serious work requires a vast store of knowledge, and either a large memory must be provided or the computer design must allow of the co-operation of an expert by question and answer. This is something more than the submission of a number of variant translations all of which, as far as the specialist can tell, are equally probable.

Mr. G. M. E. Williams (*communicated*): I refer to Mr. Davies's remarks in this discussion on the embarrassment of the Deuce machine by two queuing and flow problems, in road traffic, and in communication within a colliery, by the large numbers of variables to be handled, and the real time-scale of the events being computed being within very few orders of magnitude longer than computing time within the machine. These problems are of a type similar to a production or process control situation. Mr. Davies's experience is thus very valuable as a lesson in studies now going on in the application of computers to production roles. It emphasizes what is already evident, the considerable extent of storage systems, the need for very rapid access and operation, and multiplicity and speed* of input and output equipment which computers will be required to possess in many of these applications.

In a related but perhaps distant sphere, the implications and method of use of a computer, particularly for language translation, as described by Mr. R. H. Richens, of Cambridge, for instance, in a talk on the 8th March, 1956, in the B.B.C Third Programme, entitled 'Problems in Mechanical Translation', can,

I suggest, be of use in conveying qualitatively to the non-mathematically trained the approach and the difficulties of using computers for purposes other than the subject of this session. There is a great and difficult problem of conveying these ideas, of bridging the gap between the universities' and the computer makers' laboratories, and the lay user in industry in the future.

Many people have had some, if very elementary, personal experience of translation to or from a foreign language in their school-days. In dealing with ambiguities of words and sentences, and in the need to order every act of a computer, much can be conveyed in non-mathematical terms, analogous to dealing with numerical problems.

THE AUTHOR'S REPLY TO THE ABOVE DISCUSSION

Dr. A. F. Parker-Rhodes (*in reply*): Mr. Ullrich reveals several of the popular misconceptions about the problem of mechanical translation; these are based on a general impression of what goes on in a translator's head, without having ever made an exact mathematical analysis of the actual operations required. Admittedly such an analysis is extremely complicated and will take a long time to complete, but it is, of course, a necessary preliminary to any serious attempt at mechanical translation, and we have got far enough with it to be able to answer some of Mr. Ullrich's points.

It is not true that dictionaries and grammars contain all that is needed for translation; a mechanical-translation dictionary bears very little resemblance to one compiled for human translators, and so far very few languages, mostly very obscure ones, have been subjected to adequate grammatical study by competent linguists. But what is often not realized is that adequate grammars and dictionaries, containing all the required information, at least within the requirements of a restricted context, *can* be compiled. Mr. Ullrich's example of the two senses of 'dispose of' does not require for its solution a knowledge of common opinion regarding Stalin and Montgomery; the fallacy here is to forget that such a sentence can occur only in a definite context, and this context can be defined (at least in principle—the practical realization is still in the future though technically foreseeable) sufficiently to enable all such ambiguities to be

cleared up. If it had no context attached, it really would be ambiguous—political judgments such as Mr. Ullrich presupposes are themselves a sort of context, and could be encoded and stored in the computer as well as any.

It is also not true that, to make a correct translation of an article on some technical subject, a full knowledge of the technicality is required. It is all a matter of the correct use of terms; admittedly this is a large part of what a training in a particular subject gives one, but no highly qualified expert would agree that it was all. The correct use of technical terms may in some instances be complex enough, but in fact when one looks into specific cases in adequate detail it appears that this kind of translation is the easiest of all to mechanize, because there is almost always a quite simple correspondence between the strictly technical terms of any two civilized languages. What a computer could not do is to spot the author's mistakes; sometimes a human translator can do this, but it is questionable whether he ought or ought not to act on it. The human translator who is not an expert on the subject gets into difficulties because he has no adequate dictionary; reading such a dictionary would be a very poor way of learning a subject, so naturally they have not been written, but the point is they could be written, and certainly will be once enough financial backing is put into mechanical-translation research.