

THE LANGUAGE PROBLEM OF SCIENCE

J. E. HOLMSTROM

UNESCO, Paris

The language barrier is one of the greatest obstacles in the dissemination of science. The current need is for a greater number of reliable translations—Dr Holmstrom enumerates the main difficulties met in technical translating. As a long term policy, scientists should perhaps be encouraged to learn more languages or the adoption of a universal language might be feasible.

IT HAS been estimated that at least one million scientific articles, reports, patents and books are added to the world's libraries every year, but that over 50 per cent of these are written in languages which more than half the world's scientists cannot read.

This is the simplest possible statement of a situation which is pictured a little more fully in *Figure 1*. The widths of the vertical sections show the relative proportions of scientific literature published in the six languages most commonly used, by scientists and all other languages in the aggregate. The heights of the horizontal sections indicate the relative proportions of scientists able to read each of the six languages. Consequently, the blackened rectangle where each vertical section intersects the horizontal one for the same language represents an area of understanding in which no linguistic problem arises. The remainder represents areas of literature the potential value of which is lost. This literature can only be exploited if it is translated, or if the ability of scientists to read the appropriate foreign languages is increased, or if scientific authors can be persuaded to publish in languages more widely understood than their own.

The diagram is taken from the draft of a *Report on Scientific and Technical Translating and Related Problems* which UNESCO proposes to publish next year. In this Report the possibilities and limitations of these three alternatives are exhaustively discussed in the light of comments, suggestions and facts received from some hundreds of expert critics in many countries who have read the draft. The following brief notes are based on this information. However, it must first be emphasized that the proportions indicated in the diagram are not, and cannot be made, accurate. In fact, it is for this very reason that a graphical representation is preferred to a numerical one as a means of showing the comparative orders of magnitude involved, whilst avoiding that spurious suggestion of accuracy

which figures, however guardedly explained, are apt to carry. Actually the relative volume of publication in each language varies from one branch of science to another, and changes gradually over the years. In chemistry, for instance, German was the leading language until shortly after the 1914-18 war when English superseded it. French at one time came second, but after the 1914-18 war it ranked only fourth, and now Japanese competes with it for fifth place. Nearly seventy years ago Russian reached fifth place among forty languages, but it is now competing with German for second place. There is not space here to explain how the proportions shown in *Figure 1* were derived, and it must suffice to say that they are based on statistics published by some of the main abstracting journals which together have a world wide coverage of most branches of pure and applied science. Similarly, relative numbers of scientists able to read the various languages have been assessed by weighting the total

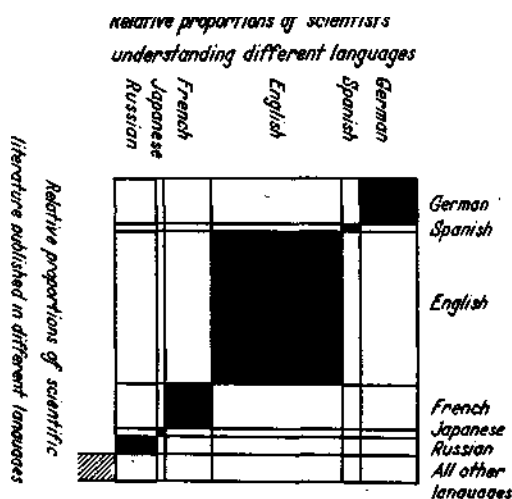


Figure 1

populations of the countries which use them in accordance with the relative degrees of scientific and industrial activity attributable to those countries and with the extent to which educated people in those countries learn foreign languages. Among the biggest uncertainties are the rates of educational and scientific advance in such countries as China, India and especially the Soviet Union. In fact so much guesswork is involved that both the height and the width of any of the blackened rectangles in the diagram may easily be in error by as much as 20 per cent. An even greater error, however, would not alter the ranking of the six languages or invalidate the opening statement of this article. In any case, the striking loss to human enlightenment and progress consequent on language barriers is clearly revealed.

TRANSLATING AND TERMINOLOGY

For the efficient communication of scientific ideas in any given language it is essential that the author knows how to write—which is an art—and that he has at his disposal technical terms which will convey to the readers the meaning that he intends.

For the efficient translation into another language, there are four requirements apart from the obvious one of knowing both the languages in question

- (1) the translator must have adequate scientific knowledge to understand fully what he is called upon to translate
- (2) he must know how to translate ; this again is an art, which at every step involves making personal choices between uncodifiable alternatives—not merely direct substitutions of the individual words of one language for the individual words of the other as if they were equated algebraic symbols, but choices of *values* of words in their context, choices which inevitably reflect the whole antecedent education and personality of the translator.
- (3) he must know, or be able to find, the nearest equivalent technical terms in the two languages.
- (4) whenever that equivalent is not exact he must appreciate, or be able to determine, just how inexact it is and be capable of introducing into his translation some qualifying phrase to correct the false or modified meaning which would otherwise be conveyed.

This fourth condition is the one which is least often fulfilled. In point of fact it is only rarely, and by chance, that a word in one language has its exact equivalent in another. Even where a term has a central meaning which is more or less generally understood, it is frequently surrounded by a penumbra of vagueness which overlaps the penumbras of

other terms having somewhat different meanings, so that when referring to a concept which lies midway an author may use one term and the reader understand this in the sense of the other. Even within a single language this uncertainty prevents words from being employed as the tools of precision they ought to be.

Although many more dictionaries of technical terms have been produced than is generally realized—UNESCO has published a *Bibliography of Interlingual Scientific and Technical Dictionaries* listing 1629 of them under 237 special subject headings and comprising 75 languages—very few of these contain definitions or illustrations of the terms agreed upon by authoritative bodies. Consequently, even a scientific translator, if he is working on the margin of his own professional field and is compelled to rely on dictionaries for the special terms, may easily make such a mistake as supposing, if he is a Frenchman, that ‘soldering’ in English includes welding as does *soudage* in French; or if he is an Englishman that *ciment* always means ‘cement’, whereas often it is used as a synonym for *béton*, concrete. These are simple examples which have their counterparts in every branch of both pure and applied science, and the consequences of such mistakes can be serious ; in industry even financially so.

To mitigate this situation UNESCO is encouraging international scientific and technical organizations to sponsor multilingual dictionaries for their respective fields, in accordance with certain principles designed to ensure that these dictionaries shall fit into place in a mosaic progressively covering all fields and all necessary languages in a uniform manner. It is recommended that such dictionaries contain a mixture of three categories of terms, distinguished typographically or by symbols, and it is hoped that in successive editions the proportion belonging to the first category will progressively increase :

- (1) terms linked with definitions published by the British Standards Institution and by corresponding other national member bodies of the International Organization for Standardization (UNESCO will shortly publish a bibliography of monolingual glossaries containing such definitions)
- (2) terms recommended for use, in approved senses, by specialized organizations
- (3) others, including regional variations, which are not recommended but may be encountered in the literature.

UNESCO is also contemplating a plan to encourage appropriate international organizations in setting

up multilingual terminological bureaux which would act as clearing houses to regulate the development of new terminology in particular groups of subjects, helping translators in their difficulties and collecting raw material to be processed and considered for inclusion in dictionaries.

Correct terminology, however, is only one facet of translating. As already suggested, this demands that the translator should be simultaneously a competent subject specialist, linguist and author. These qualities are rarely found in perfect combination, especially where the less common languages and the more recondite specialities of science are concerned. Those who know enough science to translate well find this a fascinating occupation ; but in terms of financial rewards they would probably be able to turn their knowledge to better account in some direction other than translating. At the same time, from the consumer's point of View, translating is necessarily expensive. Anyone wanting a copy of some article which has appeared in a language he can read need only buy the periodical or report containing it for perhaps 2s but if a translation has to be made by a specialist this will cost perhaps £10. Consequently, the translation will only be worth obtaining if the scientist has grounds for supposing that it will be worth a hundred times as much to him as anything published on the same topic which might be found in his own language. One remedy for this situation is to spread the cost of translating by the organization of indexes, catalogues or files of unpublished translations enabling copies of these to be obtained on payment. The Commonwealth Index of Scientific Translations (the London centre for which is ASLIB, 4 Palace Gate, W.8) is one example of this system. Similar arrangements have been made in other countries, particulars of which will be given in the UNESCO Report. The system is not, however, devoid of difficulties.

MECHANICALLY AIDED TRANSLATING

As translation is not a purely logical process, it can never be mechanized. Nevertheless, it can be said that the more technical a translation, the smaller the part of the linguist as such and the greater that of the subject specialist. This thesis is the justification for the attempt that has been started in the United States and England to replace the linguist's share in the work by the use of electronic machines. Built on the lines of mathematical computers, these machines are able permanently to register sequences of code patterns of electrical impulses corresponding to the different letters of the alphabet, fed into them by operating a type-writer keyboard. It can be arranged that, if two

equivalent words in different languages have been registered at the same time, the 'typing' of one of these at any future time will cause the machine automatically and instantaneously to type out the other. If that were all, we should have a mechanical dictionary. It is possible, however, to go considerably further. The machine can be made to type out code letters which indicate how the words fed into it in the language of origin are grammatically modified or inflected. It need not be limited to single words but may be 'taught to recognize' a whole unit phrase in one language and type out the corresponding, syntactically quite different, phrase in the other language.

Obviously such a machine cannot produce by itself a translation which will be immediately intelligible, let alone have good literary style. What it can produce in a given language, when a text in another language is 'typed' into it, is a string of words, alternative meanings of homonyms, symbolic letters and odd looking phrases which can be edited and rendered in an acceptable form by a specialist in the subject of the text, even though he may know nothing at all of the original language.

Although such machines are more likely to find a possible use in handling very obscure languages, the following example so rendered from French into English may be of interest. Here *A* is the original text, *B* is the information typed out by the machine and *C* is the rendering given by the subject specialist, who does not know French (*v* means 'vacuous' or meaningless; *m* multiple, plural or dual; *z* 'unspecific'; | denotes the 'locus of decomposition').

(A) Il n'est pas étonnant de constater que les hormone[s] de croissance ag[is]sent sur certain[es] espèce[s], alors qu'elles sont inopérantes sur d'autre[s], si l'on songe à la grande spécificité de ces substance[s].

(B) *v* not is not/step astonish *v* of establish *v* that/which? *v* hormone *m* of growth act *m* on certain *m* species *m*, then that/which? *v* not operate *m* on of other *m* if *v* one dream/consider *z* to *v* great *v* specificity of those substance *m*.

(C) It is not surprising to learn that growth hormones may act on certain species while having no effect on others, when one remembers the narrow specificity of these substances.

LANGUAGE LEARNING FOR SCIENTISTS

Clearly it is desirable, if possible, for a scientist to be able to read foreign languages rather than to have to depend on translations. In the Scandinavian, countries, the Netherlands, Switzerland and some others, almost everyone has performed had

to learn to do this, but elsewhere the ability to read English, German or French is far from universal and nowhere outside the Soviet Union and Japan are there many scientists who know Russian and Japanese.

One obstacle to solving the problem of translating by making it unnecessary is the fact that often—though not invariably—a schoolboy or schoolgirl who has a bent for science regards language studies as an unwelcome distraction from his or her main interest, and pays no more attention to them than is necessary in order to pass compulsory examinations. In the crowded scientific curriculum of universities or other higher studies this attitude of mind is strengthened. Nor does the normal young scientist, still less the normal young practising engineer, encounter any great need for knowing foreign languages during the early years of his career unless and until he is forced to carry out literature searches. Usually it is not till he reaches a still more senior position that direct contacts with foreign experts, both individually and at international meetings, become important. By then he is often too busy to be able to find much time for language study and he has long passed the age at which this is easiest.

In the aforementioned UNESCO Report, language learning is considered from the rather special point of view of the adult scientist whose motive is utilitarian rather than cultural in the larger sense. It is not disputed that from a general educational standpoint very great value may attach to the attempt at learning one foreign language (perhaps a difficult classical one) with the utmost thoroughness, aiming at (even if not attaining) one hundred per cent accuracy for the sake of the disciplinary effect this has on the student's power of thinking and formulating his thoughts, also because in learning a language he is at the same time exposing himself to an immensely educative factor—namely the impact on his mind of a different civilization. Probably embryo scientists stand in as much need of this as anyone. Nevertheless, it may well be that one who has passed that stage can put his free time to better use by learning a little of several modern languages with a much lower degree of thoroughness. It is in fact an immensely valuable practical accomplishment for him, even if he cannot understand the whole of a foreign article, to be able at least to comprehend the gist and decide whether it is of sufficient interest to merit translation or elucidation by a better linguist.

It is fortunate that for the purpose of achieving a working proficiency of any foreign language the technical man automatically enjoys a great advan-

tage over the non-specialist; for the fact that foreign scientific literature contains specialized technical terms such as no school-teacher of languages can be expected to have taught is not a hindrance but a positive help to someone familiar with a particular branch of science. If the concepts are already understood the unfamiliar names applied to those concepts in the foreign languages are soon assimilated and these help to clarify the less technical passages of the text. It is rather as if he were looking at a map of a country of which he had already visited many parts, the place names being marked in a script unknown to him and that a study of the map helps him to learn. The better versed the reader is in the kind of reasoning that confronts him in a foreign language the more often can he perceive the meanings of the words without needing to consult a dictionary, simply from the context of already known expressions. This he can do still more easily if the context consists partly of those two international languages: mathematics and graphics.

A number of books have been published containing specialized technical texts in one language accompanied by notes or a translation intended to afford progressive reading practice for technical people brought up in another language. The Report will include a bibliography of such books.

It would be well if these considerations were borne in mind by those responsible for planning both school and university education. It is not that language teaching needs, at the introductory stage, to be given a special scientific bias; but education has been defined as 'what remains after you have forgotten all you were taught' and it is important that even the student who drops languages completely, with a sigh of relief, the moment he has 'satisfied the examiner' should nevertheless carry away, buried deep in his mind, that kind of structural foundation which can be built upon quickly and efficiently when the incentive to do so arises.

The scientist or engineer who knows a little of a foreign language and wants to learn more may be well advised to subscribe to a weekly technical journal in that language. For this purpose he should not rely on a journal circulating among his colleagues but should subscribe to it privately. However busy he may be, the mere fact of its weekly arrival will act as a recurrent stimulus to induce him at least to take off the wrapper and turn over the pages, occasionally reading something in it that attracts his notice, even if only a book review or an advertisement. Indeed, the latter are especially effective as stimuli, having been written with the express purpose of attracting attention and

often containing illustrations from which new technical terms are effortlessly learned. For instance, an engineer familiar with machine tools, however little French he knew, would infer at once the meanings of the following terms in an illustrated advertisement for lathes, including the fact that *pas* as here used does not mean 'not' but the pitch of a screw:

TOUR DE HAUTE PRECISION H 130
 Hauteur de pointe 130 m/m
 Entre pointe 700 m/m
 Alésage de la broche 26 m/m
 16 vitesses de broches de 45 à 1600 m/m
 18 avances de 0,04 à 0,4 mm/t
 18 pas métriques de 0,5 à 4 m/m
 Pas Whitworth de 2 à 76 filets au pouce

AUTRES

FABRICATIONS : Tour à copier de 130 X 700
 m/m
 Aléseuse d'opération à 1 tête
 Aléseuse d'opération à 4 têtes
 à cycle automatique

Before the war there existed in London a society called 'The Engineers' German Circle' which had some hundreds of members and performed a very useful function. Evening meetings were held at the Institution of Mechanical Engineers, at which German engineers of all branches of the profession who happened to be visiting London were invited to read papers illustrated by lantern slides. These and the subsequent discussions were in German but the visitors were asked to bear in mind that they were addressing an English audience and therefore to speak a little more carefully than they might do ordinarily when addressing their own countrymen. A counterpart to this society was formed in Berlin for helping German engineers to improve their English. Similar arrangements at different centres, covering all languages of technical importance, would undoubtedly meet a need.

ADOPTION OF LANGUAGES INTERNATIONALLY UNDERSTOOD

One way of reducing the need for translations consists in making the blackened rectangles in *Figure 1* deeper by improving the ability of scientists to read foreign languages, as discussed above. In principle, another solution would be to make those rectangles wider and fewer by persuading authors and publishers to distribute scientific information in languages more widely understood than those they now use.

To some extent this tendency already exists. English being the language of the countries in

which technology is most active is used also in some degree by technologists, and to a less degree by pure scientists, in other countries who wish to ensure international circulation for their ideas. On the other side of the Iron Curtain a similar trend is being encouraged in the Russian language.

In fact the language pattern represented in the diagram is not a static one but, rather, should be regarded as an impressionist sketch of the position momentarily reached as the resultant of this tendency competing with another, opposed to it, which in the course of decades may gradually alter the proportions.

The opposite tendency is one which has been going on for three centuries or more. In the Middle Ages the influence of the Catholic Church—then regarded as the sole fount of religion, therefore of philosophy, therefore of such science as existed—had made it natural that educated men everywhere should not only write and read but speak and even think in Latin. The replacement of Latin by a multiplicity of languages may be attributed in part to a need for greater flexibility. It gained impetus through nationalism.

In some countries that have long been independent the coexistence of two or more languages causes political and cultural tensions which complicate even such issues as scientific documentation. In certain other countries, whose sovereignty is of newer date, the use of national languages for all purposes including science is felt as part of the very stuff of exuberant nationhood, an essential element in the ability meaningfully to say 'we'. Ridiculous as this attitude may become when carried to excess, it cannot be altogether condemned as insubstantial sentiment. It is natural for the peoples concerned to expect that an efflorescence of their national cultures will best be fertilized by promoting their own languages. Indeed, such efflorescence can scarcely be expected to occur unless the channels of thought are those which are native to the race that does the thinking. Educationally it is unsound to make a foreign language the means of developing the capacity for thought.

The situation is one which gives rise to problems that cannot be evaded. In China, Japan and Turkey before the 1939-45 war, in India, Indonesia and Israel since then, policies have officially been adopted of promoting the use for science and culture of the languages that are locally current for everyday purposes. The same trend is occurring in yet other countries. The question of how to reconcile it with the urge—shared by the countries themselves—to maintain that internationalism which is the

beneficent glory of science is a difficult one to answer.

Efforts to rationalize the terminology in the languages of these countries have been started—particulars will be included in the UNESCO Report—and in so far as they involve deliberate attempts to clarify and codify concepts it is incidentally a gain to the world as a whole whatever the language in which those attempts happen to be made. Otherwise, from the point of view of the internationality of science, the divergent tendency represents sheer loss. Can and should it be reversed?

In the present context let us disregard all aspects of language learning and language use other than the scientific, however much more important these may be educationally, culturally and socially. Let us assume that the sole aim is to make the greatest possible proportion of scientific literature exploitable by the greatest possible proportion of scientists of every mother tongue. In terms of total, universal effort, will the most economical way of pursuing this object be by encouraging the publication of all scientific literature of more than local importance in a single one of the natural languages (such as English), in a natural language rendered easier for foreigners to learn (such as Basic English), in two or perhaps three natural languages simultaneously (such as English for the benefit of those with Germanic mother tongues, and French or Spanish for the benefit of those with Romance mother tongues), or in an artificial auxiliary language very easy for everyone to learn (such as Esperanto which is much the most widespread of these, or Interlingua whose vocabulary, described as ‘Standard Average

European’, make it readable at first sight by any educated European or American)?

These are questions regarding which many scientists are unscientific, deterred by prejudice and preconception from dispassionate analysis of the problem. So far the General Conference which decides its policy has not committed UNESCO in any way, but one of the items on the agenda of that body when it meets in October 1954 relates to Esperanto, and this may provide an opportunity for the problem to be ventilated generally.

In the above-mentioned Report, which gives the background to language problems from the special viewpoint of the scientist, care is taken not to prejudge the issue in any way. From that point of view it has been thought proper to emphasize the distinction, so important in science, between primary publications which are the actual vehicles of knowledge and secondary publications, such as abstracts, which serve to convey awareness of these over a wider range than the individual reader can find time to reconnoitre directly. Linguistically it may well be that primary and secondary publications call for different treatment. It may be unrealistic to envisage authors of the former writing in a foreign natural language or even, all of them, in an easy international auxiliary language. But it is much more practical politics to advocate, as the International Conference on Science Abstracting organized by UNESCO in 1949 recommended, that every article should be accompanied by an abstract in ‘one of the more widely used languages, no matter what the original language of the paper, in order to facilitate its international usefulness’.