Others, not requiring spinning, are cheaper—some of them may be marketed for as little as 20 cents a pound. Altschul and other scientists at Agriculture hope to see such protein-rich simulated meat products gain acceptance in the developing nations.

Some exotic means of producing new high-protein foods are being found, including a process for producing quality protein from high-purity hydrocarbons, reportedly being developed jointly by Esso Research and Engineering Company and Nestlé Alimentana, S.A. The new process was discussed at the AAAS meeting by John G. McNab, an organic chemist at Esso. McNab said that, while a number of technical and economic problems remain to be solved, the process could result in a major new source of food within the next decade.

Efforts to expand and improve world food supplies are clearly in order, whether Malthus and latter-day prophets of a catastrophic food shortage are right or not. If the present world population should, by some miraculous event, immediately be stabilized, many years would pass before all people of the developing nations were provided an adequate diet. No one predicted any miracles, but a few AAAS panelists suggested, by way of hypotheses developed in their research, that the rate of population increase will decline in the years ahead. Ulla H. Olin, a Swedish demographer with the United Nations and the Institute of Theoretical Medicine in New York, observed that the growing urban concentrations occurring throughout the world produce increasing social competition. The universally observed tendency for fertility to be less in urban than in rural areas may be assumed to reflect, she said, the presence in urban areas of a relatively higher degree of nervous tension. She suggested that interdisciplinary teams of researchers should follow up her hypothesis.

David M. Heer, assistant professor of biostatistics and demography at Harvard, reported on some model studies suggesting that the decline in death rates which accounts for the rapid population increases leads ultimately to a reduction in birth rates. He speculated that, if this should prove to be true, part of the explanation will be that, because of the lower mortality rate, parents could have fewer children and still expect to have a son survive to look after them in their old age.

These theories no doubt will be received skeptically. Whatever their validity, however, they are noteworthy as evidence that some researchers are taking a critical look at the prevalent idea of a population explosion. But for the people concerned with the production of more and better food for the millions of ill-fed people now on earth, hopeful speculations about future population trends could not be more academic.—LUTHER J. CARTER

# Machine Translation: Committee Skeptical over Research Support

Man, plain untransistorized man, has scored a victory in his continuing effort to demonstrate intellectual superiority over the computer. In the judgment of the Automatic Language Processing Advisory Committee of the National Academy of Sciences–National Research Council, skilled human translators produce much better translations than machines do. In fact, the committee is so skeptical of the possibility of achieving machine translation equivalent to translation done by human beings that it does not advocate spending for further machine-translation research.

The committee's conclusions are contained in a recently issued report entitled "Language and Machines: Computers in Translation and Linguistics," which is based on a 2-year study.* The committee was formed in 1964 by Frederick Seitz, president of the National Academy of Sciences, at the request of National Science Foundation director Leland Haworth to advise the NSF, the Department of Defense, and the Central Intelligence Agency concerning mechanical translation of foreign languages.

The creation of the committee and its report mark significant steps in the decline of the reputation of machine translation. A decade ago there was considerable support for the idea of trying to achieve machine translation, and considerable interest in the efforts of the Soviet Union in this field. However, in the last 4 or 5 years, sponsoring agencies have become increasingly pessimistic about the possibility of translating by machine and have reduced the funds they are willing to spend for such research. At present, only a small number of U.S. institutions have projects in machine translation; these include the University of Texas, Georgetown University, and the CIA. The bloom is now off the rose; the committee's report may help give mechanical translation the wilted elegance of a pressed flower.

"There has been no machine translation of general scientific text and none is in immediate prospect," the committee reported. It defined machine translation as that which was done without recourse to human translators or editing. The members found unedited machine output to be "decipherable for the most part" but "sometimes misleading and sometimes wrong," and "slow and painful reading."

### Lesser Need for Translations

In addition, the committee questioned whether there was any need for developing more extensive translation facilities. Since English is the leading scientific language of the world, the report noted the English-speaking scientist has less need for translations than does a scientist whose native language is not English. The committee maintained that it would be relatively easy to teach heavy users of Russian translations enough Russian for reading Soviet journals in their own field. The report cited the 6-

*"Language and Machines: Computers in Translation and Linguistics" (Publication No. 1416) is available from the Printing and Publishing Office, National Academy of Sciences, 2101 Constitution Avenue, NW, Washington, D.C. 20418, for $4.

and 10-week full-time Russian courses which had been developed for government personnel by the Defense Language Institute and said the committee had been informed that the institute "would welcome the enrollment of students."

In its report the committee paid special attention to the human translation resources currently available in the United States. It concluded that there was no shortage of translators even in the more difficult languages, and that, in fact, "the supply of translators greatly exceeds the demand." The members thought that all the Soviet literature for which there was "any obvious demand" was already being translated, and they pointed out the extensive translation that is done by the Joint Publications Research Service (JPRS) for its government clients. The committee reported that the JPRS had the capacity to double its translation output immediately, that it guaranteed return of 50 pages of translation in 15 days, and that it charged $16 per thousand English words for translation from any language. The committee said it was puzzled to find a rationale for "spending substantial sums of money on the mechanization of a small and already economically depressed industry. . . ."

In its report the committee argued that the only thing that could justify the "regressive and unkind" use of unedited machine translation was a convincing demonstration that its use would effect substantial economic savings. Although the committee estimated that "raw" machine translation was substantially cheaper than human translation, it felt that such translation was of unsatisfactory quality and that the post-editing work required increased the cost beyond that of many satisfactory human translations.

Despite its great skepticism about the worth of machine translation, the committee did have some kind words to say about machines. It stated that machine aids might help improve human translation, and it cited two European-based translation operations in which machines are used to prepare specialized glossaries. One of the two major areas in which the committee recommended further expenditure was that of improving translation, in part through greater use of mechanical aids. The report stated that "all such studies should be aimed at increasing the speed and decreasing the cost of translations and at specifying degrees of acceptable quality."

While dismissing machine translation as of little present or future value, the committee argued that the work that has been done on machine translation has had a highly beneficial effect on linguistics. It urged further work in the "extremely important" area of computational linguistics and specified that "linguistics should be supported as science, and should not be judged by any immediate or foreseeable contribution to practical translation." Committee chairman John R. Pierce* of the Bell Telephone Laboratories said that NSF should provide $2.5 to $3 million annually for computational linguistics, to be spent at four or five centers.

The committee did somewhat qualify its pessimism about machine translation when it stated that "no one can guarantee, of course, that we will not suddenly or at least quickly attain machine translation, but we feel this is very unlikely." Not everyone agrees with the committee. In an interview with *Science*, R. Ross Macdonald, director of the Georgetown University Machine Translation Research Project, predicted that "freely usable machine translation will be available within 4 to 5 years, and perhaps earlier than that." Macdonald readily admits that exaggerated claims for machine translation in the past have had the effect of souring many people about the possibility of ever achieving such translation. (The report notes that the CIA gave $1,314,869 directly to the Georgetown University project, transferred $305,000 through NSF, and that NSF gave $106,600 of its own funds to the Georgetown project. Macdonald argued that this was one of the errors in the report, since it was known that all NSF money given to the Georgetown project came from the CIA.)

Macdonald said that members of the Georgetown Project were "vehement" on the subject of the Pierce Committee's report and faulted the committee for having failed to discuss the subject with members of their project. Macdonald argued that the committee should have more thoroughly studied those institutions which are currently making use of machine translation—the CIA, Euratom, the U.S. Air Force, and the Oak Ridge National Laboratory.

François Kertesz, assistant director of the Technical Information Division at Oak Ridge, reports that the scientists there who have used unedited machine translation from the Russian are satisfied, "although no one is raving about the grammatical beauty." In a telephone interview, Kertesz said that 16 to 20 scientists had made regular use of the service in the last 2 years, even though the service had not been widely publicized at Oak Ridge. Kertesz said that plans were being made for increasing use of mechanical translation. "The actual cost is not cheaper than human translation," Kertesz reported, but he added that the great advantage of mechanical translation is the fact that it can be supplied much more quickly than human translation at Oak Ridge, thus meeting the scientists' current needs and interests.

But such successes with the use of machine translation are relatively few. At least for the present, it seems that translators are in little danger of technologically induced unemployment.

—BRYCE NELSON

*The other committee members were Eric P. Hamp (University of Chicago), David G. Hays (RAND), Charles F. Hockett (Cornell), Alan Perlis (Carnegie Institute of Technology), and John B. Carroll and Anthony G. Oettinger (both from Harvard).

## Sloan Foundation Program To Aid Science Foundation

Grant totaling $7.5 million designed to strengthen science education in 20 independent liberal arts colleges have been announced by the Alfred P. Sloan Foundation. Grants of $250,000 to $500,000, payable over a 5-year period, will be made to colleges in all parts of the country in the Foundation's new program announced this week.

The program, which represents the Foundation's largest appropriation for a single program in its 32-year history, will strengthen colleges' position in the sciences and will "demonstrate means by which other colleges may improve theirs." The participating colleges are Antioch College; Carleton College; Colgate University; Cornell College at Mount Vernon, Iowa; Davidson College; Grinnell College; Haverford College; Hope College; Kalamazoo College; Knox College; Middlebury College; Morehouse College; Mount Holyoke College; Oberlin College; Occidental College; Reed College; Smith College; Swarthmore College; Washington & Lee University; and Williams College.