hurdling the LANGUAGE BARRIER

By Robert T. Beyer

The author, who presented this paper as an invited talk at the seventh annual meeting of the AIP Corporate Associates on October 1, 1964, is professor of physics at Brown University. He is also chairman of the AIP Advisory Board on Translations.

When a scientist sets to work in his laboratory today, anywhere in the world, he can be assured that groups of other scientists in a dozen or more places, are engaged in work on the same problem, or on a closely related one. It would be of help for this scientist to know what the others had already done, what they were attempting, and what might be tried by them in the future. How does he go about finding this information?

Some of it he may learn quickly, by talking to interested colleagues at a meeting of the appropriate society. Certainly this is a major source of idea and information exchange.

The next best source is the literature. The alert, working scientist follows the papers in several journals that cover his interest in some measure. If he is a native-born American, these journals are almost certainly all in the English language.

He may also have a weekly browsing date with his science library, glancing at the contents of another score of journals, most, but probably not all, of which will be in English. If now he comes on a title of interest in French or in German, he makes a judgment as to the clear necessity of his understanding it; if this judgment is positive, he makes a more or less labored translation.

As a final stage, our scientist will follow *Physics Abstracts,* to catch the rarer entry from journals that he does not cover regularly. Once again, however, he may come to an article in a foreign tongue, and this time his problem may be even greater—the article may be in a language that to him is an unsolved problem. One might paraphrase the lines of Thomas Gray to write:

> Full many a genius, in obscure language bred,
> Will end his days his praises yet unsung;
> Full many a journal is born to lie unread
> And waste its learning in an unknown tongue.

The classical example of the overlooked publication is that of the genetic researches of Gregor Mendel, whose works lay unread for 35 years, because he had published them in the obscure German-language journal of Brünn, in what is today Czechoslovakia. However, this was primarily an example of an obscure journal, rather than an unknown language. A better example is provided by the Russian achievements with their first artificial satellite; their successes were foreshadowed in their literature, but this was largely unknown in the West.

Thus there are many barriers to the spread of technical knowledge—the inertial limitations of individuals, the sheer volume of publications, and the barrier of language. It is this latter topic that I will discuss this afternoon.

The American's ignorance of foreign speech is almost proverbial. Nearly 100 years ago, Mark Twain summarized it with the question in the mouth of one of his midwestern characters: "If a Frenchman's a man, how come he don't speak like a man?"

What ways do we have today of breaking or, as the title of this paper has it, hurdling this language barrier?

The first means at hand is to learn the foreign language. This is something that we have been pretending to do for years. As a general answer, it is not practical. We can all learn enough of a foreign language or two to stumble along, to mistranslate, but few of us will ever spend the time and effort that is required to master the foreign language sufficiently that we are truly comfortable in using it. I can say this from my own experience.

Nevertheless, we must continue to encourage the study of foreign language at all levels. As of the moment, French, German, and Russian, not necessarily in that order, are by a wide margin the most important other languages in physics, and it is well that we always have many who have a fair knowledge of these, and a small number who know them truly well.

My description of the possibility of getting American physicists to learn other languages brings to mind the ancient quip, "I know that honesty

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is the best policy; but tell me, what is the second best?"

We therefore turn our attention to this second-best policy. If you can't learn the language yourself, find someone else who has learned it.

This level of linguistic effort has a number of forms. In many physics departments or industrial laboratories, there will be someone who can read Russian, German, or even Chinese, possibly with the facility of a native since they might be such. However, sooner or later, this individual may begin to realize that he is being used and will turn surly. Unless he is a peculiar individual, it is not likely that he will continue indefinitely to translate for others, in any branch of physics, either gratis or even as a regular part of his salaried employment, although extra pay is liable to produce extra results.

Another possibility in the large laboratory is the hiring of a translator, to be available when called upon, or even of a translation service, to render specific articles into English. Here again, the major languages can be handled, and many of the minor ones, if one is willing to pay the price, which may be quite high.

It was against the background of such occasional, expensive, frequently repetitious, and fundamentally random translation efforts, that the American Institute of Physics began its Russian translation program in 1955, with the support of the National Science Foundation.

Since this translation project represents the principal reason why I am speaking to you today, you will forgive me if I speak about it at some length.

In the original discussions on the project, the possibility of selective translation from several Russian journals was considered. However, under the principle that what is one man's treasure is another man's junk, it was decided that there existed no method of selecting just the right articles for translation. We therefore began with what now seems the modest project of a cover-to-cover translation of the *Journal of Experimental and Theoretical Physics of the USSR*. At the time, the journal ran to about 1500 pages per year. We made a rough estimate that it would cost us a total of $20 per page to translate, edit, compose, reproduce and distribute this product, and also to advertise to the world that we were doing so. We also made another estimate—to one significant figure—that we could ultimately sell 1000 copies of such a journal. A simple calculation immediately led us to a price of $30 for a year's subscription. Somewhat later, an official of the National Science Foundation played these figures backwards, and arrived at a figure of two cents a page as the standard price for translation journals.

Our project was the first such project sponsored by the NSF. Later, the number of translations produced under NSF financing rose to more than fifty.

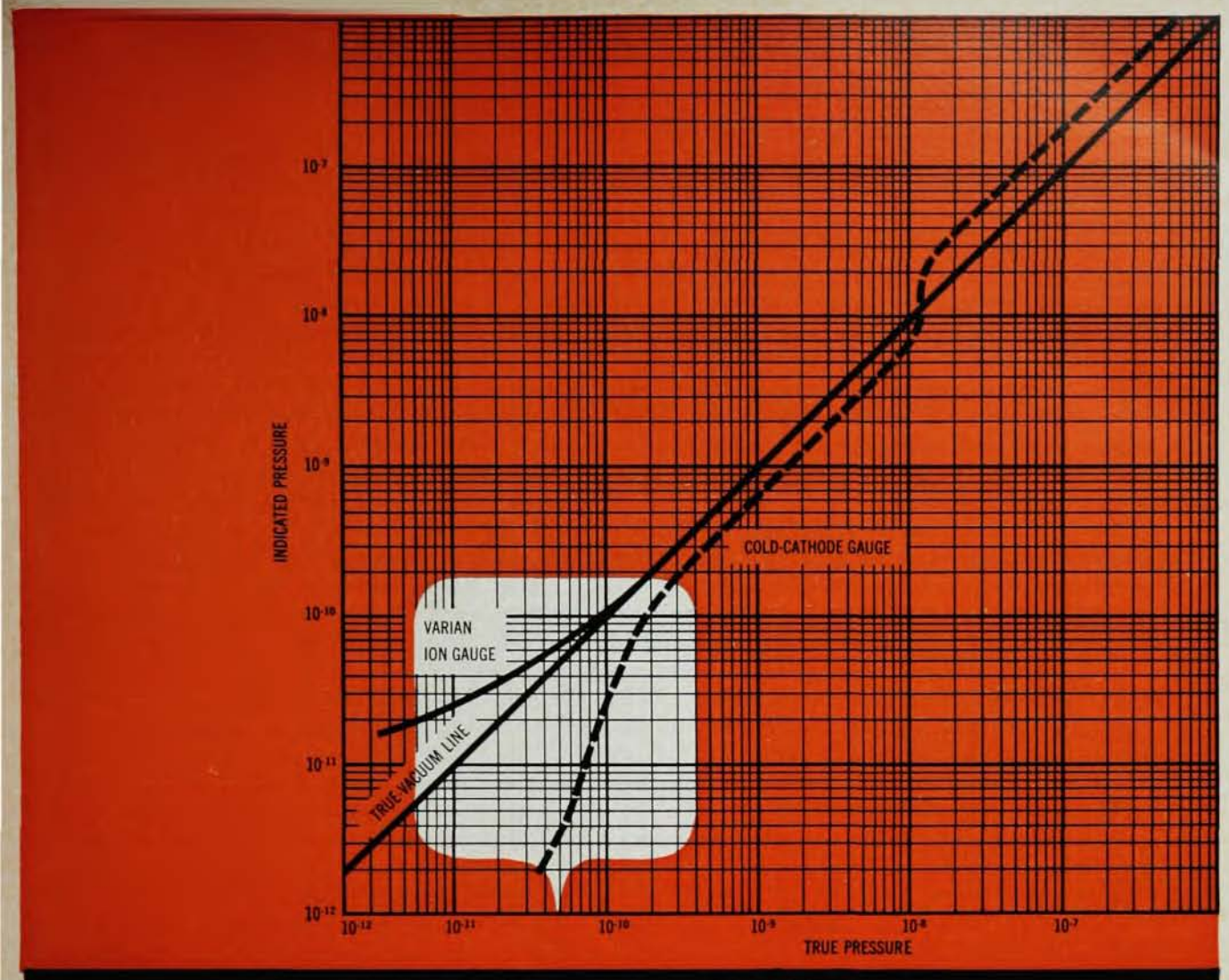
The problem of obtaining the translators was first handled by scanning the cards generated by the National Register of Scientific Personnel to find those capable of translating Russian, a process that we have recently repeated for Chinese. While many of those who claimed such competence proved to be over-optimistic, and while we forgot to see whether the same people had any competence in writing in English, most of our present group of translators came from this source.

Meanwhile, it quickly became clear that JETP was not the only Russian journal that we needed to translate. We undertook the translation of three other magazines. This time, however, we obtained the services of a translation-publishing firm, Consultants Bureau, which undertook to carry out the entire operation, from purchase of the Russian journal to distribution of the translation.

Consultants Bureau was learning, and we were learning, and the partnership proved advantageous to both. The existence of the JETP operation—the "in-house" translation—edited by a physicist skilled in Russian and translated by physicists capable in both Russian and English, served as a standard by which to measure the quality of the work done commercially. On the other hand, the cost of the commercial, profit-making enterprise served to provide us with a realistic cost estimate to judge the rate of expenditure on the in-house operation. It is a remarkable fact that the two programs, run entirely differently, have consistently cost within ten, and often within five percent of one another.

We did not stop at four, but steadily increased the number of our translation journals, rising to the number of eight. And, within the last month, the pages of JETP advertised the coming appearance of a new journal—*Nuclear Physics*—beginning in January, 1965. We expect to make this number nine in our stable.

A steady problem has been the expansion of some of the journals. In particular, JETP has increased from the initial 1500 pages to the present 4500. As a result, we have had to raise the price steadily to the present $90. However, the price increases have not caused any serious or protracted loss in circulation. We are now translating over 15 000 Russian pages per year, at a total cost of



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nearly a half million dollars annually. And yet, the subscriptions for the various journals have repeatedly reached new highs. At the present time, the size of our subscription lists range from 600 to 1300, and the dollar return is currently running just below 100% of the production costs. We are so close to breaking even that we did not ask for NSF support for three of the journals this year, and we are seriously considering operating the entire program without government aid in 1965-66. American physicists have thereby indicated their approval of the service now being rendered. In fact, this is world approval, since about one third of our subscriptions come from outside the United States.

Our efforts have been paralleled by several other groups which have undertaken the translation of other physics journals—the *Journal of Optics and Spectroscopy*, by the Optical Society, the journal on *High Temperature Physics*, by Consultants Bureau itself, the physics and geophysics sections of the Bulletin (Izvestia) of the Academy of Sciences, etc. Virtually all of the major Russian physics journals find their way today into English translation, within about six months of the date on which the original published.

At the same time, the success of these translations has stimulated the translation of Russian scientific texts.

A half-dozen years ago, virtually no publisher would touch the translation of a Russian text, since they could not be protected by copyright. Although this latter problem has still not been settled, the publishers have developed greater and greater courage, until, today, virtually all significant titles in advanced Russian physics are being translated, plus large numbers of insignificant titles.

In languages other than Russian, book translation proceeds at a much slower pace and it would be well if some stimulation could be given to the translation of the more important books in German and French.

In passing along this list of translation possibilities, we come to machine translation. Quite a number of institutions have been carrying out research in this field. I am not qualified to speak broadly on the relative success of these projects, but I have recently acquired a slave's eye view of one such enterprise. Shortly after I was called upon to give this paper, I was asked if I would edit a machine translation from the Russian for a government agency. It seemed like a good idea; I could learn something of the present state of the art.

I must confess that the results were most unhappy. I found that I spent at least as much time in editing as if I had carried out the entire translation from the start. Even at that, I doubt if the edited translation reads as smoothly as one which I would have started from scratch. I drew the conclusion that the machine today translates from a foreign language to a form of broken English somewhat comparable to pidgin English. But it then remains for the reader to learn this patois in order to understand what the Russian actually wrote. Learning Russian would not be much more difficult. Someday, perhaps, the machines will make it, but I as a translator do not yet believe that I must throw my monkey wrench into the machinery in order to prevent my technological unemployment.

Since a good translator can be classified as typewriter-limited or recorder-limited in the speed of his operation, and since the translating machine cards must still be typed, there is little speed to be gained in using the machine, even if we neglect the now considerable time of editing.

A real gain in speed may come about through character-recognition techniques, and it may well be that the combination of improvements in such machine recognition, increased literacy on the part of the machine, and the almost total ignorance of the Chinese language on the part of native Americans will make the machine translation of Chinese the real breakthrough in this area.

Let us now look at the one remaining technique for hurdling—or bypassing—the language barrier. It is perhaps our best hope: get the foreigner to write it down in English.

At first remark, this may not seem a very practical suggestion. It first presumes considerable conceit on our part, which, one must admit, we Americans do have, and as Mark Twain's character suggests. It further presumes that the other nations would be willing to sacrifice cultural and patriotic traditions, in an effort to bring about a greater understanding of their work on the part of the English-reading public. Finally it presupposes that the foreigner has already mastered the intricacies of the written English language.

Nevertheless, the astonishing fact is that, in many respects, most of the battle has already been won. The rest of the world, in full recognition of the lack of linguistic ability of Britons and Americans, has indeed come a long way in producing a scientific literature—at least a literature of physics—in the English language.

Let us consider the following evidence. For years, the Dutch have published such substantially

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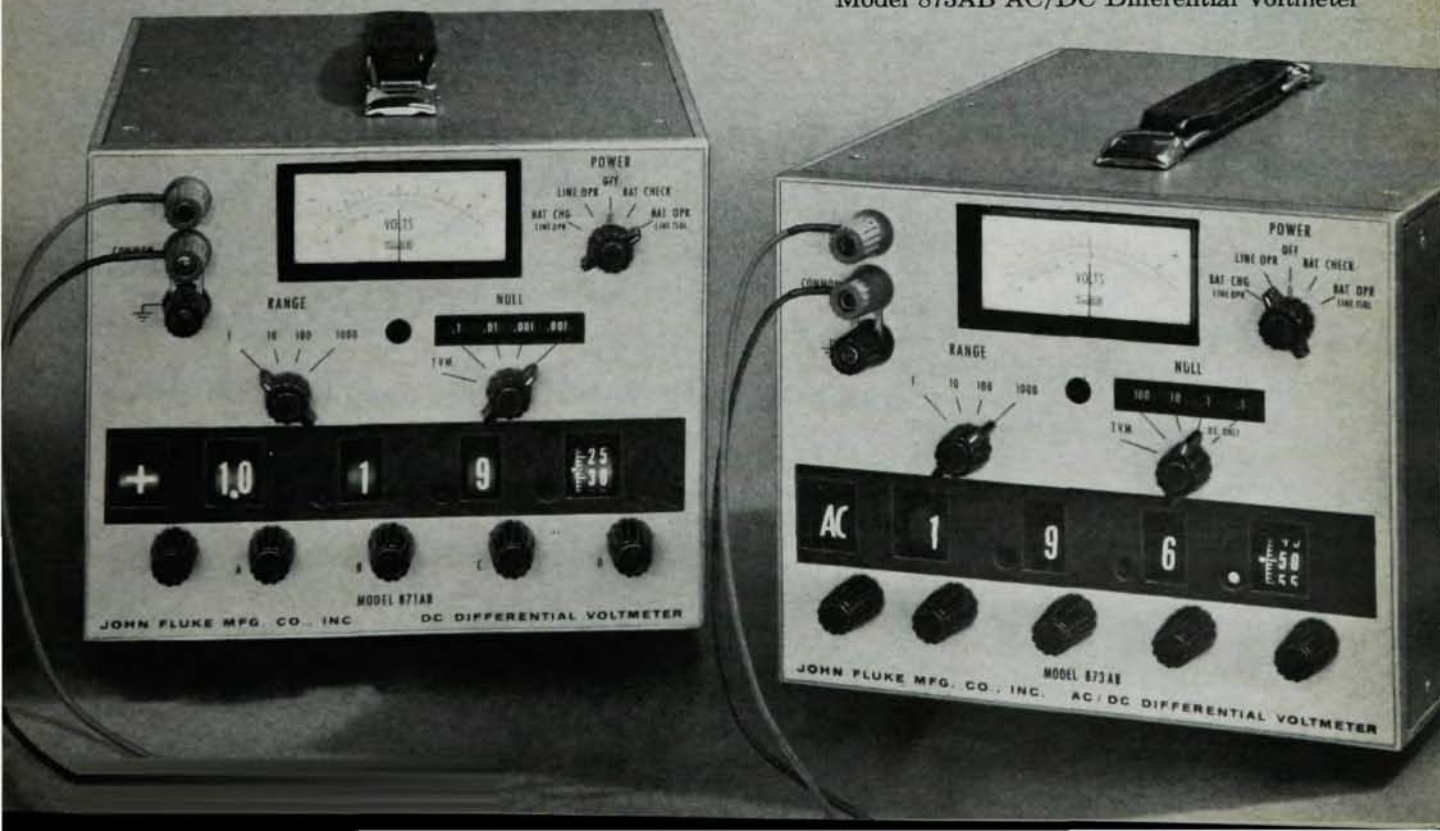

English-language journals as *Physica* and the *Philips Research Reports*. The Italians produce the nearly-all-English *Nuovo Cimento*, the Japanese have *Progress in Theoretical Physics* and the *Journal of the Physical Society of Japan*—both so nearly entirely English in content that it came as a shock for me a few years ago to find a brief article in the latter journal not written in English. You may appreciate the shock better when I point out to you that the article was written in Esperanto, and that its (misguided) author was an American. It was probably the only article in the entire issue that most Japanese scientists could not understand.

I could continue this recitation of journals at much greater length. It would demonstrate rather conclusively that outside of France, Germany, the Soviet Union, China, and a few smaller nations of lesser scientific repute, the major nations in science contribute an appreciable share of their knowledge in English.

Now, what of the four nations that I have mentioned? I have checked through a number of recent issues of the *Zeitschrift für Physik*, that monument of German physics, to find that nearly twenty percent of its recent articles have been in English. And, while it is true that most French journals cling strongly to the French pride in their language as the true international one, I have found the *Journal de Méchanique* which appears to be entirely in English.

Skipping over the Soviet publications, we may note that most of the satellite nations publish something in the English language. The *Czechoslovak Journal of Physics, Acta Physica Hungarica*, and *Acta Physica Polonica* are three cases in point. The Iron Curtain, western branch, is not a fundamental linguistic barrier in physics.

The Chinese are an entirely separate problem. For a number of years, they allowed nothing in science to leave the country, save for a single English-language journal covering all the sciences. Since only one or two physics articles appear per issue, the sampling was trivial.

We are not very much better off today. One physics and several borderline physics journals appear in Chinese with English or Russian abstracts, but the available page total still does not exceed about 2000 per year—an output scarcely commensurate with the size of the country. Someday this will be our main language barrier—but not today.

To get a feeling for the weight of physics publications in the English language, I surveyed the latest issue of *Physics Abstracts*. Now it must be admitted freely that this is a weighted sample; no article will be referenced in *Physics Abstracts* that has not been selected by the editorial staff of that journal for reviewing purposes, and, no doubt, the editors of *Physics Abstracts* are prejudiced in favor of the English language, and of the standard Western European tongues, as well as by the tradition of journals that have been well known and respected for years. Nevertheless, this supply of abstracts is largely the capital upon which the average physicist in America draws when he attempts to broaden his coverage of the literature in his field beyond what he finds in the journals he regularly scans.

The results of my survey are as follows. The sample size was 3000 abstracts, nearly ten percent of the total published in the journal during the past year. Of this total, 76% appeared in the original in the English language, 14% in Russian, 4% in French and 4% in German. Other languages accounted for the remaining 2%.

The impact of the Russian translation program can also be seen. Of the Russian percentage, more than 12 of the percentage points correspond to articles that do appear in translation journals, while less than 2 of these percentage points remain untranslated, mostly from the various academies of science of the smaller Soviet republics.

To counterbalance the prejudices of this survey, I took a very brief look into the Soviet abstract journal, *Referativny Zhurnal*. I examined about 350 abstracts in theoretical physics and elementary particles, and another 100 in magnetic and other resonance studies. The results were surprisingly similar to those just given. English accounted for 63%, Russian 24%, French 3%, German 2%, and the other languages of the world 8%. The decrease in the relative weight of English (and French and German) was contributed almost equally to Russian and the minor languages. Nevertheless, it is quite clear that English is the dominant language. (It should be further noted that the Russian abstract journal lists translations of western books into the Russian; account of this fact would raise the English percentage even higher.)

About two years ago, I attended the scientific meeting in Germany known as the Nobel Prize-Winners Conference. After two days of papers by Nobel laureates in physics, the local newspaper, in reporting the talks, carried the headline in German, "The language of physics is English." For better or worse, no one can today question that fact, and we are its lucky beneficiaries.