more diversely and effectively can only bring benefit to society and to physicists themselves.

Reference

1. See "Technological Innovation: Its Environment and Management," R. A. Charpie *et al.*, US Department of Commerce, Jan. 1967. Also, "The US Patent System," Herbert Holloman, Scientific American, June 1967, page 19.

LAWRENCE CRANBERG
Austin, Texas
7/8/77

More on language requirement

The letter on the "PhD Language Requirement" by Owen Gingerich (November, page 9) was both disturbing and excellent. It was disturbing to learn of the number of schools that no longer have a uniform PhD foreign-language requirement. It was gratifying to read of his concern over the erosion of this significant aspect of graduate education.

His report that astronomy at Harvard has dropped the departmental PhD requirement of preparation in foreign languages brings to mind the correspondence on this subject that I had fifteen or twenty years ago with the Dean of Graduate Studies at Harvard. There was great pressure in our graduate school to abandon our uniform PhD foreign-language requirement, and in support of this move the proponents cited the fact that Harvard had no uniform school-wide requirement. Surely we could do no less than to emulate Harvard. The graduate dean at Harvard replied to my inquiry to the effect that it was true that Harvard did not have a school-wide PhD language requirement for the logical reason that none was needed, because each of Harvard's graduate departments required foreign-language preparation for the PhD degree. Sadly, it appears that this is no longer true, and this leads me to note that the universities that are the great leaders in academic scholarship have a responsibility that they may not have fully appreciated. They should realize that it is the weakest aspects of their programs and requirements that will propagate most rapidly through those other schools that seeks excellence through imitation. We see here the workings of an academic Gresham's Law in which the bad policies drive out the good.

Ten years ago I served as chairman of an *ad hoc* committee of our graduate school that was charged with making recommendations for the improvement of our PhD foreign-language requirement. At that time we had a "tool" requirement that the student demonstrate skill in two languages that were approved by the student's major department and which were tested through the use of the Graduate School Foreign Language Test. One of the most striking things we found was that our "passing" score corresponded to approximately the *second percentile* compared with students enrolled in a fourth-semester college course in the language! As a result of our study the faculty of our graduate school adopted a new uniform language requirement in 1968. Under the new requirement the student should be prepared modestly in one language instead of trivially in two. Because we felt that the language requirement should be a mark of education, not of utility, the stress was shifted from the "tool" concept in which the major department identified which languages were acceptable, to a "communication" requirement in which the student chose the language. Under the new rule, Spanish or Portuguese, which are not major languages of scientific publication, could be submitted by physics students because these are important languages of communication in this hemisphere and on this earth. We made a direct approach to the problem that Gingerich cites when he says that it is "particularly difficult to require a language if a student has not mastered a foreign language before graduate school." Our new (1968) PhD foreign-language requirement is fully satisfied if the student's undergraduate college transcript shows a grade of "C" or better in a three-credit fourth-semester course in a language. The graduate student who does not meet the requirement in this preferred way may meet it by enrolling in a fourth-semester college course in a language and earning a grade of "C" or better, or by passing the Foreign Language Test at or above approximately the 30th precentile when the comparison group is students in a fourth semester college course in the language. A detailed report of our study and recommendations is available.[1]

Shortly after these requirements were adopted, a graduate student in physics expressed to me his enthusiastic approval by noting that he had studied Spanish as an undergraduate because he wanted to teach physics in Latin America, and he was pleased that the new requirement recognized the academic legitimacy of this aspiration.

The new requirements have been in effect for approximately eight years and I believe they are working well.

A few years ago a major force in the guidance of our graduate programs was the need to produce new PhD's in ever increasing numbers to meet the growing demands. One of the costs of that period of pressures "to produce" was the elimination of "frills" such as the PhD foreign-language requirement. These pressures to produce are no longer with us and so now we can focus on quality and on excellence of humane scholarship in the broadest sense. I fully support the recommendation with which Gingerich

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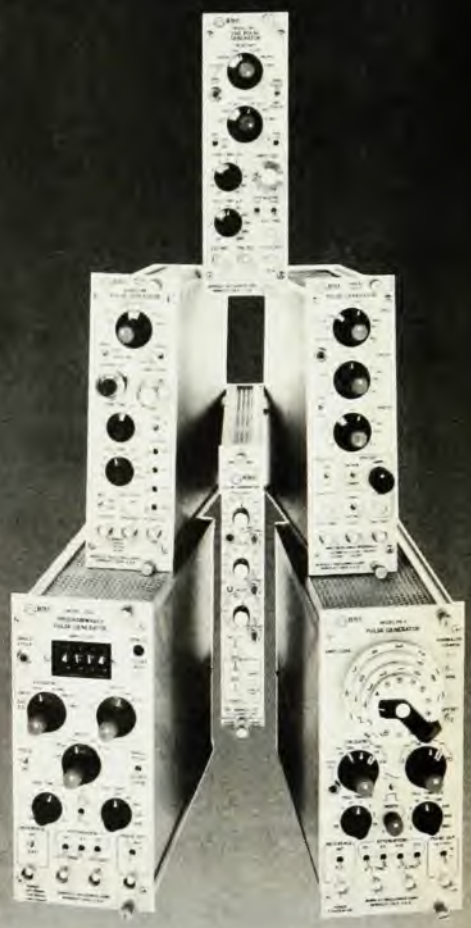

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closes his note: "I think that this group [PhD students] could be required to obtain some degree of mastery of a foreign language."

J. Robert Oppenheimer, speaking at the University of Wisconsin in May, 1959,[2] expressed the need most eloquently:[2] "Civilization, all we are, all we know, all we can do, rests on our power to tell each other about things. We do that in more ways than words; but if we do not do that, we are not human."

References

1. A. A. Bartlett, Foreign Language Annals **2**, 174 (1968).
2. G. T. Seaborg, A memorial to Oppenheimer, PHYSICS TODAY, October 1967, page 48.

ALBERT A. BARTLETT
University of Colorado
Boulder, Colorado

12/2/77

●

As a physicist who has studied some fifteen languages, I would like to make one comment to Owen Gingerich's letter: let us make up our mind as to what kind of a "Doctor of Philosophy" we want to produce. If we are satisfied with a narrow specialist who, for the rest of his life, will be rewriting his thesis, then a foreign language is an expensive luxury. (So is quantum mechanics and electromagnetic theory for those who limit themselves to celestial mechanics, and vice versa.) I believe that we have already produced a statistically significant sample of that kind of a PhD: a sentence without an elementary spelling error is a rarity, 40% of speech consists of "you know," and Pericles is a part of the digestive tract.

If, on the other hand, the words "Doctor" and "Philosophy" are to have any meaning at all: in other words, if we want to produce an educated person, then knowledge of foreign languages becomes an absolute necessity for several reasons.

First, language is more than a bunch of words: it is an artist's medium. Even if words can be translated reasonably well, the entire message can't. Homer is Homer only in Greek, Goethe in German and Hasek in Czech. If you doubt it, then listen to a "Western" in Russian!

Second, foreign languages are one of the few remaining fields of study where the pupil cannot talk his way out of a problem. *"Ich habe gefahrt"* is wrong, no matter what point of view you like. Compared with exact sciences, linguistics has the advantage that rules cannot be derived or proven: they must be learned and followed. I know of no better way to discipline the mind.

My final point may come as a surprise to many readers: going to a foreign country and not making an effort to speak the language of the host is a sign of arrogance. (The "Ugly American" image may have started right here.) It is likely that the host will offer changing into English; it is also likely that this offer will be made for the guest's convenience, and not at all in order to show him that the natives are better educated than he is: but according to good manners, the switch to English should be suggested by the host, not by the guest. If you don't think so, then imagine, say, a Hungarian representative coming to General Motors in Detroit and expecting that dealings will be carried out in Hungarian. You may, of course, argue that America is bigger than Hungary: but that proves my thesis about arrogance.

Z. F. DANES
University of Puget Sound
Tacoma, Washington

2/2/78

●

I would like to enter a plea in support of Gingerich's argument for the retention of the language requirement as a traditional prerequisite for a PhD. As an American living and working in Europe, I am continually struck by the provincialism of American scientists visiting here. The academic consequences of this are usually masked by the technical excellence of their work, but nevertheless, a subtle communication block is imposed.

There is another reason for retaining the language requirement, at once less obvious and more powerful. Alas, I fear it can not be comprehended by anyone who has *not* gone through the agony of trying to communicate in a language not his own. It is only after experiencing that process that one fully understands the limitations with which persons of non-English mother-tongue must struggle when speaking English to us, despite their apparent fluency. A simple "yes" may well mean "I hear your words and I think I am on the right track, and maybe if you keep talking I will understand what you are trying to say," rather than agreement or comprehension.

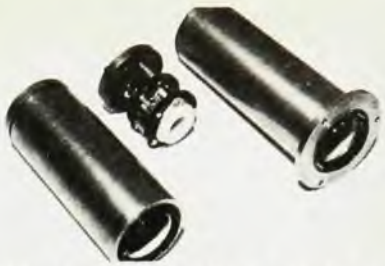
Let's not forget there is more to life than mastery of a single technical specialty.

K. A. GEIGER
Cryophysics SA
Geneva, Switzerland

12/13/77

●

Rarely have I seen such insularity as drips from Gingerich's condescending conclusion—"students should obtain some degree of mastery in a foreign language, if only as a concession to the historical origins and image of the scientific enterprise"—to a letter summarizing the uselessness of such mastery. A typical phrase: "Even though 15 years ago a large proportion of German and French articles were represented in the literature, today this is irrelevant to the majority of current research." It would appear that Gingerich anticipates that the trend toward predominantly English-language



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publication will be followed by requirements that all science courses, everywhere, be taught in English; that all students, everywhere, learn English well enough that visiting American professors need only give their colloquia, and conduct their scientific discussions, during a sabbatical year, in English; and that all shopkeepers and restaurateurs learn sufficient English to equip and feed those who arrive to educate, not to learn from, "the out-of-date natives."

On the one hand, Gingerich stresses the preprints of the most current scientific papers which keep his own work *à la mode;* on the other hand, he mentions those European scientists who were concerned that their past work was being simply rediscovered in that current work to which he refers. This would seem to be an amplifying situation, unless indeed one prohibits all past, present, and future non-anglicized work and references. I remember Bruce Billings—a predecessor of Gingerich at the American University in Beirut—once telling me that all kinds of PhD theses could be inspired by reading *der Annalen der Physik* of 50 years past. In my own scientific wanderings, I have more often found myself simply wistful, in a scientific interchange (especially, a dispute) at the language nuances I *did not know,* which inhibited better and more current learning from that interchange, than I was content that in some years I could read all this in an English-language journal or translation. Gingerich stresses preprints to remain *au courant:* myself, and most of my colleagues interested in frontier curiosity, rather than *à la mode* state-of-the-art computing algorithms, depend as much on discussion and letters—in "their," rather than "my" language—intercountry or interdiscipline.

Gingerich's left-handed defense of the language *requirement,* as a concession to historical origins and image, subordinates language *learning,* as a necessary part of a *global* curiosity in a *whole* world—of geography, of ideas. (Most of my colleagues will realize I write this letter in envy of, rather than in facility with, such language fluency: non-English or English.)

R. N. THOMAS
Institut d'Astrophysique
12/13/77 *Paris, France*

THE AUTHOR COMMENTS: The wide spectrum of well-argued responses to my letter on PhD language requirements demonstrates that this is still a highly controversial topic. In retrospect, although I still believe that nowadays it is difficult to justify a foreign language as a working tool for the astronomy or physics PhD, I would have emphasized far more strongly its desirability as a communications link in the international network of science. As an active historian of astronomy, my curiosity ranges far beyond preprints, and I am acutely aware how a greater knowledge of both ancient and modern languages would provide richer insights into the intellectual movements that make up our scientific heritage. A broader ability to communicate in tongues other than English would have greatly alleviated innumerable moments of frustration I have felt in the past several years during my visits to over 80 foreign libraries and observatories. I regret that my tone may have seemed wistful or insular because I favor a language requirement, and I heartily endorse the Boulder scheme of justifying a foreign language as a communication device rather than as a research tool.

OWEN GINGERICH
Harvard-Smithsonian Center for Astrophysics
2/21/78 *Cambridge, Massachusetts*

Invention of the laser

I was horrified to read on page 32 of the November issue that "Optical communication started in earnest when Arthur Schawlow, Charles Townes, A. M. Prokhorov and Robert Dicke invented the laser in 1958." This attribution of credit for the invention of lasers by Hans Melchior does not contribute anything to his subject—optical communications—but it does injustice to several scientists who had contributed at least as much as some included in the above list. I am thinking first of all of Theodore Maiman and Ali Javan, who made the first solid and gas lasers respectively in 1960, but there are several others. For the history of the inventions I refer to *American Journal of Physics* **34,** 903, 1966. It is an involved matter and a controversial subject that cannot be settled in a few lines.

BELA A. LENGYEL
California State University
12/8/77 *Northridge, California*

THE AUTHOR COMMENTS: Bela Lengyel's endeavor to give proper recognition to all the scientists who contributed to the invention and the realization of the laser is certainly appreciated.

HANS MELCHIOR
Swiss Federal Institute of Technology
1/9/78 *Zurich, Switzerland*

Ge(Li) revolution

Richard Pehl has written an informative account (November, page 50) of the characteristics and applications of germanium gamma-ray detectors with emphasis on the newer types made from high-purity material.

continued on page 48

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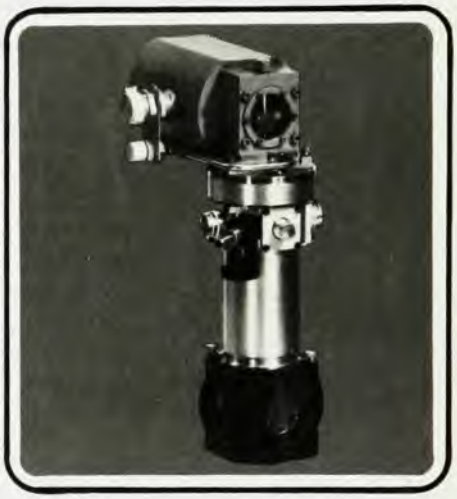

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