

designed for the economic advancement of scientists. I do agree that the economic and social position of physicians is to be envied, but I do not attribute that to the American Medical Association.

The AMA has accomplished a great deal for the science of medicine and for the standards of medical education and medical practice. But I'm amazed that Kahn should wish to have the AAAS emulate the accomplishments of the AMA for the economic and political situation of its members. I thought it was pretty generally agreed that physicians manage their personal relationships very much better than their coordinated public relations. Many of us think that the resourcefulness of AMA is inadequate to the demands of our rapidly changing culture. Understand, I'm not writing about the shortcomings of AMA—of course I wish we physicians knew better what to do. I am only trying to make clear how fatuous is Kahn's expressed desire for a scientists' association that will engineer scientists' success.

R. R. NEWELL

50 Yerba Buena Avenue,
San Francisco, California

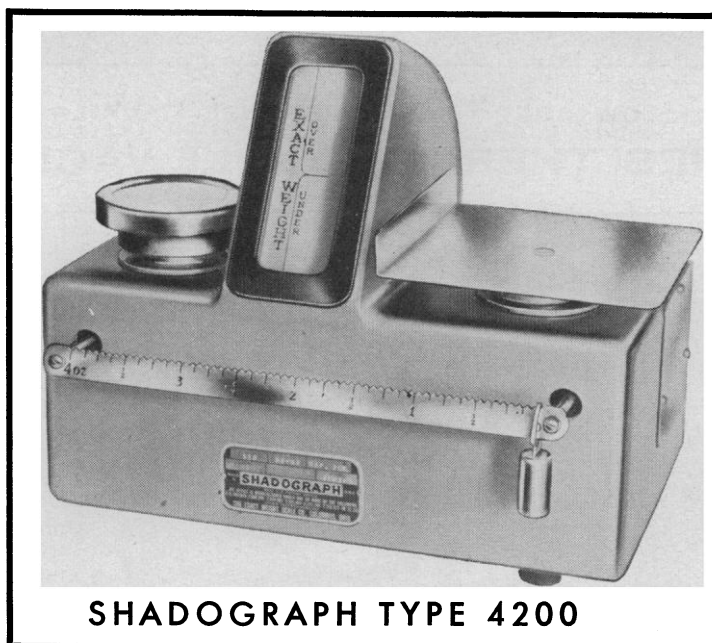
"Xenobiology"

The nominalistic problem of a generic prefix for the sciences concerned with the study of extraterrestrial autotrophs had been faced, and elegantly solved, by at least one science-fiction author long before it had become the putatively realistic concern of such august bodies as the National Academy of Sciences—National Research Council. The proper word, as any science-fiction reader should know, for the study of, say, extraterrestrial biology is "xenobiology," not "exobiology." This neoterism was used by Robert Heinlein some 7 years ago. His arguments in favor of it are set forth in the following personal letter.

You are correct in thinking that I used "xenobiology" (and several other words starting with "xeno-" in *The Star Beast* [Scribner's, New York, 1954]. But I am not certain that I coined the term; it is quite possible that I saw it used elsewhere, in fiction or non-fiction, and made use of it.

Of the several "xeno-" words I have used, I did coin "xenic," and this is a most useful adjective for designating *anything* foreign to the planet Earth—cultures, life forms, customs, history, clothing, food, you name it.

21 JULY 1961



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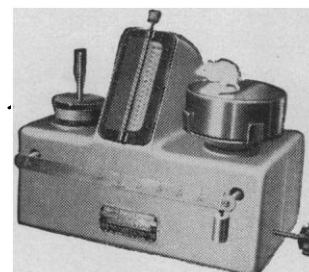
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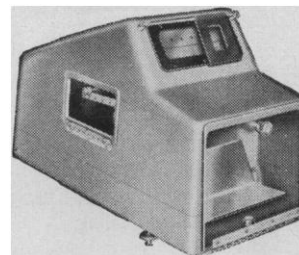
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I note that Hubertus Strughold uses "astrobiology" in the way in which Lederberg [*Science* 132, 393 (1960)] uses "exobiology" (and as you and I use "xenobiology"). Try coining a designating adjective from either of these terms: "astral" and "exic" seem to be the obvious ones. "Astral" is not only tainted with occultism, but is off in the wrong direction to start with, as "astron" is a star—and stars are about the least likely places to find life, culture, etc.

"Exobiology" does not suffer from the innate self-contradiction found in "astrobiology" but the prefix "ex-" or "exo-" has its own great shortcomings; it is tired and means too many things. The Merriam unabridged lists some 200 "ex-" words, and among them are many of the commonest words in English. . . . But "xeno-" and "xen-" have only seventy entries *not one* of which is a common word.

I submit that it is more sensible to use this almost-virgin prefix in designating non-terrestrial things, concepts, and fields of study as it will minimize conflicts in meaning, since a neologism constructed with the prefix "xeno-" is extremely unlikely to resemble or duplicate any other word already in existence (I can find only two probables; "xeno-parasite" and "xenolith"—see p. 2963 of the big Merriam).

But the situation is quite different with "ex-" and "exo-"; there are hundreds of probable conflicts with common words; e.g., a major field in "exobiology" is necessarily "exogenetics"—but exogenetic already has an established meaning in biology. A scanning of pp. 887-904 of Merriam will disclose dozens to hundreds of such conflicts.

In my opinion, "xeno-" is the best choice from the standpoint of derivation. But, be that as it may, it is certainly the best of these three in the interest of clarity and exactness.

ROBERT HEINLEIN

Colorado Springs, Colorado

I submit that Heinlein has set forth the arguments for "xenic," "xeno-," and "xen-"; let not xenophobia stand in the way of the prompt adoption of these useful, elegant, and unique prefixes for designating the extraterrestrial sciences.

HAROLD WOOSTER

2108 Seminary Road,
Silver Spring, Maryland

Exporting Universities

In response to the editorial "Diploma diplomacy" [*Science* 133, 1557 (19 May 1961)], I wish to second the motion of Arthur F. Burns that universities be exported to those countries that ask for educational aid.

It has been my observation that edu-

cation in the United States of foreign students brings much dissatisfaction to the individual himself upon his return to his native land. This is due to the fact that facilities which he has become acquainted with in the United States are not available to him in his homeland, and therefore he has little opportunity to teach others what he has learned. With the exporting of a university, the facilities would be established in his own country and would always be available to him, even after graduation.

The exchange of graduate students from foreign countries is healthy and good at the level of the individual, but for real upgrading of a country's educa-

tion the educational facilities should be built on the students' own soil and the degrees given should include graduate degrees requiring research.

Having been an engineering adviser at Cheng Kung University in Taiwan for two years, I wish to put in a word of caution regarding foreign aid to education. Education does not adapt itself too well to crash programming. At least 10 years are needed, with a tapering-off period of 5 years during which both financial aid and advisory aid are gradually diminished to zero.

H. V. FAIRBANKS

College of Engineering,
West Virginia University, Morgantown

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1. Wood, F. C., Gurin, S., and Kuo, P. T.: Medical Correlation Clinic on Atherosclerosis and Coronary Artery Disease, *Am. Pract.-Dig. Treat.* 12:235 (April) 1961.

2. Heiskell, C. L., Fisk, R. T., Florsheim, W. H., Yachi, A., Goodman, J. R., and Carpenter, C. M.: A Simple Method for Quantitation of Serum Beta-Lipoproteins by Means of the Immunocrit, *Amer. J. Clin. Path.* 35:222 (March) 1961.

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