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Comment

Elliot H. Weinberg

Few members of the United States scientific community follow the progress of their colleagues abroad on any regular basis. Among many contributing factors is unfamiliarity with the language. (In the United States more college students study Latin than Russian.) Other negative stimuli may fall under a category labeled in a recent issue of *US News and World Report* as "Techno-chauvinism." That article noted that while some 13,000 Japanese citizens are currently enrolled in United States colleges, the number of United States citizens studying engineering in Japan has never exceeded seven. Disinterest leads to limitations in terms of commercial interest in providing for translations of journals or texts. *US News and World Report* reports that in 1981 only 19% of Japanese scientific and technical publications were even *indexed* by western sources. In a later paragraph, the author (Daniel Greenberg) reports that "Representative Norman Mineta (D-Calif.) came back from South Korea last year with an astonishing account of 5700 translators looking at nothing but U.S. technical publications." In Japan, the collection and translation of foreign technical literature receive high priority, with more than 5000 scientists and engineers routinely processing thousands of foreign journals and technical reports. As John Caplan, executive director of General Motors research laboratories told Congress in 1984: "Sometimes we think they know more about GM's business than we do."

Turning our attention to science in the Soviet Union and East European countries, we find that the Soviets publish some 700 science and technology journals, amounting to 60,000 pages per year. Soviet patents issue at the annual rate of 10,000, with many also being taken out in the United States Patent Office, rarely to be seen again. In 1980, the Soviets published over 800 texts in the field of electronics alone. Within the Soviet Union there are perhaps 1,500 science centers, at least a few of which are acknowledged to be of "world class."

The Soviet's VINITI is known to be the world's best science and technology abstracting service, covering 35,000 periodicals in 66 languages from 130 countries. Some 25% of the world's scientists live in the Soviet Union, yet standard citation bibliometrics credit them with producing only 6% of the world's cited research. Explanations abound: some believe that the quality of their work is too low to be publishable, while others suspect that we simply do a lackadaisical job of looking for their publications. Possibly their reward system does not depend so heavily on credits earned by publishing in refereed journals.

This situation was nicely summarized at a recent Library Association meeting in Dallas as follows: "Much of the important social, political, and scientific literature produced in the Soviet Union and in Soviet-dominated countries is virtually unknown to Western libraries and scholars."

If not science, should we be concerned about their technology? Eugene Rivin, writing in *Mechanical Engineering*, April 1983 commented as follows: "One of the resources grossly underused in this country is foreign technology. This appears to be a self-imposed

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handicap of the United States, since other developed countries take full advantage of available information about American technology and research achievements."

In a later section, Rivin continues: "Russian scientists publish a lot, both articles and books. In the USSR, any publication in a trade magazine earns an honorarium. Books carry even larger honoraria, but one has to have clout to publish one. Accordingly, the most reputable scientists prefer to publish books, where the space is not as limited as in a paper and the honorarium is higher. Thus, the most interesting information about Russian research results, manufacturing engineering and machine tools included, can be found in these books, which are practically unknown in this country."

"Very substantial attention is paid in the USSR to dissemination of original foreign information (mostly from the developed capitalist countries). In addition to large regional and institutional libraries subscribing to original periodic and monographic publications, the major trade magazines are distributed in photocopied form, and the major technical journals are translated cover to cover. . . . Many Soviet engineers have reading ability in English or German."

The article concludes by noting that Soviet research results in the field of mechanical engineering are available essentially for free. Their use could save "many billions of dollars in research and development funding in the United States." However, currently the information exchange is all one way. "Not only are new Russian books not abstracted (or even listed) in American publications, but most of them are not even available in the Library of Congress."

Before leaving his post as Science Advisor to the President, George Keyworth encouraged an effort that led to publication of *A Study of Soviet Science*. Issued in December 1985, it was based upon interviews with about 100 United States scientists. Their summary stated that "Soviet scientists generally show an overall excellence in mathematics education, which exceeds that of their Western counterparts." This, in turn, the study says, contributed to excellence in theoretical physics, among other capabilities. The Soviets were adjudged to be comparable to the West in turbulence, plasma physics, laser physics, mathematics and astrophysics.

Regarding experimentalists in the Soviet Union, the Keyworth report states that they are "just as good intellectually as their Western counterparts . . . and have been lauded for their contributions in materials science and laser physics."

In 1985, Duke University Press published a book entitled *Sectors of Mutual Benefit in U.S.-Soviet Relations*. In it, Nish Jamgotch warns: "The Soviet Union has taken the lead from the United States in the following critical areas related to military systems: titanium fabrication, ABM battle management, ICBM "cold launch" capability, command-control-communication counter measures and intelligence, air defense missiles, etc." Jamgotch deplores the "alarming decline in Soviet studies since the end of 1982." He argues that there is developing an "academic window of vulnerability" which, in turn, can lead to serious misunderstanding of Soviet intentions and capabilities.

In an article in *Science*, dated 24 February 1984, Constance Holden commented: "It is one of the ironies of the day that as the United States defense budget becomes ever more bloated, the state of research and training about the nation's principal opponent has been allowed to wither to what many believe is the lowest point since World War II." She decries the status of Soviet international studies and of the United States lack of interest in learning the Russian language. She goes on to note a growing concern, however, on the part of Congress and others, to rectify the situation that reflects a horrendous decline in interest from the late 1960s on, with "a stunning 77% decline in constant dollars between 1968 and 1982."

Because of its by now historic mission to identify and support fundamental research in areas key to the Navy's long term interest, and recognizing that research and technology are proceeding at an unprecedented pace and in areas in which the United States cannot always claim the premier role, the Office of Naval Research (ONR) took the lead four years ago in establishing a focal point for its review and assessment of international scientific developments as they might impact the future Navy. The focus for this activity was given to a new Navy Center for International Science and Technology (NCIST), an ONR activity located on the campus of the Naval Postgraduate School in Monterey, California. Here the faculty and Naval Officer graduate students, as well as a wealth of Northern and Central California academic and industrial resources might be expected to contribute to a more complete understanding of international, particularly Soviet, scientific progress.

During these past several years, NCIST has sponsored a number of conferences, workshops and special reports. An early (July 1984) gathering at Stanford University of distinguished sovietologists attempting to better delineate the role of the Soviet scientific community in the overall political, economic, social and military affairs of the USSR resulted in a productive exchange among researchers and in a well accepted Stanford report. Other workshops concentrated on the need for improved bibliometric

techniques as current systems often prove costly, manpower intensive and just plain hostile to the user.

A number of NCIST efforts have drawn upon the invaluable assistance of Professor Herbert Solomon, currently Chairman of the Stanford University Department of Statistics. His long association with ONR includes a tour as the first head of their statistics branch (1948–1952) and another as Chief Scientist in the ONR London Office (1978–1979), where his interest in international science was heightened considerably.

Under his stimulus, distinguished academics, familiar with the Soviet scientific scene and with recent developments in fields related to Solomon's, were approached to prepare monographs under ONR sponsorship. This article is one such project. Another monograph, by Joseph Glaz, surveys statistical methods as they appear in recent Russian literature on remote sensing, and is available as a Stanford report under NR-042-267, dated October 6, 1986.

In the end, adequate comprehension of international science can come only from a much greater interest on an individual basis. Personal contact, participation at international meetings, much more extensive efforts by the professional societies to translate journals and texts on a regular basis are necessary if we are to achieve this goal. In the meanwhile, we welcome Professor DeGroot's recognition of the significance of the problem by publishing this article in his journal.

Comment

Ilya Gertsbakh

I would like to add some comments to this interesting and informative survey.

1. The "Sedyakin principle" could be a real help for estimating lifetimes under varying load and for extrapolating the results of accelerated life tests to normal operating conditions. Unfortunately, I have not seen any convincing empirical evidence that would justify a wide applicability of this principle. It is of some theoretical and practical interest to find out those models of damage accumulation for which the Sedyakin principle would be correct. In fact, it is a very strong assumption that the whole loading history influences the future behavior only via the integral of the failure rate. Let us consider, for example, the two following stressing patterns. A unit stress is applied on the time intervals of (0, 1), (2, 3), (4, 5), . . . , and a zero stress is applied on (1, 2), (3, 4) . . . . Assume that under the zero stress the failure rate is zero and that under a unit stress the failure rate is one. The second stress pattern is an application of a constant unit stress. Assume that item 1 (2) survived time $t_1 = 2n$ ($t_2 = n$) under the first and second stress patterns, respectively. The Sedyakin principle states then that for both items the future statistical prognoses are equivalent. This certainty is rather doubtful because an alternating load may have a strong adverse effect on the residual lifetime.

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2. A series of interesting works on the deviation from exponentiality for various classes of distributions have been published recently by Brown (1987) and Brown and Ge (1984), which considerably generalize and improve the results of Obretnev (1977) and Azlarov and Volodin (1981) mentioned in the survey. In particular, an upper bound $2(1 - \mu_2/\mu_1^2) = 2\rho$ has been obtained for the IFR family, and a bound of type $A\rho^{1/2}$, $1 \le A \le 4\sqrt{6}/\pi$, for a class of NBUE distributions.

3. The Pavlov-Ushakov nonparametric reliability estimator for multiply censored data in fact does coincide with the Kaplan-Meier product limit estimator. Like the authors of the survey, I was puzzled by the fact that both estimators produced exactly the same numerical results. A short note on this subject has been submitted by me to *Communications in Statistics*. The Pavlov-Ushakov result (1984) can be restated as follows: If the decision on withdrawal of an item from the test at time t is based only on the testing history during $[0, t)$, i.e., is of Markovian type, the corresponding product limit estimator is unbiased. Professor Willem R. van Zwet had indicated to me that this fact follows from more general results of Gill (1980) and Jacobsen (1986). The latter work characterizes the whole class of censoring schemes that provide unbiased product limit estimators. Recent work by Kordonsky and Rastrigin (1985) and by Kordonsky et al. (1986) present quite realistic examples of situations in which the Kaplan-Meier product limit estimator produces negative bias. This might be caused by the