

LETTERS

Higher authority

Stimulated by the work of Harvard researcher Herbert Benson (right), readers offer "statistical," experimental, and "evolutionary" perspectives on an unusual topic for *Science*—the power of prayer "in health and healing." A seminar on tenure recommended that "review mechanisms and practices should be used more, not just for narrow purposes, but to guide each faculty members' development." And "the scientific wealth of nations" is recounted.

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Testing the Power of Belief

The profile of cardiologist Herbert Benson by Wade Roush (*Research News*, 18 Apr., p. 357) and the review by Irwin and Jack Tessman of his book *Timeless Healing* in the same issue (p. 369) devote extensive discussion to Benson's intentions to demonstrate the power of belief in health and healing. One might also consider the pioneering work in this field more than a century ago by the biometrician Sir Francis Galton (1). Although his proposals were refused to directly test the efficacy of prayer for patients in one wing of a hospital as compared with those not prayed for in another wing, Galton performed a statistical analysis of the question from existing data by considering the effect of collective prayer on the life expectancy of different classes of English society. As summarized by Haldane (2)

He considered that of all classes of society in England those most prayed for were the sovereigns and the children of the clergy. If prayer is effective they should live appreciably longer than other persons exposed to similar risks of death. So kings were compared with lords, and the children of the clergy with those of other professional men. The conclusion to which his numbers led was that these much-prayed-for persons had slightly shorter lives than those with whom he compared them.

Galton also determined the frequency with which ships carrying missionaries experienced disaster at sea and compared this with the frequency of disaster experienced by other ships. He found that missionary ships sank with a frequency and loss of life only slightly greater than that of less-blessed ships. The important conclusion reached by Haldane, and one perhaps important to gain also from Benson's work, is

that in neither analysis were the differences great enough to make it probable that prayers have any harmful effect.

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1. F. Galton, *Fortnight Rev.* **12**, 125 (1872).
2. J.B.S. Haldane, in *Possible Worlds and Other Papers* (Chatto and Windus, London, 1928), pp. 237-252.

Benson needs to include a group of coronary bypass patients who know they are not being prayed for, along with the group who think they might be being prayed for and those who know they are being prayed for. The controls could then be coronary bypass atheists who adamantly doubt the efficacy of prayer, even after a good outcome. The controls required of this study would thus never benefit, and the others always would. By Benson's protocol, prayer always works, it's probably working right now, and that's why we're all not a whole lot sicker.

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Debating whether humans are "hardwired for prayer" misses the point. Whether an individual copes with the dilemma of mortality by using prayer, exercise, a walk in the countryside, or the enjoyment of higher math and astrophysics, the end result can be the same. From an evolutionary perspective, individuals who do not give up hope would be expected to be more fecund.

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Tenure Study

In Constance Holden's article "Tenure turmoil sparks reforms" (News & Comment, Apr. 4, p. 24), Lawrence Poston is described as an English professor at the University of Illinois's Urbana-Champaign campus "who headed a Chicago panel." Poston is a professor and an associate dean at the University of Illinois at Chicago. He headed a panel comprising faculty from the University of Illinois campuses at both Urbana-Champaign and Chicago.

The article quotes the University of Illinois Seminar on Tenure (the same entity as the "panel" above) as saying post-tenure review would be "enormously wasteful of faculty time and effort." Our report said "a blanket 'post-tenure' review . . . across all faculty ranks every three to five years" would be wasteful. The quoted recommendation also says that review mechanisms and practices should be used

more, not just for narrow purposes, but to guide each faculty member's development. It adds that where existing procedures suggest a substandard performance, a more focused appraisal should be engaged. Our faculty senates are discussing how to implement this recommendation.

Sylvia Manning
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I am writing to correct a statement about American University that appears in the article about tenure of 4 April. The article quotes Judith Gappa (of Purdue University), who visited our campus in 1995, as saying that we are "making greater use of full-time nontenured appointments with titles such as 'senior distinguished lecturer.'" I believe that Gappa was referring to a very small group of colleagues in our School of Public Affairs who hold the title "Distinguished Adjunct Professor." Until recently, there were five such appointments, and this year there are four.

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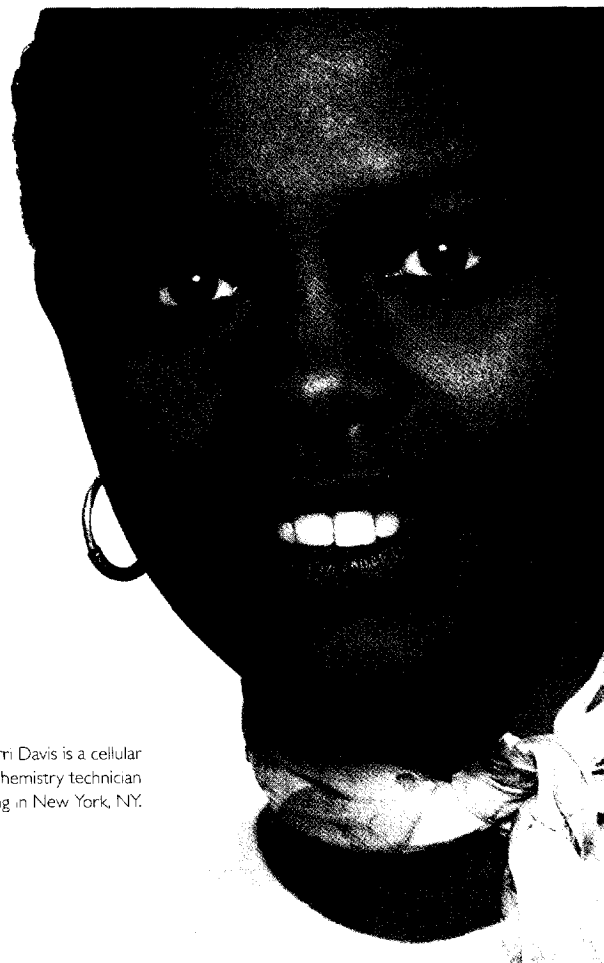
Science by the Country

In a recent Policy Forum, "The scientific wealth of nations" (7 Feb., p. 793), Robert M. May compares the scientific output of several countries based on data from the Science Citation Index (SCI) established by the Institute for Scientific Information (ISI). Some interesting patterns arose when output was standardized by the country population size or investment in research and development (R&D). The analysis focused on the top 15 countries ranked by total number of papers produced in the last 14 years. When the percentage of citations was taken into account, the rankings were similar except for India and China. Two possible reasons come to my mind to explain this result: (i) papers produced in those countries are of lower quality than the others, or (ii) discrimination occurs against papers from Third World countries, a possibility that has been invoked elsewhere (1).

It is difficult to demonstrate that such discrimination is (or is not) actually occurring, but it would be worth investigating. One could begin by comparing the mean number of citations of papers published in journals such as *Science* and *Nature*. If one finds significant differences between the mean number of citations of papers pub-

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lished in *Science*, for example, coming from laboratories in developed countries and from the Third World, we will have quantitative (although preliminary) evidence of possible discrimination, and further enquiry should be carried out.

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References

1. W. Gibbs, *Sci. Am.* **273**, 92 (August 1995).

If there is a problem of "output versus input" in the performance of French scientists—which in my opinion remains to be shown—it cannot be explained simply by "the nature of the institutional settings," as suggested by May. May's statement that "France [has] superb scientists who do outstanding work, but a large proportion do this work in dedicated research institutes: . . . CNRS institutes" is incorrect.

First, CNRS (Centre National de la Recherche Scientifique) scientists (about 11,000) are not in the majority. More than 36,000 professors are at research universities, excluding medicine and odontology faculties. This population, as well, includes

"superb scientists who do outstanding work."

Second, "working at the CNRS" generally does not mean "working at a CNRS institute." Most CNRS researchers work in university laboratories and not in "dedicated research institutes." A few statistics follow.

- More than three-quarters of the 1400 or so CNRS laboratories are located on university campuses. They host CNRS researchers together with professors and are funded and evaluated by the CNRS.

- Those university-CNRS laboratories host almost 70% of the CNRS researchers.

- Conversely, about 17,000 university researchers carry out their research in CNRS or university-CNRS laboratories.

- Not unexpectedly, in almost all CNRS laboratories, one finds Ph.D. students (about 15,000) preparing their theses.

- A rapid survey of a sample of 349 laboratories shows that at least 60% of CNRS researchers actually teach, on a regular basis, at "premier et second cycles," something like undergraduate plus 1 year.

These few figures show that if differences exist in institutional settings between France and the United States and northern European countries, they are more subtle than what is usually thought.

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May's selection of the top 15 countries does not agree with our data. The SciSearch online database includes 9.6 million documents in the period from 1981 to 1994. The ranking of the top 12 countries according to their share of the world's papers agrees with that shown by May in table 1 of his Policy Forum, but according to our data, the 13th should be Spain (1.37%), followed by Israel (1.12%), Belgium (0.96%), China (0.87%), Poland (0.84%), and Denmark (0.81%). It is surprising that Spain, Israel, Belgium, and Poland were not considered by May.

Studies by Schubert and his colleagues (1), who used data from the Hungarian Academy of Sciences [although they used a different methodology (SCI database considering only citable items and first-address country)], show the same 12 top countries for 1981–1984, but Spain ranks 14th, followed by Israel, Poland, Belgium, Denmark, and China.

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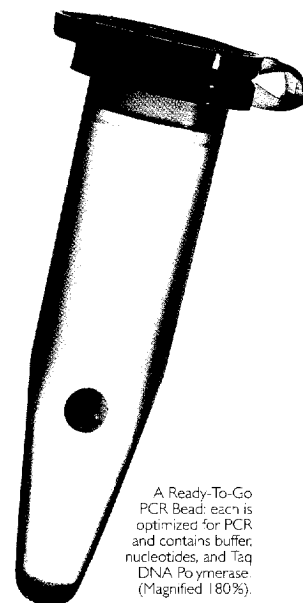
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With any of these methodologies, Spain should be included in the top 15 countries (together with Israel and Belgium). There was a great effort in R&D investment in Spain during the 1980s with the launching of the Spanish Science Law. The percentage of gross domestic product spent on R&D grew from 0.4% in 1981 to 0.82% in 1993 (2). Although this percentage is still far below the European Union average (1.9%), positive results of the Spanish effort should be noted. If one refers to the total growth in that period, Spanish scientific production in 1994 was four times that of 1981 (from 0.7% to 2% of the world's papers) and was only below that of China, which increased by a factor of 6.3 (from 0.29% to 1.31% of the world's papers).

In the absence of detailed information about methodology, May's conclusions should be considered cautiously.

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2. F. J. Ayala, *Polit. Cientif.* **43**, 5 (1995).

I find it remarkable that, in May's otherwise excellent Policy Forum, Israel is not mentioned once, despite ranking second and third in publications per person and citations per person, respectively. Israel's performance would seem to belie the statement that "there is no high relative performance by a very small country." It would have been interesting to know how Israel's rankings have changed over the years considered by May and to what extent such changes were correlated with immigration of scientists from the former Soviet Union.

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Both Israel and the former Soviet Union appear to be among the top 15 countries publishing in the world (1) but are excluded from table 1 of May's Policy Forum. It is unclear why.

The method used by May to count papers, and apparently citations as well [discussed in his note (8)], can lead to possible distortions in the analysis. Take the example of Switzerland, a relatively small country which hosts the European center for particle physics, CERN. According to this accounting scheme, all publications of CERN (and citations as well) are accredited to Switzerland. This no doubt contributes (how much?) to Switzerland's share of total publications, its very high ranking in relative citation impact in general (May's table 1) and in physics (May's table 2), in particular, and in papers and citations per person (May's table 3).

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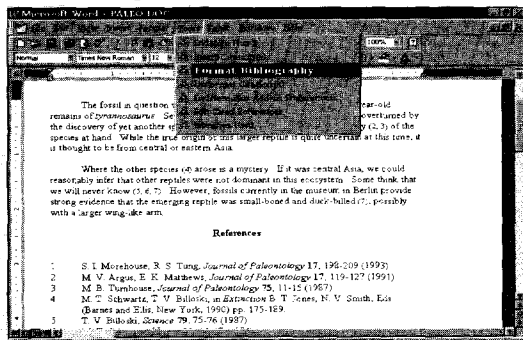
1. National Science Board, *Science and Engineering Indicators 1996* (NSB 96-21, Government Printing Office, Washington, DC, 1996), appendix A, pp.



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210-211; *The European Report on Science and Technology Indicators, 1994* (European Commission, Luxembourg, 1994), Statistical Annex, Table 1.11.i.

Response: I welcome these comments on my partly factual, partly speculative Policy Forum. In reply, I have the following comments.

With respect to Barreto's letter, my Policy Forum mentioned many possible biases in the ISI database and in subsequent comparisons among countries (see my original note 6). Barreto emphasises one such possible bias, and he offers interesting and original approaches that could shed light on the question. I hope this will prompt further work.

I speculated that the explanation for France's ratio of output of papers to input of public money being so much lower than Britain's may lie in differences between the institutional settings in which the work is typically done. Bauin effectively rebuts this speculation, at least for CNRS institutes. The question, however, remains: What does cause these large differences in output/input ratios?

Although the lower ranking places in the world's share of papers, or of citations, depend on the details of how papers with authors from several countries are handled (as discussed in note 8 of my Policy Forum), Gómez *et al.* are correct in identifying an error in the last three places (13, 14, and 15) in my table 1, which ranked countries by their shares of the world's papers. This error resulted from my combining separate tables, as part of the editorial process in reducing the length of my Policy Forum. The top 12 countries in table 1 are, as Gómez *et al.* note, correct; the bottom three were originally present for other reasons.

The omission of Spain from table 1 was particularly unfortunate, because—as Gómez *et al.* emphasize—it has done a remarkable job in recent years of advancing the strength of its science base, doubling government investment between 1981 and 1993 and trebling output.

The suggestion by Herskovic that CERN may largely account for Switzerland's top ranking in papers or citations per capita is interesting, but I think it can be dismissed as the primary cause. A glance at table 2 of my Policy Forum, which shows the five top countries in each of ISI's conventionally defined fields of science as ranked by a quality measure (essentially, average citations per paper), reveals Switzerland indeed first in physics, but also first in immunology, molecular biology and genetics, and pharmacology. It is also second in five other fields and is overall in the top five in 15 of the 20

fields. Ranking by papers or citations in relation to population size gives a similar picture.

In answer to White, table 3 in my Policy Forum, which arguably is its most significant "league table," made it clear that Israel is one of the world's top three countries in terms of quantity and quality of scientific output per capita. In the original, longer manuscript, the remark about "no high relative performance by a very small country" referred back to the opening paragraph about Olympic medals, adding, "there are no Tongas in science." This definition of "very small country" was lost in the published version; countries like Israel, Switzerland, and Sweden do superbly well in relation to their small size, but tiny Tonga they are not!

White also raises the interesting speculation that immigration of scientists from the former Soviet Union may have raised Israel's rankings over the past ten years or so. In fact, Israel produced 1.1% of the world's literature in 1981 and held this fraction steady, apart from an occasional fluctuation to 1.0%, through 1993, when the figure was again 1.1% (data from reference 2 of my Policy Forum). There is no evidence for change here, although the underlying questions are more complicated.

Robert M. May

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Corrections and Clarifications

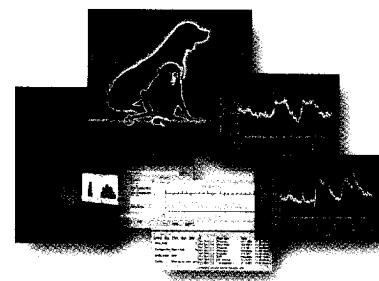
In the 28 March Random Samples item "Tyler award honors primatologists" (p. 1883), the age of the award was incorrectly stated. The prize was established in 1973.

The lower photo accompanying the Research News article "Thanks to a parasite, asexual reproduction catches on" by Martin Enserink (Research News, 21 Mar., p. 1743) should have been credited to "Stephen L. Dobson/Yale University."

Letters to the Editor

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