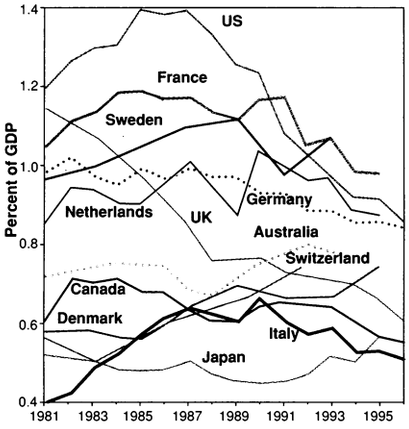
steeply." This statement is only partly correct, perhaps because May does not appear to have looked at gross expenditure deflated and converted to constant dollars. He seems to be referring only to Britain, France, and the United States, which have decreased their military R&D investment, in gross terms and as a fraction of gross domestic product.




**Trends in government-funded gross expenditure on R&D as percent of gross domestic product** [R. M. May, *Science* **281**, 49 (1998)]

Among members of the Organization for Economic Cooperation and Development (OECD), Germany ranks fourth in military R&D investment. Germany has made real increases in public investment in military R&D since 1994. Before that, Bonn had underfunded some programs. Shortfalls were covered by industry and international partners, so total military R&D investment probably did not fall steeply (*1, 2*).

Japan has the fifth largest gross public investment in military R&D in the OECD and probably the fourth largest, if one includes privately funded R&D. Japan's public funding of military R&D has increased steadily in real terms since 1976, and in 1996 was 220% of what it was in 1986 (*1, 2*).

South Korea is a new member of the OECD and has reported its military R&D investment to Paris for only 1 year. The purchasing power of Korean military R&D investment ranks sixth in the OECD. Korean government reports reveal that Seoul has increased military R&D investment steadily since 1989. It tripled in real terms between 1989 and 1997 (*2, 3*).

In neither Japan nor Korea has the increase in military R&D been at the expense of civilian R&D (*1–5*).

Outside the OECD, Russia has steeply decreased investment in military R&D (*2, 6*). The trend in China is unknown after a steep decrease in the 1980s. Reports of an increase since 1991 cannot be confirmed (*2*).

In 1997, the purchasing power of India's military R&D investment was about equal to Germany's (*1, 7, 8*). India's budget for military R&D was increased by 32% in real terms for fiscal year (FY) 1998–1999. Indian military R&D investment has been increasing steadily since the 1991 (*2, 7, 8*). In contrast with Japan and Korea, Indian government investment in military R&D increased simultaneously with decreases in government investment in civilian R&D before the FY 1998–1999 budget, although there is not clear evidence of a causal link (*2, 8*).

In summary, two of the six biggest investors in military R&D in the OECD are steadily increasing their military R&D investment. Globally, at least four of the 10 biggest investors in military R&D are increasing their budgets.

**Eric Arnett**
Project on Military Technology, Stockholm International Peace Research Institute, Frosunda, 16970 Solna, Sweden. E-mail: arnett@sipri.se

**References and Notes**

1. *Main Science and Technology Indicators* (Organization for Economic Cooperation and Development, Paris, 1997).
2. E. Arnett, *SIPRI Yearbook 1998* (Oxford Univ. Press, Oxford, UK, 1998), "Military Research and Development."
3. *Defense White Paper* (Ministry of National Defense, Republic of Korea, Seoul, various years).
4. *Annual Survey Report on R&D Activities* (Ministry of Science and Technology, Republic of Korea, Seoul, various years).
5. *Unesco Statistical Yearbook* (Unesco, New York, various years).
6. *Reducing Military Budgets: Military Expenditure in Standardized Form Reported by States* (United Nations, New York, various years).
7. *Annual Report* (Ministry of Defence, Government of India, New Delhi, various years).
8. *Research and Development Statistics* (Department of Science and Technology, Government of India, New Delhi, various years).

### *Response*

My Policy Forum focused on the G7 nations, along with five other countries, each with an output of research that is particularly high in relation to population size of gross domestic product. Arnett correctly assumes that, in this context, my discussion of declining defense R&D referred primarily to the United States, the United Kingdom, and France, which have defense R&D expenditures that are far more than the fourth-place Germany or Japan.

Space did not permit my elaborating on this point (or on many others). I welcome Arnett's more detailed and thought-provoking comments.

**Robert M. May**
Chief Science Advisor, Office of Science and Technology, London SW1H 9ST, United Kingdom

## NRC on Global Change

The News & Comment article "Global change fights off a chill" by Andrew Lawler (12 June, p. 1682) provides a good summary of the recent National Research

Council (NRC) report (*1*) by the U.S. Committee on Global Change Research and the Board on Sustainable Development. The NRC report calls for a refocus of U.S. global change research in response to the "impressive array of scientific accomplishments" and on the evolution of federal policies over the last decade of the U.S. Global Change Research Program's (USGCRP's) existence. The NRC report justifiably bemoans the recent deterioration of surface-based data collection programs.

The report also dwells on the allocation of funds among the various federal agencies and scientific approaches in the USGCRP. A pie chart in the News article shows three-quarters of the total USGCRP budget going to NASA, and the NRC report states that 61% of the USGCRP budget supports space-based observations, while "only 11% of USGCRP observations [were] devoted to in situ measurements." The implication is that NASA's part could be used more effectively elsewhere in the USGCRP for surface-based studies. Such comparisons ignore the fact that NASA's Earth observation programs serve other national interests. Over half of what USGCRP calls its budget is being used to build an infrastructure of space-based, global, monitoring systems for scientific, human welfare, and commercial purposes. The NRC report admits that if funding for Earth observations from space were cut, the transfer of funds from NASA space missions to other agencies within the USGCRP would be "unlikely."

We agree that the allocation of limited resources requires careful consideration. Surface measurements provide unique and crucial data, but satellites are the only practical way of getting consistently calibrated, real-time observations over the whole globe. Both are needed to achieve a useful understanding of the Earth System. We also believe the NRC report and the News article may give the wrong impression that all of NASA's research is space-based when, in fact, most of NASA's global change science funding (which is about 14% of the total USGCRP budget) goes to independent research institutions to do in situ studies.

Finally, it seems unfortunate that, given NASA's role in the USGCRP, no NASA scientists were on the NRC report committees.

**G. James Collatz**
Biospheric Sciences Branch, Code 923, NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA. E-mail: jcollatz@ biome.gsfc.nasa.gov

**Yoram Kaufman**
Climate and Radiation Branch, Code 913, NASA Goddard Space Flight Center. E-mail: kaufman@ climate.gsfc.nasa.gov

**References**

1. *Overview Global Environmental Change: Research Pathways for the Next Decade* (Academic Press, Washington, DC, 1998).

**Native Coral** In his article "Coral reef monitoring: Smithsonian field station gets the boot" (News & Comment, 29 May, p. 1340), Joseph Alper describes a dispute between the Kuna Indians of Panama and the Smithsonian Tropical Research Institute (STRI) that led to the closing of the San Blas research station. The dispute was unfortunate, in more ways than one. The Kuna and the Smithsonian had enjoyed a special relationship since 1925, when the National Museum of Natural History in Washington, D.C., played host to a delegation of Kuna. It was during this visit that a plot was hatched (not by the Smithsonian, to be sure) in which the Kuna would rebel against the newly formed Panamanian government, with support from the United States (*1*). This