Editorial & Letters

EDITORIAL

New Zealand's Foresight Project

How can governments best position science and technology policy while the knowledge revolution is driving profound changes in economies and societies around the world? What can small countries such as New Zealand, which account for only a tiny fraction of global science and technology investment, actually contribute to global knowledge? And what role should government play? These questions are at the heart of the Foresight Project, initiated in New Zealand last year to review priorities for public investment in research, science, and technology and to motivate strategic thinking about the future across New Zealand. The project could be a model for other small countries seeking to redefine relationships between government and industry.

New Zealand has a proud tradition of research, science, and technology. Our unique biological, geological, and climatic features have required science and technology that cannot simply be transported from elsewhere in the world. In addition, contributing to the global knowledge base has been an important part of building a national capability for locally interpreting and adapting international advances. Traditionally, government funding and institutions have dominated research, science, and technology in New Zealand, and public investment still accounts for about two-thirds of total research and development. Indeed, our private sector investment is among the lowest among countries in the Organization for Economic Cooperation and Development. New Zealanders also have a relatively low awareness of the benefits of science and technology, particularly its link to wealth creation, so it is vital that a public debate about the future direction of public investment in science and technology be tied to a general discussion about the role of new knowledge and technological change in meeting the needs of and creating opportunities for our society.

A public debate might address questions such as these: Who is responsible for providing public services that until now have been delivered by government? What as individuals, local communities, and citizens are we obligated to provide for the greater good? Where do we draw the line between public and private responsibilities? The process we undertake to answer such questions will be as dramatic as the answers themselves. In countries like New Zealand, dominated by small firms that have difficulty realizing the benefits of investing in new ideas, governments play an important role in research and technological innovation.

In the emerging knowledge economy, the role of government needs to be reconsidered. A new focus on fostering linkages and information flows and on building human capital needs to be achieved. There must be sufficient incentives to invest in knowledge creation. Governments must underpin innovation throughout all sectors of society, focusing on the needs of end users. The New Zealand Foresight Project provides a framework for various groups to think about their future and thereby define a context for the government's research, science, and technology investments. These groups—ranging from the fruit industry to local governments—are being asked four simple questions. First, describe your group's future strategic position and significance. Next, outline the key achievements or milestones that enable this position. Then, identify the new knowledge and technologies that these achievements require. Finally, review the investments required in terms of costs and benefits and articulate the expected relationship to government investments. The strategies for innovation that come out of this excercise will feed directly into the government's review of its goals and priorities for research, science, and technology investment.

In the knowledge age, developing "smart" policy will depend on engaging the wider community, drawing on extensive information, and fostering new ideas about how to address goals. This is not a task to be restricted to the academically or technologically elite. Instead, we need open and public debate about policy objectives and how they will be met. This debate must include people from all perspectives to ensure that social, ethical, environmental, and economic perspectives complement the technological perspective that scientists provide. Furthermore, the policy dialogue may itself foster the interaction between scientists and end users that is sorely needed to develop innovation in countries like New Zealand.

The success of the Foresight Project should therefore be judged by its impact on how various groups across New Zealand think about the future role of knowledge and technological change. It should also be judged on the basis of the associated changes in investments, partnerships, and competencies brought about to support our development as a knowledge society.

Maurice Williamson

The author is Minister of Research, Science and Technology for New Zealand.

LETTERS

Whose property?

A Brazilian senator argues for "recognition of the contributions and the resulting intellectual rights" of rural native groups in Brazil (below, right). International collaboration in high-energy physics is encouraged. And authorship of a ring laser design is discussed. Other letters discuss an entropy effect in virus formation, human iris morphology, a self-funding scientist, and gray whale research.

OWEN FRANKEN/PNI

The Gentle Force of Entropy

On reading the Research News article by David Kestenbaum "The gentle force of entropy bridges disciplines" (20 Mar., p. 1849), I was reminded of the old saying, "What goes around comes around." The article reports that in the case of a suspension of two sizes of spheres, the larger ones aggregate spontaneously, thereby giving more space to the smaller ones—resulting is a maximization of the entropy of the system as a whole.

In the first (1960) edition of my book (*1*), I cited the peculiar phenomenon of tactoid formation by the rodlike tobacco mosaic virus [a 1941 observation (*2*)] as resulting from a kind of entropic force. As illustrated in a figure from that book, at a certain concentration, a solution of the virus separates into football (American)-shaped aggregates or tactoids in a thereby diluted solution of the remaining individual molecules. Papers by Onsager (1949)(*3*) and Flory (1955)(*4*) were cited. Here, asymmetry in shape rather than difference in size was involved.

The topic was retained in my second (1967) and third (1976) editions, but was dropped in subsequent ones [including the current sixth edition (*5*)], as no longer being of timely interest. In the Research News article, a 1958 paper by physicists is said to have given the first explanation of this type of entropy effect. It appears, however, that physical chemists, at least Onsager and Flory, led the way.

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Bioresources and "Biopiracy" in Brazil

I congratulate Elizabeth Pennisi and *Science* for the article "Genetic ownership: Brazil wants cut of its biological bounty" (News & Comment, 6 Mar., p. 1445), which calls attention to the initiative to enact a law regulating access to biological resources in Brazil. It is important to show the scientific community the political side of this question and the different interest groups concerned about it. It was also heartening to see that Brazilian authorities have finally decided to speak publicly about the access bill.

Pennisi quotes biologist Thomas Lovejoy of the Smithsonian Institution as stating that the legislation "is potentially a real roadblock ...to scientific progress." This is an argument often invoked by international interests who perceive a national legislative framework as an obstacle to their economic goals. Haven't these same groups used the argument of "scientific progress" when applying pressure for laws protecting their own intellectual property rights in various countries, including Brazil? Exactly what does "scientific progress" mean to the economic groups that sponsor bioresearch in developed countries? A sense of justice would also require a recognition of the contributions and the resulting intellectual rights of traditional rural and indigenous communities. The intent of the proposed law is to protect these rights, while encouraging fair and efficient use of Brazil's bioresources.

Lovejoy's pessimistic prediction is echoed by Pennisi when she refers to "a series of bureaucratic hurdles that anyone who wants to collect and use biological specimens in Brazil must clear." This concern could well have been discussed by business, science, and government representatives with myself as author of the bill, or with Brazilian Senator Osmar Dias, the bill's rapporteur and a member of Brazilian President Fernando Cardoso's political party, Partido de Social Democracia Brasileiro. After $2\frac{1}{2}$ years of public hearings and seminars, however, those sectors' suggestions have not been forthcoming.

It is their apparent silence, perhaps a strategy for opposing this legislation, which may in fact represent the greatest threat to scientific progress. There are many interests awaiting approval of the law (such as Shaman Pharmaceuticals, mentioned in the article) in order to begin working seriously in Brazil, free from charges of biopiracy. The best strategy for avoiding bureaucratic "bogeymen," which frighten us all, is to contribute as soon as possible to the creation of appropriate legislation by democratic means, in the Brazilian Congress.

Marina Silva
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Super-Accelerators and International Collaboration

I enjoyed the article by David Kestenbaum (News, 27 Feb., p. 1296) about the next generation of particle acclerators. I share the opinion that we need an electron-positron collider with a performance exceeding that of the Stanford Linear Accelerator Center (SLAC) Linear Collider by at least a factor of 5 to 10 in energy and perhaps four orders of magnitude in luminosity. I also share the opinion that such a project should be truly international. However, I would like to comment on two statements in the article.

Germany's DESY lab is described as "hard at work" on a linear collider made of superconducting cavities as an alternative to the conventional technology promoted by Japan's KEK laboratory and by SLAC, and this is said to be a bad omen for international collaboration.

Indeed, DESY is making a major contribution to the international TESLA collaboration, initiated by physicists at Cornell University (since 1993, centered at DESY). At present, some 30 institutions from eight countries, including the United States, are collaborating to develop this technology. TESLA is thus a truly international collaboration where outside institutions have contributed some 50% of the total effort. Given the large extrapolation in performance parameters, we feel that it is not detrimental to international collaborations as stated in this article but important and prudent to explore all options in order to arrive at the best solution. A premature decision on the technology will not serve the international user community well.

Moreover, DESY is criticized by the U.S. Department of Energy's Peter Rosen for raising the question of a site at this stage. In the TESLA Conceptual Design Report, two sites were considered—one at DESY, the other at Fermilab. I do not feel that this is bad for international collaborations. To make a meaningful comparison of the options, the availability of a site and the total cost incurred in setting up a new laboratory—if needed—must be known.

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Shifty Eyes

I disagree with the implication that human iris morphology is more "stable" than fingerprints or retinal vasculature ("Eyeball ID," Random Samples, 16 Jan., p. 329). The iris can change with trauma, infection, inflammation of an idiopathic nature, glaucoma, and after cataract surgery. In the young, the likelihood of change is minimal.

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Funding Themselves and Others

In reading "Scientists who fund themselves" (Special News Report, 9 Jan., p. 178) by Jon Cohen, we were moved to relate this story of neurophysiologist Alexander Forbes, who not only used his own funds to support his own work (*1*), but went considerably further by helping another scientist, Ernst Theodor von Brücke, escape from Nazi-occupied Austria in 1939, so that Brücke could resume his research (*2*).

Forbes, born in Milton, Massachusetts, was the grandson of Ralph Waldo Emerson. He is one of America's premier electrophysiologists and biomedical engineers (*3*). Brücke, a prominent Austrian europhysiologist of Jewish ancestry, was an excellent experimentalist who postulated spinal cord interneurons and championed the concept of reciprocal innervation of muscles (*2*).

Soon after the Nazis annexed Austria to Germany in March 1938, Brücke was abruptly dismissed from Innsbruck University. Unknown to Brücke, Forbes immediately began to arrange a position for him at Harvard. He offered to underwrite, and subsequently assumed sole responsibility for, Brücke's salary for 2 years. He wrote to numerous scientists (including J. Erlanger, R. W. Gerard, and H. S. Gasser), industrialists (including E. Mallinckrodt), and foundations soliciting