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EDITORIAL

Science in Japan

This week's issue of *Science* is devoted to science in Japan. The commercial effectiveness and the applications of technology in modern Japan are the marvels of the world. To some, both in and out of Japan, the country's effort in basic research and support for basic research has been less impressive than one might expect from its enormous success in other areas. That gap in performance, however, is now being corrected, as Japanese institutions and Japanese funding are increasing the prominence and performance of Japanese basic science. This issue of *Science* illustrates the various successes and problems of the infrastructure for research in universities, government, and industry.

No single issue of a journal can successfully describe all of the aspects of science in a country that is as complex as Japan. But in this issue we do give snapshots of aspects of the large and increasingly successful effort in basic research. In lead articles and Perspectives, a number of world leaders in scientific thought who are carrying out their work in Japan describe their fields of endeavor and where their own research fits into the world scene. The subjects range from astronomy to intracellular signaling to the economics of health care. An essay by His Imperial Highness Akihito, Emperor of Japan, a scientist in his own right, describes the early development of science in Japan and the importance of foreign information in the development of Japanese science. He modestly leaves to the reader's imagination the extraordinary contributions of Japanese science and technology to the rest of the world. Sugimura describes modern research approaches to cancer, the leading cause of death in Japan. Recognition of the growing number of interacting carcinogenic factors may force reconsideration of cancer risk calculations. Aono discusses the beginnings of a Japanese move to atomic level material processing. Acton and colleagues discuss the Yohkoh mission for studying high-energy solar physics, Noyori the status of organic chemistry research, and Fukao seismic tomography of the Earth's mantle and its geodynamic implications. Kishimoto and Nishizuka discuss aspects of cellular signal transduction, Nakanishi neuroreceptors, and Honjo a model of immunity. Ikegami analyzes the economics of health care in Japan, while Hirano, Koizumi, and Arima discuss funding and organizational matters in research, as do a number of the news stories. The news stories describe some of the infrastructure triumphs and problems of Japanese scientists, including their common cause with colleagues all over the world in the belief that basic science is underfunded. This issue also discusses the widespread influence of Japanese institutions, as indicated by citation indices, and their relative contribution to the world's scientific literature.

Because of geographical distances, reciprocal national lecture tours have in the past been more difficult for Japan than for countries nestled in the center of Europe or on the American continent. These difficulties, however, have not hindered the exchange of information through scientific journals, and the increasing support by industry and government of Japanese science is a sign that those interactions will increase dramatically in the years ahead.

Japan is today the most prominent supporter of basic research and technology in Asia, but it is certainly not the only contributor, and the emerging competence of new and enthusiastic centers of research on the Asian continent as a whole indicates that in the near future that community will also be an increasingly important contributor to the knowledge of the world. Future issues of *Science* will be devoted to the science of other Asian nations and to the interactions of these nations in the quest for human knowledge.

Japanese science is interesting not only because of the knowledge it is developing, but also because Japan illustrates the situation of a country whose natural resources and land area are so limited with respect to its population that it must live by its wits to survive in a global economy. Modern Japan gives an example of the way in which countries are going to have to invent, improvise, and apply in order to cope with the challenges of the future. Its recent emphasis on basic research is a substantial addition from a country that has already demonstrated its leadership in application and ingenuity.

Daniel E. Koshland, Jr.