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Science in Japan: A Status Report

The nations of the world are saying, "We have seen the future, and it is Japan." A combination of awe, fear, and respect has been earned by a country whose history is as amazing as its present achievements. A nation with half the population of the United States occupies an area about the size of the state of Montana, but more than 80 percent is inhospitably mountainous. Japan imports most of its raw materials, almost all of its iron ore and petroleum, and all of its rubber, wool, and cotton. Yet it has one of the highest literacy rates and school attendance rates and one of the lowest crime rates among the developed countries.

How has this success story been achieved? The envious hypothesize that it is a combination of low-wage rates, willingness to emphasize application at the expense of innovation, and centuries of tradition that have taught docility and loyalty to the population. Admirers say that it is a combination of realistic appraisals, exemplary discipline, and imaginative policies. The readers of this issue of *Science* will find that Japan today has mixed these qualities in a way that is perhaps even more amazing than the simplistic paradigm of either extreme. Those who would like to believe the low-wage-docile-worker explanation had better read the story by Constance Holden on the Toyota-General Motors automobile plant. There, American workers on American soil are responding to Japanese management techniques in ways that are bound to revolutionize that industry. Those who would like to believe the all-they-do-is-imitate myth should read the lead articles by the world-renowned Japanese investigators Fumio Kodama, Ryogo Kubo, Shigeo Minabe, Kiyoo Mogi, Teruaki Mukaiyama, Yasutomi Nishizuka, Takashi Sugimura, and Toshimitsu Yamazaki. They represent the many Japanese scholars now doing pioneering work and making fundamental contributions to basic research across the spectrum of science from mathematics to the social sciences.

Perhaps even more impressive than the successes already achieved is that this nation, which learned early in its history that it would have to live by its wits, is even now reexamining the operation of its most venerable institutions, as Eliot Marshall reports. The school system, which on the basis of statistics might be assumed to be sacrosanct, is being reappraised by Japanese authorities because some believe more freedom and creativity are needed if it is to serve as the base for the increased innovation in the future. While recognizing the important historical value of imitation and applied science, Japan's current leaders are examining the need for a heavier emphasis on basic research. Articles by Mark Crawford and Leonard Lynn describe the economic and industrial changes that will be required to adjust to a global economy and a saturated Japanese market.

As a modern phenomenon this story is astonishing. As an extension of history it is perhaps less so, for Japan has had a legacy of adaptability. Its closed society in the 1800's responded to its clash with Western aggression by determining to learn from it. The Meiji emperor, with the help of a far-sighted group of native leaders, sent emissaries to the United States and to Europe to follow the principles of *Wakon-yosai*, the adaptation of Western concepts to fit into a Japanese cultural framework. Even earlier in its history this same nation had profited by the philosophy of *Wakon-Kansai*, the conversion of Chinese learning into Japanese values. In more recent years Japan embarked on a militaristic phase but recovered from that ill-fated period to develop a society with no significant armed forces at all. Its present leaders are already planning to modify possibly the world's most successful industrial society to prepare for the changes predicted for the 21st century.

It is a noteworthy and rare human being who is highly disciplined and yet readily adaptable to change. It is astonishing when a nation is capable of being introspective, rational, and decisive. If Japan were perfect for this instant in time, we would admire it as a rare, artistic creation of beautiful glass sculpture whose fragility would be vulnerable to future shock. That it is less than perfect, yet constantly willing to examine its imperfections and act on them, means that it is made of a metal that will last for ages. No one magazine issue—in fact, no book—can analyze comprehensively the phenomenon of modern Japan, but readers of this issue will be able to infer on reasons for its past accomplishments and will be able to recognize some of the seeds of future greatness.—DANIEL E. KOSHLAND, JR.