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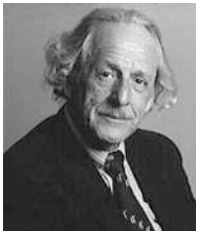

What Tonegawa's Nobel Doesn't Mean

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In the wake of the news that Susumu Tonegawa of MIT had been chosen as the 1987 Nobel laureate in medicine (See *The Scientist*, November 2, 1987, p. 4), an article by Stephen Kreider Yoder appeared in the *Wall Street Journal* (October 14, 1987, p. 30) under the headline "Native Son's Nobel Award Is Japan's Loss: Scientist's Prize Points Up Research System's Failings." The writer asserted that Tonegawa's prize is "as much an embarrassment as a victory for Japan's research community [and] illustrates the dire shortcomings of Japan's research system." (*See "Japan's Embarrassing Victory,"* p. 24)

This conclusion stems from Tonegawa's personal history. Although he earned a B.S. degree from Kyoto University in 1963, he left the country thereafter and has studied and worked outside Japan ever since. He received a Ph.D. from the University of California at San Diego in 1968, was a post-doctoral fellow there from 1968-1969, a fellow of the Salk Institute from 1969-1970, a member of the Basel Institute for Immunology in Switzerland from 1971-1981, and since then has been professor of biology at MIT's Center for Cancer Research. That expatriate curriculum vitae, along with Tonegawa's own critical remarks on the overemphasis placed on teamwork, consensus and seniority in the Japanese science enterprise, apparently fueled the argument that this prize reflects badly on Japanese science. What Tonegawa was able to achieve abroad would not have been achieved in his home country, so the argument goes.

Drawing conclusions about a nation's scientific performance from aggregate data on the Nobel Prizes is difficult enough, but to do so on the basis of a single prize is absurd.

If Tonegawa's non-Japanese working environment is a critical commentary on the deficiencies of Japanese science, how then shall we explain the Nobel Prizes won by, to name a few, Leo Esaki, Kenichi Fukui, Sin-Itiro Tomonaga, all of whom received their education and conducted their prize-winning research in Japan?

Furthermore, Tonegawa's personal style in conducting research, as described by his colleagues and students, suggests an exceptional predilection for independent work, even by Western standards. In short, to generalize as Yoder does

from the specifics of a single prize and a literally singular researcher is unwarranted.

The only meaning of this year's Nobel Prize in medicine is the obvious one: Professor Tonegawa is a brilliant researcher, whose discovery of the somatic theory of the immune system constituted a true breakthrough of revolutionary impact.

By delimiting the meaning of Tonegawa's prize this way, I am not discounting real structural weaknesses in the organization and funding mechanisms of Japanese science. Tonegawa and others accurately describe, I am sure, the frequently dampening effect that Japan's strict hierarchial organization can have on the enthusiasm and creativity of younger researchers. In the selection of research projects and funding for them, it is the senior researchers who typically control what is to be done and who will do it. Young scientists frequently see little opportunity or challenge in playing seemingly endless supporting roles. And along with their low status go low salaries. There is no question about the need for a more flexible system, one structured more on merit and less on seniority.

But Japanese researchers and science policy-makers realize this. They know that greater flexibility, a place for individualism and creativity, and a meaningful role for younger scientists are all needed to achieve the nation's goal of attaining a leadership role in basic science. Despite the incongruity of such actions with traditional social and cultural practices, the Japanese will likely make the required modifications in their science apparatus. In the past the Japanese have proved they can transcend tradition to reach a well-defined goal. And in the past Westerners have routinely underestimated the Japanese capacity for change. Yoder has perhaps misread characteristically self-effacing comments by the Japanese on the inadequacies of their science enterprise, comments that reflect more a determination to change what must be changed than resignation in the face of tradition's impediments.

It is for this reason as well that Yoder's portrayal calls for rebuttal. In seeing in Tonegawa's prize all that is wrong with Japanese science, Yoder is only reinforcing a stereotype—that the Japanese system is inflexible, overly uniform and discourages inventiveness. More and more, that is a picture of the past. In fact, it is becoming more flexible, varied and open to creativity with each passing month.

Rather than emphasizing the "dire shortcomings of Japan's research system," as Yoder does, I would emphasize that nation's recent superior performance, which seems to foreshadow a dominant role for Japan in the future. I have just reviewed data on Japan's scientific output and its impact and concluded that if Japan remains on the course it laid down some 10 years ago there is reason to expect that it will become a world leader in basic research. (See "Is Japanese Science a Juggernaut?" *Current Contents*, no. 46, October 16, 1987, pp. 3-9.)

Information gleaned from the ISI's *Science Citation Index* database, a storehouse of the literature from the world's most significant journals, shows that Japan increased its annual output of scientific articles in all subjects by some 9.8 percent per year during the period 1978 to 1980. For chemistry the increase over the period was 7.3 percent, for life sciences 10.3 percent, for physics 10.7 percent and for mathematics 4.3 percent. Compared to the performance of the United States, the United Kingdom, the Soviet Union, the Federal Republic of Germany and France during this same period, Japan surpassed its nearest rival by a significant margin. For example, across all fields of science the closest to Japan and its annual growth rate of 9.8 percent were the United States and the United Kingdom with annual increases of about 3.9 percent.

Preliminary data of more recent vintage from the *Current Contents Address Directory* corroborate the view that Japan has increased its scientific output substantially. In 1978 Japan ranked sixth in number of authors whose articles were listed in the *Address Directory*. In 1982 Japan ranked fifth. Last year Japan ranked third. In the past 10 years Japan has exhibited the highest rate of increase in article output, well beyond the rate at which we added more Japanese journals to our coverage.

Not only are Japanese scientists contributing more to the best scientific journals, but their world share of citations has increased markedly. From 1973 to 1982, Japan's share rose 65 percent. Second among major industrialized countries, and far behind Japan, was the Federal Republic of Germany which tallied a 14 percent increase in its world citation share over the same period. (See John Irvine, Ben Martin, Tim Peacock and Roy Turner, *Nature*, vol. 316, August 15, 1985, p. 588.)

A 1986 study, prepared by the U.S. Congressional Research Service for the House Committee on Science and Technology's Task Force on Science Policy, reported: "the hosting of Nobel-Prize-winning science in a country is most closely correlated with indicators of citations to the published scientific literature, which reflects the overall quality of a nation's scientific contributions." ("The Nobel-Prize Awards in Science as a Measure of National Strength in Science," *Science Policy Study Background Report No. 3*, September 1986, p. xiv.)

Since the citation data mentioned above reveal an increasingly influential role for Japanese researchers, one can only assume that Japanese laboratories will be producing their share and more of future Nobel laureates in science. ■