

Symbols of Science Policy

As a late winter snow-and-wind storm scattered branches and trees across the Northeast, I had time to reflect on two trips I recently made to Japan. During my last visit, I was given a brochure that included a large photograph of a tree with an overlay showing the connections between research fields, technology and its applications, products, and their impact on society. The tree happened to be a superconductivity tree, but I suspect that similar pictures have been drawn for many technologies in Japan. The more I thought about it, the more this picture came to symbolize for me many of the differences I had noted between Japanese and American science policy and practice.

Surely it is significant that in the Japanese vision there is only one tree. Its roots, the various disciplines, are firmly embedded in the soil of scientific knowledge, its trunk represents the core technology, the branches are industries, and applications and products hang from its branches. I suspect that the American equivalent would be numerous trees: the parent tree, perhaps showing signs of age, with technology seeds dangling from its branches, surrounded by young saplings (the venture capital companies), some obviously thriving, while others are too close together on the forest floor for all to survive.

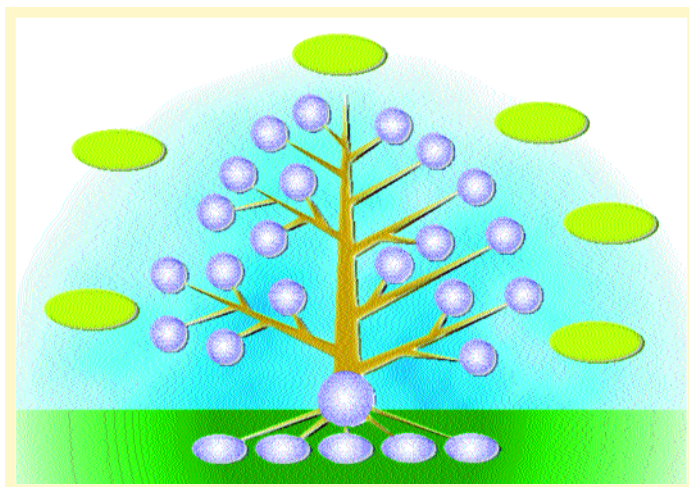
Gardeners say that one must dig a \$50 hole for a \$5 tree, an ancient proverb judging by today's prices. Last year Japan prepared the ground for a new technology orchard by passing the Science and Technology Basic Law. This law is not a funding vehicle in itself but rather a statement of the intent to markedly increase funding, particularly for fundamental research, through established channels, such as the Ministry of International Trade and Technology (MITI), the Science and Technology Agency, and the Ministry of Education. The effects of the law could already be seen when I visited in January; some scientists with whom I spoke were anticipating large increases in funding.

Both the Japanese and Americans appreciate the need to feed the roots of the tree, which represent fundamental research in many diverse disciplines. In Japan, however,

there is often a 3-, 5-, or even 10-year contract with the "arborist," that is, the funding agency that encourages the growth of trees, and a permanently installed irrigation system, so that feeding occurs dependably. In the U.S., the time taken to negotiate an annual contract with the arborist and to carry water in small buckets to the tree often leaves little opportunity to grow the technology, and feeding often occurs only when the tree is showing signs of stress.

The Japanese picture is flawed in one respect; the root system is too puny. The roots of trees spread wide, often wider than the branches. Technology draws on a knowledge base that stretches across so many apparently unrelated disciplines and so far back in time that it is perhaps impossible to visualize in its entirety. But certainly technology trees do not grow in the metaphorical equivalent of a container! One might add that by looking only at the roots far from a tree, it is not easy to predict the type of fruit it might bear. Supporting basic science does not guarantee or identify future products.

Is industry best imagined as the branches of the technology tree, as in Japan, or as independent saplings, as in the U.S.? The U.S., which once freely provided air and sunlight for some trees (the defense industry), now seems unsure whether to provide it for others (commercial industry). As the sap of invention rises from the universities and federal laboratories into industry, the assumption is increasingly that industry will provide its own air and sunlight. Without government help, industry should support research in even embryonic technologies, as well as product engineering, manufacturing, marketing, and so on. This was perhaps possible when a few isolated trees produced highly desired fruit, such as mainframe computers and telephone service. But is it wise now? Certainly Japan



has no such reservations about funding R&D in industry; agencies such as MITI are explicitly assigned that responsibility.

In early December, when I visited the famous and very beautiful garden in Kanazawa, I couldn't help but notice the meticulous pruning of the trees, more apparent than that it would have been in the summer. But it is also local tradition to support the branches of the evergreens against damage by wet snow, using a teepee-like structure of posts and rope. Does Japan prune its technology trees? Are branches that are competing for sunlight or that produce no fruit cut off? Is the growth of the tree artificially limited? It is my impression that young trees in Japan are supported until they can face the storms of international competition. The U.S., in contrast, simply allows the winter storms of free-market competition to strip off branches and topple whole trees.

Around the brochure's superconductivity tree, the Japanese artist has distributed some of the hoped-for benefits of technology, such as "saving energy and new energy resources" and "new traffic system matched with environments." In these objectives, as in the need to feed the basic-science roots of technology, both countries agree. But their treatments of the tree itself could hardly be more different. To which treatment will the trees themselves best respond? 📧

John Rowel is a consultant to the superconductor industry, 102 Exeter Drive, Berkeley Heights, NJ 07922.