

Catching Up on R&D

By Kinji Gonda

It is often difficult to distinguish between "scientific research" and "research and development" (R&D). However, national R&D spending is an important indicator that helps clarify the situation in Japan.

Fig. 1 shows trends in national R&D spending in major countries for 1965-1982. The United States and the Soviet Union spent far more than any other country and Japan ranked third, surpassing West Germany for the first time.

Japan's spending has increased rapidly in recent years. The rate of growth, adjusted for inflation, for the seven years from 1975 to 1982 was 43%, compared with 33% for West Germany, 32% for France and 28% for the United States.* Yet the share of R&D spending in GNP, which indicates the level of national R&D investment, was 2.78% (1983) for Japan, compared with 4.85% for the Soviet Union (1982), 3.04% for West Germany (1982), and 2.86% for the United States (1983).*

Japan spent a total of ¥5,881.5 billion

(\$24.5 billion) on R&D in fiscal 1983, with corporations and other private organizations accounting for 68.7% (¥4,039 billion). The share of private-sector spending was lower in Japan than in the United States (72.1%) and about the same as in West Germany. However, Japan had the lowest share of R&D financed by government: only 23.6% in 1983. This compared with 46.7% in the United States (1982), 48.1% in Britain (1978), 43.1% in West Germany (1981) and 57.6% in France (1981).* Moreover, the share of R&D financed by government has been declining since reaching a peak of 28% in 1979.

These figures indicate that the private sector is taking the lead in R&D in Japan. The number of researchers is rising each year, most of the increase being absorbed by private corporations, while those in universities and government institutions has remained virtually unchanged for several years.

More patent applications are filed in Japan each year than anywhere else in the

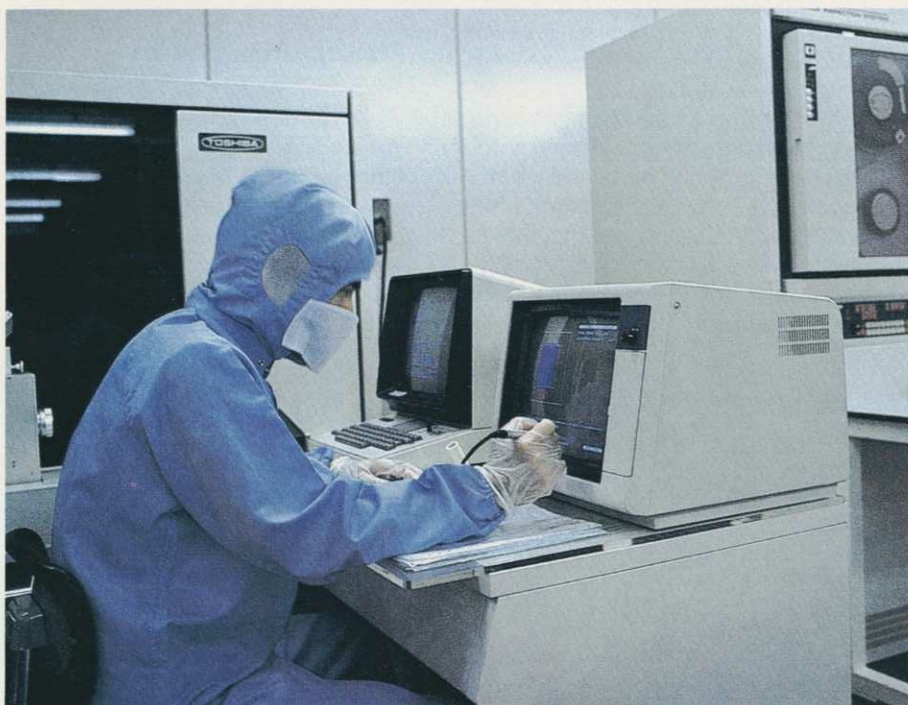
world. In 1982, 218,261 were registered, compared with 149,500 in the Soviet Union, 106,413 in the United States, 46,579 in West Germany and 39,214 in Britain. Yet despite this, the country's performance in technological trade is the poorest among major countries. Moreover, the technological trade deficit is growing, the gap vis-a-vis the United States having widened particularly sharply (Fig. 2).

**Science and Technology White Paper*, Science and Technology Agency, 1983.

Measurement hazards

These trends show that the level of a nation's technology cannot always be measured by the number of patent applications or published technical reports. The number of patent applications directly related to discoveries or inventions and leading to major technological innovation is extremely small in Japan. This may be partly attributable to the fact that the private sector which shoulders 76.3% of the total R&D spending earmarks 72.6% of their R&D expenditures for development of new products or production technology and only 5.5% for basic research leading to basic patents. Moreover, there is no way to ascertain how much of Japan's technology prowess comes from domestic R&D and how much is owed to introduction from abroad. In order to measure Japan's technological capability, therefore, it is necessary to determine to what degree Japan is capable of resolving new problems by itself. In other words, the level of potential research capability should be used as a new parameter. It is, of course, desirable that such R&D potential should be developed and improved in parallel to technological achievement.

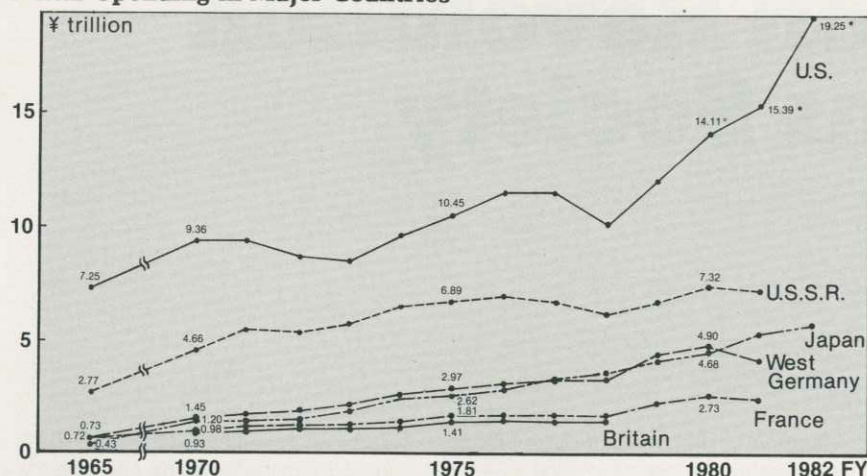
Fig. 3 illustrates relationships between R&D potential and technological accomplishment (the examples cited are based on the opinions of a limited number of experts and are not exhaustive). Numerical indicators for both factors have a base value of 3 for the United States. In most areas the level of R&D potential is either



Japan ranks third in national R&D spending, after the United States and Soviet Union.

Kinji Gonda is a professor of biophysics at Tokyo Denki University and is engaged in research on technological innovation. He has authored various books on technology.

Fig. 1 R&D Spending in Major Countries



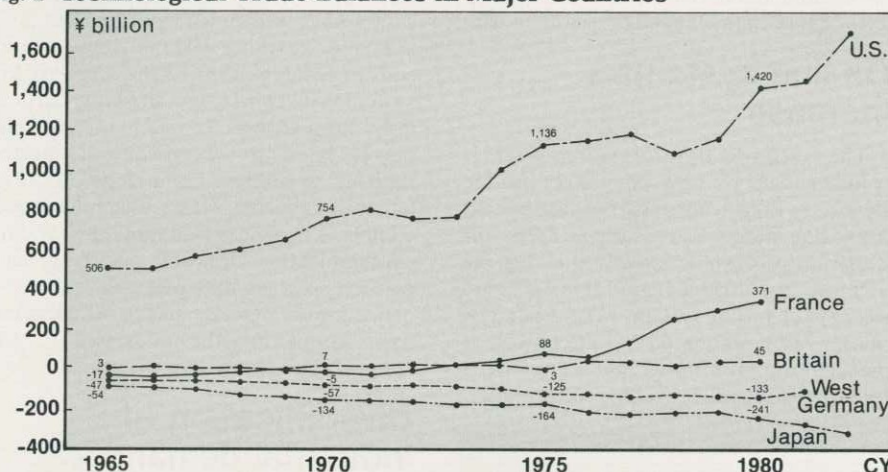
Source: Science and Technology White Paper, 1983, Science and Technology Agency

Notes: 1. A circle indicates preliminary figures; asterisks signify estimates.

2. R&D expenditures in the U.S., the Soviet Union and France include spending for humanities and social sciences.

3. Britain's 1978 spending covers humanities and social sciences.

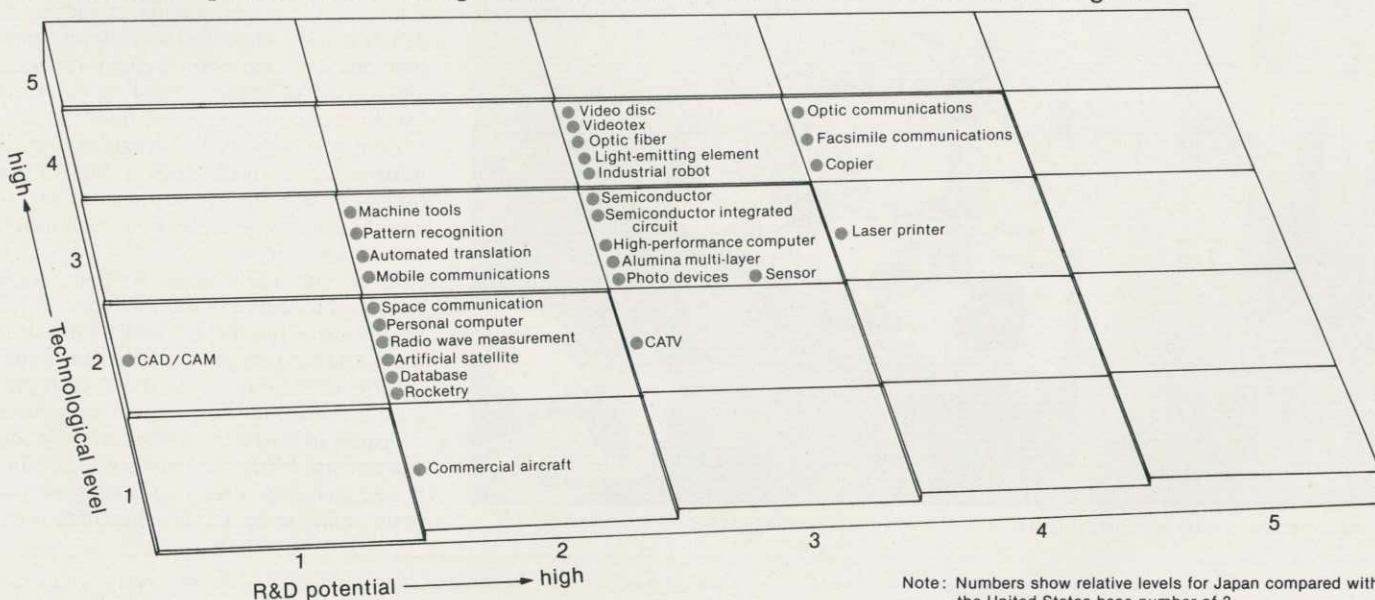
Fig. 2 Technological Trade Balances in Major Countries



Source: Science and Technology White Paper, 1983, Science and Technology Agency

Note: Figures for Japan are for fiscal years.

Fig. 3 Relationship Between Technological Level and R&D Potential in Selected Technologies



Note: Numbers show relative levels for Japan compared with the United States base number of 3.

equal to or lower than the level of technology. By extension, we can conclude that the technological level in Japan should be raised through stepped-up R&D in these areas.

The major question facing Japanese researchers today is whether, under the present circumstances, Japan will be able to develop technology leading to major innovations. According to Mensch's quantitative analysis of Kondratieff's theory on long-term economic cycles, 1965-1980 was a period of recession and 1980-1995 will be a period of depression. In order to overcome economic stagnation in the years ahead, there is a need for new technology capable of triggering real breakthroughs, and for new concepts to be created and designed to that end.

Finding the right balance

Should the present balance between government and private research spending continue, it will have a favorable impact on the development capability of private corporations, but it will retard basic research. Research and development in upstream areas requires enormous, and increasing, capital outlays, so that private sector efforts are reaching their limit. With the separation of science and technology narrowing rapidly, investment in basic research has direct bearing on the development of industrial technology. Given the fact that R&D is central, the share of basic research spending in total R&D expenditures should be increased, and the sooner the better. Moreover, the government has an important role to play in fostering innovative R&D talent capable of generating creative concepts and in technological assessment.