17. Qureshy, M. N. and Warsi, W. E. K., Proceedings of the Symposium on Purana Formations of Peninsular India (ed. Lakshmanan, S. and West, W. D.), 1978, pp. 350–358.

M. N. QURESHY

Centre for Lithosphere Studies,
204-1, Kirti Apartments,
Mayur Vihar I Extension,
Delhi 110 091, India.

D. C. Mishra replies:

We are thankful to M. N. Qureshy for his interest in our publication. However, most of the points raised by him are either very obvious or already explained in the above publication. Therefore, we do not intend to reply point wise but some of the points are taken up to show their nature.

(i) According to this writer, Ganga basin is not an east–west basin, rather it is NE–SW. What is shown in figure 4 as NE–SW is a subbasin of the Ganga basin. If somebody looks to the part of Ganga basin in Punjab he may say that strike is NW–SE. So these are strikes of subbasins which may be different in different parts of the main basin.

(ii) NGRI, 1978 is referred in the list of references and digitization is done from an enlargement of this map. For further details about this data set, the writer may kindly refer this.

(iii) Gravity anomalies due to basement ridges are usually of small magnitude and small wavelength. Therefore, the enclosure of 5 mGal along Delhi–Haridwar line is attributed to a basement ridge. The block uplift east of Delhi (figure 4) is quite clear which is for anyone to see.

(iv) Due to small order of gravity anomalies from basement ridges, they rarely get reflected as large gravity enclosed 'highs'. We had to look for small signatures like kinks in gravity contours or saddle between 'highs' to delineate basement ridges. This is the case about N–W ridge, which is shown to be passing over a saddle between two 'highs' in the N–W corner of the map.

(v) 32 km Moho depth is referred under Vindhyan basin adjoining Aravalli (line no. 15, right side page 437 of the above publication). This can be seen from the reference Reddy *et al.*, given by the writer. The two-way travel time package given by Reddy *et al.*, for deepest reflection in Vindhyan basin is between 10 and 11 s and not 12.5–14.5 s as quoted by the writer. This amounts to approximately 31–32 km. In a recent publication on CSS results from this region, the authors have shown even a shallower Moho (24 km) under Vindhyan basin[1]. Deeper Moho is reported only under Delhi fold belt which probably the writer has confused with the Vindhyan basin.

(vi) It has been pointed out that some references pertaining to Ganga basin are missing. After all, only pertinent references can be given in a publication.

(vii) In the end it has been pointed out that spectral and trend surface analysis techniques are well known tools but should be used cautiously. Regarding precautions to be taken for spectral analysis we listed as early as in 1976, the exhaustive list of precautions to be followed in this regard[2].

---

1. Tewari, H. C., Rajendra Prasad, B., Vijaya Rao, V., Reddy, P. R., Dixit, M. M. and Madhava Rao, N., *J. Geol. Soc. India*, 1997, **50**, 779–786.
2. Hahn, A., Kind, E. G. and Mishra, D. C., *Geophysical Prospecting*, 1976, 24, 287–308.

D. C. MISHRA

National Geophysical
Research Institute,
Hyderabad 500 007, India

NEWS

From copycat to innovator: Science and technology in Japan

Japan, says a recent NSF report[1], invested 2.6% of its gross domestic product in R&D in 1994. At $54 billion, Japan's overall R&D expenditures were 41% of those of the United States. In the same year, USA's investment on R&D was $133 billion – 2.5% of the US GDP of $5.3 trillion. Today Japan leads the United States in the per cent of GDP invested in total and non-defence R&D, as well as government investment in civilian R&D as a per cent of GDP. The difference, in terms of per cent GDP invested in R&D, may be a mere 0.1%, but what is striking is Japan's resolve, at a time of severe recession, to restructure the economy through knowledge and education. Says Phyllis Genther Yoshida[2] of the US Department of Commerce, 'Overall, the Japanese economy remains bogged down. Long-touted structural reforms that could help energize the economy through deregulation and financial reforms have not yet been fully implemented. Indeed, the economic recession caused postponement of many structural reforms.' Perhaps it is this slump which reinforced the commitment of Japan's major companies to R&D and to technology-led economic growth. Another motivating factor is international competition, not only from a resurgent US economy but also from the technology-driven manufacturing economies of South East Asia, in particular Singapore, Taiwan and South Korea. In a country with few natural resources, Japanese policy makers believe that education and S&T are the most valuable resources for prosperity. This abundant faith in S&T is reflected in the decision to invest 17 trillion yen in R&D in the five years 1996–2000, equivalent to $74 billion in 1987 constant dollars. This represents a 35% increase over the amount spent in the previous five years. The slump has also led Japanese researchers to work harder than in the past to justify R&D spending and purchases of costly equipment. Now Japanese researchers are forced to be more conscious of efficiency and the bottom line. There is also an increase in collaborative R&D partnerships, be they within Japan or with international partners[2]. During the period 1988–1993, almost 11% of Japan's scientific articles were internationally co-authored, up from 7% in the period 1981–1987 (ref. 1).

For a long time Japan was perceived to be a copycat good at adapting imported technology. Subsequently, Japan started beating the giants in their own strongholds – selling automobiles in the United States, watches in Switzerland, cameras in Germany, and consumer electronics in the entire world. Now Japanese companies receive more royalties and fees than they paid for technological know-how in several industry fields, including industrial chemicals, ceramics, iron and steel, and fabricated metals. In motor vehicles, the ratio of receipts to payments is 14 to 1. In 1994 Japan's export of advanced technology products of the United States was more than $28 billion – twice the value of imports from the USA. Japan's trade surpluses come largely from computers, telecommunication and electronics and the deficits from aerospace and nuclear technology and software. The Japanese decision makers recognized that the strategy of emphasizing research to adapt borrowed technology would not work in rapidly-developing technologies, such as biotechnology, gene therapy, and software for computer networks and that it was imperative to invest in fundamental science in a big way. As a consequence, industrial R&D spending in Japan which remained either stagnant or was declining every year since 1991 started increasing in the Japanese fiscal year 1995 (April 1995–March 1996). A survey of large Japanese companies has shown that the trend continued in fiscal year 1996 as well.

Japan is strong in technology and trade indicators. Not only has Japan the largest number of engineers as a proportion of its overall labour force among industrialized countries, but also the stock of scientists and engineers relative to labour force is increasing rapidly in Japan – at the rate of 8% annually during 1985–1990. It has more scientists and engineers engaged in R&D relative to its labour force (80 per 1,000 in 1993) than the USA (74 per 1,000). Despite its lead in technology and trade, Japan is still behind the US in R&D expenditures in higher education, in competitive research funding in universities, and in its share of the world's scientific articles. Japan is addressing these weaknesses by increasing the government science budgets for universities and national laboratories, and increasing national capacity for basic research and innovation[1].

A new Science and Technology Basic Law, passed in 1995, is a clear indication of Japan's seriousness in mobilizing basic research for recovery from recession. However, there was some pruning of the budget for S&T in 1997 as part of the government-wide austerity effort. But the cuts affected mostly the expansion of some large-scale programmes such as nuclear energy and space research. Public spending on industrial technology-related R&D (e.g. programmes supported by the Ministry of International Trade and Industry) will experience some of the largest increases[2].

Japan will continue to be a major challenger, says Yoshida, in internationally competitive industries in the coming decade. It will be the world's second largest source of industrial R&D after the United States. Both the Japanese government and the Japanese companies view R&D as an important key to economic growth. During the eighties, the number of US patents granted to Japanese scientists and engineers increased at an average annual rate of 10.6% – from 7,000 in 1980 to 19,524 in 1990. In 1993, Japanese inventors received about 23% of all US patents – almost half of all patents granted to foreign inventors. That indeed is a measure of how strongly inventive the Japanese are.

---

1. Johnson, J. M., The science and technology resources of Japan: A comparison with the United States, Special Report NSF 97-324, National Science Foundation, Division of Science Resources Studies, Arlington, VA, USA, 1997.
2. Yoshida, P. G., *Research. Technology Management*, Jan–Feb 1998, pp. 2–3.

Subbiah Arunachalam, Department of Humanities and Social Sciences, Indian Institute of Technology, Chennai 600 036, India.

RESEARCH NEWS

Incorporation and diffusion of lead in zircons

A. V. Sankaran

Zircon ($ZrSiO_4$) is among the most favoured minerals for age determination as it combines certain unique properties that make it suitable for this purpose. Once the mineral crystallizes, it is virtually stable for millions of years, retaining its crystallochemical characters, resisting several of the chemical and physical breakdown processes in nature. Zircon occurs usually as an accessory mineral in several rocks and is carried as a detrital mineral, during weathering of its host rocks. Being quite refractory, it escapes remelting, except possibly during extremely high grade granulite metamorphism. In its ability to incorporate appreciable amounts of radioactive elements like uranium and thorium during its crystallization (either as inclusions of uraninite, uranothorite and monazite or as substitutions for Zr^{4+} in