

have swept across the system. But Bordogna points out that no medical centre in the United States has been closed: indeed some, such as the University of California at San Francisco, plan significant expansions.

None of the financial pressures on the system appears strong enough to shake institutions that do good research and attract good students. And although administrators criticize academics for neglecting teaching, many institutions are making progress integrating teaching and research.

"There's a very different atmosphere from 15 years ago," says Bordogna. Senior staff, he says, give much more consideration to what younger members of departments think. It is hard to prove, but many long-

term observers of the system agree. "We are light-years ahead of where we were," says Paul Christiano, provost of Carnegie Mellon University in Pittsburgh, Pennsylvania.

At the same time, competition between institutions for both research funds and students continues unabated. "The diversity of institutions in this country has been a blessing and a source of strength," says Christiano.

A remarkable aspect of this competition is the success of public institutions. An extensive study of doctoral programmes by the National Research Council found the institution with the most departments ranked number one in their disciplines is the publicly funded University of California at Berkeley.

The complaint persists that too many smaller universities are trying to do too much. Bordogna says the United States can support only "50, or maybe 30" top research universities, and wishes the other hundred or so aspiring research universities would concentrate on teaching.

But there is no possibility of Washington selecting that élite. Even Pings, who represents most of the leading universities, recoils at the idea of closing the door on other schools. "There should be an open, dynamic, competitive system. If an institution can muscle in, it should be allowed to do so," he says. So long as that opportunity remains, the research university system in the United States is likely to remain the envy of the world. **Colin Macilwain**

## Japan faces problem of science recruits

[TOKYO] Despite claims by Japan's ministry of education that the country has now caught up with the West in both the output and the quality of its research, its universities still face chronic problems of limited flexibility and conservative attitudes. Critics say that recent policy moves may only aggravate the situation.

A 'white paper' produced by the ministry last month highlights the fact that Japan was second only to the United States in terms of its total output of scientific papers in the 1996 index of the Institute for Scientific Information (ISI). It also claims that Japan ranks fourth in the 'quality' of its research as measured by the percentage of total citations accounted for by Japanese papers. However, an analysis last year by ISI based on citation impact, or average citations per paper, which is the more generally recognized method of measuring quality, placed Japan seventeenth and below the world average (see *Nature* 389, 113; 1997).

But even the ministry admits that the universities, where most of Japan's public research is carried out, face severe problems. A fall in the student population means that there are too many universities competing for fewer students. Faculty members are ageing — the number of university researchers in their twenties fell from 11.6 per cent in 1977 to 4.5 per cent in 1995 — and the ministry expects a severe shortage of young researchers in the near future if these trends continue.

Responding to this situation, the government last year unveiled a plan to double the number of postdoctoral fellows to 10,000 by the end of the decade as part of a five-year plan to boost science and technology. The education minister is also considering a plan to prioritize education in graduate schools, and to increase the number of postgraduate students from 170,000 to 300,000 by 2010.

But some university faculty members are concerned that they will have to lower their



**A task for the future: how to attract and encourage able students into research.**

standards to fill graduate student and postdoctoral positions, and that four years of university education may be insufficient to produce graduates of international standard.

Another problem is the fact that faculty positions at national universities are subject to government regulations aimed at restricting the number of civil servants. Recent reforms led by Prime Minister Ryutaro Hashimoto are intended to cut the number of civil servants even further, and so the number of faculty positions at national universities is likely to be reduced still more, says Yoshiki Hotta, director of the National Institute of Genetics in Mishima, south of Tokyo. "The plan will be meaningless unless the government increases the number of research posts at universities," he says.

Leading policy-makers such as Akito Arima, president of the Institute of Physical and Chemical Research and a driving force behind government science policy, believe that a recent proposal by the education ministry and the Ministry of International Trade and Industry to strengthen the links between universities and industry (see *Nature* 390, 105; 1997) will create a large demand for university researchers.

But some in industry are sceptical. "A

strict selection mechanism will obviously be at work when we recruit new researchers," says Susumu Nishimura, director of research at Banyu Pharmaceuticals in Tsukuba science city.

"We would be looking very closely at whether they had received high-quality teaching and carried out interesting and creative research."

Nishimura points out that "many post-graduate students and postdocs at Japanese universities spend most of their time doing menial jobs under more senior researchers". A priority for Japanese universities must be to create an environment in which creative and original minds will thrive, he adds.

The white paper recognizes the need for a routine, nationwide external review system. Although Japanese universities began self-assessment of their research activities in 1992, less than half have so far brought in external reviewers, and only about a quarter of these have made the reviewers' reports public.

Critics also point out that there is an urgent need to reform university management so that the results of external reviews can be used to bring about improvements. Most external reviews have so far had comparatively little impact, and key recommendations are often not implemented, particularly if they involve changing fundamental management practices.

A recent attempt by politicians to convert universities into 'agencies' that would have greater autonomy but also greater accountability was quickly killed by the universities themselves, and by leading proponents of reform, as potentially restricting their level of public support (see *Nature* 389, 897; 1997).

But many leading Japanese scientists recognize that unless Japan implements routine external research evaluation and new mechanisms for managing universities, it will be hard for universities to produce creative and innovative research. **Asako Saegusa**