Ph.D. program, a student must complete a first year of evaluation leading to a special degree called the diplome d'études approfondies (DEA). While the success rate for DEA students in the sciences is high—more than 80% nationwide, compared to an average over all fields of 63%—there is yet another hurdle to jump. Many science graduate programs will not accept students who do not have a scholarship from France's education ministry. These ministry grants are relatively generous—about $1400 a month—which no doubt explains why the conservative French government, in its drive to curtail public spending, has been steadily cutting back their number over the past couple of years.

But an equally troubling concern, expressed by many university professors in interviews with *Science*, is that the education ministry seems to be using the grants as a tool to decrease the time students take to complete a thesis. At present, the scholarships are granted for a period of 2 years, with a third year usually given automatically to students who progress well in their work. If a fourth year is needed, the student must apply for help either to industry or, particularly in life sciences, to one of France's medical charities. Some recent actions by the ministry—including a tendency to give third-year grants in 6-month intervals rather than for the full year—are seen as bad omens for the quality of science training.

GILLES BOUQUILLON/GAMMA LIAISON

"I have the impression that the future is in peril."
—Claude Gutierrez

"In earlier days a thesis lasted 5 or 6 years," says Michel Gaillard, director of the laboratory of molecular photophysics at Orsay. Now, he says, "it is extremely difficult to propose a thesis that requires a great deal of experimentation." David Cribbs, an American biology professor at Paul Sabatier, agrees. "You can't do a thesis of international quality in 3 years," he says, adding that the pressure this puts on both professors and graduate students "encourages unambitious, conservative projects."

Despite the government promises won by student protesters last autumn to hire more professors and increase funding, it is clear that the universities cannot continue to expand forever. One solution proposed by a number of university professors is to accelerate a trend—already under way for several years—to direct a certain number of students away from the universities and toward shorter, more specialized programs. "We receive a lot of students here at the university who would have been better off in technical schools," says Gutierrez.

And although direct challenges to the open admissions policy are politically sensitive—especially with the student movement's influence so powerfully displayed in November and December—the writing is on the wall for the current laissez-faire system. In the future, France's science universities can be expected to find new ways to steer only the best students toward research while channeling those not cut out for a scientific career into other fields. "There is no question of reconsidering the free access of students to the university," says Grenoble's Bloch. "But the ultraliberal position, which says that students have the right to do anything they want, doesn't work anymore."

–Michael Balter

UNITED KINGDOM

Universities Feel The Heat of Competition

LONDON—In recent years, Britain's system of higher education has gone through perhaps the most wrenching, radical changes of any in Europe. In an effort to broaden access to what had been one of the most elite university systems in the industrialized world, the Conservative government has promoted an entire tier of colleges to university status, developed nationwide reviews of the quality of research and teaching on offer at each institution, and forced universities to compete with each other to attract—and retain—students. All this while holding down costs: The amount the government spends per university student has actually declined in recent years.

Although this transition has been painful for many faculty members, some believe the reforms were long overdue. A decade ago, only about one secondary school graduate in seven went on to university. And when they got there, they found a system geared more to the needs of research than training scientists. The life sciences at many universities, for example, were divided up into small, narrowly focused departments, forcing students to specialize early and giving little opportunity to diversify outside their major, says Keith Elliott, senior tutor in the undergraduate school of biological sciences at the University of Manchester.

The result, at least in chemistry, says Tom Inch, secretary general of the Royal Society of Chemistry, is that in some cases students found themselves with a degree increasingly ill-matched to the multidisciplinary skills sought by employers. Moreover, undergraduates were pushed through to a bachelor's degree in 3 years, with a Ph.D. often taking the same length of time—and if they dropped out in this hot-house environment, that was considered their loss.

The government's answer to these problems has been nothing if not dramatic: At a stroke, in 1992, the lower status polytechnic colleges were transformed into full-fledged universities—almost doubling the number of such institutions to roughly 88—and the university system was told to provide higher education for a third of all school leavers by the end of the century. The government can force these changes on the universities because it holds the purse strings: Universities receive most of their funding as a block grant from the government. Although universities retain the freedom to distribute their grant once awarded, the government is seeking to increase competition among universities by developing formulae to calculate the amount of each university's grant according to the quality of its research and the cost-effectiveness of its teaching.

The assessment of research has already begun, with a nationwide peer review process carried out every 4 or 5 years, which will include the new universities for the first time this year. The first assessments of teaching quality, which began in 1992, were completed last year, and the next phase is already under way. As part of the

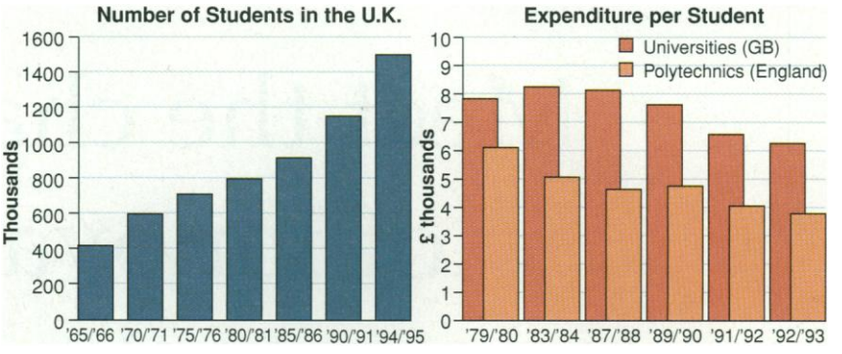
new formulae, the government has stipulated that universities must attract and keep students to maintain funding levels, and they suffer financial penalties if their target recruitment is not met. Suddenly, universities no longer have a historical right to existence—now they have to compete to survive.

The human touch. The reforms have put staff members under enormous pressure to improve teaching efficiency and research quality, but at many universities it has also prompted a sea change in their attitude to students. Hilary Evans, head of biological sciences at John Moores University in Liverpool, says that before the reforms staffers were less concerned about students who were having problems with their courses. "Now we are much more concerned about our students," she says. "The fundamental need is to change from teacher-based to student-centered learning," says Michael Brown, pro vice chancellor at De Montfort University in Leicester.

Universities have also found that they can no longer attract all students into narrow, 3-year courses in conventional disciplines. At the time of the reforms there was a shifting trend in the student population, and now 18-year-olds no longer dominate first-year students rolls; more than 50% are classed as mature or nontraditional, such as part-timers and a small but growing number who take courses by correspondence.

The government's reforms initially caused an explosion of applications for university places—30% of school leavers entered higher education last year, a figure higher than the percentage that attended universities and polytechnics before the reforms, and some 40% of all full-time students took science and technology courses. But the government had planned to expand access over a decade, so it was forced to cap any further growth until at least 1998 to protect budget plans.

Those plans include forcing the universities to improve efficiency: Funding per student has declined by 28% over the past 5 years, according to official figures. This increased the student/staff ratio by about 20% between 1990 and 1992 alone. Inevitably, this has resulted in crowded lectures and fewer tutorials. There is



Ups and downs. Student numbers are going up fast, while expenditure slides.

The Computer as Lab Assistant

As the British government ratchets up the pressure on universities to educate more students for less money, many institutions are turning to a new type of teaching assistant: computers. In 1992, the four main funding councils which distribute government funds to Britain's universities launched one of the world's largest research projects in computerized instruction, the Teaching and Learning Technology Program (TLTP), with total funds of $110 million over 4 years. And the TLTP has spawned more than 500 teaching packages from more than 30 collaborative projects across the country.

Michael Mahon of Manchester University's school of biological sciences is a member of the BioNet consortium developing and integrating information technology for biology courses. He says the number of hours students spend using such packages in his department increased from 3000 in 1992 to 77,000 in 1995, and this number is set to double this year. "Some students say they didn't come to university to sit in front of a computer screen, but good packages can cut costs and be excellent teaching aids," says Hilary Evans of Liverpool's John Moores University. And not only do computer packages cut costs; they can also bring in some income from sales to other institutions.

Computer-based teaching packages have proved particularly popular for courses leading to professional qualifications, such as pharmacy, where nationwide standards are essential. All British pharmacy departments have been involved in the development of a problem-based course, with funds from the TLTP. The drive for the project was to simulate laboratory experiments which are restricted on financial, practical, or ethical grounds, such as whole-animal experiments and pharmacological studies on tissues and organs, says one of the project directors, Peter Redfern of the University of Bath. The packages are attracting worldwide interest from pharmacy departments, he says.

Another area where computer-based packages have been effective is in simulating experiments in physics courses which might be too difficult to stage for real. "Where there are safety concerns, simulations are attractive," says Roger Linford, head of applied sciences at De Montfort University.

One of the worries about substituting computer-aided learning for practical classes is that students will not gain experience in handling real equipment. Manchester student Guy Rands, who spent the third year of his biology degree working in a laboratory of the chemical company Ciba Geigy in Switzerland, says that in spite of real practical classes his biggest frustration was a lack of bench skills. "They were almost nil when I arrived there. I really notice the benefit now I'm back in Manchester," he says.

The need to develop these new teaching aids is also adding to the pressures on staff. "Developing software is considered as neither teaching nor research when assessing academic staff careers, so there's sometimes reluctance to get involved," says Mahon. "Without dedicated specialist support it will increasingly be left to the enthusiasts," he says.

While students may not like being taught by computer, the growth of biological databases for use in research may make such experience essential. At Cambridge University, undergraduates are now taught how to manipulate and analyze sequence data accessed from the major international databases, says biochemist Chris Howell, who has organized the project. Cambridge is also using these research databases, rather than computer-aided learning packages, as a means to teach more general computer literacy. "We have appointed a full-time teaching officer, and the students seem to find it attractive," says Howell. Cath Green, a final-year biochemistry undergraduate who has worked on the databases, says: "It's fabulous what you can do with all the structural data."

–N.W.

a real pressure on practicals because of the cost of materials and staff for experimental work, says Manchester's Elliott. But the budget squeeze is not only forcing more mass teaching methods; it is also prompting innovation, such as in the increased use of computers in teaching (see box). "We are looking at innovative ways of doing cheaper projects," says Elliot. And it is making universities streamline their own structures.

The managerial approach. The competitive environment is forcing universities to adopt a more managerial style of operation and to challenge their traditional departmental organizations. Manchester University, for example, has scrapped its separate subject-based departments to form a single school of biological sciences—one of the largest of its kind in Europe, comprising 10% of all staff at the university.

By creating four separate teaching boards and organizing research into six divisions, the school matches staff expertise with student demand more efficiently than in a departmental structure, says Elliott. The school produces modular courses that are likely to be essential to cope with the growing number of part-time students and the development of quality assessments. Manchester's formula has proved popular. "We filled all our undergraduate places this year with students who had achieved very good grades [at secondary school]," says Elliot. Final-year molecular biology undergraduate Guy Rands says: "I was attracted to Manchester by the high profile of the biology school and the breadth and flexibility of the degree course. The staff were also very ready to listen to you."

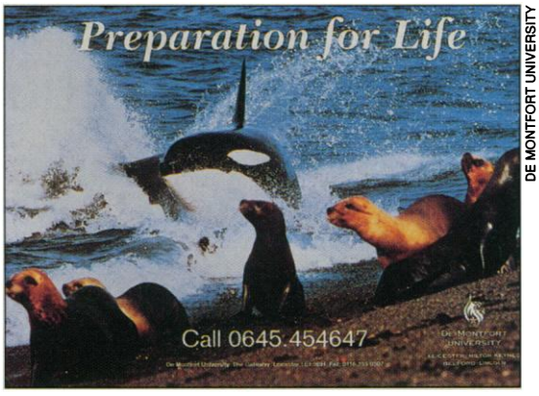
So far, the elite of the old university system—Cambridge and Oxford—have been insulated from the brunt of the reforms. They have some independent sources of income, a federal collegiate structure, and have little difficulty in attracting high-quality students. Alec Broers, head of Cambridge's engineering department, who will become the university's vice chancellor later this year, tells new students that they will be taught by eminent researchers and that "they must learn how to learn from them." But Broers is alert to the new teaching assessments and has made some modest innovations, such as allowing his engineering students to write appraisals of their lecture courses. Broers hopes this type of detailed feedback to staff may provide a model for other departments.

At the other end of the scale, some of the former polytechnics have rapidly transformed themselves into lean, competitive institutions. Their history as technical colleges providing a wide variety of courses gives them a head start in the diverse new market for students. They have also been quick to embrace new technologies. "We have been developing computer-aided learning packages since 1977," says Roger Linford, head of applied sciences at De Montfort. The university, which has four main campuses spread across central England, has also developed a number of courses based on distance learning, and it was Britain's first university to use national television and cinema advertising to attract students.

There is a strong incentive for innovations like these with the introduction of teaching quality assessments by the funding bodies and the establishment of the Higher Education Quality Council in 1992, which ensures that institutions have mechanisms to monitor quality. "The quality debate is going on worldwide but is well developed in the U.K.," says Andris Barblan, secretary of the Committee of European Rectors. Quality is set to become even more important with the setting up last year of a planning group to pave the way for a single national body responsible for all aspects of quality measurements and standards. This body will undoubtedly increase competitiveness among institutions and add further pressure on staff.

Postgrad marketplace. Postgraduate studies have not escaped the new world of competitive education. Postgrads bring their own funding with them, from a variety of sources such as the research councils, employers, and their own money. With 20% of higher education students now doing postgrad studies, attracting more postgrads is another way universities can bolster their income.

This has led to an explosion in the range of courses and programs designed to cater to all possible interests. "Some courses are just chronological and [follow] a first degree, and others are genuinely advanced study," says Martin Harris, vice chancellor at Manchester University, who is leading a major review of higher education for the government this year. Harris is concerned that the mushrooming number of courses may sow confusion and compromise quality. Students, teachers, and employers—as well as the 40,000 postgrads from outside the European Union who have chosen to study in Britain—must be assured that standards of postgraduate education and quality of provision will be maintained, says Harris.



Sales pitch. De Montfort was the first university in Britain to use TV and cinema advertising to attract students.

Harris's review is set to explore the implications of the expanding postgraduate sector, such as concerns about the quality of supervision of Ph.D. students. Adrian Barbrook, who is completing a biochemistry Ph.D. at Cambridge, says "I was lucky to have close supervision and support from others in the laboratory, but I know many students who found it difficult to see their supervisors and had little other help."

The review will also focus on the industrial relevance of Ph.D.s. The government has for several years been encouraging researchers to coordinate more with the needs of industry, and there is now pressure to make doctoral training more relevant—moves which are worrying many researchers. "The industrial approach to research is commonly one of needing to seek technology wherever they can find it and apply it as fast as they can," says Inch of the Royal Society of Chemistry. "This is not a Ph.D. training and amounts almost to plagiarism in terms of the traditional approach to research. We still need plenty of traditional Ph.D.s, but we also need some new approaches."

For most teachers, the whole system is still in a state of flux, and, while still grappling with the reforms, they believe it is too early to say whether the eventual outcome will be good or bad for Britain's ability to train future scientists. "University staff are under enormous pressure," says Inch. "It is difficult to predict the long-term effects."

–Nigel Williams