completing three years of natural science subjects at universities from 1,390 in 1970/71 to 564 in 1976/77. Bengt Gustafsson maintains that this drop has resulted from the decline in university intake in 1972/73. As the numbers of new students fell off, so did the money for teaching staff; so the universities tried to make themselves more interesting by setting up short courses such as popular astronomy and amateur geology.

These courses have proved almost too successful: students now take them in preference to long courses that can lead to research. Professor Lindqvist thinks there will be a shortfall of PhD recruits in 15 to 20 years. He points to the increasing unpopularity of the natural sciences in secondary schools, saying that it is much easier to earn maximum marks (and it is marks which count for university entrance) in non-science subjects.

There have been piles of papers written about the reorganisation of the universities. Two more commissions will be reporting soon — one on the reorganisation of teaching structures and the other on the education of research students. The first commission is expected to recommend widespread changes to create more tenured research positions and spread the teaching burden more evenly amongst university jobs.

But the crux of the matter is money. Last year, Parliament allocated the UHÄ Sk205 million (about $46 million) to provide five universities with basic facilities with which to conduct natural sciences research: research education, fundamental research, professorships and appointments for those who had passed their PhDs, secretaries, libraries, instruments and buildings. Engineering research received Sk222 million (about $50 million), to be spread over six technical universities, for the same sorts of things.

As salaries, equipment and research funds all come out of the same budget, research gets less money as the universities have to go on paying the salaries of scientists whose projects have ended. According to Professor Lindqvist, the University of Lund has to pay more than SK2 million (about $450,000) a year supporting former docents.

All the relevant authorities are demanding more money, and all the political parties said before last September's election that more money should be given. The Swedish Parliament has in fact agreed that about 1,000 jobs in the public sector — in archives, museums, libraries, positions in planning, commissions of enquiry and some teaching posts at secondary schools — should be given in the first instance to PhDs.

The union also wants the state to give increased support to the development of technology-intensive industries such as telecommunications, energy and defence, to provide secure working places for scientists as well as competitive exports. □

How the popularisation of science narrows the polarisation of the people

In the last of three articles on science and technology in China, **Tong B Tang**, research fellow at Darwin College, Cambridge, UK, reports on scientific education and popularisation

Workers from three provinces of North East China watching a lathe demonstration at a gathering in Shenyang

EDUCATION has always been a central issue in Red China. By comparison, Marxist socialism in the West was also initially strongly associated with an educational movement; it stimulated developments in the philosophy of education, and was instrumental in spreading the concept of education for the working classes. This last influence was never necessary in China: in the past, non-hereditary mandarins were selected by imperial examinations which theoretically anyone could take. Traditionally the populace has been conditioned to appreciate the advantages of education. This deep-rooted exaltation of learning however, makes it all the more important to watch out for intellectual (as well as bureaucratic) elitism.

Two years ago China introduced a nation-wide examination for university entrance to replace nomination at one's place of work. Had everyone equal access to primary education, there would be equal opportunities for all. In practice however, students who can or want to take advantage of further education still tend to come from professional families. Another uneven situation is the formal existence of "key schools", (and universities) which admit "bright" pupils (from the age of five or six onwards) and whose facilities are given priority.

Going straight from high school to university is no longer rare but the long-standing policy of mobilising school leavers to work or settle in the countryside still persists, as affirmed by Chairman Hua in August last year. There are still many technical problems but this policy, besides playing other roles, spreads learning to the rural masses.

Another effective way in which the Chinese try to redress any imbalances in educational equality is their system of marking the university entrance exam. The pass mark is regionally adjusted, and lowered for candidates who have left school and are working in the countryside; ethnic minorities are also given 10 additional marks and educational work in secluded and border areas is paid special attention. Depending on the university (higher for a "key" one), the students need 300-400 out of a possible total of 500 marks to get in. Once there, freshers who come from poorer backgrounds are given extra

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tuition.

At present formal degrees are not awarded at the end of the period of study. This will probably change soon: undergraduates sent abroad are reading for degrees. The younger of those scientists sent to participate in research are also encouraged to register for postgraduate degress; the first Chinese to receive a PhD did so last September, in West Germany. The course structure, originally modelled on the Russian system which emphasises early specialisation, is being modified. Nanjing University, for example, introduced a credit system in 1978 similar to that used in US universities, where the student is freer to choose his or her courses. Summer schools at the pre- or post-doctoral level are also being planned.

At the same time, the Chinese are putting a lot of effort into updating teaching materials: there was a conference on this topic early last year. In most subjects, there are revised editions of former textbooks in circulation, and many universities are now trying them out. (In China most schools use a unified set of texts, while for universities about 70% of the curriculum is standardised by the National Planning Committee in the Ministry of Education.) A selection of course books recommended at major overseas universities is also being looked at. Some of these books may be purchased in bulk when the students are adequately prepared in the relevant foreign languages.

During the past decade most schools and university departments became linked to communes or factories, where pupils and students went periodically to work as part of their education. This scheme has ceased, since their main duty is now assessed to be academic study; so has the "inviting in" of workers and peasants who brought in grass-roots experience and argued with the students and their teachers. However, high-technology pilot plants or small manufacturing units, which provide contacts with workers can still be found in science faculties. More crucially, the long-developed tradition of political work has not disappeared. An academic works for six days a week, one of which is devoted to political study which may include physical labour on the campus. For students in any faculty, there is a 'core curriculum' of philosophy, political economy, Party history and the history of the international communist movement. It accounts for about 200 hours out of a total 2,500 curriculum hours and carries 8 to 10% of overall marks.

With a population of 1,000 million, China has 10 million teachers for 210 million students. Of these, respectively, only 0.2 and 0.9 millions are in the 598 post-secondary institutions. As a medium-term measure to achieve a rapid expansion of tertiary education, an increase has been made in the number of students sent abroad. There are at present 180 post-graduates and 420 undergraduates in North America, Japan and Europe, 80% of whom are in natural sciences. By comparison, 1,300 from the West and the Third World are studying in China. An unusual measure, further, is that a few self-paying students who can afford it are allowed to go abroad; some think that this may be seen to serve the principle of "to each according to his capital".

The opposite tendency, namely, "to each according to his needs", is fostered by a mass movement to raise the scientific and cultural level of the entire nation.

The objectives of science popularisation are not confined to education. It serves to drive out the out-dated ideas in the social consciousness of the whole people, and to generate greater enthusiasm for the Four Modernisations (in agriculture, industry, national defence, and science and technology). The idea is that science popularisation will reduce social polarisation by narrowing the differences between city and countryside, and by reducing the alienation due to the division of labour.

The organisation of popularisation is largely, though not exclusively, in the hands of provincial chapters of the Scientific and Technical Association which are directly responsible to local authorities.

The activities take many forms. In children's and youth clubs, science classes are held and model or instrument building competitions are regularly sponsored. Summer and winter camps teach subjects that range from geology to ecology. Educational exhibitions are shown in the

Workers in Shanghai examining a water pump design

Scientists and peasants preparing a simplified medium for pollen breeding at the Institute of Genetics of the Academia Sinica

camps too, and in public parks. Public lectures are frequent, sometimes by such leading scientists as Qian Sanquiang whom some foreigners dub the "father of atomic bombs in China".

There are popular science magazines and newspapers on sale throughout the country. No fewer than 1800 popular science books have been published since the beginning of 1978. In August 1979, an Association of Science Popularisation Writers was formed.

Science fiction based on hard science only is expected to flourish soon. Posters of great scientists are constantly in print. I saw the following: Newton, Einstein, Copernicus, Marie Curie, Darwin and the inventor Edison. But disappointingly I didn't find one of an ancient Chinese scientist. Visual arts with scientific themes are also being encouraged. More than 100 new educational films were scheduled last year.

Since May last year "universities of the air" have been started in 29 local TV and radio stations. Correspondence courses are also being extended. In a few years' time there may be twice as many students in these alternative forms of education than in the regular universities and colleges. Full-time schools are also being run to give technical instruction to administrative cadres. Party secretaries and bureau chiefs from the provincial level down and leading personnel in factories, mines and oilfields attend courses lasting two weeks to four months, in farm economics and machinery, stock-breeding, fishery, forestry, enterprise management or computers. It would be amusing for the mandarins in the British Treasury to have to go to evening classes in arithmetic.

It would be unhelpful and unrealistic to imagine that despite their enthusiasm, the Chinese have no major problems ahead. As reiterated in a recent editorial in the People's Daily, the question of manpower is the foremost obstacle to the modernisation programme, and to education in particular. Many scientists have little experience of research management: here the Chinese can learn a lot from the West provided they are selective. In the transformation of education is the teachers who constitute the single most crucial sector.

If the development of Chinese science is dependent on politics, then over the next two decades, China might well fulfil its aim of developing a science of its own. It has to be careful to avoid a Scylla of Westernisation and the Charylbdis of misguided dogmatism. The Chinese believe that the human activities grouped under the name of science are intimately related to other processes in society — "if society has a technical need, that helps science forward more than ten universities"; at the same time, dialectically the reverse is also true. Science acts on the technico-economic base and is therefore partially self-supporting. □

Friends and foes of science debate in France

Jim Ritter records some observations on what was "effectively the first public debate on science and technology in France for more than a decade". It was staged last month, by *Les Amis de la Terre*.

THERE is a sense of movement about French scientific policy today, a certain loosening of the tight strictures of official silence and lay apathy. What public debate there has been about science has taken place within the cloistered university circles of philosophers and sociologists, while science policy decisions continue to be taken in equal isolation by scientific and political mandarins.

Hence the strangeness to the Anglo-Saxon eye of the programme for a debate on science and technology policy organised by *Les Amis de la Terre* and held in Paris one weekend last month. There was little discussion of concrete points of technology — nuclear power safety, pollution, and so on. There was much of more epistemological questions — the nature of quantum mechanics, the question of systems analysis. But the main stress was biological; a reaction to the "biological determinism" now being vigorously propagated in France by a group of influential far-Right intellectuals (the New Right) who claim that modern biology has "proven" the inequality of races, sexes, and classes. The organisers did well in assembling, for virtually the first time in a decade, a number of top administrators, active researchers, authors and journalists to face a concerned public.

The debate started with a panel discussion among three physicist-philosophers on the interpretation of quantum mechanics. The hall was surprisingly full and the question of whether the Copenhagen interpretation was idealist or not was entered into with great gusto. But the debate was inconclusive, the question remaining rather elusive though the level of debate was one which, in the UK, would only be found in specialised seminars.

The afternoon session on bioengineering was livelier and more familiar. The panel consisted of three directors of biological research and two young researchers. The difference of opinion ran along the same line, the mandarins seeing no reason why genetic manipulation should not be prosecuted with all possible speed while the two opponents pointed out what they saw as disquieting experimental evidence and questioned the point of research. The audience of more than 100 readily joined in. They were clearly worried while the administrators were equally clearly unused to hostile questions and overracted. The scientists quoted particular experiments to support their claim that genetic manipulation was/was not dangerous but never seemed to come to grips either with each other's claims or with the general unease among the lay members of the audience.

Sociobiology, in the next session, generated a more unanimous attitude, with two of the three biologists on the panel having written recent popular books on the subject. A clear presentation of the basics of the theory, together with an uncovering of the political attitudes underlying its "objective, scientific" attack on women, non-whites, and the poor, led to one of the liveliest debates of the weekend. The discussion was continued into Saturday evening with further analysis of the particular use of women as a target by the New Right.

Sunday morning and it was the turn of systems analysis. Here both the panel and the audience were divided on the merits of a general systems approach. Some saw it as the answer, some would replace it with catastrophe theory, some saw any such search for a totalising theory which explains all levels of the universe at once as obfuscation. The search for and critique of panaceas went on into the following physics debate. Are microprocessors the solution or the problem? Will larger and larger particle accelerators advance physics as much as more modest investments elsewhere?

The final session was on social responsibility and the hall was packed to overflowing, the debate heated. The presence of trade union representatives and members of various political and environmental groups made this discussion the most familiar to the Anglo-American ear. But when one participant pointed out that "we've heard this all before, ten years ago", one was reminded of just how damaging the long silence in French public debate has been.

In any case the science policy debate has reopened in France after a long hiatus. Any facile optimism about how easy it would be to simply confront the "expert" and "the public" has evaporated after 20 hours of long and arduous discussion. For when two "experts" disagree, how is one to choose? And how can one pose the right questions without already knowing some of the answer? But *Les Amis de la Terre* are pleased with it and plan others for the future. □

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