Blinkhorn's criticisms. It is also possible that their conclusions are correct, but that their arguments are not.

Moreover, the unfamiliarity of the notion that vitamin dosage might be quickly followed by changes of IQ is not in itself a fatal flaw; to that complaint, the authors could justly retort that the heliocentric hypothesis also at first evoked deep scepticism. But the notion is indeed surprising, and therefore requires extra-meticulous, rather than just plain sloppy, proof.

But is not the conclusion, if correct, important and thus deserving of rapid dissemination? Of its importance (if correct) there can be no doubt; it would revolutionize the education of the young, while educational administrators would quickly tumble to it that vitamin supplements are cheaper than teachers. Yet the price that must be paid by those who make truly great discoveries is the painful wait for recognition. On this occasion, the authors and the foundation of which they are members seem to be seeking a grip on history (and credulous well-intentioned parents) by timing publicity and marketing (by others) to coincide.

It is reprehensible to use what purports to be a serious study in such a way. □

Education in science

Academic scientists keen to help with the school curriculum should look closer to home.

The cause of education has become to the scientific community what motherhood and apple-pie once were to the United States. And that is not surprising. Governments may be concerned that inadequate public education (not only in science) will undermine economic competitiveness (see *Nature* **349**, 2; 3 January 1991), but the research community has an even more practical interest; what will happen to research itself if the steady supply of able students should dry up?

That, no doubt, is the narrow explanation why researchers are increasingly found to have given up time in valuable sabbatical periods to help schools and school systems to develop new science curricula, and why many research laboratories have taken to inviting school students and their teachers for brief internships. (The national laboratories in the United States have a creditable record in this regard.)

The calculation is that young people may thereby be attracted to an absorbing field that they would otherwise overlook. But efforts such as these, laudable though they are, have not spectacularly reversed the downward drift of science enrolments at universities, either in the United States or Europe. Perhaps even more needs to be done. But is it also possible that more radical remedies are required.

Academics are quick to spot the defects of the science curricula at secondary schools — the concern for facts rather than general principles, the preoccupation with humdrum measures of performance and the scant attention paid to laboratory work — but slower to acknowledge the defects of the systems which they themselves administer. The difficulty is that an education in science consists of two distinct components — a body of knowledge and understanding sufficient to allow a person with imagination to stand, as Newton said he had done, on the shoulders of earlier giants, and an appreciation of what it is to confront problems in the real world whose solutions are unknown.

Most modern science curricula are constructed so that the two elements are somehow blended; what is called project work usually makes an appearance somewhere during an undergraduate curriculum, but often in a somewhat nominal fashion. The digestion of past knowledge tends to constitute the hard core of everything.

Perpetual learning

This imbalance is understandable, even forgivable. The recitation of what is known is easier, while experience shows that all too many undergraduates are perplexed to know how best to come to grips with this material. Yet that is not how mature scientists set about the perpetual learning tasks now unavoidable in research. People faced with the need to use a new technique, experimental or mathematical, do not take several months off in order to train themselves, but rather jump in at the deep end and teach themselves on the job, by an educated process of trial and error. Why should not undergraduates be helped to master their chosen fields in much the same way?

There are several instant objections, of which the simplest is that there are no unsolved problems left that undergraduates can tackle with a reasonable hope of success. But that argument is flawed. For one thing, there is no reason why undergraduates should be indulged, as mature scientists are not, with a guarantee that all questions asked of nature will be neatly solved. And who says that people learn nothing from the frustrations of failure? The other side of that coin is that even novices may often discover truths about the natural world that have somehow eluded others. One wonders, for example, whether the now-fashionable field called chaos would have come to prominence sooner if generations of undergraduates had not been carefully directed towards the soluble problems of linear dynamics. The more serious objection to an education in science more tightly organized around the solution of real problems is that the assessment of the quality of students would then be complicated by the noise engendered by the choice of projects, but that carries less weight than appears. Why should mature scientists be less able to carry out the accurate assessment of their junior colleagues than the assessment of their peers they are always making?

The benefits would be great, and swift. A science curriculum more fully blending study and investigation would give young people a true sense of what science is like and of what it is about. That is bound to be more arresting than the diet on which young people are at present fed. That the same reform would more accurately reflect the characteristic relationship, in the research profession, beween practitioners and students is a further benefit. But there would also be more young people willing to throw their lot in with the research community, which is the overall objective. □