

Oxbridge scholarships; the top-down imposition of "evaluation"; the withdrawal from the classroom, no doubt for ever, of 300 Cockcroft advisory teachers; and now the National Curriculum.

Perhaps it all seems very rational, even reasonable, if you don't know too much. In particular you must not know about the complex interactions that go on when one good mind tries to develop other good minds in a deep subject like mathematics. It is not at all like what happens when a factory bench operative does something with nuts and bolts. Bureaucratic chains of command, simplistic evaluation procedures and detailed control of syllabuses are quite incompatible with these complex processes.

So what do the sixth forms need? Well, most importantly, a lot of friends in high places who understand what is going on, and are willing to do something about it. Unless these friends do something in the near future the mathematical base will be lost. There is always a time lag in education.

Secondly there is need for a sound survey of the situation. This might reveal the need for mathematical secondary schools, as a stopgap measure at least, to stem the tide of destruction and ensure that there will be some sixth form teachers in the future when the tide turns (if it does).

Thirdly, although this would not affect sixth forms for more than a decade, some mathematical primary schools need to be set up on the pattern of the Kodaly musical primary schools.

Without some action along these lines, sixth form mathematics will not need anything in the future. It will not in any recognisable form exist.

Yours sincerely,
CHICH THORNTON

18 Doonan Road, Nedlands 6009, W. Australia

Sixth form mathematics—the future

DEAR EDITOR,

In recent years there have been several sources of pressure on mathematics education in the sixth form. The introduction of GCSE has influenced cuts in A-level syllabi, and GCSE methods of work and assessment have been influencing the development of coursework components in A-level. More generally, the accepted need to make education at 16-plus more accessible and appealing than hitherto—we are constantly being informed that we have the lowest proportion, compared with Europe, America, or Japan, of our 16–18 year olds in full time education—is a pressure that is redoubled in the case of mathematics. This subject, because of its nature and the way it is presented at this level, is only accessible to a minority of the existing sixth form population. Opening up the sixth form to a wider range of students will obviously require a broadening of the curriculum, and it is incumbent on the mathematical community to encourage a far greater participation in mathematics by students. Finally, there is a need to disseminate the "new applicable" Mathematics—Statistics; Decision Mathematics; Modelling techniques etc—as these are not only important and useful branches of mathematics, but also are a major growth area and almost certainly the way ahead.

The need to make mathematics more accessible in the sixth form sits uncomfortably, in the minds of many teachers, with the undoubted need to maintain a high and rigorous standard for the more able mathematicians. Our main requirement is to reconcile these two apparently contradictory demands, and to deliver a range of mathematics courses suitable for the students taking them. To this end it is clear that we must retain traditional mathematics courses for our best students who wish to study the subject in some depth; courses to the standard of the present Mathematics and Further Mathematics A-levels must be kept. We must also, however, offer a range of service mathematics courses—courses which exist to serve the mathematical needs of other parts of the curriculum.

Hitherto A-level Mathematics, the traditional Pure-and-Applied, has been used by many

of those studying Sciences as a service subject. Certainly we need to continue to serve this area, but could serve it so much better with specially designed courses; there would be some justification, for example, to include such new areas as mechanical modelling. (Note that the offering of special “Mathematics for Scientists” courses, or any other service mathematics course, should not remove the choice from the student who wishes to take a “mainstream” mathematics course.)

There is a growing need to offer service courses along the lines of “Mathematics for Social Scientists” as well. This is a most important area to develop—perhaps the most important. Statistics, Decision Mathematics, and general modelling techniques could all be made much more accessible and useful to students by adopting a “Mathematics in Use” approach, and dispensing with some theory. The great developments seen in recent years in school computing facilities would be invaluable here too, and will help considerably with the implementation of a practical approach.

Once we have accepted the need to broaden the provision of mathematics in the sixth form, then we must decide how we are to do it. In the short term it is possible that the A- and AS-level system could suffice. A-level Mathematics and Further Mathematics as they stand are good courses for the more able students. There is a fairly wide range of choice offered by examining boards now—the Oxford A-level offers a reasonably flexible study programme, and the ambitious MEI Structured Sixth Form Mathematics Scheme offers even more freedom—and students wishing to study to this depth are quite well catered for.

AS-levels, introduced with the specific aim of broadening the sixth form curriculum, are surely just the place to develop our new applicable “Mathematics in Use” courses. AS Statistics already exists (and could be made less theoretical, more practical and accessible) and the gap for AS Decision Mathematics and Modelling has now been filled by several boards—perhaps a modular AS in Applicable Mathematics is called for. The possibilities are there, and only the details need to be filled in.

In the long term, whatever mathematics courses are offered will depend on the way sixth form study develops in general. If work and assessment at this level become completely modular, then there is a great opportunity for us to provide a wide ranging and flexible package of mathematics courses for students, and to attract a much larger proportion of the sixth form population into mathematical study without cutting standards for the most able.

No new developments are trouble free. A flexible system entails enormous organisational problems; the timetabling problem alone might well restrict the choice within a particular school quite severely, but this is not a reason to turn our backs on the developments. Several other problems concerning the ideas outlined above present themselves as potentially more worrying and perhaps more deeply entrenched.

AS levels have had a brief but chequered history. In principle two AS levels should be studied alongside two A levels, but in many schools this has not been popular. Rather, when this option has been taken up at all, a single AS-level course has been followed alongside three A-levels, and this has been seen as a choice for the more able. The University response to AS has been ambiguous, and in general this exam has been slow to take off. None of this means however that AS will not become commonplace given time, nor that we should ignore the possibilities that it offers to the peculiar and important place of mathematics as a subject with applications across the curriculum.

A worry with any modular approach to mathematics education—if this is the route that is ultimately chosen—is what we might term the “jigsaw problem”. Topics in mathematics are best understood in the context of more mathematics; like a jigsaw, each piece has much more meaning when the neighbouring pieces are known. Teaching mathematics in a piecemeal fashion runs the risk that the pieces will not be from the same part of the picture. This danger ought not to affect the mainstream mathematicians, and those studying a particular area of applicable mathematics will be worried less about the work in its mathematical context than in the context of its application. Completely modular schemes of work need to beware of this problem however.

The next five years should be an exciting time for those involved in sixth form mathematics. There are initiatives to pursue and courses to develop particularly for those

new areas of applicable mathematics, but most of all there is a large and hitherto unmoved population of students, many of whom would benefit greatly from further exposure to mathematical techniques, just waiting to be encouraged into at least some aspects of the subject. Sixth form mathematics teachers, and those involved in the development of mathematics education, must not shirk their responsibilities to the future students, nor to what must be one of the most important subjects in the sixth form curriculum.

Yours sincerely,
STEPHEN JONES

Berkhamsted School, Berkhamsted, Hertfordshire HP4 2BB

DEAR EDITOR,

I have a bumblebee nest in my garden. Not being inclined to investigate it too closely, it would still be interesting to know the size of its current population.

So, over a period of time I counted the number of bees entering and the number of bees leaving. The maximum difference that occurs between the two numbers will be the minimum population of the nest.

Yours sincerely,
CHARLES A. STICKLAND

63A Hindmans Road, E. Dulwich, London SE22 9NQ

Times bingo

DEAR EDITOR,

Some while back it was lamented that the *Times* Bingo was harder to check. Perhaps this started discussion which I missed, but for the record:

The 44 numbers are split into 4 sets and each card has two from a set.

1	4	8	15	17	20	25	29	34	35	41
2	6	14	19	22	24	28	30	32	37	44
3	5	9	12	16	18	21	26	31	39	42
7	10	11	13	23	27	33	36	38	40	43.

Thus the same old test that you have not won is relatively easy. (GCHQ recruitment literature is available to anyone who worked this out.)

Yours sincerely,
MARK KING

9 Overbrook Drive, Cheltenham, Gloucester GL52 3HR

If and only if

John Barber, a respectful theatre critic, now retired, said star names were no guarantee of success for a musical. It cited *Annie* which had succeeded with no big names. The Judge, Mr Justice Millet, chipped in: "I suppose *Chariots of Fire* is another example. That was an enormous success in the United States where the stars and the story were unknown". The court nodded.

Report from the High Court in London, *Independent* 12 Oct. 1990. Sent in by J. C. Sheperdson.