The De Morgan Journal 2 no. 2 (2012), 1–4. ISSN 2049-6559

INTRODUCTION

TONY GARDINER

This collection of personal recollections would be of general interest at any time. They have been collected now because of the official interest in 'mathematics schools' recently shown by those responsible for schooling in England.

The Autumn Statement 2011 from HM Treasury included the commitment:

> The Government will:
> – Invest an extra 600 million to fund 100 additional Free Schools by the end of the Parliament. This will include new specialist maths Free Schools for 16-18 year olds, supported by strong university maths departments and academics [. . .]

The Chancellor included a few words in his accompanying speech in Parliament (29 November 2011):

> These schools will include new maths free schools for 16-18 year olds. This will give our most talented mathematicians the chance to flourish.
>
> Like the new University Technical Colleges, these maths Free Schools are exactly what Britain needs to match our competitors—and produce more of the engineering and science graduates so important for our longer term economic success.

A search of Hansard reveals the following written answer (20 December 2011):

> Jonathan Reynolds (Stalybridge and Hyde, Labour)
>
> To ask the Secretary of State for Education how much funding will be made available for the new specialist mathematics free schools for 16 to 18 year olds.

2000 *Mathematics Subject Classification* 97D10 (primary), 97C60 (secondary).

> Nick Gibb (Minister of State (Schools), Education; Bognor Regis and Littlehampton, Conservative)
>
> > Specialist maths free schools for 16 to 18 year olds will receive revenue funding on the basis of the national funding formula for all 16 to 18 provision.
> >
> > We are keen to engage with all those who have an interest to explore possible models and innovative ideas. The Secretary of State for Education, my right hon. Friend Michael Gove, will consider carefully the estimated potential cost of each proposal and will be looking for projects that offer value for money.

It may take much more than money and government policy to devise effective "possible models and innovative ideas" in education. But the current interest provides an opportunity to reflect upon the relatively unfamiliar idea of 'special mathematics schools'—even if most of us have no relevant experience of such institutions, and those who do have personal experience are likely to know only one particular model in one particular social setting. This collection may both reveal the range of possibilities, and alert us to some of the dangers.

The examples given should ideally be supplemented by an analysis of those English schools which have a long tradition of cultivating an inner group of 'special mathematics students' within a much larger school. In any event, it should become clear that any such system of 'maths schools' needs to be designed not only to deliver what is required within the local cultural setting, but should seek to exert a beneficial influence on the surrounding school system. If special provision at age 16–18 is not to be hijacked by a privileged minority, the curriculum for age 5–15 must be designed to provide as many students as possible with a solid mathematical grounding. That is, any system at 16–18 has to build upon a system prior to age 16 which lays the kind of foundations which would allow students and teachers to assess at age 15 or so who might benefit from the available distinctive programme at age 16–18.

My own life's work has been devoted to nurturing the mathematical interests of adolescents from ordinary backgrounds. So in one sense I would be delighted to see a number of experimental institutions which explored—in an honest and humane way—what can, and what cannot be effectively nurtured during adolescence. Nevertheless, if we are to do more than simply spend the allocated funds by the end of the parliament, we will need genuine insight into the task ahead, rather than some naïve belief that a combination of state funding and the market

will suffice. In particular, we need to escape from the present culture of accountability in schools—with the associated 'gaming' of targets and league tables.

Mathematics education is a long game; and teachers at all levels need to rediscover the importance of laying strong foundations, and understand the need to keep in mind the formalisms these foundations will later have to support (even if this is to occur in a later phase, and a different institution). We will also need to reclaim the rich discipline of elementary mathematics from the miserable substitute of test-preparation which has supplanted it in recent years.

Among the international examples of special provision, there are those that have experimented with identifying mathematical talent *early*—say at age 8, or age 10, or age 12. Such an approach tends to assume that 'mathematical talent' is like coal or oil: a fixed resource that can be located—and then exploited. This approach involves a kind of 'reification'. Because we talk loosely and informally about 'mathematical talent', we slip into believing that the words describe something 'given'; they don't. It is true that one can identify youthful talent; one can also train it to perform remarkable feats at age 14, or 16, or 18. What often proves harder to control is the kind of inner commitment that is required in order to explore the mental universe of mathematics, and the persistent refusal-to-admit-defeat, that are both an essential part of the adult mathematician. Early identification also comes up against a kind of 'interference' effect, or uncertainty principle: in the wrong kind of setting, the very act of 'identifying' an instantaneous talent, and of then treating a young pupil as 'special', can easily disturb the pupil's direction of development.

The current proposals in England avoid early identification and focus on age 16–18—though they do so for pragmatic reasons: many statutory requirements that restrict what can be attempted at age 5–16 do not apply at age 16–18. Practical constraints are sometimes important; but the need to respect social and psychological factors would seem to provide a deeper reason why the international examples tend to focus on ages 15–18 or 16–18.

Some observers may dislike the idea of special provision at any age. However, we currently have exactly such a split at age 18, where our leading universities increasingly discover that home-grown applicants from ordinary schools lack the necessary grounding to benefit from what they have to offer. As a result, these institutions increasingly

recruit from other countries. It seems worth asking whether better provision for all up to age 16, and special provision for some from age 16, might allow more of our own children to benefit from these remarkable institutions.

About the author

Tony Gardiner (born 1947) is a British mathematician. He was responsible for the foundation of the *United Kingdom Mathematics Trust* in 1996, one of the UK's largest mathematics enrichment programs, initiating the Intermediate and Junior Mathematical Challenges, creating the *Problem Solving Journal* for secondary school students and organising numerous masterclasses, summer schools and educational conferences. Gardiner has contributed to many educational articles and internationally circulated educational pamphlets. As well as his involvement with mathematics education, Gardiner has also made contributions to the areas of infinite groups, finite groups, graph theory, and algebraic combinatorics.

In the year 1994–1995, he received the Paul Erdös Award for his contributions to UK and international mathematical challenges and olympiads.