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# The Popular Image of Mathematics

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The popular image of mathematics is that it is difficult, cold, abstract, ultra-rational, important and largely masculine. Many persons operating at high levels of competency in numeracy, graphicacy, computeracy in their professional life still say 'I'm no good at mathematics, I could never do it.' They perceive mathematics to be alien to themselves and their professional concerns.

For many people the image of mathematics is associated with anxiety and failure. When Brigid Sewell asked adults on the street if they would answer some mathematics questions, 50% fled. (She was gathering data on adult numeracy for the Cockcroft Committee of Inquiry.) Extreme mathephobics are undoubtedly a small minority in Western societies, and may not be significant in other countries, but their existence, and that of the popular image of mathematics raises a number of important questions. How widespread is the popular image described above? Does it correctly describe mathematics? What causes it? Can any change in educational practices alleviate it? Is there any hidden agenda behind the popular image?

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It could well be that the popular image of mathematics is the single most important issue of concern for the Philosophy of Mathematics Education network—important in terms of social significance—for mathematics serves as a 'critical filter' (to use Lucy Sell's term) controlling access to many areas of advanced study and better-paid and more fulfilling professional occupations. If its image is an unnecessary obstacle which blocks popular access to mathematics, then it is a great social evil. Of course, changing the image alone may do little to solve the problem. That is the politicians's and advertiser's view. It may be that the nature of the populace's encounters with mathematics also needs to be changed, to be humanized.

These insights are increasingly widespread. Alvin White has founded the Humanistic Mathematics Network and has been actively promoting mathematics as a humanistic discipline through the network's conferences and newsletter. ICMI sponsored a conference on the popularization of mathematics in 1989 in Leeds, England. An outcome was the volume The Popularization of Mathematics edited by A.G. Howson and J.-P. Kahane in the ICMI Study Series, Cambridge University Press, 1990. This book offers valuable insights about the problems of mathematics described above, and a range of possible measures to address them. The upcoming conference ICME-7 has a Working Group 21 on the Public Image of Mathematics and Mathematicians, with Thomas J. Cooney as chief organizer.

Given this attention, what can PoME uniquely contribute to the understanding and solution (or rather initial steps towards the solution) of this problem? It could be argued that even if PoME cannot offer something unique, the problem is of such importance that all efforts directed at it are valuable. However PoME does have something unique to contribute. On the one hand, the image of mathematics, the nature of mathematics, conceptions of mathematics all find their most systematic treatment in the philosophy of mathematics. On the other, their promulgation, dissemination and re-creation is largely affected through education. Hence the study of the intersection and interaction of these two fields, which is the concern of the Philosophy of Mathematics Education, has a central role to play.

To return to the questions listed above: How widespread is the image of mathematics as difficult, cold, abstract, ultra-rational, important and largely masculine? To answer it, first the distinction must be drawn between mathematics as

a discipline (what professional mathematicians understand as mathematics) and school mathematics. As it happens, both of these can share the popular image described above, at least to outsiders. Such an image is associated with negative attitudes to mathematics.

However, research on children's attitudes toward mathematics in the past two decades shows fairly widespread liking of the school subject, certainly in the years of elementary schooling. In the later years of schooling attitudes become more neutral, although extreme negative attitudes are relatively rare. Presumable this downturn in attitudes is due to such things as adolescence, peer-attitudes, the impact of competitive examinations, not to mention the image of mathematics conveyed in (and out) of school. According to this image, school and the discipline of mathematics are all of a piece, beginning in school, and then rising like a ladder to dizzy heights of abstraction. In contrast, numeracy, contextual mathematics, even ethnomathematics are perceived to be quite distance from 'academic mathematics', presumably because of the differences in context and surrounding practices.

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Does the popular image indicated above correctly describe mathematics? The answer to this is both Yes and No. First the Yes part. The experience many learners have, and certainly in the West virtually all citizens go through the educational process for many years, confirms this image. Teachers and others and the experience of learning itself all confirm this view.

Secondly the No answer. The image of mathematics is not as described in many enlightened schools and colleges, and certainly does not have to be that way. This pertains largely to school and college mathematics. What about the discipline of mathematics itself? This is where the philosophy of mathematics enters directly into the picture. Philip Kitcher has described a 'maverick' tradition in the philosophy of mathematics which emphasizes the practice and human side of mathematics. This has been termed variously Quasi-empiricist, Fallibilist, and Modernist thought in education, philosophy and the social sciences. Such mathematicians and philosophers as Lakatos, Putnam, Hersh, Davis, Tymoczko, Kitcher have been at the forefront of these developments. The maverick tradition is represented by Tymoczko's anthology New Directions in the Philosophy of Mathematics (Birkhauser 1986) and more recently has found expression in Philosophica volumes 42 (1988) & 43 (1989) edited by Jean Paul Van Bendigem (to be expanded and reprinted in book form in Sal Restivo's series Science Technology and Society, SUNY Press).

The point of this story is that this maverick tradition rejects the image of mathematics described above as unnecessary, mistaken and downright false. To use Reuben Hersh's image: mathematics has a front and a back. In the front, the public are served perfect mathematical dishes, like in a classy restaurant. In the back, the mathematicians cook up new knowledge amid mess, chaos and all the inescapable associated human striving, successes, failures (and displays of ill temper!).

Can any change in educational or other practices alter the popular image of mathematics? Presumable change is always possible, or else we would all give up! The first step must be to raise consciousness about the future of mathematics, and about the fact that there are alternative and competing conceptions of it. Promulgating such views within educational circles and beyond in society at large are vital. But the final question must be asked. Is there any hidden agenda behind the popular image of mathematics?

If there are, then strong resistance to change can be expected. The status quo always has its own momentum, and is difficult to change. But there is a more radical view that the kind of popular image of mathematics described here serves conservative interests in the mathematics community and in society in general. For if mathematics is viewed as difficult, cold, abstract, ultra-rational, important and largely masculine, then it offers access most easily to those who feel a sense of ownership of mathematics, of the associated values of western culture and of the educational system in general. These will tend to be males, to be middle class, and to be white. Thus the argument runs that the popular image of

mathematics described above sustains the privileges of the groups mentioned by favouring their entry, or rather by holding back their complement sets, into higher education and professional occupations, especially where the sciences and technology are involved.

This argument is quite radical, and may involve assumptions unpalatable to some. It may not be accepted that the popular image of mathematics has a hidden agenda or serves particular interests. Even so, it should be conceded that the type of popular image of mathematics described obstructs the full participation of all sectors of the population in higher education and professional occupations involving mathematics, especially in science and technology. It may also prevent citizens in modern society from developing critical numeracy and the mathematical confidence needed to understand the social uses of mathematics and to question statistics, whatever their source. Thus even from a traditional liberal perspective it can be argued that the common popular image of mathematics impedes both industrial and technological development and the full expression of democracy in a mathematically empowered citizenry.

# Poems by Lee Goldstein

### Pythagoreanism

Virtual reckoning:
The accounts of the world
Require an inconsistency
To be countermanded
By the presentiment
Of numbers
And by inchoatively
Reforming the tempest
Into files of noological charts.

- 1987

### Impedimenta Mathematica

When I am in the differential abandonment
In which I could grasp the probationary thing or facient;
As the thing is less its manner,
Then it may be seized in order
To satisfy the necessary condition;
But, ah, there remains yet that nagging prototaxic bent
To recollect one of English's innominate,
To boot, the set of all nonce elements;
Alas, it mimics itself typically in paradox

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