Worshipful Company of Glass Sellers, Mansion House Banquet

October 26, 2004

Lord Mayor, Lady Mayor, Master of the Glass Sellers and Mrs Whiteman, my Lords, Ladies and Gentlemen, it is indeed a great honour to attend your dinner and be invited to reply on behalf of the guests and to introduce such an important but unusual subject for these occasions, namely mathematics and the City. However I am impressed that there are so many mathematical experts here tonight. I am particularly in awe of the knowledge of the actuaries whose Master is here also.

I am particularly pleased to make the connection between mathematics and glass first because of the contribution to this industry of your Master's research over many years. Secondly, because, as I enjoyed recalling this evening, sitting opposite the Master of the painters and glaziers company, there is a splendid celebration of mathematics in the stained glass window in the Wren Library at Trinity where Sir Isaac Newton is presented to the king by a Rubensesque lady in a very low cut dress. Being in a stained glass window in such company is obviously the top honour that any mathematician can aspire to, at least in England. My third and more serious reason stems from the collaboration at the Cavendish Laboratory in Cambridge between my great grandfather William Garnett and James Clerk Maxwell, one of the world's greatest mathematician and physicists. There was a slight problem about William even being my great grandfather because Cambridge rules in the 1870's precluded marriage for College Fellows. He and his fiancée waited seven years and then he left for another career in education, which I will return to.

James Clerk Maxwell was the discoverer of the laws of electro-magnetic propagation of light and radio waves. When William's son, whom he named Maxwell, came to write his Fellowship thesis for Trinity in 1906, he calculated, on the basis of Maxwell's equations, how light is diffracted by tiny gold particles in red glass to make it look red. The theory is still valid and is now used to calculate how high frequency electrical signals move through semi-conductors. Glass is not only half made of silicon, but glass is now closely related to silicon technology - I hope you read Lord Wade's report to the House of Lords last year on 'Chips with everything', which concluded that silicon still has a lot of potential for business and that the UK needs to do more to promote this business.

Nowadays not only business but government and even parliament increasingly discuss, implement and justify their policies in terms of numerical indicators, targets and achievements. Provided this is done honestly, this approach undoubtedly contributes to more open government and good management. I experienced the sharp end of this approach when I lost my bonus as Chief Executive of the Met Office. This was because we missed one of our targets of delivering forecasts by ten minutes. More importantly however we over achieved our main target, when we improved the accuracy of forecasts substantially and even beat the US at predicting the track of hurricanes. But as my story of red glass demonstrates, mathematics is much more than government statistics and book-keeping. It is essential for the thorough analysis of natural phenomena, technology, living systems, and also for studying the working of organisations.

Mathematical thinking links all these studies together, and has enriched our understanding of the world around us. The ideas of chaos and limited predictability that arose in research on weather forecasts and on the spread of diseases have proved useful for financial dealing, not to mention dealing with the surprising behaviour of the wobbling bridge full of people enjoying some random vibrations.

Having this kind of overview of complex issues is surely why those with mathematical educations hold so many senior positions in the city and industry. It made us feel important to see a list of them on Stephen Hawking's door in the Maths department in Cambridge.

In the UK we are fortunate that the City takes this enlightened view in its recruitment practice. It will certainly help the City to retain its global prominence. It was noted last week in the Paris newspaper, *the Figaro*, that London's pre-eminence even makes it a natural focus for bringing thousands of activists and protests. Is this a new kind of invisible export? It certainly adds liveliness to London. The excellent job prospects of mathematicians in the city is one of the reasons why good students still flock to read mathematics in the leading UK universities - unlike the depressing decline in mathematical studies in some major continental countries.

One might say there are two strands to the history of mathematics and commerce in its widest sense which is still reflected in how mathematics is applied today. First there was the

tradition of statistics and probability which leads to the prediction of risk on which the insurance business is built. The Old Testament and the Koran disapprove of such prophesying. This caused some criticism when insurance began in London. The same criticisms were raised when weather forecasting began in the 1850's. In Islamic countries forecasts end with "Inch'Allah". Even the Royal Society had doubts about forecasting in the 1860's which indeed led to their cessation for eleven years. The first head of the Met Office Admiral Fitzroy committed suicide, but MP's from Devon and Cornwall approved. Their constituents I fear had benefited from all the shipwrecks that had been averted by the success of Fitzroy's storm warnings. Business does not always want too much information.

The second strand of commercial mathematics was stimulated by the need for better navigation. The early astronomical calculations led to Newtonian mathematics with its concept of perfect predictability. Back in the seventeenth century the City must have been impressed when they and the Government listened to the financial advice from the famous committee whose members included a mathematician, architect and philosopher namely Isaac Newton, Christopher Wren and John Locke.

These two strands have come together today when modern mathematics and computing enables us to combine the statistical and deterministic traditions to estimate uncertainties. But this approach is just beginning - there is still a long way to go.

How should the mathematical community and the City work more effectively today? What is best practice? Insurance companies worked with UK academics on a scheme part funded by DTI. This continues as the Risk Group in Lloyds Register; one product was the seasonal forecast for hurricanes at UCL which this year warned in August of the unusual large number of landfall hurricanes. Our US friends in Colorado and Florida were quite wrong, and, as I heard last week, hurriedly had to revise their predictions!

The DTI Faraday Partnership based at the Smith Institute is working with Universities on providing mathematical advice to manufacturing, transport and financial service companies. Communication between academia and business is improving in other ways. The City has its tradition of Gresham Lectures. I have recently been appointed by UCL to be director of the Lighthill Institute of Mathematical Sciences to bring together London universities and members of mathematical societies. We have well attended evening meetings on topical

mathematical issues such as extreme values and risks, complex industrial and biomedical processes. The critical need is for more openness about problems and research development. The City could to more to explain its potential needs for mathematical advice and to share its thinking about where mathematical research could be of greatest use.

I am sure the major accountancy consulting firms, which certainly use mathematics very effectively, could benefit by better communication to the academic community. Equally academics have to do more to improve communication, perhaps using the newly formed mathematical science institutes in Cambridge, London and Manchester for this purpose.

In proposing the long term health of the Glass Sellers, I of course have to mention climate change. One of the great dangers is flooding of London caused by melting of the Antarctic ice sheets. Using the same mathematics of slow viscous flow that Pilkington used for their glass float process my colleagues at UCL are calculating, and comparing with the help of satellite data, the slow creeping of these ice sheets. You will be relieved to hear that we have more than 1000 years to go on present projections before the glass like motions of ice sink us completely. However the Prime Minister has quite rightly emphasised the urgency of dealing with climate change through all means at our disposal because of the undoubtedly great problems of human health and to the economy. Commerce will assist this global campaign through Europe's carbon trading scheme.

Finally I give you the toast of the Glass Sellers Company, may it flourish, root and branch for ever, and good health to the Master.