Cedric Smith – a mathematical castaway

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C. A. B. Smith (c.1918-2002) holder of the Weldon Chair of Biometry at the Galton Laboratory was a member of the Mathematical Association for over sixty years. Amongst his scientific work, he developed the standard statistical methods now used to map genes onto chromosomes and he wrote a text book *Biomathematics.* He recently contributed a poem written by the mysterious ‘Blanche Descartes’ to the *Gazette* and it was published posthumously.†

The pseudonym ‘Blanche Descartes’ was connected with Smith’s contribution to the problem of ‘dissecting a rectangle’ and ‘Blanche’s dissection’ which was published with three others (A. Stone, R. Brooks, and W. T. Tutte) in 1940 and a problem which has been recently been resurrected in the *Gazette.*‡ It is an investigation which seems very pure in its scope but turns out to be useful in the design of electronic networks. Smith, for one, would not have been surprised, and indeed, would have applauded the fact.

In preparing an article on desert island theorem several years ago, I asked Cedric Smith what seven theorems and a book he would take to a desert island.§ As I cannot claim anything more than a brief acquaintance with him, I was somewhat surprised, but delighted to receive, what amounted to an autobiographical account of how he was drawn into mathematics. Here is his thoughtful and illuminating letter:¶

‘I’m not quite clear what sort of an answer you expect. It seems to be a mathematical version of Desert Island Discs. However, while one can take a collections of discs, or tapes, or CDs, to a desert island, and play them over and over again to pass the time, that is hardly what one would do with mathematical theorems, or ideas.

¶ The letter is dated 17 June 1990 (written by Smith in his own number system). He used a system of arithmetic based on symbols 0 to 5 and replacing the others by these symbols printed either upside down or in reverse (i.e. equivalent to using negative symbols, referred to in the letter). The letter opens: ‘Many thanks for your intriguing letter. I apologise for being a bit slow in replying, but as it happens I have been exceedingly busy lately trying to deal with 4 urgent problems at once, as well as all the normal business of life.’
One theorem leads to another and another, and so on. One could say that one would like to take with one 7 theorems which would lead on and on to a large number of fascinating results. But how is one to know in advance?

With regard to which book I would like to take, I have no hesitation whatever, that is, if a book in 2 volumes is allowed. It would be *Winning ways*, by Berlekamp, Conway and Guy.* There is probably enough there to keep one busy reading it for the rest of one’s life, not to mention the infinity of investigations it would suggest. And it has a unique style. It is the only serious mathematical treatise I know which consists of a continual series of puns from beginning to end.

As for the 7 ideas or theorems or plums which I might take, I would prefer to answer a slightly different question, which I think would be more appropriate to maths. There are times in life when one seems to go through a door which opens a new and wide vista. Or when one is going along a road, and suddenly comes to the brow of a hill, with a view in front in all directions. In the same way, there are the moments (or periods) in life when some discovery opens up a vast range of new possibilities. Non mathematically, such occasions occurred for me in my late teens when I discovered serious music, and art and poetry, and, from a religious point of view, the Society of Friends. From a mathematical point of view they might be as follows (I’m not trying to make them exactly 7).

The first discovery was the discovery of algebra. My brother, who was considerably older than me, came to me one day, when I was around 7 years old, and said, ‘Think of 2 numbers. Add them, multiply them, and tell me the answers. Then I will tell you what numbers you thought of.’ I asked him how he did it, and he said, ‘by algebra.’ Somehow I found a copy of Todhunter’s *Algebra* in the house, and read it straight off, from beginning to end.† It was obvious that here was an extremely powerful tool for solving all sorts of problems, as well as a delight in its own right.

This was followed by the discovery of calculus. I am rather puzzled to put a date on that. I know that I learnt it by reading an engineering text book belonging to my brother, which was a masterpiece of exposition: I have never come across a better one. I do remember that when I was still living in Leicester, which my family left when I was 12, there was a mixed class at my school, composed of pupils of various ages. One day the senior

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† Isaac Todhunter (1820-1884), the great writer of text books in the Victorian era is generally castigated for his pomposity and criticised for his unoriginality. However, his books had an enormous influence. His *Algebra* brought out by the Cambridge publishers Macmillan in 1858 went through numerous editions.
mathematics master wrote some formulas on the board, and said, ‘these are elliptic integrals, and cannot be expressed in simple terms.’ I was very impressed, though of course I did not know that in the future I would be very interested in elliptic functions. So I must have known a fair amount about integrals then.

With algebra and calculus one has a most powerful set of ideas, to deal with a vast variety of situations, static and dynamic. My predecessor, J. B. S. Haldane, remarked that the way to test an idea or a hypothesis was to put it in algebraic form.* And it is still true that a wide range of investigations in the forefront of applied mathematics (including such matters as statistics and biological maths) use very little more that simple algebra and calculus, even today.

In the years round about the age of 20 I met quite a few fascinating new ideas, each opening out a new vista, It isn’t easy to put them into chronological order, or order of importance. One of the most far reaching was at the age of 21, when a remark I saw [sic] made me realise that arithmetic could be simplified in a great variety of ways by using negative digits as well as positive ones. I found later that this had occurred to about half a dozen others, including Cauchy, who had made great use of it in his calculations. So, for the last 50 years, I have used it myself a great deal, and I have worked out how to get computers to do the same, though so far I haven’t had time to put that into practice. Life is just too busy. But what I did not realise until fairly recently is that that is also a gateway into a large unexplored region: I and a friend have got some quite exciting results.

Another new vista opened up through [a] combination of 3 apparently distinct lines of investigation. One was Lewis Fry Richardson’s research into the causes of war, very largely on a mathematical and statistical basis.† Another was the publication of the book on the *Theory of games and economic behaviour* by von Neumann and Morgenstern.‡ The third was Jimmy Savage’s work

* J. B. S. Haldane (1892-1964), the evangelising atheist, was the first holder of the Weldon Chair (1937-1957). As if to prove his point about the usefulness of algebra, Haldane used difference equations in the pursuance of biological problems.
† L. F. Richardson (1881-1953), another Quaker, was an all-rounder in mathematical subjects. His studies of conflict situations included modelling them using differential equations. His extensive work in meteorological studies and numerical analysis was made at a time when computing power was rather limited, but it was influential (as ‘Richardson’s Method’ for computing eigenvalues and eigenvectors suggests).
on the foundations of statistics. Put together, these showed that one could construct a coherent mathematical theory of decision making, rather than leave it as a matter of intuitive guesswork. Which has 2 consequences of importance. It puts statistical theory on a really satisfactory basis for the first time. And what is of rather more importance, it shows that maths has a special place in the study of social issues, and can illuminate them. That has had a profound influence on my life. It has led me to associate with a group of academics, of various disciplines, who wished to make a proper academic study of conflict, and its resolution. I am assured by some of my friends, who are very reliable, that several threatening disputes have been solved or considerably moderated by their intervention, on a confidential basis. The same ideas can be used in many cases to deal with quarrels between neighbors and similar situations as shown first by the same academic group. This approach, or ‘mediation’, is becoming widespread in the USA and Australia, and is now being taken up in Britain.

Apart from these ideas already mentioned, there are a number of other exciting ones, though less important than those I have already mentioned. For example, the theory of special relativity and tensor calculus. Special relativity gives one a new view of the universe, embedded in a 4 dimensional space-time, instead of embedded in space and developing in time. Tensor calculus shows how what appear to be quite complicated relations can be reduced to simple formulas, by suitable notation. Then, around 45 years ago, I got very interested in elliptic functions, after realising that they could be presented in a very much simpler and more elegant way than is customary in text books. I corresponded with Prof. Neville, and published two or so short notes in the Mathematical Gazette, which, as far as I know, nobody has ever read, presumably with the exception of Neville.* Then there is the use of mathematics in biology, as exemplified by a new book by J. D. Murray, which is a masterpiece of exposition.† But one could hardly take that usefully to a desert island, because, as Prof. Murray forcefully points out, useful progress depends critically on close collaboration between mathematician and biologist.

Well, if one excepts mathematical biology for the reason I have given, that gives 7 fruitful ideas, some extremely so. They don’t quite answer your question, but I don’t quite know what would.

* C. A. B. Smith, On the definition of elliptic functions, Math. Gaz. 28 (May 1944), pp. 41-45. E. H. Neville (1889-1961), a Cambridge trained mathematician, was a leading figure in the development of the Mathematical Association. In mathematics he was an expert in Elliptic Functions but was erudite generally, and in the service of the Mathematical Association put this to use as its librarian.
Mathematical ideas are not exactly something one can play on a record player."

Cedric Smith was a frequent contributor to the Mathematical Gazette in the 1940s. In several of the articles, he shows a concern for solving problems and for matters of notation: his abbreviation and the suggestion of writing a function as instead of the problematic are instances. But Smith’s vision was larger than these issues might suggest. Bear in mind the final paragraph of his book Biomathematics:

‘Mathematics needs to be wisely guided. Like other instruments, it can be used properly and with discrimination, or foolishly and inappropriately. Even the finest and most effective instrument can be put to base as well as to noble purposes, to impoverishment and destruction as well as to the enlargement of life and the creation of beauty.’

For Smith at Trinity College Cambridge, reading mathematics in the 1930s, exploring mathematics was a journey. His Quakerism was a major influence in his life generally. So were his feelings about mathematics. The ‘vistas’ opening up before him, and the experience of coming ‘to the brow of a hill’ were very reminiscent of the Victorian mathematicians who saw ‘Mathematics as a tract of beautiful country’ opening up before them, and ‘seen first at a distance’ waiting to be explored.‡ And so, even now as we enter the twenty-first century, the Romantic Age of Wordsworth which played a part in influencing Smith, will no doubt live on in mathematical exploration.

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† C. A. B. Smith, Gamma Function, Math. Gaz. 23 (Dec. 1939) p. 479; The sign of a determinant, 26 (July 1942) p. 137; Note on the Gamma Function, 26 (July 1942) p. 138; On the notation for a function, 26 (July 1942) pp. 138-139; (with V. E. Gumbrill), Linear equations in integers, 28 (Feb. 1944) pp. 22-26; (with R. S. Scorcer, and P. M. Grundy, Some binary games, 28 (July 1944) pp. 96-103; The counterfeit coin problem, 31 (Feb. 1947) pp. 31-39.

‡ Presidential Address to the British Association, Southport, Sept. 1883. (Collected works of Arthur Cayley, vol. 11, pp. 429-459.)