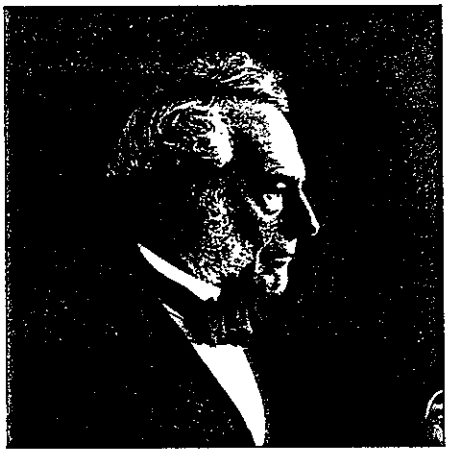
Michael Berry

A very Victorian correspondence

The Correspondence Between Sir George Gabriel Stokes and Sir William Thomson, Baron Kelvin of Largs (two volumes) ed David B Wilson 1990 Cambridge University Press 783pp £125.00hb

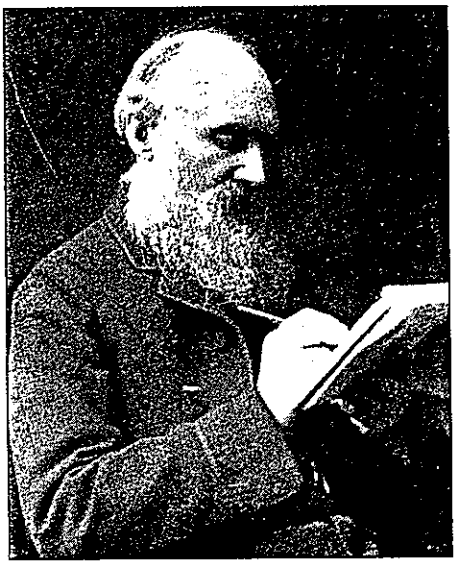
WE physicists have long revered these two great Victorian scientists, but I suspect that until recently most of us did not realise the degree to which their careers were intertwined. Now, in this second book, following his 1987 *Kelvin and Stokes* (Adam Hilger), David Wilson gives the evidence demonstrating how closely they communicated about every aspect of their work, over a period of 55 years. He has deciphered their letters (656 of them), sometimes with considerable difficulty from scrawled and pencilled remnants, and presents them here, spelling mistakes and all, to give a unique and fascinating picture of scientific life in the last age of classical physics.

Sir George Stokes 1819–1903



As might be expected, many of the letters concern fluid motion and the associated mathematics. This begins in 1847, with an early discussion by Stokes (S) of the necessity for multivalued potentials in multiplying connected domains, soon followed by an astonishing aside, foreshadowing modern work on chaos, about the "infinite variety of motions of endless complexity within a closed space" if the customary restriction to irrotational flows is lifted. Kelvin (K) "perceived a fine instance of elasticity in an incompressible liquid, in . . . Paris, on a cup of thick 'chocolat au lait' ". There is the famous P.S. in which K describes the theorem relating line and surface integrals, which we now attribute to S (who never claimed credit) because he later set it in an examination. We find S appreciating the fact (underlying turbulence) that viscosity is a singular perturbation: ". . . the unique motion which would be determined mathematically . . . on the *assumption* of continuity [between finite and zero viscosity] is not the actual motion, the latter being of the unstable kind". There are many discussions about solitary waves and their greatest possible height, and about vortex motion and the instability of interfaces. The latter continues even into the last letters (1901) with a persistent disagreement about which sorts of discontinuous flows are allowed, and how eddies can be generated at boundaries.

Some indication of the variety of their scientific interests, and their endless curiosity, is provided by the following sample of topics they explored: ball lightning (K): "I do not feel sure about [this] being a real phenomenon"; complex dielectric constant as representing (S) "metallicity and vitreosity"; intimations of superconductivity (S):



Lord Kelvin 1824–1907

"It appears therefore that a wire with resistance nil is roughly realisable in actual experiment"; the influence of multiple scattering in lighthouse illumination seen through fog (S); the growth of snow crystals (S): ". . . latent heat of solidification . . . favour[s] a growth of the crystal in places where the crystal projects"; much discussion of X-rays and radioactivity: K reproduces Becquerel's observations, and notes that uranium ("a marvellous enigma") smells like garlic when rubbed, and S replies that as a boy he knew a similar smell, from rubbed quartz.

We learn a lot about their professional lives. K's first lecture "was rather a failure as I had it all written, and I read it very fast". K is in too much of a hurry to read the proofs of a paper, and asks S to do it for him. There are many discussions about papers submitted to the Royal Society, of which S was secretary for many years (to the detriment of his research career, in K's opinion). K mentions "a most absurd paper (fortunately very short)". They freely admit mistakes (S): "I would not have communicated such an immature speculation [about potential theory] to one with whom I was less intimate, nor even to you, only that I wanted to announce my election [to the Lucasian Professorship], and thought I might as well do the two things at once". Worldly concerns occasionally intrude: K wants to resign as editor of an unprofitable journal, worries about his frequent applications for research funds (S allows him to use a new grant, exceptionally, to defray costs he has already incurred), and urges S to keep silent while he applies for a patent on a remedy for an "anticipated difficulty in telegraphic communication". K regrets that Foucault seems ignorant of earlier work by Joule (about heat generated by eddy currents), and wonders whether "to write to the French Academy giving these references, for the credit of England". Although both were born in Ireland, there is only one mention of politics, from K: "Are you trying to re-collect the scattered supporters

of Irish Nationality and make another effort for independence? Or, do you fraternize with the Saxon, the enemy of your country?"

There are curious omissions. There is no evidence here that they fully appreciated the significance of Maxwell's electromagnetic theory (although they were deeply saddened by his early death). And Stokes' theory of the discontinuities in asymptotic series, now understood to be of central mathematical importance, is never mentioned. I suspect this to be a selection effect, because the two men often met, and may not have corresponded about everything they discussed.

I learned something from almost every page. All physicists should read, or at least dip into, this collection of treasures. Libraries should buy it, but at £125 for two modest volumes I do not expect many of us would dare to ask for it as a birthday present.

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John Polkinghorne

Heavenly pursuits

Can Scientists Believe?: Some examples of the attitude of scientists to religion ed. Sir Nevill Mott 1991 James and James 182pp £21.00 hb

CAN scientists accept religious belief? Of course they can, and many do. Sir Nevill Mott has had the good idea of assembling a collection of accounts of how individual scientists view the matter. He himself only began to take an interest in religion when, at the age of 50, he was invited by the then vicar of the University Church in Cambridge to talk about science and religion. This led him to read some theology and to embark on a quest which carried him into the dogmatically capacious and accommodating bosom of the Anglican Church. His essay in this volume is personal and frank, and it is "an attempt to present a form of Christianity without miracles". There is no doubting the sincerity of Mott's views, but I believe that Christianity is odder, more profound and more interesting than he currently recognises.

The essays that follow are a very mixed bunch. Some writers take a particular theme in the relationship between science and religion and develop their account of it. Thus David Bartholomew, professor of mathematical statistics at the London School of Economics, uses his professional expertise to discuss the intertwining of randomness and predictability in the process of the physical world in relation to questions of providence, and to consider the justification of belief, particularly through the convergence of various lines of argument, none of which by itself is absolutely certain. Sir John Eccles once again reviews his belief in a dualist account of mind and brain in interaction. I am not competent to comment on the neurophysiology invoked, but I am sure that there are other ways than following Descartes which enable one to reject a reductionist account of mind as if it were a mere epiphenomenon. Peter Hodgson reiterates the respectable arguments which suggest that the idea of God as both rational and contingent was a significant factor in bringing about the rise of modern science in sixteenth century Western Europe. The Archbishop of York (whose entry into the ministry was still being lamented as a loss to pharmacology when I was a young physicist in Cambridge) contributes a characteristically perceptive piece comparing the vocations of scientist and priest and drawing attention to such qualities as order and wonder which link the two.

Not all the contributors write from within the Christian tradition. Cyril Domb gives us a perspective from orthodox Judaism and V Ya Frankel expresses his perplexity about what makes people take religion seriously. Sadly, he tells us that his experience in Russia was that he "only met one highly intellectual man, a mathematician, who was religious". A notable omission from the symposium is any essay from the (scientifically fruitful) world of Islam.

A good many of the other pieces were somewhat disappointing. There is little evidence in some of them of the degree of intellectual seriousness which the authors surely bring to their science and which, without demanding professional theology, they ought not to leave behind when they think about religion. For instance, the topic of miracles surfaces frequently, but it is treated in a very unsophisticated way. The central problem is theological: how can the utterly consistent God be thought to do totally unexpected things? Any notion of a celestial conjurer doing an occasional turn is theologically incredible, but that does not rule out the possibility (so familiar from physics) that unprecedented circumstances might be accompanied by wholly novel happenings. It would have been good if someone had spent some space in a careful discussion of this question. For the Christian it is essential, because of the central role of Christ's resurrection.

I have left till last the contribution I enjoyed the most. It is the final essay, by Francis Everitt of Stanford University, USA. He has given us a brilliant and lively piece, darting around science to show its dependence on its own kind of faith and its own experience of mystery, and around the Bible to show religion's use of reason and even (Ecclesiastes) scepticism. Talking about the way that great discoveries are so often felt to have about them a dimension of "givenness", of coming from out of the blue, Everitt says "Am I really, you ask, attributing unconscious intellectual creation to divine inspiration even when its vehicles are agnostics like Dirac and Fermi? My answer is a qualified yes". He seems to me to belong to a tradition within which I also would want to take my stand, a tradition which believes that those who are wholeheartedly seeking truth are truly seeking God, whether they know him by name or not.

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John Wilson

Whither FORTRAN?

FORTRAN 90 Explained Michael Metcalf and John Reid 1990 Oxford University Press 294pp £14.95pb

KEEN FORTRAN watchers or standards "junkies" will be aware that the long-awaited new standard has now reached DIS (draft international standard) status and, with any luck, could emerge as a fully fledged standard later this year. The first compilers for the new language (for such it is) can be expected to hit the streets around the same time and those physicists for whom FORTRAN is still an essential tool will be in urgent need of a book to explain it to