was forged in the 1850s by Irishman James Booth. He believed that education was advanced by examination, and he would have arrived at this belief by surviving the examination rigours of Trinity College Dublin (including five attempts to become a Fellow through an extra-intensive examination). He was a vigorous campaigner in the field of education, especially in the education of girls. He joined the RSA in 1852 and used it as a vehicle for founding a national examination system, stirring up the Society before wearing out his welcome and being sidelined.

Booth gets ample coverage in the book but the author does not mention that he was an accomplished mathematician. A member of the RS, he contributed work on the theory of curves and surfaces as well as elliptic functions and elliptic integrals, and becoming known for Boothian 'tangential' coordinates. In this written history there is little connection with the mathematical world (neither mathematics nor statistics are present in the Index).

In modern times a practical problem connected with mathematics did arise, and the RSA responded. It co-sponsored a project by Emma Norris with a Report (2012) on 'Solving the mathematics problem: international perspectives on mathematics education' (available online). The problem addressed was that of half the school population failing to achieve GCSE mathematics at secondary school level.

The Royal Society has the Copley Medal as their top level of recognition while the RSA introduced the Albert Medal, struck in in 1863, commemorating Prince Albert who had recently died. In modern times Stephen Hawking was awarded this annual medal for making science more accessible, and Tim Berners-Lee for the invention of the World Wide Web. Other people honoured include, just to give a small selection, Michael Faraday, Charles Wheatstone, G. B. Airy, J. P. Joule, William Thomson, Queen Victoria, H. v. Helmholtz, Thomas Edison, Lord Rayleigh, Joseph Swan, Marie Curie, Orville Wright, Ernest Rutherford, and Claus Moser (who prided himself on being a non-mathematical statistician). A feature of all winners is utility, whether derived from their work or by the agency of patronage. As the author says, unlike the exclusive clubs (for example the RS and the RAA), prize winners do not need to be members and they may even wonder about the identity of the RSA after they had been chosen. The medal can sometimes seem to be awarded for the benefit of the RSA rather than added prestige for its recipients. There is such a thing as reflected glory.

The author of this book is the resident historian of the RSA. It can happen that histories of institutions written by insiders can turn into a whitewashing exercise. But this is not the case here. The book gives a panoramic view of an old and worthy institution, and its story is told with a touch of humour, while the author is unafraid of being gently critical at the RSA's expense.

10.1017/mag.2022.93  TONY CRILLY
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**Frank Ramsey: a sheer excess of powers** by Cheryl Misak, pp. 537, £25 (hard), ISBN 978-0-19875-535-7, Oxford University Press (2020)

Dead at 26 years of age, Frank Plumpton Ramsey (1903-1930) is one of the twentieth century's most remarkable intellectuals. With justification he can be seen by mathematicians, logicians, economists, and philosophers as making fundamental contributions to each of their fields. It is strange that he is not better known.

Ramsey's base was Cambridge. He was brought up in this world of academe where his father was a mathematics don at Magdalene, and, after school at

Winchester, his undergraduate days were spent at Trinity studying mathematics (J. E. Littlewood was his supervisor for analysis). He became a Fellow of King's where he taught Tripos mathematics through lectures and supervisions. Acclaimed geometers Patrick Du Val, Donald Coxeter and group theorist Philip Hall were among students who judged him inspirational.

By the 1920s the Mathematical Tripos had been reformed, but not enough to the liking of G. H. Hardy (President of the Mathematical Association, 1925-26). It remained as it had for over a century, a rather tedious course dominated by examinations. Ramsey took Part 1 after only a year (enough for a B.A.) and Part II in 1923. The Order of Merit and naming the Senior Wrangler (the top student in the Tripos examinations), so prominent in the Victorian era, had been officially discontinued, but Ramsey was *de facto* the Senior Wrangler of his day (1923).

FIGURE 1: Frank Ramsey c. 1924

Though he was born post-Queen Victoria there is something very Victorian about Ramsey: he was interested in everything, and did not to recognize the rigidity of subject boundaries. During his undergraduate period he expanded his horizons as his attention to mainstream Tripos mathematics waned. As a result he sampled Cambridge societies and spent a great deal of time contributing to such as the Decemviri, the Magpie and Stump, the Heretics, the Moral Sciences, the Cambridge Union, the Political Economy Club, and the Cambridge Philosophical Society. His favourite activity was undoubtedly spending time with the Cambridge Apostles founded in 1820, where membership was by invitation. While this attitude would result in Tripos failure for most, this did not happen in Ramsey's case. He could do mathematics in an almost natural way.

It is difficult not to like Frank Ramsey, 'a large, untidy, shy, & charming man with a wide and winning smile'. As the author says, there is plenty of evidence to suggest he was simple, honest, hearty, and of generous character with an easy-going naturalness coupled with a healthy appetite for life. His home life though had been hard. His father Arthur Stanley Ramsey (the writer of textbooks in applied mathematics) was an aloof man with a fierce temper. The boy was closer to his mother Mary Agnes (known as Agnes), an active person in progressive causes who took to letter writing to the newspapers and materially helping the poor by delivering them milk.

His younger brother Michael went into the Anglican Church and became the 100th Archbishop of Canterbury. The subject of religion must have made for interesting discussion around the family table as Frank was a committed atheist from

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the age of thirteen. Michael said his brother was cleverer than he was—and you can hear him saying this very thing on YouTube.

With all his achievements why is not Frank Ramsey better known amongst mathematicians? One reason was his interest in foundational theories rather than in the superstructure of mathematics. Moreover, he is not easily pigeon-holed as his work straddles subjects external to mathematics. But these considerations cannot supply the whole answer, as we certainly know much about of Bertrand Russell and the other don who shaped Ramsey's intellectual life, John Maynard Keynes.

Ramsey read Russell and his programme of basing mathematics on logical principles. Russell's Theory of Types was proposed in order to avoid paradoxes that occurred in a primitive set theory. Ramsey was not wholly in agreement and refined it. In August 1926 he gave a lecture to the British Association for the Advancement of Science in Oxford. His lecture ‘Mathematical Logic’ was enthusiastically received, and Hardy and E. H. Neville suggested he publish it in the *Mathematical Gazette* (it appears in volume 13, Oct. 1926, pp. 185-194). It is an accessible account of the subject pre-Gödel. Ramsey both opposed Hilbert's formalism and intuitionism (which he dismissed as the Bolshevik menace of Brouwer and Weyl), though in his latter years he appeared to soften his opposition to the latter.

In 1920 Keynes published his work on the foundations of probability, to great acclaim; Russell said it was ‘undoubtedly the most important work on probability that has appeared for a very long time’. This did not stop the young Ramsey from challenging Keynes's view that probability was some kind of extension of deductive logic. Ramsey put forward a theory of subjective probability, the ‘degrees of belief’ theory which has subsequently gained ground as the Bayesian theory. From a young tyro this is remarkable, and he was clearly ahead of Bruno de Finetti (1937), his work been published posthumously in 1931. Generous to a fault, Keynes recognized Ramsey's brilliance in summoning up this work:

> Ramsey argues, as against the view which I had put forward, that probability is concerned not with objective relations between propositions but (in some sense) with degrees of belief, and he succeeds in showing that the calculus of probabilities simply amounts to a set of rules for ensuring that the system of degrees of belief which we hold shall be a consistent system. Thus the calculus of probabilities belongs to formal logic. But the basis of our degrees of belief—or the a priori probabilities, as they used to be called—is part of our human outfit, perhaps given us merely by natural selection, analogous to our perceptions or memories rather than to formal logic. … So far I yield to Ramsey—I think he is right.

As an undergraduate Ramsey translated Wittgenstein's *Tractatus* from the German, and after graduation travelled to Austria to undergo psychoanalysis, as almost a normal thing to do in a period when the work of Freud loomed large. (While in Austria he engaged with mountaineering in the true Cambridge spirit of taking his books with him and climbing in the same shoes he would wear walking along King's Parade). He met Ludwig Wittgenstein and stayed with his family. Ramsey found Wittgenstein exhausting and intense, a man who demanded attention, and that exclusively fixed on himself. To some he was the ‘mad philosopher’ and he was certainly a challenge to be around, but he was treated well by Ramsey who made him feel at home in Cambridge.

For mathematicians of the mainstream, Ramsey contributed a very tasty morsel. His paper ‘On a Problem of Formal Logic’ published in the *Proceedings of the London Mathematical Society* (1930) gave rise to Ramsey theory with attendant

Ramsey numbers. This arose as an offshoot to the paper's main business. For it, we have to imagine $n$ randomly placed points in the plane where each is joined to each by either a blue edge or a red edge. If $n \geqslant 6$ Ramsey's theorem states that there is always exists either a red triangle or a blue triangle. This is expressed as the Ramsey number $R(3) = 6$. So, out of randomness there is some structure present, and Ramsey's theorem is encapsulated by stating that 'complete disorder is impossible'.

With this theory there are some difficult combinatorial problems ahead. Moving onto quadrilaterals, pentagons, …, it is known that $R(4) = 18$, but only that $43 \leqslant R(5) \leqslant 49$, it being conjectured that $R(5) = 43$. The exact values are unknown for higher values of $n$, and the gaps between possible values widen, for example $102 \leqslant R(6) \leqslant 165$ and $205 \leqslant R(7) \leqslant 540$.

The various theories that received the 'Ramsey touch' tend to be recondite, and rather than letting the modern accounts interrupt the book's story, there are 'boxed' capsule summaries by various experts at the appropriate places. For example, economist Joseph Stiglitz judged that Ramsey's paper on taxation published in the Economic Journal (edited by Keynes) provided a landmark in the economics of public finance. Above all Ramsey was a philosopher, of a rare kind, who could look at a topic with a mathematician's eye (for which he was criticized by Wittgenstein for not focusing purely on Philosophy).

For people interested in British cultural life of the 1920s, this book will be a valuable source, and also for those wanting new light on the careers of such figures as Wittgenstein, Sigmund Freud, Lytton Strachey, G. E. Moore, Richard Braithwaite, C. D. Broad, Bertrand Russell, Lionel Penrose, John Maynard Keynes, Clive and Vanessa Bell, and the educationalist A. S. Neill (whom he met in Austria). Ramsey was closely linked with the Bloomsbury Set and the Vienna Circle. Also in the cast list are mathematicians G. H. Hardy, Max Newman, J. E. Littlewood, L. E. J. Brouwer, and the algebraist Issai Schur. Finally, we are left with a tantalizing 'What if': shortly after Ramsey's death Alan Turing went up to King's College as a freshman, and what a combination that would have been.

This is everything a biography should be. It does not overwhelm us with technicalities but keeps a steady focus on a person grappling with the struggles of growing up, and the relationships with family and academic personalities, all told against a backcloth of the scientific advances he was able to make (though an error in the family tree diagram escaped the proofreader's eye).

The scholarship is superb, and the specialist will be able to check the author's claims through the Notes in conjunction with a comprehensive Bibliography. It is accessible to the non-specialist too. I can't wait to reread it.

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**The secret formula** by Fabio Toscano, pp. 161, £22 (hard), ISBN 978-0-69118-367-1, Princeton University Press (2020)

Most readers of this review will know something about the priority dispute between Tartaglia and Cardano over the solution of the cubic equation, but perhaps like me were rather vague about the details. This account is a welcome clarification. It uses an impressive collection of the actual correspondence between the two of them, and also between Tartaglia and others who became embroiled at various stages. The original challenges were 'private' in that they were communicated by letter, not in a live face-to-face conflict. Some of the letters are far from polite! Tartaglia discovered how to solve various forms of cubic equations but always