using modern decay constants, quoting MSWD values for all the re-calculated linear regressions. The introduction describes these fresh calculations, discusses how the re-calculated ages are used, and reviews new methods of age determination and interpretation.

The following 20 chapters describe the Precambrian geology of Africa, starting with the early Precambrian platform of southern Africa and ending with the Trans-Sahara mobile belt which extends from Algeria to Benin and Nigeria in the south. The chapters have a strong thematic quality which preserves the unity of the different aspects of the shield geology, and each of them is illustrated with maps and includes a review or synopsis.

The last three chapters begin with a review of the Phanerozoic igneous activity in Africa (which is closely connected to the thermal structure established during the late Precambrian Pan-African tectono-thermal event), followed by accounts of the succession of tectono-thermal events in Africa and the authors' conclusions concerning the evolution of the continent. Among these conclusions, the tectono-thermal and magmatic events in Africa are seen to have continued since early Archaean times with only short interruptions around 2,440–2,275 Myr and 1,740-1,425 Myr, this almost continuous history of events consisting of two similar sequences. The first began with the appearance of crustal stability around 2,500 Myr, followed by localized rifting and a sequence of tectono-thermal events which led into anorogenic granite plutonism down to 1,750 Myr. The second sequence began with local tectono-thermal events at *c.*1,400–*c.*1,300 Myr leading into several regional events through 1,185–1,140 Myr and *c.*950–*c.*600 Myr. This was followed by anorogenic granite plutonism until 425 Myr, after which the African shield gradually became destabilized by rifting from *c.*200 Myr to the present day.

By its nature this is not a book to read casually, yet the immense amount of information and the insightful and critical approach make it a fundamental resource for anyone with interests in Africa and the way regional geochronology leads to an understanding of its history. Geological cross-sections would have helped bring to life the details of the text and its numerous maps, and it is hard not to express some disappointment that the authors decided not to examine the ways in which the isotopic composition of strontium constrains African crustal evolution.

Yet the final word must be the sense of authenticity which comes from the text, an authenticity which will be apparent not only to those who have first-hand knowledge of Africa and its geology, but also to anyone who has come to value an understanding of its geological history. □

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All in the mind

David Singmaster

The Great Mental Calculators: The Psychology, Methods, and Lives of Calculating Prodigies Past and Present.
By Steven B. Smith.
Columbia University Press: 1983. Pp.374. $29.50, £28.

PRODIGIES occur in only a few fields: mathematics (usually in mental calculation), chess, music, memorization and languages. They intrigue us because their abilities are so unusual and they are often written about, though usually in the popular press where their freak value is well appreciated.

The present book is the first devoted entirely to calculating prodigies. It greatly expands and extends previous, more general works such as A. Binet's *Psychologie des Grands Calculateurs et Jouers d'Echecs* (1894), F. Barlow's *Mental Prodigies* (1951) and R. Tocquet's *The Magic of Numbers* (1960). Professor Smith's subtitle is an accurate description of the contents of his book, though I find it convenient to consider the three main sections in reverse order.

The final section, "Lives", gives detailed descriptions of 20 calculators and brief accounts of 21 more. A further 15 or so are mentioned elsewhere in the text. Smith is especially strong on contemporary calculators; about 12 of the people mentioned may currently be alive. Such a figure indicates that the incidence is about one in several hundred million, that is between 5.6 and 6.0 standard deviations from the mean. This seems as good a definition of prodigality as any, though earlier estimates varied from one in a thousand to one in a million.

The two most notable prodigies covered here are George Bidder and Alexander Aitken. Bidder (1806–1878) was the son of a Devon stonemason. He discovered multiplication by arranging objects in a rectangle, and by the age of nine could easily multiply two six-digit numbers mentally. He became an outstanding engineer in that era of great engineers, being proposer and engineer of the Victoria Docks in London, a founder of the Electric Telegraph Company and President of the Institution of Civil Engineers. His abilities as an expert witness were legendary — one opposing counsel asked for him to be barred since "nature had endowed him with particular qualities that did not place his opponents on a fair footing".

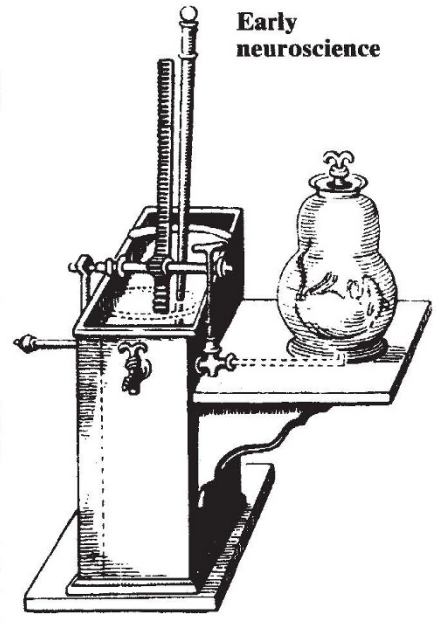
Bidder was especially good on logarithms and compound interest. And two days before his death, he mentally calculated the frequency of red light from the speed of light (then taken as 190,000 miles s^{-1}) and the fact that there are 36,918 wavelengths per inch, obtaining the result 444,433,651,200,000.

Alexander Aitken (1895–1967) was born in New Zealand, the son of a grocer's assistant. He displayed no unusual talents until he was 13, when a master remarked that squares could be computed using $a^2 = (a + b)(a-b) + b^2$. From then he spent the next four years practising mental calculation; in 1916, in a remarkable feat, he recalled all the details of men in a platoon when the roll-book was lost in a raid. Aitken eventually became professor of mathematics at Edinburgh University and a Fellow of the Royal Society. His speciality was the extraction of non-integral roots (for example $\sqrt{51} = 7.141428428557$, where the last two places should be 43) and finding decimal expansions of rationals (for example the 96 figures of the expansion of 1/97).

Both Bidder and Aitken stand out for two further reasons. Each wrote extensive descriptions of his methods, and each made wide use of his skills in his professional life, applying mathematics to develop further calculational methods and to extend the range of problems susceptible to mental calculation.

The second section, "Methods", is the briefest and covers the techniques actually used by calculators. Though the mathematics is usually straightforward, the application is often remarkably ingenious and skilfully arranged to minimize memory load. Using some of these ideas and a little practice, I think anyone could mentally square a two-digit number and perhaps multiply two two-digit numbers. More interesting are the methods used for non-integral roots, logarithms, compound

Early neuroscience



Robert Boyle's experimental apparatus in which air was evacuated from a chamber containing an animal, thus asphyxiating the animal and showing that "there is in the Air a little vital Quintessence". The illustration is taken from Mary A.B. Brazier's *A History of Neurophysiology in the 17th and 18th Centuries*, published by Raven price $81.