*Mathematical analysis and physical astronomy
in Great Britain and Ireland, 1790-1831:
some new light on the French connection*

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MATHEMATICAL ANALYSIS AND PHYSICAL ASTRONOMY IN GREAT BRITAIN AND IRELAND, 1790-1831: SOME NEW LIGHT ON THE FRENCH CONNECTION

Alex D.D. Craik

Abstract. — The reception by British and Irish mathematicians of late-eighteenth-century French mathematical analysis, and its applications to astronomy, is here re-examined. The main early British participants were John Robison, John Playfair, Robert Woodhouse, John Toplis, John Brinkley, John West, William Spence, John Herapath, James Ivory, William Wallace, and Mary Somerville. Their activities and publications, and those of some others, are outlined. The reviews of John Playfair and Robert Woodhouse, many little-known, are highlighted. Finally, we discuss why, despite the work of these individuals, reform of British mathematics was at first so slow; and why, in contrast, the eventual modernisation of the Cambridge Mathematical Tripos examinations, following the efforts of Charles Babbage, John Herschel, George Peacock and others, led to rapid improvement.

Résumé (Analyse mathématique et astronomie physique en Grande-Bretagne et en Irlande (1790–1831): quelques nouveaux éclairages sur les liens français)

On examine ici la réception à la fin du dix-huitième siècle, parmi des mathématiciens de Grande-Bretagne et d'Irlande, de l'analyse mathématique française et de ses applications à astronomie. Les premières contributions britanniques furent celles de John Robison, John Playfair, Robert Woodhouse, John Toplis, John Brinkley, John West, William Spence, John Herapath, James Ivory, William Wallace, et Mary Somerville. Cet article présente leurs activités et leurs publications, ainsi que quelques autres. Les comptes rendus de John Playfair et

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Robert Woodhouse sont étudiés de près. On analyse enfin les raisons pour lesquelles, en dépit des travaux de ces individus, la réforme des mathématiques en Grande-Bretagne a d'abord été si lente, et pourquoi la réforme du Cambridge *Mathematical Tripos*, elle, a finalement débouché sur une amélioration rapide.

1. INTRODUCTION

The several writers who deplored the decline of British mathematics during the latter half of the eighteenth century perhaps overstated the case. Certainly, there was no-one of the calibre of Newton. But, in the first half of the century, there were talented mathematicians, such as Taylor, De Moivre, Cotes, Colson, MacLaurin, Stirling, Landen, Waring, and Thomas Simpson who all espoused analysis, as well as the leading geometers Robert Simson and Matthew Stewart who influenced John Playfair. But mathematicians of other nations, particularly Euler, d'Alembert, Lagrange and Laplace, now led the way; and between 1750 and 1790 few British mathematicians followed their innovations. Importantly, there were no British institutions such as the nationally-sponsored Academies in Paris, Berlin and St. Petersburg to encourage, coordinate and support mathematical and astronomical research.

The Royal Society in London included many wealthy dilettanti among its fellowship; and, under the long presidency of the botanist and naturalist Sir Joseph Banks during 1778-1820, a marked antipathy had developed towards mathematics. Moreover, unlike in the European Academies, fellowship of the Society brought no financial rewards. Only near the end of our chosen period did effective scientific institutions begin to emerge; and only after the peace of 1815 did renewed scientific contacts between Britain and France begin to bear fruit. The Astronomical Society of London was founded in 1820 by several disenchanted fellows of the Royal Society, among them Charles Babbage and John Herschel (but not James Ivory); it became the Royal Astronomical Society in 1831. Also, after Banks' demise, some changes were made in the running of the Royal Society that improved the standing of mathematical subjects. The benevolent Society for the Diffusion of Useful Knowledge was founded in 1826, mainly by the politician and amateur mathematician and physicist, Henry, Lord Brougham. Then, in 1831, the British Association for the Advancement of Science was founded on the initiative of Brewster, Herschel, Babbage and others. This last year is chosen as the end-date of our study, for it marks the beginnings of a nation-wide scientific forum. It also happens to be

the year of publication of Mary Somerville's influential *Mechanism of the Heavens* [Somerville 1831].

In mathematics, for too long there had been a reluctance to replace Newton's method of fluents and fluxions by the superior Leibnizian notation of the calculus and its subsequent improvements. But the first introduction of this "continental analysis" to Great Britain was not due to the Cambridge Analytical Society led by Charles Babbage, John Herschel and George Peacock, as was long claimed. Certainly, their 1816 English translation of Lacroix's *Traité élémentaire de calcul…* [Lacroix 1802], [1816], and Peacock's book of *Examples* [Peacock 1820] were used by students in Cambridge and beyond, and so contributed to the modernisation of British mathematics. But they were neither first nor alone: the matter is well put in Niccolò Guicciardini's *The Development of Newtonian Calculus in Britain 1700-1800* [Guicciardini 1989, 136]:

> The struggle for the reform of mathematical education at Cambridge has been mistakenly viewed as a process in which British mathematics was successfully reformed. Historians largely based this view on recollections of former members of the Analytical Society who liked to describe themselves as the originators of interest in continental mathematics and the revival of research in the first half of the nineteenth century. This is clearly false. They were anticipated by Woodhouse at Cambridge, and as we have seen there were several other centres of reform as equally important as Cambridge…

In fact, before 1816, numerous British and Irish mathematicians had read, reviewed, summarised and translated French analytical works, and some made original advances. Their achievements are the focus of the present paper. Much has already been described by [Guicciardini 1989], [2004], [Panteki 1987]; [1991], [Crosland & Smith 1978], [Grattan-Guinness 1985]; [1986], the present writer and others; but the extent of this awareness of French mathematical science has widely been underestimated. Here, the matter is examined afresh and some overlooked material is described. It is worth emphasising that the main focus of this paper is the reception of French analysis and its applications to astronomy: a more general account of British and Irish mathematics and its applications during the Hanoverian period is beyond its scope.

The general context is described in Section 2. Then Section 3 describes the necessary "prelude to change," in which some transitional figures interact with the works of French savants. Section 4 is devoted to the remarkable influence of Laplace's *Mécanique céleste* [Laplace 1799–1827], the achievements of some leading British analysts and astronomers, and