

In Memoriam

Derek Thomas Whiteside (1932–2008)



It is enough and to spare. I warmly wish you well.  
Sincerely, D.T. Whiteside

Tom Whiteside (left) in discussion with ~~one of his early and great mentors Sir Harold Hartley~~, c. 1960. Courtesy of his daughter, Philippa Whiteside.

Derek Thomas Whiteside died in Wokingham, Berkshire, on the 22nd of April 2008. It is not a rhetorical exaggeration to assert that he was one of the greatest historians of the exact sciences of the twentieth century. His contribution to Newtonian scholarship is as monumental as it is complex, and these lines are written with a view to attempting a first evaluation of the heritage that he has left, especially in the eight bulky green volumes of Newton's *Mathematical Papers*, often referred to, much to his pleasure, as "Whiteside's papers." As will emerge, it is important to consider this accomplishment not as a closed chapter in the history of mathematics, but rather as a work that must be opened and read so that it can inspire future research for a long time to come.

Whiteside was born in 1932 in Blackpool. His mother died when he was five and his father, incapacitated during the First World War, took care of him and his brother. Whiteside's origins were humble, but he was able to rise to the status of a Cambridge Emeritus Professor thanks to his extraordinary talent. In 1951 after education at Blackpool Grammar School he won a State Scholarship to Bristol University. In 1954 he was awarded a B.A. in French and Latin.

After two years National Service (1954–1956) spent as a Trooper in the Fifth Royal Tank Regiment, during which he was stationed at Barce in Libya, he went up to Cambridge University where he gained a PhD for a thesis, written under the supervision of Richard Braithwaite and Michael Hoskin, which was published as “Patterns of Mathematical Thought in the Later Seventeenth Century.” This paper revealed to the then very small community of historians of mathematics that a truly towering scholar had entered into its business. Whiteside was amused to recall that he had written it in twenty-nine days. Given the power of his mind and the stamina that characterizes his work he was most probably telling the truth [Whiteside, 1961].

When, after obtaining meagre financial support, the young researcher began what was to be his twenty-year work on the edition of Newton’s mathematical papers, our knowledge of Newton the mathematician was quite unsatisfactory. A short, well written, book by Herbert Turnbull, had appeared in 1945 [Turnbull, 1945]. In order to get information on Newton the mathematician, one could also rely on works by German and Russian historians, who had been working following the lead of Moritz Cantor, A.N. Krylov and A.P. Youschkevitch.<sup>1</sup>

In those years, a constellation of stars of Newtonian scholarship (the so-called Newtonian Industry), including Rupert Hall, Richard S. Westfall, Frank Manuel, I. Bernard Cohen, James McGuire, Frank Manuel, and Betty Jo Teeter Dobbs, were about to change our image of Newton in many ways. These pioneers were basing their research mainly on manuscript collections that were still *terra incognita*. Whiteside found most of his manuscript sources in the Portsmouth Collection at the Cambridge University Library, in the Wren Library at Trinity College, and in a “private” collection, namely the manuscript collection housed at Shirburn Castle, the property of the Macclesfield family (and recently acquired by the Cambridge University Library). It must have been exciting to open these boxes for almost the first time and indeed a person with less energy, and less mathematical and palaeographic intelligence than Whiteside would have soon been defeated by the project of putting the manuscripts in chronological order, transcribing, translating and annotating them. Some of the manuscripts are rough, untidy, almost illegible notes. Their mathematical content is difficult to grasp for many reasons. The geometrical figures are often lacking and the mathematical notation is arcane. The concordances with contemporary literature are almost always implicit, given Newton’s notorious reluctance to cite other authors, even in his private notes. The mathematical reasoning is often just sketched in broad outlines. Indeed, Newton the mathematician often adopts an assertive, rather than argumentative style: how he got his results (almost invariably correct) is a matter for speculation. As Jean Bailly remarked [Bailly, 1782, p. 150]: “[Newton] has often spoken in the manner of prophets, who speak of that which one cannot see.” This style has fostered the myth, propagated by acolytes like William Whiston, of the genius who sees in one stroke what others achieve with painful and laborious work. Be that as it may, Newton’s mathematical work was characterized by many mysteries and Whiteside’s research has dispelled many myths surrounding Newton the mathematician.

Whiteside solved all this bewildering complex puzzle in twenty years of intense work, in which he found editorial assistance first from Michael Hoskin (who was certainly of great help, especially with the early volumes), but then, and most notably, in the later volumes from Adolf Prag who became a very dear friend and source of constant encouragement. Generally, such editions are the work of a team of scholars not, as in this case, an almost single-handed enterprise. The resulting eight volumes have been on my table for many years and I know very well how indispensable a work it is. The magnitude of this achievement has been appreciated world-wide<sup>2</sup> but it can be gauged exactly only by the handful of scholars who have tried to approach Newton’s mathematical manuscripts. After days of work on perhaps two folios, one inevitably wonders how Whiteside could do all this, almost single-handedly and in a comparatively short time-span. He was actually left alone in the University Library to peruse the precious collection. He did not use a typewriter but jotted down in his none too easy handwriting all the transcriptions, translations and editorial notes. At Shaftesbury Lane, the staff of the Cambridge University Press, after setting special types for Newton’s notation, produced the magnificent volumes. It should be added that Whiteside was working without a formal contract with CUP (only after the fifth volume was in press was a formal contract signed) and with only tenuous connections to Cambridge University (though in 1976, he was appointed Reader in the History of Mathematics, and, in 1987, Professor of the History of Mathematics and Exact Sciences, later Emeritus). Whiteside never taught regularly, and, I have

<sup>1</sup> On Russian literature on Newton’s mathematics see the information provided in Youschkevitch [1974] and Shkolenok [1972].

<sup>2</sup> Whiteside was awarded the Koyré medal of the International Academy of the History of Science (1968), the Sarton medal of the History of Science Society (1977), the Euler Medal of the Soviet Union’s Academy of Sciences (1985), an honorary D Litt. from Lancaster University (1987), and was elected as a fellow of the British Academy (1975).

been told, he supervised only one student for a master's degree. Having no co-workers and, in effect, no students, his was a life of solitary commitment.<sup>3</sup>

The translations provided are in general quite accurate, I would say more literal than the one offered by Cohen and Withman in their recent translation of the *Principia*. A few idiosyncrasies can be noted.<sup>4</sup> But generally Whiteside is a master in rendering the meaning of Newton's Latin in a very reliable way. This accuracy is not the result of a cold appreciation of Latin grammar but rather of Whiteside's deep intimacy with Newton's mathematical agenda.

The long introductions to the volumes constitute an intellectual biography of Newton. They should be consulted not only by historians of mathematics, but also by any reader interested in Newton's life. These are very readable and very reliable pieces, which complement the biographical works of Hall, Manuel, and Westfall. I believe that historians of seventeenth century science should be more aware of the trove of information that is in some measure hidden in these introductions. I say "hidden" since one would not expect such a wide ranging view of Newton's life in a critical edition. From these introductions emerges Whiteside's conviction that Newton was primarily a mathematician. Historians of other sectors of Newton's intellectual achievements might feel somewhat frustrated by Whiteside's one-sided view. His reluctance to accept the cogency of Dobbs's work on Newton's alchemy is well known, and is in resonance with the attitude taken by two other great co-workers in the Newtonian Industry, Cohen and Hall. One of Whiteside's typically violent rebuttals appeared in 1982:

"In all the thousand of sheets of his (Newton's) preserved mathematical papers I can detect no hint of any belief by him in number mysticism, no trace of the extravagance of hermetic mathesis: no neo-Pythagorean arithmologies lurk there that I know of, no cabalistic *gematria*, no cryptic magic squares or motifs of John Deeist style" [Whiteside, 1982, p. 121].

Until recently, it has been fashionable to rather uncritically defend the image of Newton as dominated by Paracelsian interests, and this view, now discredited by more accurate recent research, seems to survive outside the scholarly world with notable resilience.<sup>5</sup> Whiteside's instinctive and passionate reaction, which until a decade ago, might have appeared as just stubborn positivistic prejudice, now could be accepted as much more motivated and interesting. Also Whiteside's exclusive interest in the mathematical works of Newton, his surgical excision from the Newtonian *Nachlass* of mathematics and mathematics alone appears nowadays less extravagant, now that we are beginning to appreciate the relative independence of the many sectors of Newton's intellectual production [Iliffe, 1998].

The publication of the *Mathematical Papers* changed our image of Newton the mathematician in many ways. I would like here to mention four areas where the impact of Whiteside's work had been particularly notable. (A) In Volume 1, we find a reconstruction of Newton's early mathematical researches carried on in the so-called *anni mirabiles*. The influence of René Descartes, Frans van Schooten, Francois Viète, William Oughtred, John Wallis, and Isaac Barrow is documented for the first time in fine detail. From these manuscripts, it emerges also that Newton placed his most famous discovery, the method of fluxions, in a much broader context which includes studies of the organic description of curves and mechanics. (B) Even more astonishing is the series of manuscripts, edited in Volumes 4 and 7, that prove Newton's involvement in researches in pure geometry. For his own purposes Newton read the works of Apollonius and Pappus, developing many interesting ideas on projective geometry that just surface in Sections 4 and 5, Book 1, of the *Principia*. Before the edition of these manuscripts only a handful of scholars had intuited the extent and depth of Newton's geometrical work [Milne, 1927; Huxley, 1959]. (C) In Volume 6 Whiteside edited the manuscripts relating to the *Principia*. The nature of the mathematical principles underlying Newton's *magnum opus* had for centuries been one of the puzzles of Newtonian mathematics I referred to above. Whiteside was able to disprove the myth about the existence of an analytical *Principia* written in calculus terms, but also showed that in a few instances Newton used advanced calculus tools.<sup>6</sup> The simplistic dichotomy between a wholly algebraic and a wholly geometric *Principia* was exploded under Whiteside's

<sup>3</sup> As a matter of fact, this is unfortunate since the assistance of a palaeographer might have been a great help with the physical description of manuscripts, the study of their watermarks, ink, foliation, binding and paper. This information might be relevant for improving on Whiteside's dating, which relies basically on his unsurpassable ability to appreciate small changes in Newton's handwriting, and on internal and external evidence. A palaeographic approach to dating has been suggested in Shapiro [1992].

<sup>4</sup> For example, Whiteside translates "philosophus" with "scientist" [Mathematical Papers 8, 451].

<sup>5</sup> This view is powerfully defended in the magisterial Webster [1982].

<sup>6</sup> Most notably, in the study of motion in an inverse cube force field (Cor. 3 to Proposition 41, Book 1), the attraction of ellipsoids (Cor. 2 to Proposition 91, Book 1), the solid of least resistance (Proposition 34, Book 2), the study of the Moon's inequalities in Book 3.

deep critical insights. (D) A fourth result I would like to mention is the edition of the papers concerning the controversy with Leibniz that one finds in Volume 8. As is well known Newton engineered his campaign against the German deploying forensic and historicist tools which solidified in a trail of manuscript drafts to the *Commercium Epistolicum* (1713). Volume 8 was published one year after Rupert Hall's magisterial *Philosophers at War*, and complements Hall's work in many ways [Hall, 1980]. Of course, Whiteside is much more sensitive to the mathematical topics that were taken so seriously by the two combatants. The polemic did indeed have philosophical, and even political, motivations, but the "philosophers" at war were also two towering mathematicians and their confrontation touched themes such as the use of higher-order infinitesimals in mechanics, the solution of the inverse problem of central forces, the advantages of integration in closed form over integration in terms of power series, etc., that Whiteside documented and commented on for the first time.

Several examples of the prodigious depth that Whiteside could reach in his analysis might be given. Let me mention three results. The first occurs in Volume 6, where Whiteside comments on Newton's papers on the motion of the Moon's apogee (Volume 6 on pp. 508–537). These are very difficult, private calculations (they are written in connected prose, the geometrical diagrams are just sketched), that notoriously made Newton's head ache. In order to understand what Newton is doing one really needs a scholar of fabulous mathematical insight. Newton did not succeed in this case, and a correct theory of the apogee's motion was given only by Alexis-Claude Clairaut, Jean d'Alembert, and Leonhard Euler in the middle of the 18th century. A second *tour de force* is the analysis of Newton's work on the projective classification of cubics which occurs in Volume 7 on pp. 420–434. It was unclear how Newton could understand that all the non-degenerate cubic curves can be obtained by central projection of one of the five "divergent parabolas." These folios shed light on Newton's path towards this important result, but again his reasoning has to be reconstructed from a very opaque text. A third example is the analysis of Newton's corrections to Prop. 10, Book 2, of the *Principia* in Volume 8 on pp. 312–424. These folios are made up of Newton's untidy notes in which he tried to remedy a mistake that occurred in the first edition of the *Principia*. The interpretation of Nicolaus I and Johann Bernoulli was that Newton made this blunder because of his poor understanding of higher-order infinitesimals. Newton was able to correct the mistake after a long series of trials and errors which shed much light on his mathematical practice. Here we really encounter Newton at work, we do not see the polished result, but we witness the process of discovery. . . but we can see this only after Whiteside's intervention! Many more examples could be given, of course: the eight volumes are such a treasure house of information.

After the above very cursory exemplification of Whiteside's results a few words on his methodology are in order. Whiteside did not approach Newton as an isolated genius. Whiteside had read the seventeenth century mathematical literature extensively and therefore knew the mathematical works that adorned Newton's library in every detail. One of his primary aims was to put Newton's manuscripts in their seventeenth century context. Three examples might illustrate how precious is the information that he was able to provide. It is well known that Newton formulated a general coordinate transformation for central projection in Lemma 22, Book 1, of the *Principia*. Whiteside notes that this technique might have been inspired by Philippe de La Hire's method of *Planiconiques*.<sup>7</sup> In discussing Newton's organic generation of conics (a mechanical description of conic sections), Whiteside observes that similar constructions were published by Evangelista Torricelli and Pierre de Fermat. But Newton, according to Whiteside, derived inspiration also from Jan de Witt, "Elementa Curvarum Linearum" in appendix to the second Latin edition of Descartes' *Geometria* (on pp. 229–238), and from Frans van Schooten, *De Organica Conicarum Sectionum in Plano Descriptione Tractatus* (1646) which Newton had read in the *Exercitationum Mathematicarum* (1657) (on pp. 293–368).<sup>8</sup> Third, Whiteside shows how Newton's reconstruction of one of the *hyptios* porisms reported by Pappus in Book 7 of the *Collectio* bears resemblances to Fermat's "Porismatum Euclidaeorum Renovata Doctrina" which appeared in *Varia Opera Mathematica* (1679), pp. 116–119.<sup>9</sup> These indications allow us to see Newton as a mathematician of his own time, indebted to the works of others, and to dispel the image of the genius who is advancing into new territory relying only on his own powers. I believe that these indications of concordances with works of other mathematicians that abound in Whiteside's edition should be more attentively studied in order to place Newton in the context of the mathematics of his time.

<sup>7</sup> Appended in La Hire [1673, pp. 75–94]. See Whiteside's commentary in *Mathematical Papers* 6, 271.

<sup>8</sup> *Mathematical Papers* 1, 34, 40 and *Mathematical Papers* 4, 292–293.

<sup>9</sup> *Mathematical Papers* 4, 224, 284, 316, 318 and *Mathematical Papers* 7, 243.

Another characteristic of Whiteside's commentary is his policy of translating Newton fluxional or geometric language into the language of the differential and integral calculus. While this policy is extremely helpful to the modern reader, it tends, in some instances, to obfuscate the meaning and genre of Newton's work. Whiteside had an inclination to believe that there exists a mathematical content the meaning of which lies beyond the contingency of its expression in a particular language. On this view, translating Newton's results into Leibniz's language would be innocuous. A consequence of this attitude is Whiteside's attribution of the notation for partial derivatives to the young Newton (who used lateral dots to denote certain algorithms for differentiating an algebraic function), a view that encountered strong opposition from scholars of the Bernoullis, who attribute this discovery to the Basel school.<sup>10</sup> In general, Whiteside showed little interest in or respect for the achievements of eighteenth century mathematicians: he was inclined to say (if not to write) that all that Pierre Varignon or Johann Bernoulli had done on central force and resisted motion was to reformulate Newtonian mathematical results in a different language, the language of ordinary differential equations. Whiteside passionately defended a view of the long seventeenth century that is opposite to the one endorsed by another, equally great and idiosyncratic, scholar, Clifford Truesdell, who rather sided with Euler in casting a critical eye on Newton's geometrical style.

A third characteristic that I would like to mention is the use of nineteenth-century sources as relevant secondary literature. I think that Whiteside was indebted to nineteenth-century, more than to twentieth-century, historians. He built his historical research on the careful reading of Cantor's *Vorlesungen* and, especially, on the works of a series of distinguished Victorian British authors. In his comments on the *Principia* the impact of Stephen Rigaud, Joseph Edleston, William Rouse Ball, Edward Routh, Henry Brougham, or Hugh Godfray, was greater than that exerted by I.B. Cohen. In his study on cubics, Christopher Talbot and Rouse Ball are cited more frequently than Charles Boyer. In his study on Newton's geometry Whiteside relied upon Michel Chasles and George Salmon. This intimate knowledge of Victorian mathematics gives a curious patina, beloved by all his acolytes, to Whiteside's annotations. His mathematical vocabulary and notation is very much dependent upon nineteenth century mathematical literature. This fact sometimes has its consequences: when Whiteside reads Newton's work on projective geometry through the eyes of Chasles he is probably led to attribute to Newton an awareness of projective geometry that is, at most, only *in nuce* in Newton's works. When he uses Cantor in order to read Newton's quadrature techniques he translates them into the terms of recursive procedures of integration that Newton did not envisage. The risk of a "nineteenth-century anachronism" lurks behind Whiteside's commentaries. It is in itself a virtuous risk given the quality of nineteenth-century research in the history of mathematics to which Whiteside could refer. Until the late nineteenth century there was a continuing tradition of commentaries on Newton's mathematics in Britain, and especially in Cambridge. Newton was a hero, but also a pedagogical fixation for Cambridge coaches who were intent in preparing their students for the Tripos. In his solitary studies in the University Library, Whiteside modelled himself as the last interpreter of an ancient tradition of British commentators of Newton's work [Warwick, 2003]. From many points of view his work was possible only in Cambridge where Whiteside found the rich archives and the competent librarians, the prodigious precision and reliability of the Press, and an academic environment that had the vision of conferring a Chair on a scholar who never lectured or supervised [Rigaud, 1838; Brougham and Routh, 1855; Edleston, 1850; Rouse Ball, 1891, 1893; Godfray, 1871; Talbot, 1861; Salmon, 1896; Chasles, 1860].

I know very well how generous Whiteside could be with other scholars, even with much less talented ones, and how long and detailed could be his handwritten letters (I received several over 40 pages long). More than ten years ago, I visited him at his home. After a wonderful afternoon spent learning masses of Newtoniana he loaded my arms, my protestations notwithstanding, with Volume 8 of the *Mathematical Papers*, the two volumes of the *Variorum* edition of the *Principia*, and a lighter (but annotated in Whitesideian hand) Joseph Hofmann *Leibniz in Paris*. He was a tall and heavy man, then not in such bad health as not to be able, none too gently, to throw me out of the front door with the heavy present. Ringing the bell was of no help and I flew back to Italy with my heavy luggage. Thank you again, for much advice and encouragement, Professor Whiteside!

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<sup>10</sup> See, for instance, *Mathematical Papers* 1, 421–424 and *Mathematical Papers* 8, 424. For a different view, Engelsman [1984].



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