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IN MEMORIAM

Wilbur Richard Knorr (1945–1997): An Appreciation

unexpectedly from cancer on March 18, 1997, aged 51. He was the author of four magisterial books: *The Evolution of the Euclidean Elements* (1975, based on his Harvard thesis), *Ancient Sources of the Medieval Tradition of Mechanics* (1982), *The Ancient Tradition of Geometric Problems* (1986), and *Textual Studies in Ancient and Medieval Geometry* (1989). In addition, he published 64 articles (of which 11 were sets of entries for encyclopaedias, dictionaries, etc.), many of these long and technical, five substantial essay reviews and other shorter reviews, and, at the time of his death, he had a further 18 articles in progress.

He was born on August 29, 1945, in New York and educated at Harvard University, where he received his B.A. (*summa cum laude*) in 1966, his A.M. in 1968, and his Ph.D. in 1973 (his thesis advisors were John Murdoch and G. E. L. Owen), so all of his subsequent work was achieved in a mere 24 years. He had a natural ability with languages and taught himself Greek, then Arabic, and then Hebrew (which he also used to discuss some aspects of the Hebrew translations of mathematics). Another of his interests and abilities was playing the violin and making music: he was in the New York State Competitions Youth Orchestra while in high school, the Harvard Orchestra of which he was first violin and manager, and informal chamber groups, but gave up playing when he went to Stanford. (When his friend Edith Mendez asked why, he replied that it would have taken 10 hours a week and he felt that he wouldn't have the time.) During his seven years as a Ph.D. student, he was a teaching fellow at Harvard, then an assistant professor at Berkeley; thereafter he was a postdoctoral fellow for a year at Cambridge UK, four years at Brooklyn College, and a year at the Princeton Institute for Advanced Study, before he took up a position at Stanford where he stayed for the rest of his too short life. He was on the editorial boards of the *Archive for History of Exact Sciences*, *Isis*, and *Historia Mathematica*, and a referee for several journals, very actively so as authors can testify, this being yet another illustration of his passionate concern for thoroughness in his subject and the tenacity with which he held to a point of view.

The development of his interests can be seen in the emphasis of his books. The first phase was his interest in the establishment of mathematics from before Euclid to Archimedes and Apollonius—the foundations, nature, and methods of early Greek mathematics—and is roughly bracketed by the books, *The Evolution of the Euclidean Elements* and *The Ancient Tradition of Geometric Problems*. The second phase, dealing with the ancient editions of texts, their reception by Arabic mathematicians, and their further transmission up to the medieval period, was introduced

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by the almost unknown and unobtainable *Ancient Sources of the Medieval Tradition of Mechanics*, and reached its fullest exposition in his *Textual Studies in Ancient and Medieval Geometry*. The final phase, a study of medieval material in its own right, was only beginning to blossom at the time of his death.

His first book, which was based on his thesis, was a detailed study and proposal concerning the geometry lesson by Theodorus in Plato's *Theatetus*, 147c–148b, where, in a much disputed passage about which other books and long articles have been written, Theatetus says, of the sides of larger squares incommensurable with the side of a given square, ''There [at 17, or was it 19?] for some reason [what reason, if any?], he stopped [or, was it, he ran into difficulties?].'' This book formed the basis for much of Wilbur's subsequent work on early Greek mathematics.

His work on the ancient editing of texts and their transmission culminated in his massive *Textual Studies*, 850 finely printed pages long, and which finished with a 444-page discussion of the various versions of Archimedes' *Dimension of a Circle.* He ended this with one of his characteristically bold speculations about the roles and identities of ancient personalities, proposals over which he was often vulnerable to criticism which others did not desist from making; here is suggested, with proper caution and extensive analyses and reservations, that Hypatia may have been the editor of the original text that has been passed down to us. Unfortunately he did not have time to produce a synthesis of his interests in medieval mathematics, as I am sure he would have done had he lived; his unpublished projects include a significant number on this topic. He had not yet been able to write anything significant on one of his hobbies, biblical studies.

It may surprise those outside the subject that the story of Greek mathematics, of Euclid, Archimedes, and Apollonius, their lost predecessors, and the later transmission of their works, has been in a turmoil for the past 40 years or so. It had seemed in mid-century that the picture presented by T. L. Heath (who built on the work of his colleagues and predecessors, principally Tannery in France and Zeuthen in Denmark, and all of that founded on the critical editions of the Danish philologist Heiberg) needed only a few final touches to be completed, but the past is often like a cracked mirror in which we peer to see a distorted vision of ourselves, and the postwar generation saw things very differently. Heath and his colleagues formulated Greek mathematics in the style of the 19th century; for example, Pythagoras's Theorem for them was more an equation $x^2 + y^2 = z^2$ than Euclid's version of literally cutting up geometrical squares and reassembling them into a larger square, and they saw intimations in Greek mathematics of the difficulties that they had in setting up the real numbers on which most of mathematics is now ultimately based. (It may not be irrelevant that Paul Tannery, the historian, was a brother of Jules Tannery, a mathematician who had participated in these 19th-century developments.) We are now much more conscious of these tendencies and strive, though not always successfully, to understand the past on its own terms; more about the past has been uncovered; and we are now more historically severe: Pythagoras's Theorem may have nothing to do with Pythagoras, and aspects of it were known to Mesopotamian mathematicians 1500 years earlier! Wilbur Knorr was a leader

in this reevaluation, and it may not be an exaggeration to say that he was probably the most dedicated and prolific student of this topic ever, and may eventually be seen as one of its most influential exponents. Whatever else he did, and however much some may want to carp at the details of his proposals or rewrite sections of the story he presented, everybody must acknowledge that, with enormous energy, he read and was aware of practically everything that had been written on or around his subjects, and often went on to give detailed reactions to it. One small instance of this is his bibliographic essay [30] appended to the paperback re-edition of Dijksterhuis's *Archimedes*, in which he listed over 400 further Archimedean studies, and discussed many of them briefly and clearly. In all his work on Greek mathematics, he argued for an autonomous development of the subject, independent of philosophy, and he was sometimes impatient with those who wrote without venturing into the technical details; this led him into some acerbic controversies. He could also be sharp with colleagues and friends, especially in his letters and also in print. But his constant concern was with a detailed, informed, and careful account of the topic in hand.

His commitment to the extent, nature, and interpretation of evidence can be clearly seen in those places where he strayed away from his main interests. One example is his essay review [77] of van der Waerden's *Geometry and Algebra in Ancient Civilizations*, where he analysed sceptically the whole sweep of the evidence in the book, especially, and at some considerable length, Alexander Thom's proposals concerning the geometry of megalithic sites and van der Waerden's use of it. And this same critical scrutiny was not restricted to such things on the fringes of his interests; a central and fundamental example of this is the article [59] which appeared shortly before his death, on Heiberg's text of the *Elements*, where he began to pick away at what is almost universally regarded as the absolutely solid and secure presentation of the very foundation of the subject.

His books were initially expensive but this was inevitable given their length, the then policy of the publisher of his first book, their difficult typesetting, and their illustrations (often many line drawings, photographs, and, in his *Ancient Tradition*, a glorious colour plate, one of several illustrations of the iconography of ivy leaves). Judy Grabiner, a colleague and friend, tried to cheer him up: "Why library sales alone ...," at which he interrupted: "Yes, library sales alone." Alas, this was one of the features that, to begin with, restricted their circulation and readership; another was, quite frankly, the difficulty in reading them, a combination of their length, their meticulousness, their minutely referenced notes, and, often, the novelty, boldness, and revisionism of their point of view, as long-held and cherished opinions were subject to new investigation. There are different explanations of why he wrote so much. One credits the American university system, where tenure at the good institutions requires a substantial body of publication; this, Wilbur explained, makes you work so hard for just long enough that the habit becomes ineradicable. But his total involvement in the subject is perhaps sufficient explanation, just as Milton wrote in Lycidas of "... the spur that the clear spirit doth raise/(That last infirmity of noble mind)/To scorn delights and live laborious days." And, alas, Wilbur suffered

Lycidas's fate: ''Comes the blind Fury with th'abhorred shears/And slits the thin-spun life.''

At the end of his life, he made in [65] a final brief and, if I may introduce a personal note, for me movingly poignant return to his first interest, the pre-Euclidean issue of incommensurability and proportion theories. My own interest in Greek mathematics was kindled by reading his first book, and my efforts since then have been dominated by exploring variants of his proposals. While I have never faltered in my appreciation of his work, I felt that he thought that he had cleared up that particular topic to his own satisfaction and so there was no need to return to confront and either rebut or assimilate any serious alternatives. When, in Autumn 1996, he was invited to attend a meeting to celebrate my 60th birthday, and after his melanoma had been diagnosed and treatment had been initiated, it was as though he planned to come and present to me his final ideas on this, his first interest—an ingenious and attractive supplement to his original proposals on incommensurability—in a last attempt to win me back to his own point of view and persuade me that it was, by and large, more plausible than my own. In January 1997, after interferon treatment for his cancer that seemed to do nothing to arrest its progress, he gave a talk at a joint AMS and MAA conference in San Diego; he looked fitter than everyone else, he was still jogging daily, and nobody could have guessed that he was dangerously ill. (The photograph of him reproduced here was taken at this time.) At the end of January, just before aggressive chemotherapy and radiation treatment had started, he was still hoping to arrange this medical regime round his trip to England in mid-April. But, by the end of February, when the treatment had left him so weak that such a visit seemed impossible, he prepared a paper to be read in his absence. There was an ominous note in a businesslike letter on March 10, discussing the details: ''My condition has become even more complicated of late with some new symptoms currently undiagnosed. So it seems clear that I will not be able to attend the conference in April.'' A week later he fell into a coma and died on March 18. These last weeks must have been as active as, or even more so than, any others in his life, as other reports show. Henry Mendell, his one-time student, friend, and literary executor, e-mailed me the day before his death, and finished with: ''It is heart rending to see someone's intellectual life end on p. 40, halfway through page proofs.'' And the editor of the journal in which [62] appears added a note which reads as follows: ''Dr. Knorr, having revised the text of this article to meet the comments of a referee, mailed the typescript and computer disc to the Editor on 10 March, together with a letter that included his proposed Note on Contributor. The letter made no mention of the writer's health, but because he was rumoured to be unwell, the article was immediately copyedited, proofed, and proof-read, and a marked set of proofs was posted to the author on 18 March. Sadly, on that very day Dr. Knorr passed away.'' Wilbur always liked to have the last word, and so it is perhaps appropriate to end this brief review of his scholarly work with his own overview, in this Contributor's Note, written when he must have realised that he was doomed: ''His work, which consists of four books and about sixty articles, focuses on ancient geometry (especially with work

of Archimedes and Euclid) and its extension into the Arabic and Late Middle Ages. His methods combine technical, historical, and text analytical approaches in dealing with the primary documents. For instance, in a few recent papers he has examined the textual issues affecting use of the Euclidean corpus. His current projects include studies of medieval Latin tracts on the quadrant, and comparisons of ancient manuscripts (mostly from thirteenth-century Paris) and related manuscripts that are suggestive of a common provenance.''

A dedicated scholar whose only real indulgence was books, a rather private person who could come across as a terrifying machine for producing learned books and articles—this may conjure up a vision of a stooping and reclusive hermit. But no! His essential need in life besides a good library was a good gymnasium, where he would weightlift and work out. He had warm and close relations with his family: his first book is dedicated to the memory of his father and uncle; the photograph on the dustjacket of his last shows his nephew, niece, and their penguin struggling to climb on the lap of their favourite Uncle Billy; and his mother moved to Palo Alto for the last weeks of his life while his sister came for visits whenever she could. Those who were close to him can testify to his warmth, his humour, and his humanity, and he always had time for students, staff, and junior faculty; a notice in the *Harvard University Department of the History of Science Newsletter* (No. 2, Fall, 1997, p. 5) captures this very well: ''Uniting a passion for precise scholarship with a gentle, quirky humor, Wilbur was a forceful scholar and a kind man.'' When he was in England, he stayed with us. My wife anticipated that this would be a business meeting: we would discuss work and she would get on with other things. Instead he sangs songs to my elderly mother-in-law who lived with us and came out for walks with her to feed the ducks, he explained his work to my wife in ways that she could understand and found interesting, and he plied us with good wine. His friends know of his playfulness and his infuriating puns, his love of roses and baroque music, and his generosity of spirit.[1]

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[2] Wilbur Knorr's own notes, on which this bibliography is heavily based, have a range of different categories for articles that have not yet been accepted for publication—in revision, under review, in process, in progress, in preparation, draft completed, revised as ..., for *Journal of* ..., intended for *Journal of* ..., for submission to *Journal of* ..., circulating in preprint—all of which I have here put under the heading ''In Preparation.'' (This diversity perhaps illustrates the process of conceiving, planning, writing, revising, submitting, reviewing, revising again, proofreading, ... that goes on behind the production of a scholarly article, but which is almost invisible in the printed version, apart from an occasional detail in an acknowledgment.) This bibliography will need updating after the eventual fate of these items has been decided; his literary executor, Henry Mendell, hopes to see as many as possible through to a state suitable for publication.

Century. (A draft of this was completed as ''Astronomy at Paris in the 1920s: Princeton MS Garrett 99'' and revised as ''What Pictures Teach: MS Garrett 99 and Paris Astronomy in the 1290s.'')

86. Euclid and Eudoxus: The Origin of the Euclidean Theory of Proportion.
87. *Mythos* vs. *Logos:* Plato's Ironic Strategy in the *Timaeus-Critias.*
88. Ancient and Medieval Versions of Hero's Rule for Triangles.
89. Ancient Techniques of Square Roots.
90. Two Ancient Rules for Roots and their Extension.
91. On the Anonymous Graeco-Latin Translations from Sicily in the 12th Century.
92. Robert Grosseteste's Euclid: Mathematics and Philosophy in the 13th Century.
93. A Tale of Two Theons: Ancient Discussions of the Measurement of the Earth.
94. Medieval Determinations of the Vernal Equinox: Roger Bacon, William of St. Cloud, and John of Murs.
95. Roger Bacon's *Kalendarium* (British Library, Cottonian MS Vespasian A II): The Missing Piece of Corpus Christi College MS 221.
96. Euclid and pseudo-Euclid: A Typology of Interpolations in the *Elements.*
97. Richard of Geddinge: A 13th-Century Scholar.
98. A Note on Psalm 19.
99. Paul at Miletus: A New Approach to the Historical Background of the Prison Epistles.
100. Aristotle and the Chronology of Eudoxus.
101. Five Studies in Medieval Latin Manuscripts:

i. Three Illuminated Astronomy Books from the 13th Century (Vatican, Bibl. Apost., MS urb. lat. 1428; London, Brit. Lib., MS Add. 30380; and New York, Publ. Lib., MS 69), and three affiliated MSS (Paris, Bibl. nat. MS lat. 7475; Tournai, Bibl. de la ville, MS 87; and Baltimore, Walters Gallery, MS 46).

ii. Four Paris Astronomy Books, ca. 1305 (London, Brit. Lib., MS Royal 12 C 17; Oxford, Bodl. Lib., MS Ashmole 1522; Florence, Bibl. naz., MS Magliabech. II iii 24; and Paris, Bibl. Sorbonne, MS 595); and three affiliated MSS (Oxford, Bodl. Lib., MS Rawl, C 117; and Florence, Bibl. Laur., MSS Plut. 18, 1 and 2).

iii. An Illuminated Bible, in the Style of Master Honore: Harvard MS Latin 36.

iv. A 13th-Century Scribe and his Contributions to Astronomy Books (re: Vatican, Bibl. Apost., MS pal. lat. 1414; London, Brit. Lib., MSS Harley 13 and 3735; Basel, Oeffent. Bibl. Univ., MSS 0 II 7; Paris, Bibl., nat., MS lat. 7421; Copenhagen, Kong. Bibl., MS Add. 447, 2; etc.).

v. Another 13th-Century Scribe and his Astronomy Books (re: Stockholm, Kung. Bibl., MS X 767; Princeton, Univ. Lib., MS Garrett 99; London, Brit. Lib., MS Harley 13; Glasgow, Univ. Lib., MS Hunter 444; Oxford, Bodl. Lib., MS Tanner 192; etc.)