

## Preliminary Comments on *Decoding the Heavens*

These comments refer to Jo Marchant's account of the collaboration between Michael Wright and Allan Bromley, which makes up the second and first parts of chapters 6 and 7 of *Decoding the Heavens*. They are based mainly on a first reading of unpublished correspondence between Wright and Bromley from 1984 to 1996, now held by Anne Bromley. The author did not attempt to contact Anne Bromley during the preparation of the book. Had she done so this material would have been made available to her.

The correspondence is in the form of letters, many hand-written. From Wright and Bromley's joint and individual publications, from the recollections of people in Sydney, and from the content of the letters dated after 1996 there is good reason to think that Marchant's assertion (p.188) that that communication between the two dried up is wrong. The email archives from the the University of Sydney Department of Computer Science are the obvious place to look for evidence of this but retrieving them could take a while and we feel that the paper correspondence provides sufficient evidence that Marchant's account is seriously inaccurate in other ways as well.

Some of these comments draw on conversations in May and June 2009 with Frank Percival, the clockmaker who worked closely with Bromley from 1985 and 1987 to build a reconstruction of the Antikythera mechanism and continued to contribute from his specialist knowledge until Bromley died. Michael Wright stayed with Percival for a couple of nights during his visit to Australia in 2000, and has remained in touch with him. Percival is now in his eighties and might have been reluctant to talk with a stranger about his significant part in the studies of the Antikythera mechanism and his long friendship with Bromley, but his recollections could have been another source of information and verification of Wright's memories.

Marchant has said that she did not contact anyone in Australia for her book because there are so many different points of view about the story of the Antikythera mechanism that she decided to write from the perspectives of each of the main protagonists in turn to tell things as they saw it. We feel this explanation is inadequate. Apart from the author's own, Wright's perspective is by far the most prominent in the book and it seems to us that normal journalistic practice would require at least an attempt to verify his memory and her understanding of events from 25 years ago. If Bromley was alive Marchant would certainly have sought his input. Her decision to ignore the best sources of information about his perspective on the story has left her reporting of Wright's perspective open to questions and of Bromley's role in the overall story seriously flawed.

Sandra Oates, Anne Bromley

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Page	Quotation	Comment
170 (1) and	<i>(1) The two men [Michael Wright and Derek de Solla Price] had briefly met, when Price had called at the Science Museum to see the</i>	Price died in September 1983. A letter from Bromley dated June 1984 mentions that he is still getting over the flight home and goes on to discuss calculations of gear trains, the al-Biruni device (later called the London Sundial Clock and apparently the Byzantine sundial), and the Antikythera mechanism. Thus Wright and Bromley started studying the mechanism “in earnest” at about the same time and their studies were collaborative from the beginning.
185 (2)	<i>newly discovered Byzantine sundial during his visit to London in 1983. But that was before Wright started studying the Antikythera mechanism in earnest, and within fortnight of that meeting Price was dead.</i>	The correspondence also shows that they got into misunderstandings about credit and publications and worked them out as they went along. This is hardly unusual.
	<i>(2) For the last five years he Wright) had spent every spare moment thinking, planning, preparing for his work on the Antikythera mechanism.</i>	
172	<i>...interested in high-performance computing, and so [Bromley] had become a lecturer in the computer science department. But he also had a keen interest in mechanical calculators, in fact anything to do with the history of computation and measurement. In his small house ... he had a garage full of adding machines, bits of clocks and giant analogue computers...</i>	These passages set up a false contrast between Wright as practical worker and Bromley as dilettante theorist that becomes overt later in the chapter.
174	<i>[Bromley] was convinced that [Babbage's] designs would work, but he had been looking at them from the point of view of a computer scientist. He understood the logic and the theory behind them, but he wanted to know more about how the parts of the mechanism would have been made and put together...</i>	Just like Wright and Price, and indeed like thousands of other children up to the 1970s and 80s, Bromley's interest in mechanics and Meccano began in childhood and was life long.
		Bromley built his collections of mechanical computers to learn and to demonstrate the multiplicity of techniques involved. They were the reason he got started on Babbage and the knowledge he had developed in working with them was part of the basis for his confidence that Babbage's design for Difference Engine No. 2 could be built.
		With that background, it's meaningless to say that Bromley was looking at Babbage's designs “from the point of view of a computer scientist”. He went to Wright for details of nineteenth century techniques, not because he didn't know about “making geared mechanisms.”
		Wright would have been one of the few people who could understand what Bromley was on about. Maurice Wilkes was another, witness the correspondence he edited after Bromley died. Bromley formed strong friendships with both of them.

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176	<i>...Instantly, Bromley was mentally converting [the Antikythera mechanism's] gear trains into circuit diagrams...</i>	<p>The author gives no indication of the source of this insight into Bromley's instant mental conversion, which on the face of it is highly unlikely. Bromley had profound knowledge and a long-standing interest in mechanical computing. Why would his first reaction to an ancient and unique mechanical calculating device be to convert it to electronics?</p> <p>The correspondence shows that in fact his first reaction was to analyse the gear trains and consider the astronomy.</p>
176	<i>... and a new plan began to form in his mind. He would be the man to solve the Antikythera mechanism.</i>	<p>Marchant gives no hints about what Bromley's plan might have been, and neither does the correspondence of the next 10 years. In the second half of 1984 Bromley and Wright exchanged at least eight letters, each asking for and receiving comments on draft papers on various subjects. From 1985 to 1995 they discussed strategy for research on the mechanism and many details of their individual and joint work on it. They also discussed other matters of technical interest, and professional and personal problems. The letters indicate a respectful friendship between two mildly eccentric people who had many interests in common and who were working, in spite of obstacles, on a joint project both found deeply interesting.</p> <p>Marchant appears to have invented this “plan to be the man” as part of her dramatic notion that the Antikythera mechanism took possession of researchers (page 2, 216 and elsewhere), like some kind of Hellenistic Sauron's ring.</p>
177	<i>...Bromley had a theory that the device couldn't have been driven by the slow-moving big wheel...</i>	<p>This was an observation rather than a theory and Bromley didn't claim it. In his first Antikythera paper, published in Centaurus in 1986, Bromley thanked Wright for pointing it out to him and stated his understanding that F. C. Zeeman had made it in public. He acknowledged Zeeman again in later papers.</p>

Page	Quotation	Comment
177	<p><i>... He tweaked the gears and came up with his own variant... Back in Sydney, [Bromley] tried out a rough model of the mechanism using Meccano gears then worked with a clockmaker called Frank Percival to build a proper reconstruction. They had terrible trouble getting the sharp, triangular teeth to mesh properly, but after rounding them off at the edges it worked sweetly – much better than Price's model.</i></p>	<p>Frank Percival laughed when he heard this and said that it was Wright who had terrible trouble getting triangular teeth to mesh properly in his own work on old clocks. According to Percival, when Bromley left the newly completed model with Wright for a while Wright pulled it apart to see how they had got it to run so smoothly and then couldn't get it back together.</p> <p>Bromley and Percival worked on the reconstruction for more than two years. On the practical side, the work included making gear cutters and experimenting with methods of dividing the wheels, all using hand techniques that could have been or that they knew to have been available to a metalworker in Hellenistic Greece. It's incorrect to say that they had to round the teeth off at the edges, except for those on the very smallest wheels. For most of them the technique was to adjust the depth of the cuts.</p> <p>The “proper reconstruction” was completed in 1987. The work of developing it and the completed model itself were a significant factor in Bromley's obtaining permission to study the original mechanism.</p> <p>Bromley and Wright discussed this reconstruction at their usual detail and length while it was in progress.</p>

Page	Quotation	Comment
177	<p><i>... Wright, meanwhile, was rapidly losing faith that any part of Price's reconstruction could be trusted. The only way to find out for sure was to go and study the fragments.</i></p>	<p>The word “meanwhile” makes it difficult to know when Marchant suggests Wright's loss of faith occurred, though the next paragraph implies that it was before Christmas 1989. Wright's disbelief in Price's work is a key element in Marchant's portrayal of Wright, but the correspondence suggests that she overstates the significance Wright gave it and how early it developed.</p> <p>In October 1984 Wright commented in response to one of Bromley's early draft papers on the gearing of the mechanism, “It seems to me that the real point of 'Gears from the Greeks' is the message, 'they could do it and they did!'. Isn't Price's reconstruction almost incidental?” This and further correspondence in that years strongly suggest that at that stage Bromley was more interested in the details of Price's reconstruction than Wright was.</p> <p>In May 1989 Bromley applied to the University of Sydney for special study leave. His supporting statements include a summary of work to date on the Antikythera Mechanism, in which he describes how “<i>Reluctantly, I reached the conclusion that all of Price's observations would have to be repeated as the number of errors was substantial enough that none of his observations could be taken entirely on trust.</i>”</p> <p>In November 1993, five years after the events of this section and shortly before the last trip Bromley and Wright made to Athens to complete their radiographs, Bromley wrote from England to Percival, “<i>After a lot of hard talking I have convinced Michael that we can be <u>certain</u> of almost none of Price's reconstruction - basically the front dials with parapegma, the 127 tooth gear (D2?) in the Metonic train, and that's it.</i>”</p> <p>Bromley might have been wrong to think that Wright's conviction was so recent, but if Marchant had known of the letter she could at least have asked Wright about it.</p>

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177	<p><i>... Christmas 1989 Bromley swept into Wright's office bearing a triumphant air... "I've just come from Athens!" he announced grandly. "The museum has given me permission to work on the Antikythera mechanism!"</i></p> <p><i>Wright's jaw dropped. All this time he had been dreaming about studying the mechanism and now Bromley – his friend, the man he had confided in – had stolen his idea.</i></p>	<p>Bromley's first trip to Athens was in Christmas 1988, and Wright knew all about it. He wrote some funny letters responding to Bromley's numerous postcards and their cryptic observations of the Antikythera mechanism and the Tower of the Winds.</p> <p>Throughout 1989 Wright and Bromley wrote frequently, sometimes daily, about their thoughts on the mechanism and about plans for study in Athens. In May Bromley sent Wright a copy of his own research proposal with the comment "<i>Feel free to use any of it that is of aid in raising grants to go to Athens. I want to see you there!</i>"</p> <p>On 23 October Wright reported that he had applied for a grant from the Royal Society for his own trip to Athens but that he thought he was unlikely to get leave from the Science Museum. A letter from Bromley dated 1 November 1989 told Wright the exact dates he would be in Athens and London and provided two Athens addresses.</p> <p>Bromley's arrival from Athens was in no way a surprise to Wright.</p> <p>The first written mention we have found of studying the mechanism in Athens is in a letter from Bromley dated 2 November 1984, and discussions about work in Athens continued at intervals for the next four years. Wright and Bromley discussed what they could expect to achieve, how to demonstrate their qualifications and seriousness as scholars, and possibilities for finance.</p> <p>Studying the mechanism directly was never Wright's idea alone and Bromley did not steal it.</p>
178	<p><i>Wright... swallowed his pride and asked Bromley to take him along as his assistant.</i></p>	<p>The idea that Bromley could casually take an assistant along to study these unique items, with virtually no notice to the authorities and on his own first study trip to Athens, is unlikely on the face of it and it's not what happened.</p> <p>The author might have been confused by the fact that in 1990 Bromley was able to partly fund Wright's stay in Athens by including him as an associate researcher on a study grant from Sydney University. In a letter to Wright Bromley carefully explains that the grants are only available to members of the University and this is the only way he could obtain the funds. In other words, he went to considerable trouble to help Wright get to Athens with him.</p>

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179	<i>Bromley was unwell after a particularly lively night out...</i>	This is possible, though the implication that Bromley was goofing off while Wright did all the work is just a slur. But it's also possible that Bromley was unwell because of Glandular Fever, which he contracted around this time and to which he and his doctors attributed much of his ill health throughout the 1990s. There's no way to tell now. It's only worth pointing out because it's another stroke in the ugly portrait Marchant is painting.
182	<i>...the museum's scientist, a bright, matronly woman called Eleni Magkou.</i>	Did the museum have only one scientist? Seems unlikely. According to the Antikythera Mechanism Research Project website "Eleni Mangou is chemist and Head of the Chemical and Physical Research Department of the National Archaeological Museum in Athens since 1979."
182	<i>With so many layers of gearwheels all appearing on top of each other, it was impossible to tell how the mechanism was arranged.</i>	The author doesn't seem to know anything about Bromley and Wright's experiments with stereoscopic viewing. These preceded the tomography, and provided significant new detail about the mechanism (including some new inscriptions) as well as for the design of the tomography equipment.
183	<i>Wright decided to build the necessary equipment in his workshop at home...</i>	Wright did indeed build the equipment, but he and Bromley collaborated on its design through frequent letters and occasional phone calls. Percival, whose continuing contributions to the work Marchant ignores, made a test model of the mechanism so that Wright could test his equipment before the trip to Athens. Bromley and Wright both "read up on tomography", they both experimented with photographic techniques, and years later Wright asked Bromley to review the draft of his paper about it.
184	<i>Bromley soon sweet-talked Sydney University into providing some extra funds...</i>	This is ridiculous. What university would ever "provide some extra funds" at no notice to an absent academic, however sweet his talk. If Bromley indeed found some extra funds it was by re-allocating money within his research grants, and he had to account for it. This makes him sound like a con artist.

Page	Quotation	Comment
184 – 5	<p><i>...Bromley taking the exposures and Wright doing the delicate job of developing the plates – spending hours on end in the darkness before emerging blinking into the bright Athens sunlight. Then a smiling Bromley would drag him off to the nearest bar for a glass or three of retsina.</i></p> <p><i>... Bromley coming during his university's summer vacation and Wright using his precious holiday time.</i></p>	<p>Here we go again. Marchant implies that Bromley sat around drinking while Wright slaved in darkness developing the plates. Wright used up his precious holiday time while Bromley just filled in time while the university was on vacation. Taking the exposures was also a delicate job requiring heavy concentration and steady hands. Bromley also used precious holiday time for at least some of these trips, and in some years was unable to take his unused holidays because he had courses to teach. They both worked very hard. They both enjoyed themselves enormously.</p>
185	<p><i>It was February 1994...</i></p> <p><i>Then Bromley dropped a bombshell. He thanked Wright for his work, but announced that as the lead partner on the research project, he would be taking all of the radiographs back to Sydney. The best way to study the images was to scan them into a computer and he had a student who was waiting to get started.</i></p>	<p>Bromley's student (Bernard Gardner) finished his honours project in November 1993, so the date of this alleged announcement is incorrect. Moreover the announcement itself was unnecessary. In February 1991 Wright commented on the “great news” of a student who could consider problems of resolution and storage of information and that building a scanner sounded like fun. So Wright knew and agreed that the radiographs would be scanned in Sydney and that one of Bromley's students would be doing it. There was no bombshell.</p>
185	<p><i>For the last five years [Wright] had spent every spare moment thinking, planning, preparing for his work on the Antikythera mechanism.</i></p>	<p>The correspondence shows that Bromley had done the same thing, much of it in correspondence and conversation with Wright.</p>
185	<p><i>He had built his own equipment, learned new skills and patiently coaxed details out of the stubborn fragments that no one else could have hoped to glean.</i></p> <p><i>Wright was exhausted and didn't have the energy to argue. He hated confrontation and felt he had no chance of winning against the forceful, supremely confident Bromley. Wright had given the project everything he had. He flew back home with nothing.</i></p>	<p>Bromley had built two reconstructions, learned new skills, studied a new language and patiently coaxed details out of the stubborn fragments in collaboration with his colleague and friend, Michael Wright.</p> <p>Two months later, in April 1994, Wright faxed Bromley a proof of a report he had given on linear tomography and asked for comments. So much for exhaustion and defeat.</p> <p>In December 1995 Wright's alleged sense of betrayal did not prevent him from writing that “<i>you are most welcome to stay with us</i>”. Bromley stayed home, but responded with a chatty letter, written on Christmas Eve, in which he described a talk he had recently given about the mechanism. “<i>I felt the speaker glossed over some details - like what the heck it was and what the hell it did.</i>”</p>

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187	<i>The years following Wright's last trip to Athens with Bromley...</i>	These excerpts are from the introductory pages to Chapter 7. The chronology of this section is fuzzy, but the implication is that it's about events in Wright's life that occurred between February 1994 and the receipt of a letter from Bromley's wife in 1999 or 2000. The section also strongly implies that there was no meaningful communication between Bromley and Wright during this period. Both implications are false.
188	<i>Meanwhile any correspondence from Bromley had dried up.</i>	Wright and Bromley talked over a number of personal matters, including the breakup of Wright's first marriage, the beginnings of his relationship with his second wife, and his difficulties at work, in letters dating from the late 80s to the end of the paper correspondence in 1996.  The paper record contains further letters or email printouts from 1997 or 1998. From the content the record is incomplete, but it is sufficient to show that there was no breakdown in the relationship and the break in the correspondence does not appear to have caused undue distress to either party.
190	<i>Wright had no way of knowing that on the other side of the world the research project was not going as Bromley had hoped.</i>	He knew it at the end of 1995. In the Christmas Eve 1995 letter, in addition to the remark quoted previously, Bromley wrote: <i>"I think we are missing the wood for the trees and the mass of information in the X-Rays has become an excuse for me to not think about [the mechanism]. I think instead about how to digitise and image process {yuck!} the X-Rays. Typical busy work. But where to instead?"</i>
190	<i>In fact, Bromley was desperately trying to hide from Wright – and everyone around him – that he was ill and increasingly unable to work.</i>	"Everyone around him" in the 90s knew that Bromley often felt inexplicably tired and frequently unwell. He saw doctors, and was told that he was suffering after effects of Glandular Fever (Epstein-Barr virus). This seemed a sufficient explanation.
190	<i>Then, as the end of the century approached, Wright received a letter from Bromley's wife explaining that her husband had been suffering for years from a form of cancer called Hodgkin's lymphoma and that he was deteriorating fast. 'If you want to see him,' she wrote, 'you have to come soon.'</i>	Anne Bromley does not recall writing any such letter.  The wording seems to support Marchant's claim that Bromley had been trying to hide his illness. In fact the diagnosis of Hodgkin's lymphoma was not made until 1998 and Bromley immediately told anyone he thought might be even faintly interested.
190	<i>[Wright] turned up on Bromley's doorstep exhausted and nervous...</i>	It's understandable that Wright was exhausted and nervous when he reached Sydney, but he didn't just turn up on the doorstep. Anne Bromley met him at the airport and brought him back to her home.

Page	Quotation	Comment
191	<i>After years of denial about his illness, [Bromley] couldn't escape the fact the he was dying.</i>	There was no denial about his illness and Bromley did not attempt to escape the probabilities of its outcome.
191	<i>He told Wright... that for years he had dreamed that his name – and his name alone – would be attached to the final solution of the Antikythera mechanism; that was why he had guarded the results so jealously.</i>	This was a private conversation and only Wright can now comment on the accuracy of the report. But the alleged dream is out of character. Bromley was not much interested in personal fame; if he had been he would never have gone into such an obscure field of study (the history of mechanical computing) and once there he would have published much more than he did. He was interested in understanding things. Frank Percival comments that with the Antikythera mechanism Bromley was “like a kid.”
191	<i>To Bromley, knowledge really was power. Throughout his life he had defined himself by what he knew and others didn't. It was what drove him to become the world's foremost expert on Charles Babbage, and it was what drove him to return to Athens year after year to study the Antikythera mechanism. Knowledge wasn't to be shared, it was to be held on to like a currency, to be bartered at a later date." (pp. 191-192).</i>	This is grotesque, as dozens - perhaps hundreds - of students, colleagues, and friends could have attested. It's particularly disturbing that this section is not written as Michael Wright's view; it is written in the voice of the author, with all the weight of an apparent authority. Yet Marchant has stated that she made no attempt to test this description through Sydney University, where Bromley was based for his entire professional life, or with anyone in Australia.  The prominence of this baseless description is indicated by the presence of an index entry, presumably the work of an independent indexer, for “Bromley, Allan G.; character of”. It should read “character assassination of”.  Bromley freely gave from his knowledge, sometimes considerably more than was expected. More importantly he consistently and generously supported people in pursuing the knowledge they wanted to find. This included many hours of unpaid work editing grant applications and coaching younger colleagues, as he did Michael Wright, through the processes of research proposals and publications. Outside the academic world he was a popular speaker to organisations such as the Sydney Clockmakers Society and the Australian Computer Museum, and at a personal level provided encouragement and practical advice to many people who were unsure of their own abilities. Encouragement often meant encouraging people to talk about their enthusiasms, including those whose enthusiasms were uncommon and who were very sensitive to signs of boredom. The arrogant knowledge hog Marchant describes could never had been the generous listener that Bromley was.

Page	Quotation	Comment
191	<p><i>Once... he gave a seminar on the Antikythera mechanism to an audience of curators at the Science Museum. At the end, as is customary at such events, one of them raised his hand and politely asked a question. Bromley looked straight at his inquisitor; eyes twinkling, the corners of his mouth curling through his beard into the hint of a smile.</i></p> <p><i>'That,' he said finally, 'is for me to know and you to find out.'</i></p>	<p>According to Bromley's sister, this was one of their mother's favourite expressions. It's at least possible that Bromley was joking, though it would be easier to judge that if we knew the question and the inquisitor.</p>
191	<p><i>Eventually, Bromley's wife found a way.</i></p> <p><i>'You've done this great body of work,' she coaxed. 'Let Michael go and make sense of it all, so that your efforts can be recognised.'</i></p>	<p>Anne Bromley does not recall saying this or anything like it. Although this is presented as a direct quotation, the author never attempted to verify it with the alleged speaker.</p>
192	<p><i>Bromley ... finally succumbed in September 2002.</i></p>	<p>Bromley died on 16 August 2002.</p>
192	<p><i>Wright was asked to write an obituary for Bromley. Unlike the perfectly glowing accounts that appeared elsewhere, his article was the painful result of an urge to tell what he felt was the unvarnished truth. 'If I sometimes resented the way in which Allan took, and kept, control of the project, I recognise that without him I might well never have got to Athens at all,' he said.</i></p>	<p>This obituary appeared in the Horological Journal (November 2002). The correct date of Bromley's death is prominent in its first paragraph.</p> <p>The correspondence between Wright and Bromley raises many questions about Marchant's account of the history of their collaboration. However it confirms this sentence, which comes immediately after the one Marchant quotes: 'His other great gifts to me were to teach me to order my thoughts and to trust my own judgement.' Those are not the gifts of someone who pursued knowledge for the sake of power. They are gifts that build intellectual independence and the capacity to express original ideas.</p> <p>It's unfortunate that the "perfectly glowing accounts that appeared elsewhere" apparently raised no questions in Marchant's mind.</p>