

Professor Charles. Just a quick follow-up on the related question. This is not my field at all, but the one thing that I did believe happened is that those gas clouds don't just nicely produce one star with a planetary system, that we see many multiple-star formations and huge interactions with them, and yet you have those lovely systems coming out. Things are a lot more complicated than that, aren't they?

Dr. Pinilla. Observations have shown us that binarity increases with the stellar mass. So we expect multiple systems to be more common for stars that are more massive than our Sun, and less common for solar-type stars and for that reason we try to avoid binaries because they actually affect a lot of planet formation. But it's an interesting topic in itself to try to understand how planets form around circumbinary discs. We do all suspect interactions and when we see what you see here is dust, so you don't see it so clearly, but when we see the gas, we can see a lot of potential interaction with encounters in the star-forming regions. Now with *Gaia* that we know locations and velocities with high precision, we can try to go back in time and see how many interactions have happened in this business.

The President. I look forward to the Pinilla–Charles correction to the Drake equation. [Laughter.] Thank you so much. Just a couple of announcements. The licensing situation is not getting solved but it is close to being. It turns out that all our neighbours in the courtyard have a licence, they just didn't tell us, so we're on it, but it's taking time. The next Open Meeting will be on Friday the 9th of January. You are all welcome to attend. I think we should just end with applause for a wonderful set of talks today. [Applause.] Thank you everybody, I look forward to the next meeting.

THE REORGANIZATION OF THE UK ASTRONOMICAL OBSERVATORIES — 'OBSERVATORY WARS'

By Ian Robson

One of the key events in the history of UK ground-based astronomy was the closure of the Royal Greenwich Observatory (RGO) and the Royal Observatory Edinburgh (ROE), to be replaced by the UK Astronomy Technology Centre (UKATC) located on the site of the ROE on Blackford Hill Edinburgh. Although that took effect in the late 1990s, the discussion surrounding the status of the two Royal Observatories had been raging for over a decade beforehand. This is a personal compilation of the history and the reasoning behind that major upheaval, using archival records of the time where available, open-source data, input from colleagues, and personal involvement. I have striven to ensure it is as accurate as I can determine.

Introduction

As we will see, funding, or lack of it, lies at the heart of all the decision-making regarding current and future astronomy developments and as such, there has always been pressure on financial budgets. My introduction to the management side of supporting UK astronomy

was with my appointment to the *United Kingdom Infrared Telescope (UKIRT)* Advisory Committee in 1978. That provided advice to the funding agency, SRC (Science Research Council), regarding the construction of the telescope, which was led by the ROE, and its subsequent operation on the Big Island of Hawaii. *UKIRT* opened to the community in 1979 and subsequently I became Chairman of the *UKIRT* Users Committee from 1980–83. That began a long-standing link with the Royal Observatory Edinburgh.

At the same time (1980–83) I was appointed Chairman of the Astronomy II Committee. That funded the astronomy research grants to universities, new projects, and support for the ‘establishments’ — the two Royal observatories: the RGO and the ROE, the former being situated at Herstmonceux, Sussex. Also funded were small sections of the Rutherford Appleton Laboratory (RAL) at Harwell. In turn, the two Royal Observatories supported the telescopes on their ‘island sites’, in Hawaii and Australia for the ROE and the Canary Islands (La Palma) for the RGO. The funding was primarily to support the day-to-day operations of the telescopes but additionally, and critically importantly, their new instrumentation. Hawaii hosted the newly commissioned 3.8-m-diameter *UKIRT* infrared telescope, located on the summit of the 14 000-ft dormant volcano of Mauna Kea, while on La Palma, at the much lower-altitude site of the Roque de los Muchachos Observatory, the *Isaac Newton* optical telescope (*INT*) was located. The *INT* had been moved from Herstmonceux in 1979 and as part of the relocation was provided with a new 2.54-m-diameter mirror made of Zerodur (a new material of very low coefficient of thermal expansion) rather than the original 98-inch Pyrex mirror. During that period, Professor Alec Boksenberg was Director of the RGO and Professor Malcolm Longair was Director of the ROE. Malcolm was also Regius Professor of Astronomy at Edinburgh University and Astronomer Royal for Scotland. The La Palma site would be the future home for the new 4.2-m-diameter optical telescope, the *William Herschel Telescope (WHT)*, which would be commissioned in 1986.

In 1981, overall funding for astronomy research was provided by the Science and Engineering Research Council (SERC), which was formed out of the Science Research Council. The SERC was a UK governmental, non-departmental public body (NDPB). The astronomy funding was passed down to the Astronomy and Space Research (ASR) Board, which, to a first approximation, split the funding between ground-based and space-based astronomy research. The Astronomy II Committee reported to the ASR Board and as Chairman I was a member of the Board, and my role was essentially to fight for the ground-based astronomy community — and that was always a fight due to lack of funding. In due course, following a management re-organization the ASR Board morphed into the Astronomy and Planetary Sciences (APS) Board, which funded ground-based astronomy through the Ground-Based Programme Committee (GBPC), the Studentships and Fellowships panel, and the Theory and Computational panel.

The role of the two Royal Observatories and the location of the RGO

In the mid 1980s there was severe pressure on budgets across the whole of SERC. Possibilities of relieving that pressure for the ground-based astronomy budgets translated into a number of attempts to merge the two Royal Observatories. In particular, that focussed on what to do with the RGO when it left Herstmonceux, which had become too expensive to maintain and its telescopes were obsolete following the move of the *INT* to La Palma in 1979. Indeed, those budgetary pressures were so serious that SERC even set up a committee under Sir John Kendrew to review the value and cost of CERN membership. That recommended a cut of 25%, which could not be implemented.

In the spring of 1985, SERC set up a Working Group under the Chairmanship of Sir John Kingman. That was to re-evaluate the rationale of having two Royal Observatories for ground-based astronomy and to comment on whether to relocate the RGO to a university or to merge with the ROE, with all options being open for consideration. However, that immediately hit a

snag when Professor Donald Lynden-Bell, the President of the Royal Astronomical Society (RAS) at the time, complained that there were no practising optical astronomers on the panel. After some to-ing and fro-ing and concern about being the only active research astronomer on the Group (additional astronomers not being allowed), Professor Richard Ellis agreed to serve, but only as an advisor. The existence of that Working Group caused significant alarm in the UK community and Sir John Kingman asked the RAS President to seek community input, which was received in a number of letters. Both the ROE and Daresbury Laboratories suggested hosting the RGO at their sites. The Working Group's final report was released in 1985 December and was endorsed by SERC Council in 1986 January. The recommendation was that the RGO should be moved from Herstmonceux closer to a university, or be merged with the ROE at Edinburgh with some of the technical and engineering activities going to the RAL, which was already building the *James Clerk Maxwell Telescope (JCMT)*.

SERC then invited UK university Vice-Chancellors to make bids to host the RGO. Eight bids were received, including from Cambridge, Manchester, Edinburgh, Oxford, and Durham. In 1986 March a shortlist of three bids was selected; Cambridge, Edinburgh (ROE), and Manchester. At about the same time the RAS conducted a Fellowship-wide survey and received the following responses: to move the RGO, yes or no? no (444) yes (242); if it has to move then to where: Cambridge (286), ROE (189), Manchester (164), elsewhere (152). After firstly favouring a merging with the ROE at Edinburgh, apparently very considerable pressure was brought to bear that resulted in SERC Council making the final recommendation in 1986 June that the RGO should move to a new site in Cambridge, with a target date of completion by 1990. That caused a large outcry in the community, letters to the press, and a campaign by Patrick Moore to 'Save the RGO'. However, the die was cast, the RGO would move from Herstmonceux.

The Ground-Based Plan: the future of UK ground-based astronomy

While all that debate was going on the scientific focus was directed towards the next generation of optical telescopes. SERC had set up the Large Telescope Panel, chaired by Professor Richard Ellis. That was charged with making the case for the UK to participate in a large (8-m-class) optical/infrared telescope. Following that review the GBPC set up a Panel under Professor Sir Alan Cook (Chair of the APS Board) to address the strategic long-term funding and opportunities for ground-based astronomy and planetary science. I was a member of the Panel, and it produced a crucial glossy report that was published in 1989 — the Ground-Based Plan. That was far-reaching and recognized that if the UK was to participate in future programmes and new facilities, it was inevitable that given the likely funding situation, current programmes and/or facilities would have to cease. Specifically, the Report recommended that support for new facilities should be focussed on the following: the completion of the second phase of the *MERLIN* radio interferometer — becoming *e-MERLIN* and with the additional large dish at Cambridge; around a 25% share of a Polar Cap (*EISCAT*) incoherent-scatter radar at Svalbard; at least a 25% share of a gravitational-radiation observatory; an 8-m optical/infrared telescope package including at least a 40% share of an 8-m-class telescope. To fund that 15-year strategic plan, the APS Board should set aside £2M each year, to be found from the existing programme if additional funding was not forthcoming. That plan was approved and clearly set out the principle that the UK must plan for access to the next generation of astronomical facilities and that current projects/facilities/activities may have to shrink or even close in order to provide the necessary funding. That was quite revolutionary because at the time the ground-based astronomy community had developed a reputation for always wanting new facilities but not being prepared to terminate existing and possibly life-expired telescopes. The inability to close the small Kottamia optical telescope in Egypt was a prime example that was often used to beat the astronomers around the head.

In 1988 I was appointed Chairman of the GBPC by the SERC Director of Science, Dr. Barry Martin, with a remit to implement the recommendations of the Ground-Based Plan. That position also made me a member of the Astronomy and Planetary Science Board. That was a time of tight budgets but also of future opportunities. Dr. Ian Corbett replaced Barry Martin in late 1989.

The move of the RGO to Cambridge and the future is Gemini

A key event for UK astronomy was the move of the RGO from Herstmonceux to a purpose-built, brand-new facility at the University of Cambridge, adjacent to the Institute of Astronomy (IoA). That began in 1988, and the new location was officially opened by the Duke of Edinburgh on 1990 June 14. With budgets being tight and a growing space-science programme, there was additional scrutiny on the ‘fixed costs’ within the astronomy programme. That focussed attention on the two Royal Observatories and their significant staff costs, including the support for the operational facilities in Hawaii and La Palma. (The Australian *Anglo–Australian Telescope* and the *UK Schmidt Telescope* are excluded from this narrative although the Schmidt did have an operational activity at Edinburgh in terms of support and a plate-measuring machine — *SuperCOSMOS*.) I remember a heated discussion at a GBPC meeting concerning the support from the RGO for La Palma and that subsequently resulted in an audit of the two observatories by the SERC Director of Science (Dr. Ian Corbett), the senior secretary (David Schildt), the GBPC secretary, Dr. Peter Fletcher (I think), and myself. In 1990 Professor Malcolm Longair left the ROE for the University of Cambridge and Dr. Paul Murdin from the RGO took over as Acting Director in 1991.

One of the key planks of the Ground-Based Plan was a significant share in a future 8-m-class optical/infrared telescope. Two possible options had appeared on the scene: the US-led *Gemini* Telescope Project, and a European Large Telescope, which would be at least 50% Spanish. The *Gemini* project consisted of two identical 8-m optical/infrared telescopes, one situated on Mauna Kea in Hawaii and a second on Cerro Pachon in Chile. The European Large Telescope was to be an 8-m optical/infrared telescope located on La Palma alongside the *WHT* and *INT*. That latter option was heavily supported by the RGO for obvious reasons. In the end a GBPC review panel opted for the *Gemini* proposal, although not without significant disagreement in the community. In the autumn of 1990 that recommendation was presented to the APS Board, which accepted it. The project was formally initiated to progress with further involvement in *Gemini* but without a legal agreement to join. [As a footnote, the ‘European’ telescope on La Palma was ultimately constructed and became the 10.4-m *GranTeCan*, which started operations in 2009.]

An amusing anecdote to that was that prior to the final decision-making meeting of the APS Board regarding acceptance of the *Gemini* project, Professor Richard Ellis (who was at Durham at the time) and I had agreed to meet up with Ian Corbett and Peter Fletcher at Heathrow airport (as a suitable meeting location that was quite feasible in those days before enhanced airport security). That meeting would entail Richard and me flying down from Newcastle Airport. Unfortunately, we ended up talking too long in his office at Durham, which meant catching our flight from Newcastle airport was looking to be on very shaky grounds. Following a rather hectic and rapid car dash to Newcastle Airport we just made it with Richard being left to check in while I parked up. We were the last people to board the British Airways BAC111 and found ourselves sitting across the aisle from the violinist Nigel Kennedy, who’d been playing at Newcastle University Union (while his Aston Villa football team was being beaten at Newcastle). On arriving at Heathrow and getting my bag down I passed Nigel his violin case (carefully) saying “I think this belongs to you”, to which he replied “thanks, and it costs a whole lot of money too”. Being a Newcastle supporter I naturally commiserated about the Aston Villa loss. The Heathrow meeting turned out to be very useful in terms of deciding our final strategy for the upcoming Board meeting and

Richard and I flew back to Newcastle later that afternoon.

No sooner had the decision on *Gemini* taken place when SERC was hit with a major funding crisis resulting in a shortfall of £52M. Savings were required from all areas of the programme and the GBPC was faced with planned cuts of £3.6M in FY91/92, £6.8M in 92/93, and £8.0M in FY93/94. Those were savage in-year budget reductions and would require drastic action to achieve them. The university grants were mostly protected, major projects were slowed down or delayed, but there were still broad cuts across the rest of the programme in a salami-slicing round of activity. Inevitably, the funding of the establishments came under further scrutiny and another panel was set up to address that issue. The outcome of that (the Hughes report) was to seek savings of £1M from the RGO and the ROE and to consolidate optical and infrared instrumentation on a single site. While nothing immediately transpired for a variety of reasons, that was essentially the beginning of what came to be known as ‘Observatory Wars’.

In 1993, a SERC review of the Observatories’ management recommended that the RGO and the ROE (along with the island sites) should come under a single Director of Observatories. That was then implemented with Professor Alec Boksenberg, then Director of the RGO, being appointed to the position. At the same time there was another management change when Dr. Paul Murdin moved from the ROE to SERC to develop UK Space Science at the British National Space Centre in London. At the time I was the Director of the *James Clerk Maxwell Telescope* and the Joint Astronomy Centre in Hawaii and so I reported to Alec. Programmatically, another positive step in implementing the goals of the Ground-Based Plan was achieved when, in the same year, SERC officially signed up to a 25% share in the *Gemini* international optical/infrared observatory project.

And now we are PPARC and ‘Prior Options’ looms large

1994 April saw another major event take place: the dissolution of the SERC to become PPARC — the Particle Physics and Astronomy Research Council. That slimmed-down but more-focussed Council was now bereft of the RAL work and essentially consisted of a headquarters in Polaris House, Swindon, the two Royal Observatories, and their associated ‘island sites’, along with other funded facilities, some, like the Anglo-Australian Observatory, overseas. Professor Ken Pounds of the University of Leicester was appointed as the PPARC Chief Executive.

In the meantime, the UK Government, in 1993 May, produced a policy review that would shake the UK science establishment to its core. That came in the form of a science white paper that was entitled ‘Realising our potential: A Strategy for Science, Engineering and Technology’. It basically asked the question whether UK government-funded science establishments were necessary in the first place and if so, whether the work could better be delivered through the private sector rather than government — in essence, could they be privatized. The terms of reference for that exercise were announced in 1994 February although the review had already begun in the previous December. The review reported in 1994 June. This process was generically known as ‘Prior Options’ and although many research establishments had been included (*e.g.*, Rutherford Appleton Laboratories and Daresbury Labs) PPARC was excluded, probably because it had just recently been formed.

The Prior Options review produced a high level of criticism from the length and breadth of the UK science community. The Government’s official response to the review recommendations came in 1995 September and although it did not support some of the recommendations, it decided to expand ‘Prior Options’ to include a wider range of establishments. This time PPARC was included (although the direction of travel had been known to PPARC a couple of months before the official announcement and a great deal of time and effort had been spent in trying to avoid that result given that some of the industry-based PPARC Council members were broadly in favour). So now all the PPARC establishments were subject to

review for potential privatization and to be run by ‘service providers’. That meant that the Joint Astronomy Centre in Hawaii, of which I was Director, suddenly became part of Prior Options and my focus had to turn away from the science to managing what would turn out to be a huge piece of work in terms of preparing prospectuses and legal aspects. That seriously detracted management from being able to concentrate on science delivery and planning for the future. Prior Options would also have an impact on the on-going saga of the Observatory Wars.

Meanwhile, it was clear that the overall funding situation was becoming even tighter, and the tension between the funding for the ‘establishments’ (the two Royal Observatories) and funding university grants for astronomy research would increase. That was because the cost of the UK’s 25% share in the *Gemini Telescope* operational support would be significant, especially as it would be based overseas in Hawaii and Chile, while at the same time the university astronomy community was rapidly expanding, with new groups being set up in many physics departments. That resulted in an increased demand for research-grant funding. Finally, there was a growing desire on the part of some large university departments to have a significant share of the UK astronomy instrument-building capacity, thereby challenging the near-monopoly position of the two Royal Observatories.

The ‘Hough’ reviews of the Royal Observatories

In 1994 PPARC management set up a Panel to review the future of optical, infrared, and millimetre astronomy in the UK. That was led by Professor Jim Hough of the University of Hertfordshire. The timing of the review was governed by the international agreement for the operation of the joint UK–Australia Anglo–Australian Observatory (AAO) in Australia and the development of the tri-national (UK, Canada, Netherlands) funded *JCMT* in Hawaii. The inter-governmental agreement covering the AAO meant that if the UK was to withdraw or change contributions it had to give notice by 1996. Likewise, the current *JCMT* Development Fund would expire in 1999 and the *JCMT* Board would need notification during 1995 in order to plan for future telescope and instrument developments beyond that date. The membership of the Panel included an international astronomer, Dr. Reinhard Genzel, and each Royal Observatory Director nominated one person. John Peacock was nominated from the ROE while Robert Laing was nominated from the RGO, and it was Robert who first coined the phrase ‘Astronomy Technology Centre’ although not in the same format that would eventually be created, as he had envisaged continued support for the island sites rather than just an instrument-building centre.

The Panel reported to the PPARC Director of Science (Dr. Ian Corbett) in 1995 January (the Hough-1 report) and that was presented to PPARC Council on February 16. The Report made a number of far-reaching recommendations, the three key ones being: universities should become more involved in instrument construction; the two Royal Observatories should be merged into a single, smaller unit, which would be known as the UK Astronomy Technology Centre (UKATC); the island sites should be autonomous, reporting to respective Telescope Boards. An obvious conundrum followed: where would a UKATC reside? Or, put another way and as seen by most people, the most obvious solution would be to locate it at one of the two existing Royal Observatories, and in which case, which would remain open and which would close — bring on the ‘Observatory Wars’.

The recommendation that the two island sites should be autonomous, receive funding directly from Swindon Office, and be managed by executive boards, was not so much of a difference for the Hawaii site, at least for the *James Clerk Maxwell Telescope*. That had effectively been the position since 1992, when I took over as Director. I reported to the international *JCMT* Board and received funding essentially directly from the three agencies (UK, Canada, and the Netherlands) and the previous managerial link to Edinburgh was reduced. As we will subsequently see, from 1996 April 1, the Joint Astronomy Centre (JAC)

in Hilo, Hawaii, which was the management HQ supporting the *JCMT* and *UKIRT*, was supported directly from Swindon Office. The same became true for La Palma, which was jointly funded by the UK and the Netherlands, with a small Spanish interest.

Returning to the Hough-1 Panel, the PPARC Council meeting of 1995 February accepted the general recommendation of autonomy for the island sites but had reservations about the concept of a UKATC. This was for a number of reasons: financial, operational, and political. It was also felt that an adequate cost-benefit analysis had not been undertaken to justify a UKATC. Therefore, PPARC management immediately instigated a second panel to analyse the technical and financial requirements of a UKATC, including its size, skill mix, management structure, and relationship to the island sites. That was also chaired by Professor Jim Hough. Included in the terms of reference of that Panel was the crucial recommendation as to where this new UKATC should be located. That would be a fast-acting panel, reporting to the PPARC Director of Science by the end of 1995 May, in time for the PPARC Council meeting of June 6.

All of that was causing great unease within the astronomical community, especially after Ken Pounds gave a report to the National Astronomy Meeting at Cardiff in 1995 April amid mounting criticism from a variety of sources that there had been a lack of consultation throughout the process. On paper it would appear that in the battle to be the UKATC, the RGO would have the upper hand, being located in a modern, purpose-built facility in Cambridge, the seat of major astronomy research, and the home of the Astronomer Royal (Professor Sir Martin Rees) and the home of the Director of Observatories (Professor Alec Boksenberg). However, within the university astronomy community there was a considerable push for Edinburgh, mainly based on its project-management track record and the future move to infrared astronomy.

While all that was going on Alec Boksenberg announced he would retire and when that took effect the two Observatories would again be split, each having its own Director. Dr. Jasper Wall was appointed to the RGO and Mr. Stuart Pitt to the ROE. That was a key time of flux and it was clear that the future of the observatories had to be fought for. I had known and worked with Dr. Adrian Russell of the ROE since going to the *JCMT*, where Adrian was a support scientist and Head of Instrument Development. He moved back to the ROE to take up the position of UK Project Manager for the *Gemini Observatory* project. Adrian was a great guy in all respects, bright, knowledgeable, and extremely helpful. His only negative was in being a Sheffield United supporter. I was very keen that he should not apply to be ROE Director at that time, although he was the best candidate for a future UKATC Director. I lobbied hard for that solution. My reasoning was that the position of ROE Director would be mired in the politics of the Observatory Wars and he should keep his powder dry on the assumption that when the ROE won the battle, he would not have been smeared in the political infighting at a senior level and would be in a prime position to take on the Directorship of the UKATC (to which he was subsequently appointed in 1998). On the other hand, Stuart Pitt, as head of ROE administration and a terrier of a Scotsman, was the ideal candidate to take the ROE forward through the subsequent battlefield. Indeed, that was the consensus view of the senior staff at the ROE, in effect making Stuart Pitt the only Director of the ROE to ever have been elected by his peers.

The recommendations of the Hough-2 report were profound. They concluded that a UKATC would provide a core of specialist staff for instrument design and construction along with telescope development, that a UKATC should work with the university community in instrument building at an approximately equal share, and that it needed a staff of 45 to fulfil that required remit. Finally, and crucially, it recommended that the UKATC should be based at the ROE Edinburgh, mainly on the basis of the move towards infrared astronomy but also because of the project-management track record at the ROE. It was also noted that there was a considerable synergy between the ROE and the co-located University of Edinburgh astronomy unit, the Institute for Astronomy (IfA). The Panel had also pointedly noted that

that synergy was lacking at Cambridge even though the RGO and IoA were next door to each other. So, there we have it — a UKATC at Edinburgh and the future of the RGO and its staff very uncertain but closure seeming a distinct possibility. However, there would be a lot of water to flow under the bridge before those far-reaching recommendations would become a reality. In looking back, it is worth noting that a potential possible solution could have been to create the UKATC at RAL, but because RAL was then in another Research Council that idea was not seriously considered.

The Hough-2 draft Report and recommendations were circulated to the Astronomy Committee, PPARC Council, and senior members of the UK astronomy community. Alec Boksenberg, as Director of Observatories, wrote a detailed, four-page document on 1995 June 6 (I assume as input to the PPARC Council meeting) effectively arguing against all the recommendations of the Hough report, including autonomy for the island sites. On-going concerns about lack of effective communication between PPARC and the community continued to swirl around on email and in letters. The attitude of the IoA and Cambridge University to the potential closure of the RGO caused some internal tensions and as Richard Ellis, by then Director of the IoA, commented to me that when a senior astronomer at the IoA was asked if the IoA should support the RGO the reply was that “the RGO wasn’t Royal, it wasn’t at Greenwich and it wasn’t an observatory!” That speaks volumes for the degree of antipathy felt towards the RGO by some. It didn’t help that another major astronomy arm of Cambridge University, the Cavendish Laboratory, including the radio astronomers from the Mullard Radio Astronomy Observatory, was literally remote from the IoA in terms of both geography and collaboration. Nevertheless, it must be acknowledged that the RGO had considerable support from within the community, especially amongst the traditional optical astronomers.

The 1995 June meeting of PPARC Council again failed to support the plan and with hindsight that was perhaps not surprising. Reading between the lines those recommendations were too much of a bite to take at one go without having ‘rolled the pitch’ beforehand, something that had been impossible given the short time-scale for the Panel to report. Also, with starkly divergent views amongst senior astronomers in the community, the decision of Council failing to support the recommendations is readily understandable in that such a major recommendation to close the RGO was contentious and of course political. It was, therefore, inevitable that the final decision would take some considerable time. To add to the impasse, the RGO had been in its new building for only some six years, so closing it would not appear to be without criticism from on-high. So, the fight was on to save the RGO and lots of gnashing of teeth within the community ensued. The final Hough-2 Report was sent to Council in July and the final decision was poised for the PPARC Council meeting in 1995 September. A lot of work was undertaken over the summer by Ian Corbett and senior astronomers to try to crystallize the position regarding future ground-based projects, in particular, *Gemini*, given the lack of projected funding.

PPARC becomes subject to Prior Options

However, as we have noted earlier, the process of taking the Hough-2 recommendations forward was effectively put on hold following the announcement on 1995 July 26 by Ian Taylor, the Minister for Science and Technology, that PPARC would be assessed under the Prior Options programme. PPARC focus would be turned away from a decision about forming a UKATC, to one of preparing prospectuses and in the case of the overseas sites, seeking specialist legal advice. PPARC Council set up a small panel to assess the Prior Options progress. That was chaired by Professor Ian Halliday (a member of Council) and included the PPARC CEO Ken Pounds and Adrian Carter of the Office of Science and Technology. The panel would report to Council on December 6 but an interim report to the September Council by Ian Halliday stated: (a) that the principle of PPARC owning telescopes, or being

a member of a collaboration that owns telescopes, in order to guarantee secure access for the UK astronomical community, is fully justified; (b) that the PPARC should endeavour to retain and develop telescopes well beyond 2000, and to continue to operate and maintain them efficiently, effectively, and economically; (c) and hence the ‘abolition of programme functions’ option should be rejected.

The paper went on to outline the possible options as: (a) ‘Integrated’ — Hawaii + La Palma + RGO + ROE as a single organization — in effect the status quo; (b) ‘Separate’ — four academic organizations; (c) ‘UKATC’ — essentially Hough-1; (d) ‘RGO’ — Hawaii and ROE independent; RGO and La Palma combined as a single organization independent of the others. However, options (b), (c), and (d) resulted in a number of sub-options to consider and the result was a large range of management possibilities. The report then detailed the on-going discussions of costs, management, and potential impact on future activities. One thing was very clear: that was going to be a complex process.

Meanwhile, an obvious up-front question for Prior Options was whether the local UK academic institutions (Cambridge and Edinburgh universities) might be interested in running the two UK sites. On 1995 August 1, Jim Sadlier, the Royal Observatory Secretary, wrote formally to Richard Ellis (Cambridge) and Andy Lawrence (Edinburgh), asking them to begin internal enquiries as to that possibility. Following that letter, Richard Ellis wrote back on August 9 expressing a general enthusiasm and noting that an internal working group had been set up comprising the IoA, the Mullard Radio Astronomy Group (MRAO), and the Department of Applied Mathematics and Theoretical Physics to consider further the possibilities. He also pointed out there could be many difficulties to overcome and that in any case it would need to be considered by the General Board of the University. That was followed up by a letter from the Vice Chancellor of the University of Cambridge to Ian Halliday, again expressing positive views but noting that much would depend on the financial situation and the PPARC future programme.

While all of that upheaval was going on, yet another funding crisis arose for PPARC. In the light of the reduction in planned spend on ground-based telescope developments, the Ground-Based Telescopes Development Panel (the Williams Panel) was reconvened to consider a revised programme and to recommend that to the 1995 December 6 PPARC Council. Clearly, that was going to be a ‘busy’ Council meeting. Meanwhile, in October the RGO prepared an extensive document entitled ‘Our Future: Memorandum to Prior Options’, comprising 28 pages of arguments and 9 Appendices. That was followed by a paper from Walter Gear, John Peacock, and Andy Lawrence on behalf of the ROE Management Board entitled ‘ROE and the future of UK Astronomy’ presenting the ROE view of how best to support ground-based optical-infrared-millimetre astronomy.

A University Consortium?

In 1995 November, a consortium of Cambridge, Durham, and Oxford universities sought to investigate whether a charitable trust could set up a not-for-profit company to manage the astronomy programme and the UKATC, while PPARC retained responsibility for programme policy. That was met with a range of both support and lack of enthusiasm from the university hierarchy. It was also clear that neither Cambridge nor Edinburgh Universities were willing to represent the interests of other universities, which was quite understandable. In 1995 December, PPARC Council approved the proposals from Ian Halliday regarding the way forward for Prior Options along with a revised time-table with an implementation date of 1997 April. Those were then forwarded to the Minister. The key recommendations were: that PPARC should retain ownership of the telescopes on Hawaii and La Palma and seek, through competitive tender, to contract managing organizations to operate them on behalf of the Council and its international partners; that PPARC should invite tenders for the provision, under contract to PPARC, of services, including the procurement of instrumentation and

technical support currently provided by the Royal Observatories' UK sites (RGO and ROE). Work then began in earnest in terms of making up prospectuses for potential bidders and refining the 'rules of the game' in terms of what could and could not be disclosed. To oversee the process a steering committee was set up under Ian Halliday and a management committee under the chairmanship of John Love, PPARC Director of Administration. However, it was clear from the start that PPARC lacked knowledge and experience of that type of process, and external advice, including legal advice, would have to be obtained.

Although somewhat isolated in Hawaii, Prior Options caused much additional work. On paper, the Joint Astronomy Centre was the most obvious site to transfer to public as opposed to UK-government operations, especially given the way that many US facilities were operated through a third party (AURA — the Association of Universities for Research in Astronomy) rather than directly by the funding agency, the National Science Foundation (NSF). For the JAC the work involved figuring out the international legalities, especially given the tri-nation *JCMT* funding, the planned expectation of operating closely with the *Gemini-North* facility (to save money), and looking at other innovative means. There was lots of discussion regarding the way forward and about how a JAC might be structured, how it would interact with *Gemini*, possible bidders, rules about in-house and management bids clarified, and interfaces needing attention. That revealed the potential complexity and the dawning realization of the possibility that the management could easily become more complex and costly to administer rather than simpler and cheaper! At the same time *JCMT* operations were completely focussed on the delivery from the ROE and commissioning of the world-beating and world's first submillimetre 'camera', *SCUBA*. As it turned out, that instrument would be the saviour for the *JCMT* in the downstream international review that would be called for later.

On 1996 April 25 a Department of Trade and Industry (DTI) press release was made announcing that the Minister had accepted, in full, the conclusions of the Review of the Royal Observatories (the Halliday Panel). The key recommendation was that management of the UK telescopes and the delivery of the instrumentation programme currently carried out by the Royal Observatories should be subject to competitive tendering by all competent suppliers. That was officially welcomed by Ken Pounds on behalf of PPARC and a bulletin was issued describing the outcome, the process, and the proposed time-table, which we shall return to later.

That announcement stimulated further work, led by Richard Ellis, on the suggestion that a consortium of UK universities might come together to bid. A key aspect seemed to be that any organization wishing to bid must already be in formal existence at the time of the bid. Although it was noted that the consortium should maintain neutrality on the RGO vs. ROE UKATC situation, there was clearly support for the RGO to be the main contender in spite of Hough-2. The group of four universities (Cambridge, Durham, Oxford, UCL) decided to leave things across the summer but to resume in September, when the nature of the bidding and rules had become clearer. In the meantime, they would seek to have meetings with representatives of the RGO and the ROE.

As Prior Options work gained pace it became clearer what the JAC was required to produce in terms of quality targets for the assessment of the management of the operation. That would mean a lot of work. To manage the progress, PPARC set up assessment panels to oversee the three tendering processes. For Hawaii, a special Prior Options meeting was convened in Boston (USA) on 1996 May 14. That had very high-level representation comprising Harvey Butcher (NL and *JCMT* Board Chair), Don Morton (Canada and *JCMT* Board), Wilfried Boland (NL and *JCMT* Board), Wayne Van Citters (US, Head of Astronomical Sciences Division NSF), Pat Roche (UK Chairman), Matt Griffin (UK and *JCMT* Board), Jim Hough (UK), as well as the PPARC contingent and myself.

Astronomy and political debate

However, not only was Prior Options causing great angst within the entire UK science community, it became both contentious and political. In the UK parliament there was a major debate on Prior Options on 1996 June 11 brought about by an opposition amendment. That was opened by Dr. Gavin Strang (Labour, Edinburgh East) with the statement: "I beg to move, That this House believes that Government support for science and technology is vital to the United Kingdom's future; recognises the crucial long-term contribution which the public sector research establishments make to the economy and to extending the boundaries of knowledge; regrets the rationalisation and fragmentation of these establishments in recent years and opposes the dogma-driven privatisation objectives of the Prior Options Review." [Spelling, capitalization, and punctuation as in the original.]

That was followed by an Early Day Motion tabled on July 9, which stated: "That this House is deeply concerned at the serious threat to the United Kingdom science base posed by internal disruption and loss of staff morale caused by the Prior Options Programme to privatise Government Scientific research institutes; notes that the timescale for Prior Options is already three months behind the schedule announced in a Government Press release of April 25; understands that the second tranche of institutes to be privatised under Prior Options is likely to incur costs exceeding £100 million; condemns the lack of foresight of the legal minefield requiring huge fees to be paid to United States and European lawyers for the disposal of Particle Physics and Astronomy Research Council sites in Hawaii and La Palma; deplores the fact the transfer into private ownership of overseas observatory sites alone is expected to result in half a million pounds of unanticipated legal costs; regards Prior Options as unviable; and calls upon the Government to halt the process and recognise that the policy represents the worst in Government dogma and is a gross waste of taxpayers' money." [Spelling, capitalization, and punctuation as in the original.]

Alongside that the House of Commons Science and Technology Select Committee had launched an inquiry into the Prior Options Reviews, into which the Royal Society made the following submission in 1996 October, summarized by:

There are four key points:

- the Government has not provided evidence for the assumptions underpinning the Prior Options process as currently being applied to PSREs (Public Sector Research Establishments)
- those assumptions need to be set in the context of national strategy for research, both within the Science Base and at Departmental level
- care is needed to ensure that Prior Options does not damage the highly successful collaboration that has built up between Universities and Research Council Institutes
- repeated reviews questioning the continued existence of PSREs, over and above the normal reviews undertaken periodically by Research Councils or Departmental owners of PSREs, adversely affect efficiency and productivity.

Let the bidding begin

Those protests hit a brick wall and at the end of July, Jim Sadlier wrote to interested parties that the *Official Journal of the European Union (OJEU)* notice would be issued in early August requesting bidding for the tendering of the work of the Royal Observatories. That was an important milestone because once issued, it sets in train a legal framework for the process, including a time-line. The information pack that went alongside the *OJEU* notice was very extensive and drawn up by legal experts. That triggered a response from

the four key universities of Cambridge, Durham, Oxford, and UCL indicating an expression of interest in bidding on behalf of the newly formed UCAR, the University Consortium for Astronomical Research that Richard Ellis had worked so hard to introduce.

Throughout the summer of 1996 there were numerous letters written by astronomers to the press and scientific journals. Martin Rees, in his role as Astronomer Royal and member of the Royal Society, continued to be opposed to the cost reductions and potential closure of the RGO and, more generally, with the way PPARC was handling the issue. I remember visiting the RGO in the summer to discuss the Prior Options process, and during a meeting with Jasper Wall, he noted that he was convinced the UK astronomy community would not let the RGO be closed. I wasn't so sure at all and pointed out that if Ken Pounds offered the choice of retaining the RGO or awarding a postdoc to each university researcher then just how committed would the community be. My feeling was they'd go for the postdoc but he was not convinced and continued to believe that the RGO would, in the end, be the choice for the UKATC, or at least be preserved as an institution.

On 1996 September 4, PPARC issued a news bulletin explaining the proposed implementation of the Prior Options Review. That explained there would be three separate but parallel tendering exercises: to manage the operation and development of *UKIRT* and the *JCMT* on Hawaii and to provide services to *Gemini North* when it came into operation; to manage the operation and development of the ING telescopes on La Palma; to provide the range of services currently provided by the RGO and the ROE. It also promised to provide an update for the community at the Royal Astronomical Society Ordinary Meeting on October 11. The planned time-table was for bids to be received by mid-February 1997 and then be assessed by evaluation panels. It was unclear how long the evaluation might take but hopefully the recommendations would be presented to PPARC Council by 1997 April.

A bidders-briefing conference was subsequently held on 1996 September 6. That included a section on 'pre-qualification'. 24 organizations attended and many questions were put forward for clarification, one being the status and importance of the Miscellaneous Governmental Organization status enjoyed by the JAC. That instrument brings tax and visa benefits to staff at the overseas sites as well as freedom from import duty for new instruments. The answer to the query was that that was being investigated.

Replies from potential bidders to the bidding questionnaire were due by September 20. UCAR followed that up in September noting that they intended to form a charitable trust that would in the future be extended to all UK universities that had a significant stake in observational astronomy and that they had considerable support from the community. Andy Lawrence indicated that Edinburgh would not be joining. A community-wide meeting was organized by UCAR at UCL on 1996 October 8. That was attended by 31 astronomers from 13 universities, not including the original four.

PPARC then selected the bidders felt to be suitable to proceed to the next stage. There were eight bidders for the UK programme, ten for Hawaii and seven for La Palma. In fact, we in Hawaii had been directly contacted only by the US managing agency AURA, and the UK managing agency Serco plc. That had resulted in a single meeting with representatives of each on a purely information-only exchange with strict rules of engagement. It was also known that Serco had formed a 50-50 collaboration with the University of Edinburgh to bid for the UK option.

In the autumn a written parliamentary question asked the President of the Board of Trade to make a statement on the future of the Royal Observatories. On behalf of the Government, the Minister for Science and Technology, Mr. Ian Taylor, replied on 1996 November 5: "The Government accepted the recommendations in the report of the prior options review of the royal observatories which had been endorsed by the council of the Particle Physics and Astronomy Research Council. These were that the management of the overseas telescopes and the provision of the instrumentation programme provided by the royal Greenwich observatory and the royal observatory Edinburgh should be subject

to competitive tendering by all competent suppliers. PPARC is currently implementing the recommendations of the review with the intention of an invitation to tender being issued this month.” [Capitalization as in the original.] So, in spite of all the protestations from the science community, in early November Prior Options was apparently well and truly up and running politically speaking, and PPARC was expected to be delivering it. But, watch this space!

Things are not going to plan for Prior Options, the beginning of the end

In fact, progress on the project plan for the implementation of Prior Options continued to slip as detailed work by lawyers unearthed a number of issues. Together those meant that the tender document for the Prior Options process could not be agreed and therefore could not be issued on the planned project time-table. Further legal work would need to be undertaken. That resulted in a delay to the invitations to tender (ITT) being announced on November 1, moving the ITT release date to November 14, with a new closing date for bids to be 1997 February 28. However, on November 22 a further delay was announced, this time with no new dates for the ITT or the resulting reply by bidders. Clearly things were not going well behind the scenes.

On November 15, Jasper Wall issued a letter to the community inviting astronomers to join the NAT — the National Astronomy Trust, which would be a non-profit company limited by guarantee with charitable-trust status (CLG). This would be headed up by Jasper Wall, Neil Parker, and Keith Tritton of the RGO. Clearly as an RGO-based organization it was unclear how it would sit with UCAR or the community as a whole. An opening meeting was planned to take place in London on December 4.

However, a bombshell announcement took place on November 29 when Jim Sadlier wrote to potential bidders that PPARC was “unable to proceed with the current tendering exercise for the contracting out of the programme of the Royal Observatories”. Quoting from the letter: “in recent weeks PPARC has identified a number of significant pressures on its capacity to fund its current and future programme at the anticipated level and has been advised that there may be new and significant liabilities which need to be investigated further. Without a full analysis of the impact of these changes, in the context of the current 1996 PES (Public Expenditure Settlement) and Allocations, PPARC is not in a position to disclose with sufficient certainty the full nature and extent of its assets and liabilities pertinent to the contracts for which you have been invited to bid. In these circumstances it would be inappropriate to issue the Invitations to Tender which have been prepared. The current estimate is that it will take some months to complete this analysis and it will therefore no longer be possible to adhere to the planned timescale for the award and announcement of contracts. I attach a copy of a UK Government statement which will be made in Parliament today.” [Spelling, capitalization, and punctuation as in the original.] The Government statement concludes that that current tendering exercise has been formally terminated.

It remained unclear exactly what precise financial circumstances and liabilities had been unearthed. Speculation focussed on whether the on-going impact of the Prior Options work, which had been unfunded by Government and was effectively taking funds directly from the astronomy programme, would have required much more funding from the astronomy programme than could have been sanctioned. It was also the fact that the new science budget had just been announced, and that had confirmed that there would be no additional funding for the Prior Options processes. Therefore, those costs would directly impact the science research programmes. Another avenue of speculation was that the work by the lawyers had unearthed some interesting aspects, one of which was the status of the Miscellaneous Governmental Organization (MGO) aspect of the JAC that had been raised in the questions at the bidder’s forum. The lawyers concluded that if the PPARC staff were moved too close

to the RCUH (Research Corporation of the University of Hawaii — the managing agency for the 'local' staff) terms and conditions, and if they were moved to a dollar salary (which was one of the possibilities under consideration), then that would effectively remove the MGO status currently enjoyed by the JAC. Being an MGO gave the JAC particular advantages, such as relief from import duty and special visa status with very extended stays for PPARC staff on secondment from the UK. Without MGO status, the way that the JAC was operated by PPARC would change dramatically and it seemed that PPARC (and I assume Canada and the Netherlands) did not wish to lose those advantages. So, how to treat the MGO status of the JAC was one of the complicating factors for the Hawaii site and was probably one of a number of risks and uncertainties that contributed to PPARC recommending that the current Prior Options tendering action should be terminated.

A subsequent article in *Nature* was very critical of the Government and the Prior Options process for the Royal Observatories and it noted that if the Opposition party (Labour) won the next election, due in spring the following year, it would make its own decision "based on science, not ideology". Both NAT and UCAR continued to proceed with organising themselves into viable bidding bodies. NAT held its community meeting on December 4, which attracted 17 attendees with 10 being separate from the RGO. The next meeting was scheduled for 1997 January 8. It is hard to overstate the amount of effort that went into these meetings and preparations of paperwork and looking into the legal status of charitable trusts and just energizing the UK astronomy community. There is no doubt that those involved in UCAR and NAT worked long and hard to argue for their cause, preserving the importance and capability of UK ground-based astronomy.

In parallel to the Prior Options troubles, PPARC was facing a very serious financial challenge. It informed the Ground Based Facilities Committee (GBFC) meeting in early December that the budget would be short by £2–4M over the coming two financial years and £2M per year thereafter. Reasons given included the cost of Prior Options so far, increases in international subscriptions, increases in university grant overheads, and restructuring costs. PPARC called a meeting of its four Site Directors on December 6. At that meeting each was required to prepare a single proposal that took into account a 30% cut with immediate effect and those would be discussed at the 1997 January 31 meeting of the GBFC. However, the *Gemini* Director, Dr. Matt Mountain, had been assured that his programme was protected from those cuts. As it turned out, Hawaii came out of that cut-back relatively unscathed for the time being compared to other areas. *UKIRT* had a slow-down in new instrumentation and a lack of commitment downstream, while the *JCMT* would be subject to an international review following a couple of years of *SCUBA* observations.

Benchmarking of costed options for the establishment of a UKATC

At the 1997 February 26 meeting of PPARC Council it was stressed that Prior Options was paused rather than cancelled and Council approved the Executive advice to remove the two island sites from the prospectus and leave only the UK domestic option open for future bidding. That was then sent for Ministerial approval. It was noted that because that was under Ministerial review it would be politically very sensitive and that discussion outside of PPARC or its bodies needed to be treated judiciously. It was interesting to note that a number of other government entities had just been released from the Prior Options process, but not PPARC.

In the meantime, PPARC Council had set up an internal panel to benchmark costed options for delivering the astronomy programme, focussing solely on the Royal Observatories. That panel would be made up of mainly Council members and would be chaired by Brian Eyre (AEA Technology). It included Dr. Sue Ion (BNFL) and Professors Enderby (University of Bristol), Hough (University of Hertfordshire), Pounds (PPARC), and Longair (University of Cambridge and non-Council). It would work to a very short time-table, reporting to the

Council meeting of 1997 May 20/21. The terms of reference were: “to consider a range of internally costed models for restructuring the Royal Observatories to deliver PPARC’s programme; to assess the cost effectiveness of each of these models; to take account of the downstream effects of such models and any implications for the science programme; to advise Council on the analysis of costed options, and, to recommend the way in which the restructuring should be managed.” [Punctuation as in the original.]

The evaluation criteria were listed under the following headings: cost-effective delivery; responsive capacity; interfaces with PPARC, community, and telescope facilities; minimizing PPARC’s risks and liabilities; transitional arrangements. Also, it was required that two benchmarking proposals should be submitted; one as a PPARC facility following PPARC rules and procedures and secondly under a different operational model whereby programme delivery and costs may be shared with a third party. The rules of engagement were specified and to ensure a level playing field PPARC (Swindon HQ secretariat) would provide the programmatic information about the future agreed programme. The Observatories would be able to inject additional (non-programme-approved) work they believed would be obtained. It was stressed that that was not a bidding process as in Prior Options but an internal review.

The implication is clearly that that would be the long anticipated ‘shoot out’: the culmination of Observatory Wars and there would be a single winner and a single loser between the RGO and the ROE. That meant that a considerable amount of work would fall on Swindon Office and the two Observatories over a very short period of time. The specifications, costing tables, and rules of engagement were released on 1997 March 21 and the bids were required by April 21! Those were very tight time-scales.

Jasper Wall promptly wrote to the VC of Cambridge explaining the situation and including a first pass at an RGO submission. That was an extensive document, based on the Company Limited by Guarantee (CLG) proposal of the proposed National Astronomy Trust and it projected that there would be a large positive discrepancy between the future work expected to fall to the RGO compared to the ROE. Meanwhile, the ROE had been talking to Serco about the possibility of them bidding to operate the UKATC. Serco had taken over the NPL in 1995 and had a potential interest and also a connection in that Donald Pettie, the Chief Engineer of the ROE, was a close friend of Serco’s Chairman George Gray. That led to discussions between Serco and the University of Edinburgh about the possibility of a joint venture. The final submission to PPARC from the ROE included three options: (i) traditional PPARC operation; (ii) a progressive partnership with the University of Edinburgh; and (iii) a Joint Venture Company owned by the University of Edinburgh and Serco plc. Throughout that, a key argument in the ROE submission was that instrumentation was the key to the future, and the instrumentation expertise was strongest in Edinburgh.

The decision of the Benchmarking Panel was essentially to endorse the Hough-2 recommendations — the UKATC goes to Edinburgh. Those were in turn approved by PPARC Council and forwarded to the Government for final approval in 1997 May. As it turned out, that was just after New Labour had come to power on May 1. The PPARC Council recommendations were subsequently leaked to the press (*Daily Telegraph*) on May 24, which concentrated on the projected closure of the RGO. That sparked a flurry of activity in the community with emails and letters to MPs and Ministers. In particular, Martin Rees and Phil Charles were very vocal in support of the RGO and looked to see if the decision could be reversed by meeting with the Science Minister (John Battle) before the official announcement. Richard Ellis wrote to his local MP, Anne Campbell, on June 9 in which he sought to gain the higher moral ground by urging her not to criticize PPARC in the upcoming meeting with the Minister, because although he was personally disappointed with the decision to favour Edinburgh over Cambridge, the fundamental decision to have only one Observatory was correct and was widely acknowledged in the community. He noted that astronomers needed to work with PPARC rather than against it and attempting to change the Council’s benchmarking decision could set things back by one or two years and cause more anguish

in the community and the Observatory sites. It would also exacerbate the financial situation for PPARC. To keep things fair, Edinburgh, represented by Andy Lawrence and Professor Michael Rowan-Robinson (QMW) along with two Edinburgh Members of Parliament, also met with John Battle to press their case.

In a separate note Richard Ellis pointed out that for the IoA the decision was serious in terms of accommodation as the rapidly expanding research complement had been partly housed in the RGO building and it looked impossible to re-house the staff in the existing IoA. He proposed that Cambridge University seek to negotiate with PPARC with the aim of retaining the RGO building for astronomy.

Judgement Day — a UKATC at Edinburgh

1997 July 4 was the date of the momentous announcement for UK astronomy by the new Labour Government. In a written parliamentary answer, the Science Minister, John Battle, announced approval to bring together the work of the two Royal Observatories to a single site and that would be known as the UK Astronomy Technology Centre and it would be located at Edinburgh. The same Parliamentary announcement confirmed that following advice from PPARC it would no longer have to adhere to the Prior Options process. At a stroke, that brought to an end the questions of privatization of the operations of the Observatories and island sites. The Hansard record is presented below. [Spelling, capitalization, and punctuation as in the original.]

Mr. Battle: The Particle Physics and Astronomy Research Council (PPARC) has decided to concentrate the work it funds at the Royal Greenwich Observatory (RGO), which is based at Cambridge, and the Royal Observatory Edinburgh (ROE) in a new UK Astronomy Technology Centre (UKATC) at Edinburgh. This new name will better reflect the fact that the Royal Observatories are now really observatories in name only. Their main function is to provide technological support for the telescopes operated by PPARC on behalf of British astronomers.

A substantial amount of money will be freed up as a result of this decision amounting to £2.4 million per annum over the next four years and at least £4 million per annum thereafter. This sum, which is equivalent to approximately 20 per cent. of the budget for astronomy grants, will be re-invested in basic science. It will fund grants to astronomers doing exciting new science in our universities. In addition, I am confident the new UKATC will benefit greatly from the increased efficiency and better co-operation between scientists which will result from combining the RGO and ROE programmes.

This decision will allow PPARC to reorganise the Royal Observatories in the way which best meets their scientific requirements. I believe that, as the responsible Research Council, they should have the freedom to manage their research facilities efficiently and effectively. PPARC will develop this in consultation with the unions and other interested parties. Under the previous administration, PPARC was bound to implement the conclusions of the 1995 Prior Options Review of the Royal Observatories that the management of the United Kingdom telescopes and the delivery of the instrumentation programme currently provided by the Royal Observatories should be subject to competitive tendering. PPARC have reviewed the situation in the light of developments since then and have advised me to release them from this obligation. I have decided to follow this advice in line with our long-standing opposition to dogmatic privatisation.

The concentration at Edinburgh will take place over some years. The RGO is an historic institution with a great tradition that has already survived two changes of location. I am asking PPARC to explore every possible avenue for keeping the institution alive. Nevertheless, this decision will lead to some job

losses. Therefore I have asked PPARC to make every effort to help anyone who loses their job to find alternative employment.

I have laid a copy of the report on which PPARC's advice was based and a copy of my letter to the Chairman of PPARC in the Library of the House.

On the same day PPARC announced a press release justifying the decision and given the momentous nature of the decision, that is worth repeating in full.

The Particle Physics and Astronomy Research Council welcomes the Government's decision today to release it from its obligations under the Prior Options process to review the future arrangements for the Royal Observatories. This allows PPARC to re-organise the Observatories in the way which best meets scientific requirements and protects scientific research in the Universities. PPARC now intends to implement the conclusions of its review panel on the Royal Observatories, which it accepted in full and have now been endorsed by the Government. The recommendations were that:

- the case for continuing to operate the two UK sites (the Royal Greenwich Observatory (RGO) and the Royal Observatory Edinburgh (ROE)) was not sustainable;
- there should be a single internationally visible UK Astronomy Technology Centre (ATC) to incorporate PPARC-funded activities at RGO and ROE, located at one of the sites;
- the ATC should be located at Edinburgh for the reasons given in the Panel's report.

These conclusions were consistent with the recommendation of PPARC's earlier reviews of the needs of the UK's ground-based optical, infrared and millimetre-wave astronomy programme; with the key findings of the prior options review and with the broad support of the UK astronomy community as expressed through the Royal Astronomical Society survey, for a move to operation on a single site. PPARC's ability to implement these conclusions will help free an average of £2.4 million per annum over the next four years and at least £4 million per annum thereafter. Without the restructuring now planned, the additional costs of continuing with the present structure and staffing levels would have had to be found at the expense of other parts of the programme — primarily grants to universities. The savings represent approximately 20% of the astronomy research grants. The money will be reinvested in astronomy.

The Decision brings to an end a period of some 15 years uncertainty about the future of the Royal Observatories. The Council's decision to proceed with this internal reorganisation will produce a structure matched to the long-term needs of ground-based astronomy in the UK. PPARC will be able to deliver its plan programme more cost-effectively.

The restructuring will not affect the operation of the existing telescopes on the island sites (on La Palma and Hawaii) nor the UK's contribution to the construction of the two 8-m *Gemini* telescopes being built in Chile and on Hawaii in collaboration with the USA, Canada, and South America. The Council has planned an outstanding future programme of astronomy planetary and space-science research and training, providing access for the UK community to a range of world-class facilities including the new *Gemini* telescopes, with unprecedented image quality, due to start operations in 1999. The other facilities include ground-based telescopes operating across the wavelength spectrum; and a range of current and future space missions. The Minister's decision now will be important in protecting that research.

The detailed case for the choice of Edinburgh as the UK Astronomy Technology Centre was set out in the report of the Council's review Panel chaired by Dr. Brian Eyre CBE, FEng (Deputy Chairman AEA Technology Plc). The key elements are that the Royal Observatory Edinburgh approach:

- more closely matches the current and future programme requirements for an advanced astronomy technology centre with the necessary skill mix to produce state-of-the-art instrumentation in collaboration with universities and/or overseas partners;
- to repayment work more closely matches the PPARC mission and objectives at least risk.

Staff of the Observatories have been informed of this decision, as have PPARC's international partners. PPARC is in the process of drawing up an implementation plan in consultation with all the organisations involved, including the trade unions, for the establishment of the ATC and for the delivery of the PPARC programme. The Minister has also asked PPARC to explore every possible avenue for keeping alive the historic institution of the Royal Greenwich Observatory.

As noted above, a major factor in the announcement was that that would, in principle, save a significant amount of money for PPARC. However, and perhaps not surprisingly, the potential cost implications were a major issue for the DTI and Ian Corbett had several tough meetings with DTI and Treasury officials seeking reassurance. Their worry was that SERC had effectively made a loss in moving the RGO from Herstmonceux to Cambridge and they were now about to make a further loss in disposing of the RGO building and staff. In the longer term PPARC would be expected to recoup the initial financial hit, but governments and politics tend to think short-term. However, the ROE had finally won and apparently the end was in sight for the RGO at Cambridge.

The implementation of the Observatory Wars decision

PPARC promptly set up an Implementation Steering Committee to oversee the decision, which also included changes to the management of the island sites. That Committee met on July 17 and had five key objectives, which were: "(a) to create a new PPARC entity — the UK Astronomical Technology Centre (ATC) on the Blackford Hill site in Edinburgh; (b) to divest PPARC of management responsibility for the delivery of non-ATC functions currently carried out by the ROE, and of the ownership of assets and liabilities associated with these functions; (c) to divest PPARC of management responsibility for the delivery of non-ATC functions currently carried out by the RGO, and of the ownership of assets and liabilities associated with these functions; (d) to ensure, in co-operation with other interested parties, the continuation of the ROE and the RGO; (e) to develop the management autonomy of the overseas facilities through increased delegated authority."

Those objectives essentially set the scene for the UKATC and remain today. Likewise, there were a number of important policy issues underlying those objectives. Those were: "(a) the ROE and the RGO, as presently constituted, will cease to be PPARC establishments and will be replaced by a newly constituted PPARC unit, the ATC; (b) the ATC's mission will be narrower and more focussed than that of the ROE and the RGO. It will be to provide technological support to the UK's astronomy instrumentation programme and to the development of PPARC's overseas ground-based facilities; (c) its longer-term viability will depend on its ability to deliver work cost-effectively in collaboration and competition with university groups and other suppliers; (d) the names 'ROE' and 'RGO' will be retained but the organisations to which they will be assigned will be decided by the Monarch advised by PPARC/OST through the Home Office/Scottish Office; (e) subject to negotiations with all

interested parties, the name 'ROE' will apply to the range of activities on Blackford Hill; (f) the transfer of non-ATC functions and the assets and liabilities of the RGO and the ROE will be contingent on negotiations with a range of interested parties, and decisions will be subject to rigorous business analysis to satisfy the requirements of public accountability; (g) organisations which require non-ATC functions may, provided they satisfy eligibility criteria, compete for funding through the normal peer-review review processes; (h) the Directors of the overseas facilities will have the authority to negotiate and place contracts with the ATC or other supplier organisations on the basis of cost-effectiveness; (i) the Directors of the ATC the ING and the JAC will have delegated authority to develop and implement distinct personnel policies and systems consistent with their specific business needs." [Spelling, capitalization, and punctuation as in the original.]

The document also covered the Management structure and Delegated Authority for the three sites.

Following that, Jim Sadlier, on behalf of Ken Pounds, issued a letter to PPARC staff updating progress since the July 4 announcement. As well as the expected meetings with the two universities involved, Ken Pounds met with the Standing Committee of Astronomy Professors on July 9, the Directors of the RGO (July 7) and the ROE (July 16), and the trade unions on July 28. Dr. Adrian Russell had been appointed as interim Director ATC and subsequently met with *Gemini* staff at the RGO individually to see how best to protect the *Gemini* work programme during the transition period.

The end is in sight for the RGO

On the assumption it would be closed, there were many issues to be sorted out at the RGO. Those included the library, the RGO archive, and the Starlink node. Staff of the RGO then attempted to organize a 'management buy-out' and Jasper Wall, Neil Parker, and Sue Tritton submitted a detailed 40-page proposal and business plan to PPARC in an attempt to maintain the RGO. That plan continued to be based on a Company Limited by Guarantee (CLG), retained a technology capability, seemed to require a construction programme that was in excess of what PPARC was planning, and would be a competitor to the UKATC. The plan went to the October meeting of PPARC Council but discussion was deferred until the December meeting.

On October 8, Professor Donald Lynden-Bell on behalf of senior staff of the IoA and Richard Hills of the Cavendish Lab wrote to Ken Pounds and PPARC Council pointing out the long history of the RGO and the potential for further work to be undertaken there in spite of the concentration of technology at Edinburgh. That on-going, and mostly PPARC-funded, work was in the fields of wide-field astronomy, astrometry and post-*Hipparcos* missions, astronomical data archiving for the UK, and supporting research. In November, the Cambridge University VC wrote to the Chair of UK Council arguing to retain the RGO along the same lines as Donald Lynden-Bell. Richard Ellis, as a member of the Implementation Steering Committee, also tried to rescue aspects of the RGO along the same lines of focussing on wide-field astronomy, astronomical data archiving, and astrometry (post *Hipparcos*). However, there was the growing recognition that PPARC would not back down and would not support an establishment that wished to retain its technology arm and would therefore be a competitor in some areas to the newly constituted UKATC. The final decision was made at PPARC Council on 1997 December 12, the RGO would be closed and its assets disposed of, and the staff transferred or made redundant. In fact, the RGO would finally close on 1998 October 31, bringing to an end 323 years of operation from its previous sites of Greenwich, Herstmonceux, and, finally, Cambridge. However, the future of the RGO building at Cambridge would now come into the frame.

On replying to the Cambridge's VC letter of November 20, Ken Pounds brought up that question and asked for a Cambridge view on how they would react to a transfer of the RGO

building to the proposed RGO CLG, or if the University might be interested in acquiring the building from PPARC for a negotiated sum, some of which might support operation of the CLG for a couple of years. The reply came on 1998 February 6. That was generally non-committal but was positive on the discussions with Ian Corbett regarding the transfer of some RGO staff to Cambridge. It also brought up the matter of the RGO name, which Cambridge would have preferred to retain but now looked likely to transfer to the National Maritime Museum, which was responsible for the operation of the original Observatory at Greenwich. That would satisfy the requirement of the Science Minister and the site at Greenwich would include a public-understanding-of-science aspect as well as being a national museum. However, Martin Rees remained opposed to such a move and wrote to John Battle expressing his dismay. Ken Pounds then wrote to Battle pushing the main reason for the decision to close the RGO (the dire financial situation of PPARC) and supporting the case for the transfer of the name to the museum at Greenwich, something that he noted was strongly supported by PPARC Council and the National Maritime Museum.

The situation now focussed on discussions with Cambridge University on the status of the RGO building, the transfer of some astronomy functions along with selected staff and of redundancy for those who would not have future funded roles. In the discussions it was quickly agreed that three RGO staff members would transfer to Cambridge University with regard to Starlink support and that the post docs would similarly transfer across. The non-staff costs then became a focus of negotiation, specifically the joint library and the RGO building. On 1998 September 10 John Love wrote to the University with a proposal for PPARC to surrender the lease of the building and for the University to then buy it for £2.75M. In exchange, PPARC would pay £750k to the University towards the alterations and extension of the IoA building and would pay 50% of the costs of moving the library from the RGO building to the IoA up to a maximum of £25k. Importantly, the name 'Royal Greenwich Observatory' would be excluded from any agreement.

Further staff transfers would be in the astronomy survey group and a small number of research staff. Some PPARC staff would not transfer to the University but would be relocated in the Cavendish building to the south of Madingley Road. Some PPARC staff would transfer to the UKATC in Edinburgh.

As part of the disposal of the assets within the RGO building, I remember a particularly unpleasant experience of visiting in late 1998 along with Colin Cunningham (ROE) and other representatives from La Palma and RAL to determine whether any of the equipment could be relocated to our respective sites. It was very depressing and given that it was not obvious that Hawaii would be a good location, especially given the shipping distance, I left after lunch. I believe the RGO conference-suite table and chairs eventually got transferred to Edinburgh!

The UKATC

So now we have the background to the decision-making process that led to the 1998 closure of both Royal Observatories and the formation of the UKATC at Edinburgh. Although on paper that included the closure of the 'old' ROE as it had previously operated at Edinburgh, they were undoubtedly the winners. The closure and dispersal of the RGO resulted in a large loss of staff from Cambridge and the transfer of eight staff to Edinburgh. Those turned out to be of high calibre and would serve the ROE well in the coming years. What is often forgotten is that there was an equivalent process that took place at Edinburgh, with the transfer of 'ROE' research staff to the University of Edinburgh (IfA) along with the Wide Field Astronomy Unit, which oversaw the UK Schmidt photographic survey plates and the *SuperCOSMOS* plate-measuring machine. That left the UKATC as a predominantly technology-focussed institution as intended by the Hough reports. The UKATC was officially opened on 1998 October 23 by Lord Sainsbury, the Minister for Science, with Adrian Russell as its first

Director. However, the size of the UKATC was more than double that recommended by Hough-2 and, depending on the work requirement, has fluctuated around or above this figure ever since.

Just to add an end-point to this story, in 2000 the UK announced its intention to join the European Southern Observatory, ESO. That would entail having access to a suite of 8-m telescopes (the four *VLTs*) but, more importantly, to be able to participate in the *Atacama Large Millimetre Array (ALMA)* on Cerro Chajnantor in Chile and eventually the next generation of ground-based telescopes, the *Extremely Large Telescope (ELT)*. The UK finally became a member in 2002 June and as part of the accession fee the UK agreed to provide the *VISTA* wide-field infrared/optical telescope, which was being built by the UKATC. *VISTA* had been put forward by a consortium of UK universities, led by Professor Jim Emerson of QMUL, for government support from a special university infrastructure fund, and secured £35M of funding. The UKATC had contributed important expertise to the proposal and its leadership in its construction was invaluable. After a number of hiccups *VISTA* was eventually delivered to Cerro Paranal in Chile, but that is another story, or rather a saga, in which I became involved as Director UKATC. Hopefully, someone will take up the baton and recount the story as it is intriguing, interesting, and a story well worth telling.

Regarding the on-going operation of the UKATC, it was becoming clear in the mid-2000s that we were becoming an oddity within PPARC, which was essentially a university grant-awarding and project-awarding body along with supporting the astronomy delivery on the two island sites. The Astronomy Technology Centre was not sitting comfortably within PPARC, especially as it was not a cheap facility and there had already been one attempt to close it, so the possible writing was on the wall for another attack. Therefore, with the blessing of PPARC senior management, as Director I initiated a discussion with RAL to become part of CCLRC [Council for the Central Laboratory of the Research Councils] (Rutherford and Daresbury Laboratories), probably within the Technology Department. However, no sooner had that discussion begun (we had only one meeting but received a positive reception) when, out of the blue in 2007 April, PPARC was, at a stroke, merged with CCLRC to become the Science and Technology Funding Council (STFC). One of the rationales for that merger was that the new body would have an economy of scale and would benefit from PPARC's strategic planning and financial diligence.

However, that merger opened up a major problem with regard to the overall funding; a multi-million pound 'black hole' was discovered in the finances. That would have severe impacts on projects and for the laboratories as a whole. A major casualty was the UK's participation in the *Gemini* Observatory. The *Gemini North* telescope had started operations in 2000 and was followed by the *Gemini South* telescope a couple of years later. However, by 2008 the criticality of the STFC funding situation described above resulted in the UK having to save a significant amount of money and so it was with regret the UK had to 'withdraw' from the *Gemini* operations. But, after a major outcry in the UK, re-admittance followed in December 2009, but, unfortunately, it was to be only a reprieve. Only three years later, in 2012, following on-going STFC financial problems, the UK formally withdrew from the *Gemini* Observatory. This time there would be no way back and that particular strategic aim of the Ground-Based Plan would be taken up through our membership of ESO. However, financial pressures continued and with two further closure threats fought off it was agreed that the UKATC should become a unit of the Technology Department of STFC, which duly took place. And, ending on a positive note, the UKATC continues to play a leading role in supplying world-beating instrumentation for the ESO 8-m telescopes (*VLTs*), the next generation (*ELT*) of ESO's ground-based telescopes, as well as space projects like the *JWST*, *MIRI*, and *LISA*. But that is another story.

With the invaluable benefit of hindsight it is probable that if the original Kingman conclusions of 1985 had been implemented then the current situation, broadly speaking, could have been in place by 1990, and all the resulting angst and expense would have been avoided.

However, the turmoil of Prior Options would probably have been unavoidable.

Acknowledgements

I would like to thank the following for providing input and comments on the text: Professor Jim Hough, Dr. Ian Corbett, Professor Richard Ellis, Professor Andy Lawrence, Dr. Adrian Russell, Professor Phil Charles, Professor John Peacock. I am particularly indebted to Richard Ellis for cataloguing and then digitizing a subset of his extensive archive and providing me with access to those data, without which this project would never have progressed.

REDISCUSSION OF ECLIPSING BINARIES. PAPER 30: THE SLIGHTLY EVOLVED F-TYPE SYSTEM BK PEGASI

By Ahmet Cem Kutluay & John Southworth

Astrophysics Group, Keele University, Staffordshire, ST5 5BG, UK

BK Peg is a double-lined detached eclipsing binary containing two late-F stars in an orbit with small eccentricity. We use light-curves from the *Transiting Exoplanet Survey Satellite* (*TESS*) and spectroscopic measurements from previous studies to measure the physical properties of the companions to high precision. We obtain masses of $1.411 \pm 0.004 M_{\odot}$ and $1.254 \pm 0.004 M_{\odot}$, and radii of $1.990 \pm 0.004 R_{\odot}$ and $1.460 \pm 0.004 R_{\odot}$, which are among the most precise measurements made for those quantities in normal stars. Those properties match theoretical stellar-evolution models for a solar chemical composition and an age of 2.65 Gyr. We also present an updated ephemeris of the system, as a result of our *TESS* measurements and a collection of mid-eclipse times from previous studies.

Introduction

This study is part of the on-going series¹ in which known detached eclipsing binary systems (dEBs) are re-analysed based on new photometric data, primarily obtained with the *NASA Transiting Exoplanet Survey Satellite*² (*TESS*). Our main objective is to exploit space-based observations³ to refine the measurements of the stellar components' properties and to incorporate those systems into the *Detached Eclipsing Binary Catalogue*⁴ (*DEBCat*^{*}).

In this work, we present a study of BK Pegasi (Table I), a dEB composed of two late-F stars in a slightly eccentric orbit. The system has the unusual characteristic that its more massive and larger primary component (hereafter star A) has a slightly lower effective temperature than the secondary (star B). That is a consequence of the primary's on-going evolution toward the sub-giant stage on the HR diagram⁵.

^{*}<https://www.astro.keele.ac.uk/jkt/debcats/>