1,000 Days to First Light
Construction of the Perth-Lowell Telescope Facility, 1968-71

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ABSTRACT

NASA launched its Viking probes to Mars in late 1975 after establishing an International Planetary Patrol Network of telescopes for planetary observations. Network sites were spread across the globe, and negotiations for a facility at the existing Perth Observatory in Western Australia began in 1968. 1,000 days later the new telescope saw first light. The new facility is unique in design. Inside a dome, the telescope sits atop a 12.8 m pier with wrap-around concrete staircase and supporting legs. This investigation discovered how, at the risk of compromising performance, such a departure from standard observatory design arose, and what the drivers were for the decision-making process. The principal designer was a public servant architect, Mr Tadeusz Andrzejaczek who was said to have made opportunistic design changes, but it seemed improbable he would have had such influence over a scientific installation. Image quality and astronomical seeing was a new science in the 1960s, and structural vibration amelioration was met by designing in massive strength and rigidity. Thermal expansion and wind stresses on the facility were reduced by design features including shade fins and protective walls, and ground thermal disturbance was addressed by subjectively raising the height. Seeing measurements were not a design requirement. The initial design was by Government Astronomer Bertrand Harris, and requests for re-designs came from him, but in close negotiation with Andrzejaczek who desired a structure of futuristic shape and proportions. Harris' designs were strongly influenced by his personal and professional background, and Andrzejaczek's design criteria were driven by his alignment with contemporary European architects and his artistic Post-Modern flair.

Key words: Perth, Lowell, telescope, construction, design

1. INTRODUCTION

The oldest known sky-watching construction is a 7,000 year old pattern of rocks in south-eastern Australia (Norris et al., 2012). From this to contemporary extremely large telescopes, optical, land-based observatories have just a few basic features in common. Mid twentieth century structures were no different in requiring an open space to build, and a (preferably) raised lot away from the general population. But such projects are now only feasible when very specific science requirements are requested, justified, costed, approved and realised.

In 1966, one of only a handful of university/publicly funded Australian observatories (Astronomical Society Australia, 2017), the Perth Observatory (PO) in Western Australia (WA) relocated 25 km due east, to the top of a nearby escarpment. The main research telescope at the new PO is known as the 61 cm Perth-Lowell. After arriving onsite in 1971, this telescope played a significant role in planetary surveys (Baum, 1974), the search for extra-terrestrial intelligence (SETI) (see NASA ADSAbs), exoplanet discovery (Thompson and Bryan, 1989), supernovae searches (Thompson and Bryan, 1989), meteorite astrometry (Burman, 1992), planetary ring discoveries (Bowers, 2017) and comet astrometrics (Sherrod et al., 1973). It is mounted under a motorised dome atop a tower, and is a focal point for visitors who come from far and wide for historical and star-watching tours.

The Perth-Lowell facility has its origins at the National Aeronautics and Space Administration (NASA) and the Lowell Observatory (LO) in Flagstaff, Arizona. Mars was in opposition in 1969, 71 and 73 with the best viewing expected for the southern hemisphere in 1971, and this International Planetary Patrol Network (IPPN) of observatories was to supply important data for NASA. The Perth-Lowell facility would go on to perform well in planetary surveys of Mars, Jupiter and Saturn (PO Archive; Fisher, 2016; Baum, 1974; Baum et al., 1970).

The excitement of the Apollo decade of space travel began in 1961, and by 1969 NASA's IPPN was expanding around the globe. NASA engaged the LO who then wished to establish and operate eight telescopes placed strategically, to enable 24-hour observation of the planets (Baum et al., 1970). The Perth-Lowell would be very important for collecting southern hemisphere observations, especially helpful for the Viking Mars missions of the mid-1970s (see Williams, 2017).

The manufacturer of the telescope, Boller and Chivens (B&C), were a Pasadena, California company founded in 1946 and specialising in mechanical and optical equipment (Winans). Their business was financially supported by Caltech faculty member, Arnold Beckman (Gallwas, 2004). Negotiations between the PO, the LO, B&C, NASA, and several WA Government departments finally resulted in a very unique telescope housing. As a result of an ongoing memorandum of understanding, the telescope is still on loan at the PO in 2017.

A Western Australian Heritage Council assessment describes the main PO building as a "…well-resolved example of the Late Twentieth-Century International style…" with "…high social value…" and "…very high scientific value…"…and with a "…high degree of authenticity. Changes to the place have been limited to construction of the new telescope buildings throughout the grounds including the 61 cm Reflector Building in 1971…" (WA Government, 2017).

The Perth-Lowell installation is a three-legged, concrete structure with a wrap-around external stair case and a 12 m tall telescope pier that extends 3 m into the ground and is exposed to the elements. For reasons discovered by the current research, this unusual design changed in height over several architectural iterations, and was variously influenced by predilection, science, budget, aesthetic licence and opportunism.

The radiant point for this investigation is an anecdote about the tower height, often repeated by PO Astronomical Officer, Mr Greg Lowe to Star Viewing Night patrons. When recently asked, Lowe re-iterated he "…believed that it was a result of the astronomers back in the late '60s taking advantage of the WA Government's largesse and lack of scientific know-how, in order to have the building made as high as possible to escape the shimmer at ground level." (Lowe, pers. comm., 2017). Further discussion about the uniqueness of the structure was uncommon and uncorroborated. Lowe is a retired, long serving, highly regarded employee of the PO and subsequent contact with him and the Acting Government Astronomer at the time, Mr Ralph Martin (Martin, pers. comm., 2012), raised the question of how such subjective licence was given/taken.

Why so tall? Avoiding ground thermals by raising the tower to forest canopy height does not place it in lamina air flow, and the cost of doing so far outweighs the cost of clearing some trees and placing it at a more modest height. The story of this telescope is relevant at many levels. Night- and day-tour hosts for the PO use the Perth-Lowell dome as one of their key talking points, not only for its astronomical achievements, but its physical housing, political story, instrumentation, and example of a unique piece of scientific hardware with real connections to economies and people.

2. GOALS

What circumstances lead to a local State Government architect deeming it "pleasing" (PO Archive) to raise the telescope to twice the specified height?

This essay focusses on two deceptively simple questions:

- What is the best explanation for the exaggerated height?
- What influences resulted in the atypical and futuristic, final design?

The answers involve analysing and synthesising several evidence trails. There are the individuals' trails: principal architect at the PWD, Mr Tadeusz Andrzejaczek (1915-1987), Director at the LO, Prof. William Alvin "Bill" Baum (1924-2012) and Acting Government Astronomer at the PO, Dr Bertrand "John" Harris (1925-1974). There was the telescope's trail: NASA, LO, B&C, transport, installation. And there were the local institutions' trails: Mt Stromlo Observatory, PO, WA Treasury and the PWD.

This essay examines a period leading up to and including the 1,000 days before first light on 8 April 1971, of the Perth-Lowell telescope. It describes how WA's multi-cultural, international, science community produced the unique telescope installation. It also shows how the design of the tower was influenced by specific features of existing buildings around the world, as well as the personal and professional predilections of two key individuals.

3. METHODS

The over-arching methodology was adapted from the University of Texas at Austin's, Historical Approach to Research (University of Texas). These guidelines are paraphrased below:

- identify a topic of significant interest to the astronomical community,
- search for and collect as much relevant information as time and resources allows,
- derive tentative hypotheses about the questions being addressed,

- obtain evidence that is high credibility, for as many of the details as possible,
- organize, analyse and synthesize the salient information, and
- write an essay to share the findings with the scientific community.

In the first instance, the topic chosen for this report has relevance and importance at three levels. Locally, the Perth-Lowell telescope facility is widely cherished and lauded when visitors arrive at the PO for either historical tours or star viewing sessions. Regionally, the PO and in particular the 61 cm telescope, is a remote and important scientific installation in one of the most remote capital cities in the world. And globally, the PO is proud to have been part of international science, and has recently had a full history written about it for a PhD thesis (Bowers, 2017). The current work supplements that PhD, and complements an existing PO library of historical artefacts and documents.

Searching for, collecting and obtaining information had several sources:

- personal, authorised face-to-face interview in the home of Andrzejaczek's son, Krysystof. The meeting was not digitally recorded, but hand written notes were taken,
- personal conversations with builders, surveyors, astronomers and other researchers,
- personal emails to managers of observatories, history researchers, government departments, academics, scientists, engineers and artists,
- PO and LO archived documents,
- WA Government departmental records and archives,
- text books, PhDs, and high credibility web sites,
- NASA's abstract service was used as a primary source search engine as much as possible, and
- an extensive general internet search for telescope installations that resemble the Perth-Lowell was undertaken.

4. RESULTS AND DISCUSSION

Table 1 is a timeline from 1915 to 1971, of selected events for each of the two key personalities in this story. It shows how different their backgrounds were, but as will be seen, it hides the great similarities in their motivation, intelligence and professionalism. Andrzejaczek's life trail is on the left, and Harris' is on the right. Some significant astronomical and historical dates are also inserted throughout. As a general reference, this timeline should help the reader follow the initially very different, but then overlapping lives.

Tadeusz Andrzejaczek was born just after the end of WW I, in 1915 in Częstochowa, the second largest city in the southern Polish province of Silesia. Just a year before, Russia had relinquished it's 100 year rule over the region, to the invading German Army. Tens of thousands of inhabitants were forced to flee to the next province, and Andrzejaczek, having been born into very difficult family circumstances was taken by his grandparents to their home in the northern city of Bydgoszcz, some 400 km away. Andrzejaczek completed his schooling there, before moving to the Polish capital, Warsaw at around 18 years old. Whether or not he travelled around Poland during his teen years is unknown, but unlikely (Andrzejaczek, pers. comm., 2017).

Concurrent with the post-war re-unification of Poland, and other geo-political re-shaping by the 1919 Treaty of Versailles, an architectural design movement was beginning to appear. The Modern Movement of the first half of the 20th century includes the International Style that originated in Europe around 1925. France's Le Corbusier, and Germany's van der Rohe were in the vanguard of this style (Pennsylvania Museum Commission, 2015) and well known examples include Le Corbusier's 1928 Villa Savoye in Paris and van der Rohe's 1929 Barcelona Pavilion in Spain.

Andrzejaczek's tumultuous young life was obviously difficult, but he had a deep interest in form and the built environment, and due to his love of all things French was doubtless aware of the bourgeoning International Style in architecture (Andrzejaczek, pers. comm., 2017). One of the observatories in his birth city of Częstochowa has some interesting resemblances to the Perth-Lowell telescope design (see Waldemar, 2014). Spending the interbellum period in Warsaw, the talented and creative Andrzejaczek joined the Polish Army in 1939 at the age of 24. Army life was not kind and while still in Warsaw he suffered a shrapnel injury to his knee within a week of signing up. Polish captives were not treated strictly as prisoners of war by Germany, but he spent the rest of the war in German concentration camps.

Bertrand John Harris was born 1925 in Patchem, Sussex in a tranquil, green south east corner of England. Harris' young life was quite different to Andrzejaczek's. Harris attended the Royal Grammar School of King

Edward VI in Guildford. He played rugby, cricket and chess. He won a Magnus mathematics prize, took part in debating and graduated in 1941 (Jennings and Utting, 1996). By age 21 he had served three years in the Royal Navy and had become employed by the Royal Greenwich Observatory, London.

Andrzejaczek made an extraordinary exit from the German holding camp system. Strongly enamoured of the French, he would frequently socialise with French inmates, dress like them, eat like them and speak their language. This behaviour was to pay off when, as the war was coming to an end, his German captors slaughtered all the Poles in his camp, releasing the French. Andrzejaczek portraying himself as a French prisoner, escaped, and fled to Italy and eventually, London by 1946. Interestingly, Andrzejaczek was to marry a Polish woman who was also a Francophile and wartime underground agent (Andrzejaczek, pers. comm., 2017).

This is as close as Harris and Andrzejaczek got to each other before their eventual meeting in Perth, WA. Both men were in London for the next handful of years, Harris completing a science degree, and Andrzejaczek completing a diploma at the Polish School of Architecture. By 1956 Harris was Experimental Officer at the Greenwich Observatory and had married a civil servant in a neighbouring county parish church. Also, by 1956 Andrzejaczek had sailed to Australia under the Australian Government's Assisted Passage Migration Scheme which was an effort to increase the country's population after the two world wars.

1963 finally sees both men settling in Perth. Andrzejaczek had ultimately disembarked at Australia's largest city, Sydney on the east coast before temporary accommodations in Canberra and an interim career in Adelaide. Opportunity and lifestyle brought him and his wife Maria to Perth, where they would live till he passes away in 1987 (Andrzejaczek, pers. comm., 2017). Harris accepted the post of Assistant to the PO Government Astronomer in 1957 and succeeded him in the job in 1963 (PO Archive). The next decade would see both men in the prime of their careers, before Harris passes away in 1974 (Jennings and Utting, 1996).

At this point, it is important to gain some global perspective. In 1964, the LO and PO had both been in existence for around 80 years and Australia's pre-eminent observatory at Mt Stromlo near the eastern seaboard, for 40 years. The PO was having funding and light-pollution issues and was going through a period of negotiation with government regarding budgets and relocation. Several of the observatories that would comprise the IPPN were not yet built, and existing observatories in South Africa and India that would eventually contribute to the IPPN, were reaching the end of their working lifetimes. NASA was just a few years old but B&C, the telescope manufacturer, were looking forward to a 20 year anniversary. Architecturally, Post-Modernism was rejecting the austerity of the International Style and new buildings were reflecting the local history whilst also being artistically expressive. A futuristic flair was becoming evident.

Andrzejaczek is not a common name in Australia, so a simple social media search quickly discovered the family who granted a face-to-face interview with Andrzejaczek's son, Krysystof. What was revealed over coffee and biscuits, was an amazing trail that lead Krysystof's family to Perth. Two important, specific details arose from the interview. First, the Australian National University's (ANU) online biography of Andrzejaczek describes him as "…a dreamer and an idealist…" who would not "…compromise on deeply felt principles…" (Sierakowski, 2007). According to his son, this is not really true. Rather, he was "…very energetically driven to complete his projects…", was "…very pragmatic…" and "…believed anything was possible…" (Andrzejaczek, pers. comm., 2017).

Andrzejaczek's ANU biographer, Charles Sierakowski, was a fellow graduate of the Polish School of Architecture in London. Sierakowski's own 2012 biographical interview is online (Sierakowski, 2012), and confirms that Andrzejaczek was Project Architect for the Perth Cultural Centre which is a post-International, Brutalist style (Apperley et al., 1994). But Andrzejaczek's son was somewhat sceptical about the accuracy of Sierakowski's description of his father's motivations. Andrzejaczek's other well known projects include the Kalgoorlie Court house, which is a Stripped Classical building and Perth's Anzac House, which has undergone many re-births (Apperley et al., 1994).

Second, according to his son, Andrzejaczek was "…absolutely fascinated…" with La Grande Arche de la Défense that was being built in Paris during the last few years of Andrzejaczek's life. The architect for La Grande Arche, the Dane Johan Otto von Spreckelsen (1929-1987) was a contemporary of Andrzejaczek who would become Director of the Danish Royal Academy of the Arts, and who used strong geometric shapes (Danish Government). Andrzejaczek would have definitely known about Spreckelsen's work because, as his son repeated, he was "…very much in touch with what was going on around him in the world…" often taking holidays to Europe and spending much time visiting and photographing buildings of interest to him, sometimes at the expense of including family in the pictures (Andrzejaczek, pers. comm., 2017).

The history of astronomy, and in particular Johannes Kepler's tract in the 'Six-cornered Snowflake' (Kepler, 1611) reveals strong interest with the Divine Proportion, otherwise known as the Golden Rectangle. If a rectangle with length 'b' and width 'c' has:

$$\frac{a}{b} = \frac{b}{c} \cong 1.618 \qquad \text{where} \quad a = b + c$$

then it is said to be in Divine Proportions. This ratio is seen in very many places in biological morphology, and is thought to be a basic element of nature and therefore visually pleasing. It is seen in the proportioning of body parts in plants and animals and in such structures as the Parthenon and the Taj Mahal (Surrey University, 2017). Coincidence as it may be, it is none-the-less instructive to consider that Andrzejaczek may have been at least unconsciously leaning towards these visually pleasing dimensions in the Perth-Lowell design. This may well be a simple human preference, but Andrzejaczek's personal history suggests he was particularly conscious of form and proportion, and likely to have known of the Golden Rectangle.

PWD records and PO archives show Harris' initial sketch, subsequent iterations, and Andrzejaczek's free-hand concept drawings all outside the Divine Proportion. Fig. 1 clearly shows this. If the final subjective decision to raise it to its present height had not been made, the structure would not have made Andrzejaczek or Harris, entirely happy.

According to his son, Andrzejaczek "…was a workaholic…" but also a great socialiser, home entertainer, cook and raconteur. In Perth, he and his wife would often entertain political, social and academic luminaries, having dinner parties followed by long, intensive, boisterous, discussions, often centred around anti-fascism and culture. Andrzejaczek was also artistic in his recreation, enjoying portrait painting, never buildings, and supporting compatriots like Mr John Birman OBE, who was the Perth Festival Director for nearly twenty years (Bolton, 2007).

Andrzejaczek's culture/art paradigm is relevant to his relationship with Harris. The ANU's biography web page on Harris was co-written by Ms Muriel Utting who also wrote a history of the PO between 1896-1962 (Utting, 2000). The other author of Harris' online biography entry was Prof. Philip Jennings, recently retired but still actively working on renewable energy and climate change at Murdoch University, WA (Murdoch University, 2017). Unfortunately, neither Utting's history, nor Jennings personally, were able to elaborate on Harris' ANU biography but both agree he was active in Perth's local amateur stage-play scene (Jennings and Utting, 1996).

According to Haynes et al., (1996) Harris could also be very pragmatic. On p93 they say he leveraged a government plan to build a freeway "…straight through the observatory…" by "…threatening to delay this costly operation…". The co-authors of that book are highly credible, hailing from the Commonwealth Scientific and Industrial Research Organisation (CSIRO), the Anglo-Australian Observatory (AAO) and the University of New South Wales. They would have been acutely aware of the determination applied by Harris to retaining functionality of the PO.

Returning to the timeline again, between 1964 and 1968 some rather large steps were taken. Despite the fatal setback of AS-204 (otherwise known as Apollo 1), NASA was making fast progress with the Apollo Program about to fly around the Moon. They were setting their sights on Mars with the Viking Program (Nature, 1969) and would soon engage the LO to develop the IPPN.

Harris was simultaneously negotiating with the Bergdorf-Hamburg Observatory in Germany to build a dome to host a visiting meridian transit survey team (PO Archive; Bowers, 2017), as well as expediting the recently approved move of the entire PO to a new site in the nearby Perth hills. At 380 m altitude, the new location in the Darling Ranges is seven times higher than the previous site (ElevMapweb), light pollution from the city's half million residents (UDIAWAweb) being the primary reason for the move (Bowers, 2017). Harris would have been pleased to have a new raised lot away from the general population, but had no inkling of the opportunity coming his way over the next few years.

Andrzejaczek was involved in the design of the meridian building on the new PO site, and although how he became involved was not discovered, there is documentary evidence that he was highly regarded and known by Harris. In a 1965 letter from an observatory manager in Hamburg, Dr J. von der Heide, to Harris, Heide remarks that Andrzejaczek's design of the new Meridian Dome was "…as technical as artistic very good building. We are very indebted to you and we beg to say our high respect to Mr Andrzejaczek." (cited in Bowers, 2017).

Around this time, new telescope facilities were being built at Cerro Tololo, Chile (1966), Mauna Kea, Hawaii (1967) and Kavalur, India (1968). These would become part of the IPPN, the Coordinator for which was William Baum. Harris was dedicated and active, and made interstate lobbying trips on behalf of the PO, so he was well known to the Director of the Mt Stromlo Observatory, Dr Bartholomeus J. Bok. When Baum visited Mt Stromlo, Bok recommended he approach Harris to discuss inclusion of the PO in the IPPN. The subsequent introductory letter from Baum to Harris is dated July 19 1968 (PO Archive). Baum's letter explained that the best telescope for the job was a 61 cm B&C Cassegrain reflector with focal ratio F/75. The LO would build a 35 mm film camera to take 4.5" images in quick succession through a range of inline filters (PO Archive).

It was more than 12 months of to-and-from communications mainly between Harris and the LO, and between Harris and Treasury, before in September 1969, the business manager of the LO suggested the loan of a B&C telescope for use in the IPPN, and that it may be retained for subsequent use. The official offer was to come later on 5 December 1969 and included funds for two local operators, equipment, supplies and petty cash. The telescope would be fabricated in five months for a June 1970 delivery (PO Archive; Millis, 2017). But the PO was responsible for building the housing for the telescope.

Those were heady days. Frank Borman, James Lovell and William Anders were preparing to blast off to the Moon, Harris was in his new office, successfully enticing international astronomy programs to the PO, and Andrzejaczek was a highly regarded local architect with experience in designing telescope facilities. Exactly 1,000 days after Baum's letter, the Perth-Lowell telescope was to see first stars. The clock was ticking.

There are four basic parts to a telescope installation. A solid stand (or pillar) on which sits the particular telescope mount, attached to which is the telescope or Optical Tube Assembly (OTA). All of this is housed in an appropriate structure, the design of which varies hugely but addresses such factors as the desired science, budget, protection from weather, optimizing functionality and, perhaps, aesthetics. But in 1968, who in the world knew the logistics of such an undertaking? And how would a scientist in far-off Perth, WA, find the latest and best? Of course the US Department of Defence was only now conceiving of the Advanced Research Projects Agency Network (ARPANET) that would inspire the global internet of today - this was an era of paper based mail, aeroplane trips and conferences, especially so for scientists like Harris who suffered the tyranny of distance.

In a September 1969 letter from Harris to the LO, he asks for some details to allow him to design the housing. He asked for specific housing requirements of the telescope, dimensions including pillar height, axis location, OTA length and minimum internal radius of the dome. In this no-nonsense letter he warns the LO that ground-level seeing conditions would seriously impair results, so this is the first suggestion that he wanted to have as tall a structure as possible. He went on to suggest an octagonal dome with hinged flap shutters to keep costs down but also to reduce wind loads, and he was very straight forward with his pessimistic views on the bureaucratic and slow-moving work force in Perth's PWD (PO Archive).

That same day, Harris wrote to his Treasury Department outlining the specifications of the telescope, and two weeks later he was writing his acceptance letter back to the LO. His discussions with Treasury were far from over, but in the letter to the LO, Harris expressed gratitude for the generous offer and advised of his subsequent plans. He was already preparing sketches and would forward them to the PWD as soon as possible for them to do their own drawings and costings. He again warned that the PWD plans may take 12 months just to get approval, and that their workers were very slow. He made it clear that he was still engaged in bureaucratic discussions with Treasury and that parliament would have to approve the expenses (PO Archive).

Harris subsequently learned that NASA's telescope supplier would be B&C in conjunction with the LO, and the OTA required 3.5 m radial clearance inside the dome. He set about designing a housing facility. His original first sketch of the Perth-Lowell tower is a simple pencil drawing on notepad paper (second from left in Fig. 1). The design is reminiscent of the building in which he had spent much of the previous few years - the Government Astronomer's observatory/residence onsite at the old facility near the city. He drew a rectangular building 8.5 m x 7.0 m with a second storey floor 7.3 m above the ground. The access stairwell was offset to one side within the building. The 'dome' is an octagonal structure with 2.6 m OTA clearance and has aspects in common with the old PO's 4-sided lookout tower cupola.

In an undated letter of around this time, Harris lays out the requirements for the installation. The letter is likely intended for the PWD because it was apparently accompanied by his sketches and a promotional brochure from B&C (PO Archive). In it he makes a few stipulations and a few concessions. The structure was to be built on the "…central ridge of the Bickley site…" some 91 m north of an existing astrographic telescope dome.

In this letter, Harris planted a confusing seed for the potential of increasing the height by saying that on economical grounds, the ideal height of the telescope axis has been reduced from 12.2 m to 9.4 m. No documentation was found to explain the increase from 7.3 m to 12.2 m, then back to 9.4 m. The building would now have two storeys of 3.6 m, plus 2.1 m for OTA and mount. Critically for the design outcome, Harris advises that his sketches are for a rectangular building "…on the assumption that the added cost of corner bricks is less than that of skilled labour for the curved end-walls of existing telescope buildings." Curved walls are not mentioned again.

Harris made another big concession to the budget in this initial proposal. His obvious preference for a hemispherical dome that would minimise wind resistance was mentioned but his octagonal design was offered as a concession to the budget. He also explains his first approximation for design of service rooms and utilities and, ever the pragmatist, he describes two more detailed aspects of the building: a 1.5 m square hatch in the top level floor that will accommodate raising/lowering telescope parts and other equipment via a block and tackle hoist mounted inside the dome, and the arrangement of internal doors with respect to bearing the load of the dome down through the structure to the ground. Harris was clearly more than an academic. He was also a good construction project manager.

This letter (PO Archive) was likely dated late 1969 because Harris then wrote to Baum on 23 January 1970 outlining exactly the same details, as well as advising that he had met with Andrzejaczek just after Christmas 1969, and was awaiting a quote from the PWD. Presumably, that recent meeting with Andrzejaczek was the crucial point when both men had an agreed understanding about the best height for the facility.

The PWD's preliminary cost estimate of AU$ 62,000 arrived 11 February 1970 and was based on first-round drawings done by Senior Draftsman Mr A. Chinnery – selected by Andrzejaczek for his experience in drawing the plans for the main buildings of the new PO (WA Government, 1969). Within a few days, Harris wrote to Treasury asking for funding, and although he was looking around for ideas to use the telescope after the IPPN program, he was advising Treasury that it was unlikely the telescope would be required to be returned.

April 1970 would have been Harris' most stressful month. In a stream of carefully worded letters swapped between himself, Treasury officers and the Under Secretary of the WA Government's Finance Department, the value of spending the equivalent of a total annual PO budget on one installation, drew some revealing and depressing sentiments from the bureaucrats:

- "Observatory work is mainly of scientific interest and the principal benefit to the State is one of prestige." (Finance Officer P. Wilson in PO Archive),
- "There would be no direct benefit to the State." (Finance Officer P. Wilson in PO Archive),
- "However, outlaying AU$ 62,000 for a AU$ 90,000 facility was appealing.", and
- "The advantages were intangible and support is not given." (Chief Finance Officer K. Binks in Po Archive).

Despite the politics, by 20 May 1970, Harris had somewhat surprisingly, received approval from Treasury, acceptance from Baum, approval from NASA and had signed a Memorandum of Understanding. He had specifications for the camera that the LO workshop was building, specifications for the telescope and dome, and knowledge that B&C were in the design and fabrication phase. He had also reminded Andrzejaczek of the 1 April 1971 deadline for observations to start.

Everything looked good, but other than the aforementioned letters, Harris' first sketch had no supporting scientific documentation that describes the technical requirements of height, thermal ground effects, wind turbulence, orientation, humidity. Was any of this considered?

A CalTech alumnus, and Chief Engineer at B&C (Winans), Mr William Baustian worked for Lick and Kitt Peak Observatories, and was probably one of the best known experts on the logistics of building large telescope facilities. Baustian was very experienced, and wrote widely about many aspects of setting up all aspects of a research observatory (see Baustian 1966; Baustian 1968; Baustian 1970), but he did regard telescope housing as "…a necessary evil…" (Baustian, 1971). So although there was knowledge in the international community, no evidence was found that it was sought by Harris or Andrzejaczek, or even suggested by NASA or the LO. It is interesting that Baustian was very well known to B&C and the LO and presumably Baum, but no evidence was found that Harris communicated with him about specifications for the telescope housing.

Telescope manufacturer B&C, though no longer in business, have a present-day web site built by exemployees and enthusiasts and email contact with them was helpful. One of their web pages (see Winans) has links to installations of their telescopes around the world. Photographs of telescope housings are not prominent in these pages, but they do have a good representation of the Siding Spring Observatory (SSO) in New South Wales, Australia. In the 1960s, the SSO also housed one of B&C's 61 cm reflectors (Winans). A quirk of these telescopes, is that they require to be installed on an off-set pier, hanging, in the southern hemisphere, off the south side. This was confirmed by email from Peter Verwayen, Senior Operations Officer at the Research School of Astronomy and Astrophysics, SSO (Verwayen, pers. comm., 2017) and adds to the required design considerations around the flexure of the exposed concrete pier for the Perth-Lowell. After installation, vibration issues did plague the performance of the telescope but they were not due to the engineering of the pier (WA Government, 1969). The metal wheels that rotated the dome caused too much vibration and were eventually replaced with pneumatic wheels (PO Archive). But all this was ahead of Harris and well after first light.

There is also no evidence that Harris spoke to Bok at Mt Stromlo about installations for the new telescope. This is surprising considering Bok had written an article for the Journal of the Royal Astronomical Society of Canada in 1960, in which he identifies at least four other locations in WA that had significantly more clear nights per year than Perth (Bok, 1960). A draught of this journal paper is held in the LO archives as part of the Perth-Lowell project records. The other sites are in remote rural towns north and east of Perth where the climate is hot and dry, but clearly they were not seriously entertained as sites for NASA's IPPN installation.

There was one stipulation the astronomers agreed on: the LO suggested in an early letter that the new dome should be "…high enough to avoid ground-level seeing problems…" (PO Archive). In a later letter from Harris to the LO, he hints that the new dome should be higher than the existing University telescope building, but no evidence was found to suggest that the seeing from this telescope was a particular problem.

Email contact with various overseas observatories was not very fruitful in terms of finding drivers of design criteria for telescope housings in the 1960s. Similarly, an internet search for expert or technical specifications for moderate sized research observatories returned minimal information about what features were considered.

The particular features that make the completed Perth-Lowell structure unique are the physical isolation from other buildings, the external stairwell, the curious height and the exposed pier. Could there be similar examples elsewhere in the world that either Harris or Andrzejaczek might have seen? As Andrew Williams, retired astronomer from the PO, said in an unpublished Statement of Significance: "Elevated domes for telescopes are extremely rare, and only a handful exist worldwide, making the Lowell dome a truly unique building." (Williams, 2016).

A fairly broad internet search uncovered less than a dozen observatories with a tallish tower that was not the smaller part of an incorporating building. Most observatories are built to the 'hemisphere atop a cylinder' design, with an internal stairwell to a second storey observing platform. There are certainly some very unique designs like the expressionist Einstein Tower in Potsdam, designed in 1921 by German Erich Hentschel, 1997 (Hentschel, 1997web). The Tuorla Observatory in Finland is tall and isolated, but again, a dome atop a cylinder (Tuorla Observatory). The Marina Towers Observatory in Wales is tall, on a cubic building, and isolated, but the building encloses the stairs (Marina Towers Observatory, 2015). The extraordinary Sphinx Observatory on the Jungfrau peaks in Switzerland has some common attributes, but again has internal stairways (Jungfrau Observatory, 2017).

What became clear from recommendations by observatory managers, is that there are just a very few obvious guidelines, but that local conditions dictated engineering specifications, and the end product. For instance, both the Director at Armargh Observatory (Ireland) and the Project Manager at Stellarium Gornergrat (Switzerland) agree that geographical location is the primary consideration, followed by local placement and general seeing optimisation (Burton 2017, Riesen 2017). It seems Harris was doing exactly what any good astronomer would have done in 1960s Australia.

Site location is obviously important. Mr Peter V. Birch, PO astronomer from 1970 during the IPPN program related in a personal communication that he believed the tower was raised to such a height in part to be able to see over the existing forest canopy and track Mars as far as possible towards the horizon (Birch, pers. comm., 2017). This is linked to the question of why the dome was situated exactly at a height contiguous with the tree canopy - a height at which lamina air flow is unlikely - a fact made clear in much modern literature on turbulence as related to power generating wind turbines (see Sagrillo, 2009). Sagrillo (2009) offers the common and generalised rule that the whole of a wind turbine must be clear at least 10 m above any structure that is within

150 m. The 12 m high dome floor of the Perth-Lowell is 10 m away from 15 m tall trees on at least two sides. It is in turbulent air amongst the forest canopy.

In any case, to prepare the site for construction, bulldozers had arrived during the first week in July 1970 (PO Archive), and the Eucalypts of the Jarrahdale State Forest presented no real obstacle, even providing some marketable timber (PO Archive). The new PO site was higher, darker and more remote than its predecessor, and clearing land for the new telescope facility simply required Harris' request from the lessor of the property, the WA Forests Department (PO Archive).

As the bulldozers were moving in, there are two letters that give perspective to several threads of this story. First, Andrzejaczek's full report is dated 10 July 1970 and constitutes the most complete description found in the records. In it, he describes several criteria best listed here:

- the pier foundation will descend 3 m into the ground and sit on "…ironite rock subsoil…",
- no explosives to be used,
- a hoist with 2 tonne capacity will be installed inside the dome above a 1.5 m square hatch,
- to reduce thermal turbulence from roofing, ground level buildings on the south side will be excluded from the design,
- the dome floor will now be 12.3 m above ground,
- to support the dome floor, two vertical concrete walls will rise alongside the otherwise exposed telescope pier that will be 0.8 m square,
- horizontal, concrete 'fins' will connect the two 'legs' and act as solar irradiance shields,
- extra concrete foundations will be laid in the event that walls of perforated bricks are subsequently required to protect the pier from strong winds,
- a 25 mm gap between the pier and all parts of the structure, including the dome floor, will result in "…no transmission of vibrations from the supporting structure onto the pier."
- the dome enclosure would be a low thermal capacity metal/plywood structure, the cavity of which would be ventilated,
- the dome itself would be a double skin of sheet metal, and
- amenities building with steel roof located at ground-level on east side (WA Government, 1969).

Clearly, he and Harris had been in close communication about what was actually going to happen. The height was back up to 12.3 m and Andrzejaczek had worked out how to support the dome floor with a unique concrete structure. Also obvious, is that wind turbulence and thermal seeing was seriously being considered now.

The second letter was from Harris to Baum and dated 13 July 1970. Harris advises that the "…structure has grown…partly because the architect thinks the appearance will be more pleasing if it is taller." Herein lies the crux of this whole investigation. Around June 1970, Harris and Andrzejaczek were obviously getting close to their preferred design and Harris was now boldly presenting it to NASA's representative. He was simultaneously stating to Baum that marketable trees had been removed from site, clearing was underway, and (still hedging his bets) there'd been a misunderstanding by Andrzejaczek when he'd read a letter from the LO Business Manager in which was made a statement about "…favourable times for planetary observations…". Andrzejaczek took this to mean there was plenty of time to complete the project (PO Archive; Millis, 2017).

Harris was looking at 260 days to first light on 1 April 1971 and no holes had yet been dug. Andrzejaczek was still hoping for a completion date of 1 March 1971, but his department's first estimate was for a 34 week project starting 3 August 1970 and ending 31 March 1971. And more modifications were to come.

The next records show that in August, there were some significant onsite changes and the new quote was now almost double the original. An insulated, metal, hemispherical dome was to be built by the State Engineering Works, there were changes to the hatch and many aspects of the ancillary mechanisms. And the height was now going to be 11.4 m, though this conflicts with Andrzejaczek's month-old report. In the end, a AU$ 12,500 dome was to be delivered to site and AU$ 43,000 diverted from a Government project for a gaol extension in the northern city of Broome (WA Government, 1969). Given that the current WA Government hold the plans shown in Fig. 4, it can be safely assumed that this is what was eventually built, and a recent personal measurement of the tower by the PO Outreach Manager Mr Matthew Woods concurs with the 12.3 m height of the dome floor.

Vegetation was certainly removed and pruned to height around the new site. Plans obtained from the WA Government under the Freedom of Information Act 1992 (Fig. 2), show that all trees were removed from a rectangle with its western side 18.3 m from the dome, southern side 10.7 m from it, eastern side 10.7 m and northern side 12.2 m from the dome. To the south is a large open area where trees over 9.1 m were removed. Outside the exclusion zone on the north side, trees of 15.2 m height were removed.

When it comes to astronomical seeing, the WA Government's State Records Office (SRO) archives hold engineering documents describing wind loads on the concrete pier, and design features to mitigate wind stress and solar thermal stress. Shortly after completion, annoying vibrations of 5" were considered too much, and efforts made to reduce it to 2". The physical structure of the Perth-Lowell was built to rigidly withstand movement by the wind, for instance designing the wrap-around external stairs and the fact that 50% of the budget went to concrete, half of which comprised the 26 m^3 telescope pier (WA Government, 1969). At one point, attempts were made to stabilize the wind vibrations by placing steel props around the outside of the structure (WA Government, 1969).

Perforated concrete blocks were proposed to ameliorate wind loads on the pier, but placing the dome at canopy height doesn't seem like the best choice. Add to this the single constant seeing parameter found throughout the evidence trail - ground thermal turbulence. Communication with Ken Kattner (Kattner, pers. comm., 2017), of the Putman Observatory in central Texas, USA, revealed that today's materials and engineering technology can produce a reasonable telescope dome on a tower with an exposed pier that also allows the local winds to cool ground thermals (see Orion Observatory). In the 1960s this was likely possible but would have been prohibitively expensive.

No evidence exists to indicate pre-construction optical seeing measurements being taken. In-fact, in two letters from the LO to Harris, a laissez faire attitude was evident. On 22 September 1969 the LO Business Manager said simply "…some type of shelter would be required…", and on 5 December 1969 the same person said they were not concerned about the type of housing, just that it be "… high enough to avoid ground-level seeing problems. If strong winds are common, perhaps some sort of windscreen could be provided…" (Millis, 2017). Harris' response was a little more specific, stating in his same September 1969 letter mentioned above, that the floor level of the new building should be "…at least as high as the existing telescopes…" the words "at least" being underlined. This presented the possibility that seeing from the existing 40 cm telescope may have been compromised, but log books and archives indicate no such issues (Bowers, 2017).

In a personal communication, former PO astronomer Andrew Williams had no knowledge of any seeing measurements being taken before construction. The first evidence for recorded conditions appears in the Perth-Lowell telescope Log Book entry of 10-13 April 1971. That log has an entry indicating the first night's seeing was too poor to observe, and the following few nights were clouded out. The first entry of internal dome conditions appears early evening of 16 April 1971. Dome temperature, humidity, transparency (0-10) and scintillation (0-10) were logged that night (PO Archive).

Lorenzo Zago of the European Southern Observatory provides a good and credible coverage of the basics of atmospheric seeing (Zago, 1995), and lists three main contributors:

- scintillation - mainly caused by air movements at around 12 km,
- turbulence in an interface layer between 30 m and 500 m, and
- ground and structure turbulence up to 30 m

Starting with these bulk atmospheric qualities, a seeing index may be constructed as a Full Width Half Maximum of an averaged disk of light taken during a 10-30 s exposure. For modern telescopes, a FWHM seeing value below 1.0" is good and 2.0" is acceptable. According to Zago, the telescope housing itself can contribute as much as 2". In 1972, astronomers using the Perth-Lowell were still trying to get the FWHM under 5", aiming for 2" (WA Government, 1969).

Distortion of stellar images was still poorly understood in the early 60s, the 1962 International Astronomical Union symposium in Rome recommending global data collection of seeing conditions for all significant telescopes – using the inadequate, 5-stage Danjon scale of lunar eclipse brightness (Roddier, 1981). Other measures of seeing like the Fried Parameter (Fried, 1966) and Strehl Ration can be calculated, but these tools were only just appearing in the literature in the very late 1960s (see for example Hazra, 1975). Zago pointed out in 1995 that there was no way to directly measure the factors immediately around the telescope that impacted on seeing. Birch advised in a recent email that scintillation seeing at the Perth-Lowell was assessed objectively on a 1-10 scale, similar in concept to the Pickering Scale (Astronomy Magazine) but without recourse to actual measurements. He recalled also that transparency was subjectively assessed on a 1-10 scale as a measure of

"…how dark the sky appeared to be…".

Back to the site. Construction had been set to start on 3 August 1970 and be completed, including the dome by 31 March 1971. This clearly did not allow time for testing before the first observation run of Mars on 1 April 1971. The 12.2 m height is mentioned in Harris' letter to Treasury on 16 February 1970 and by 13 July 1970, a week after the trees had been bulldozed prior to construction, Harris advises Director Baum at the LO that Andrzejaczek "…unfortunately…" had misinterpreted a letter from the LO Business Manager to mean there was plenty of time for the construction project (Millis, 2017; PO Archive).

As with the PWD and PO archives, the LO archives are a well kept and complete set of paper documents and they were made freely available by their respective managers. From this time, however, documented evidence about the construction essentially stops. The next communications are about post-construction issues around vibration mitigation and the logistics of setup and operations.

On 29 August 1970, however, the WA public were made aware of the project in a newspaper article that, presumably after an interview with Harris, informed of the need to withstand gale-force winds, to avoid ground thermals, to shade the pier and to have a low thermal capacity dome. The article says that as of that date, excavation of the foundations had been started. Fig. 4 below shows the newspaper article alongside a picture of the almost finished product. The latter does show some distance between the dome and the treetops, but clearly indicates that canopy-level air flow would impinge on the dome.

Around this time, there was plenty of communication between Harris and the LO about operational procedures, and an inventory of items to be shipped was sent in October, but virtually no documentary evidence of the actual construction process. By years end 1970, B&C were packing up the telescope for sea freight. The LO would be paying B&C just under US$ 9,000 to transport the telescope and have a B&C technician help install it. An early estimate of the telescope's arrival onsite was for November 1970, but by 22 February 1971 the shipping agent Loretz & Co., advised the telescope went to dock on 22 January, and left dock around 25 January on board the SS Gertrude Baake (Millis, 2017). It was six weeks before it docked at Perth's main harbour, Fremantle, then another 2 weeks in customs and processing.

After clearing customs, the telescope was eventually onsite in late March. With assistance from a B&C technician, it was eventually installed around 5 April 1971 and the aperture opened on the evening of 8 April 1971. Documentary evidence to elaborate on these few weeks was not found, but it is recorded that inclement weather delayed observations until at least 10 April 1971 (PO Archive).

5. CONCLUSIONS

The Perth-Lowell telescope installation was a late 1960s idea originating from NASA's need to have 24 hour observations of Solar System planets including Mars. Particularly needed was continuous atmospheric observations in anticipation of planned Viking missions. A global network was required, and locating one in the south west of Australia was beneficial, especially if it could be arranged before favourable planetary alignments in 1971. Several sites in the southern half of Western Australia had been appraised in 1960 by the Director of the premium observatory on Australia's east coast – Dr Bartholomeus Bok from Mt Stromlo.

The LO in the USA was to operate the IPPN for NASA, and through astronomy conferences and international connections, Bok had recommended the PO Archive be included in the network. Over a 3 year period of professional, persuasive and pragmatic negotiations, the PO's Bertrand John Harris managed the construction of a tall, isolated, post-modern telescope housing that saw first light 1,000 days after he was first contacted by the LO. He completed this task in close association with a WA Government principal architect, Mr Tadeusz Andrzejaczek.

Unknown to each other, Harris and Andrzejaczek both studied and worked in London for a handful of years either side of 1950, but they didn't meet until they were both settled in Perth, Harris by 1957 and Andrzejaczek by 1963. By then, each had lived through very different lives, but each brought similar qualities to the PO project.

Andrzejaczek was born into poverty in war-torn Poland, raised by grandparents and injured within a week of enlisting for WWII. A survivor of six years in German concentration camps, he made his way to London where he qualified in architecture. He was inspired strongly by French culture and closely followed architectural styles of the day. Qualifying for sponsored migration, he and his family boarded a ship for Australia in 1953 (P and O, 1953). He had a short career in Adelaide, South Australia then moved to Perth where he designed many public buildings including court houses, office blocks, police stations and art centres. Andrzejaczek was an avid portrait painter and socialised frequently with politicians and leaders in their fields. His son described him as pragmatic but having the belief that anything was possible. He was very aware of world politics, culture and design.

Growing up in 1930s south east England, Harris had a less traumatic youth, was a high achiever in a private school and married in a nearby parish church. He joined the Royal Navy and began his career with the Greenwich Observatory in London subsequently accepting an offer as Assistant Astronomer in a small, remote city on the other side of the planet. Harris proved his mettle in negotiations with authorities and energetically expanded the PO's international programs at the same time as overseeing the relocation of the entire observatory to a new site. Battling disinterested politicians and severe budget threats, he nonetheless employed Andrzejaczek to design several of the new telescope housings, including the object of this essay. After glowing compliments from international astronomers about Andrzejaczek's work, Harris cultivated the ideal person for the Perth-Lowell telescope job.

When the NASA-funded IPPN idea was presented to him, Harris immediately saw the benefit not only to the PO, but to WA's future as an important astronomy centre. NASA was offering a large, expensive telescope for indefinite loan, and all he had to do was build a housing for it. He had a new site ready to go, but a short timeline.

At a time before the internet, before easy recourse to contemporary peer reviewed expert knowledge about such projects, Harris and Andrzejaczek relied on their personal drive and experience to manage a project that was like no other in the world. These two men had vastly different life experiences, but both were technical and artistic, professional and strong. Harris had his hands full with politics and international negotiations, while Andrzejaczek had the deserved respect for his designing skill and for having his 'finger on the pulse' of contemporary culture. Both had high self confidence, a no-nonsense approach, and a regard for each other.

Outside of Harris and Andrzejaczek, it is not evident that expert knowledge was sought or offered for this project. Ground thermals, wind turbulence and mechanical vibration were all addressed with subjective confidence, the project growing as and when the opportunity was seen by either of these two men. It's true that Harris later lamented the fact that he "…did not take sufficient care in the planning stage to ensure that the pier was rigid enough…" and wanted to "…discuss this … with people who have experience in the design of telescope dome buildings and the associated stability requirements." (PO Archive). But this is 20/20 hindsight. He was very time-poor during the construction management phase, and international research, as slow as it was in the late 1960s, would have prevented the deadline being met.

Although it is also true that Harris quoted Andrzejaczek as having wanted the installation to be taller so it was more 'pleasing' to look at, the evidence suggests that in their regard for each others' technical, cultural and social idealism, it was realised that Harris' purposes were served best with the highest possible dome, and Andrzejaczek's input resulted in Divine Proportions (knowingly or not). Harris' skill at negotiating on the budgetary side of the project ensured the funds to achieve the best outcome.

In 1,000 days, the Perth-Lowell design went from a 7.3 m tall cubic structure with an octagonal dome and hinged fabric shutter, to a 12.3 m Post-Modern concrete edifice with an automated, hemispherical dome containing a 2 tonne hoist and a brand new 61 cm Boller and Chivens reflector. It had it's post-installation problems, but is still (in 2017) onsite under a Memorandum of Understanding with NASA.

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Table 1. Timeline of Salient Dates for Tadeusz Andrzejaczek and Bertrand Harris

Andrzejaczek	**Year**	**Harris**
Born southern Poland	1915	
Moves to Bydgoszcz with grandparents	1916	
	1917	
WW I ends	1918	
Poland re-created by Versailles Treaty	1919	
	1920	
	1921	
	1922	
	1923	
	1924	Mt Stromlo Observatory opens in Australia
International architecture style arises in Europe	1925	Born southern England
	1926	
	1927	
	1928	
	1929	
	1930	
	1931	
	1932	
Moves to Warsaw	1933	
	1934	
	1935	
	1936	
	1937	
	1938	
German massacre in Bydgoszcz	1939	WW II begins
Enlists and leg shrapnel then German holding camps	1940	
	1941	Matriculates Royal Grammar School, Guildford
	1942	
	1943	Joins Royal Navy
	1944	
Out of holding camps	1945	WW II ends
Living in London	1946	Employed at Royal Greenwich Observatory
	1947	Boller & Chivens founded
	1948	
	1949	
	1950	
Graduates Polish School of Architecture, London	1951	
	1952	Graduates B. Sc. Uni London
	1953	
Arrives Sydney Australia (Perth stopover)	1954	
Sydney to Canberra to Adelaide	1955	
	1956	Promoted to Experiment Officer Greenwich Obs.
	1957	Assistant Astronomer at PO
	1958	NACA merged into NASA
	1959	
Bok's article on potential Australian observatory sites	1960	Apollo era begins
	1961	Acting Govt Astronomer at PO
	1962	
Arrives Perth to stay	1963	Becomes Govt Astronomer at PO
	1964	
Highly praised for Meridian dome design	1965	
Cerro Tololo Observatory opens	1966	PO moves to Bickley
Mauna Kea Observatory opens	1967	Harris gets Meridian program running
Kavalur Observatory opens	1968	Baum writes to Harris
First Moon landing	1969	LO confirm shelter etc needed
Full architect report July	1970	Bulldozers arrive July
Telescope arrives Fremantle Mar	1971	Telescope installed and first light April 8

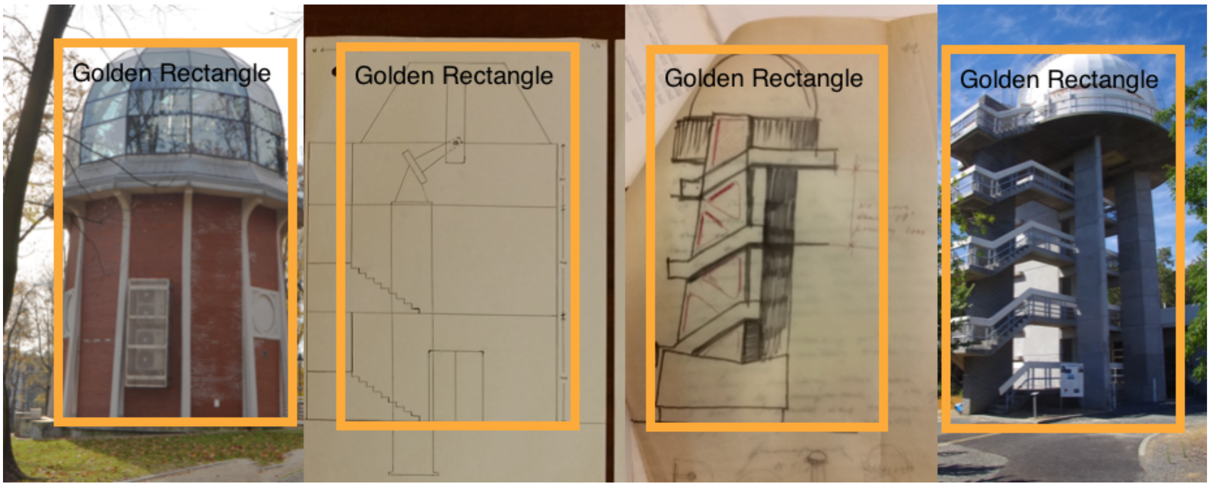


Fig. 1 The Divine, or Golden Rectangle, in orange, is a visually pleasing shape seen in nature and used in architecture. The observatory in Częstochowa (far left), conforms to this shape, as does the final Perth-Lowell facility (far right). Harris' first sketch, second from left and Andrzejaczek's early concept do not fit the Golden Rectangle.
(Credit: L-R J. Waldemar, B. J. Harris, T. Andrzejaczek, R. Hunt)

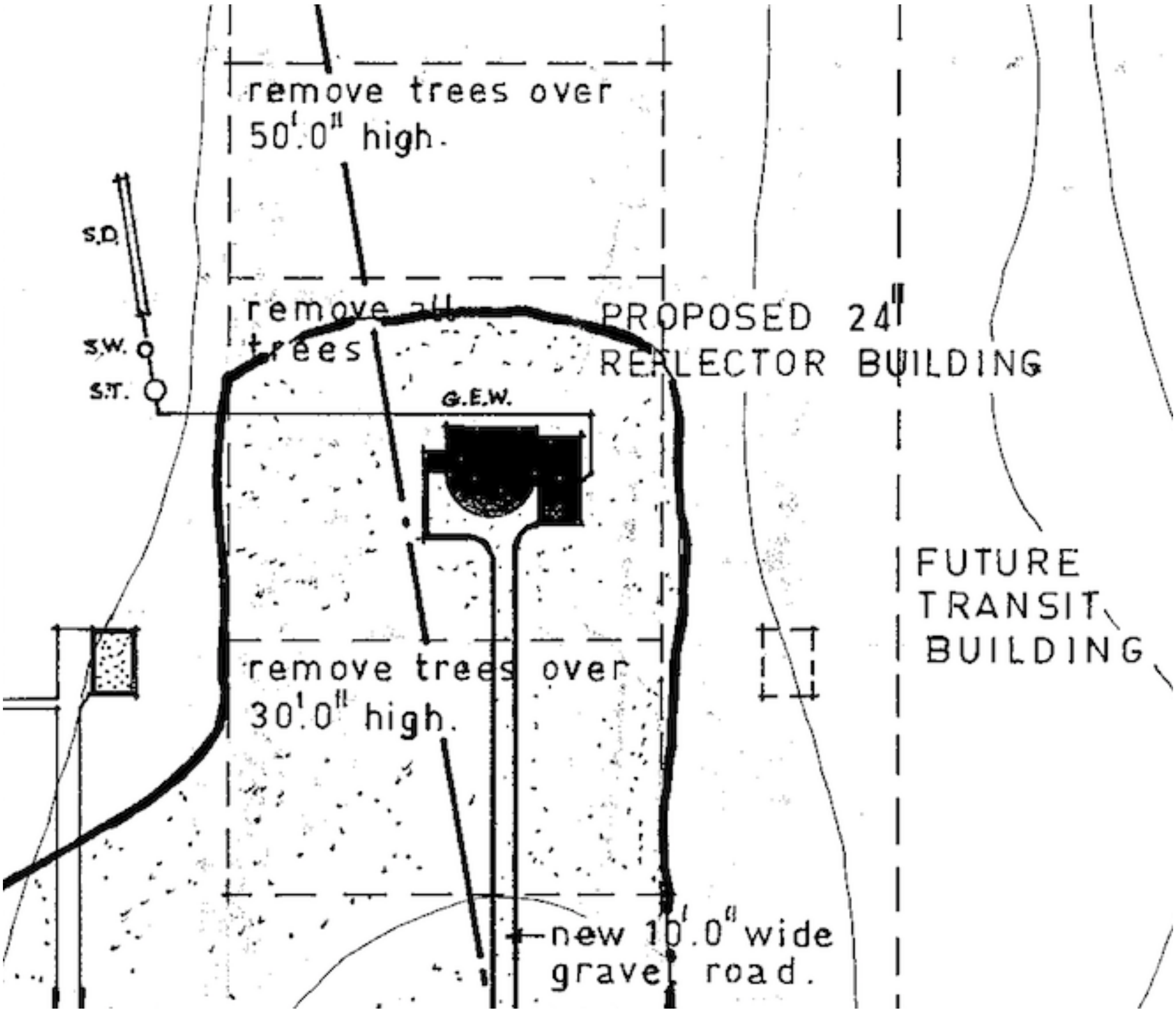


Fig. 2 Part of the site plan for the Perth-Lowell facility which is shown in solid black. All trees and vegetation were removed from a rectangle immediately around the tower, particularly up to 60 ft to the west. Trees over 50 ft were removed outside a line 40 ft to the north, and 35 ft to the south. Today, trees of at least 40 ft grow within 30 ft on the west, north and east sides of the facility.
(Credit: Cann, PWD)

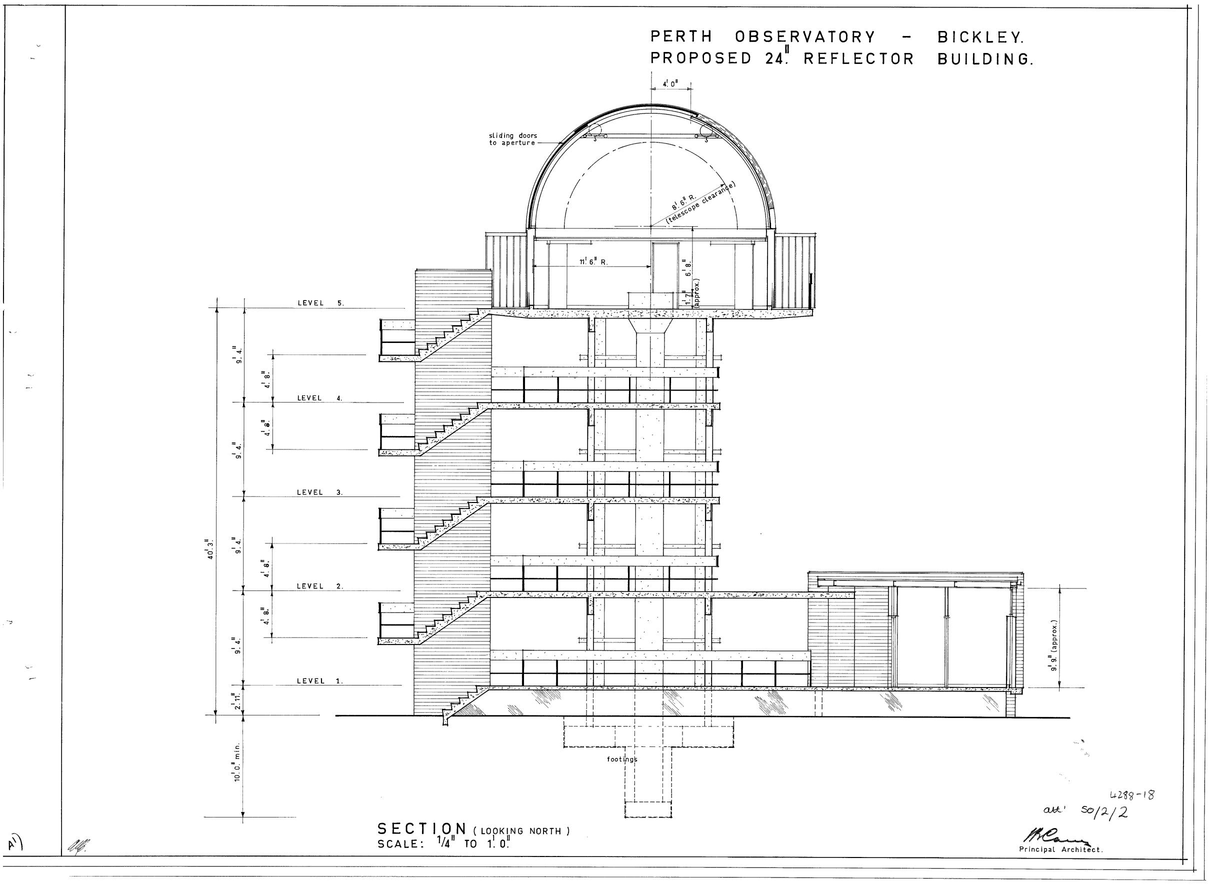


Fig. 3 Final plans for the Perth-Lowell telescope facility. The height of 40 ft 3 inches is clearly shown, as is the exposed pier and wrap-around staircase. Shade fins can be seen as horizontal members behind the pier. The supporting concrete legs are not shown in this cross-section.
(Credit: Cann, PWD)

"WEST AUSTRALIAN" 29TH AUGUST 1970

Architecture

Tower will house space telescope

The 45ft.-high tower at Bickley to house the 24in. United States telescope will have a free-standing centre pier.

This major structural component will support the reinforced concrete platform carrying the telescope and protective dome.

This centre pier must be as stable as possible and will be protected against solar energy by horizontal fins on the northern side.

Perth's summer sun can cause soil surface temperatures to rise above 150deg. This could result in a lot of movement in the 45ft. pier if it was left exposed.

The telescope, from Lowell Observatory in Arizona, will be used to aid America's space exploration programme. It will be part of a round-the-world, 24-hour watch, aimed particularly at Mars.

Excavations have been started for the new tower on the Perth Observatory site. The telescope will be one of the few in the world on an elevated platform.

It is important that an instrument of this size should be located above the level of thermal turbulences, which affect clarity of vision.

The tower structure and its external staircase will be built of reinforced concrete. The static and revolving part of the dome will be of a steel-frame, metal-sheet construction, which cools rapidly at night.

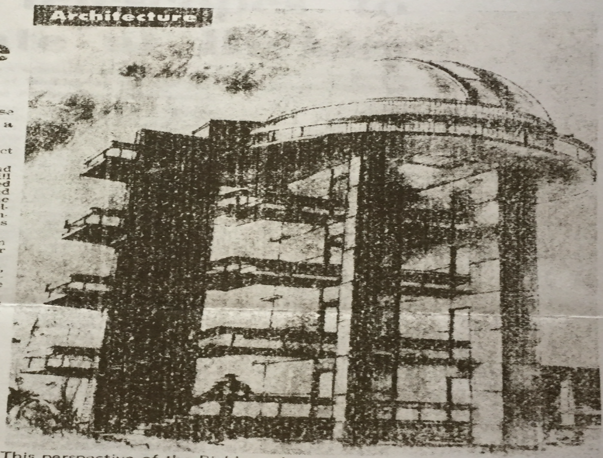
The staircase has been designed to have other practical values.

It will act as a bracing, to withstand the pressures of gale-force winds.

Also, each level will be a staging area for stabilising the telescope's mirror, which will have to be lowered at regular intervals. The mirror will have to be taken to a workshop-laboratory for cleaning and aluminising.

The telescope will be the biggest in this State. It is due to arrive in Perth later this year.

Construction of the $60,000 tower (about half the value of the telescope) is scheduled to be completed before the end of March. It was designed by the architectural division of the State Works Department.



This perspective of the Bickley telescope building shows how the dome is located on a free-standing centre pier.

State Library of Western Australia

Fig. 4 Left: On 29 Aug. 1970, the WA public was promised a new Perth-Lowell telescope installation. Other than some journalistic errors of fact, the article uses one of Andrzejaczek's later drawings that captures the final outcome very closely. Right: The facility was open for business 230 days later.
(Credit: The West Australian, WA State Library)