Royal Observatory, Cape of Good Hope, Republic of South Africa

Ian Glass

1. Identification of the property

1.a Country/State Party: Republic of South Africa

1.b State/Province/Region: Western Cape

1.c Name: The *Royal Observatory, Cape of Good Hope* is the original name for the headquarters of the present-day *South African Astronomical Observatory*.

1.d Location: latitude 33° 56′ 4″ S, longitude 18° 28′ 39″ E, elevation 15m above MSL.

1.e Maps and Plans: Property diagrams and other maps of the Royal Observatory property exist from many epochs. See also Figs 8.1 and 8.13.

1.f Area of the property: 9 hectares

2. Description

2.a Description of the property

Introduction

The Royal Observatory occupies a small wooded hill about 6 km east of central Cape Town, within a conservation area known as the Two Rivers Urban Park. Its location was originally chosen to be within view of the Table Bay, the anchorage in front of the City, to permit the visual signalling of time to visiting ships. The property is one of the last remaining places close to the city centre where the original ecology of the area is preserved. Its low-lying portions are subject to occasional flooding.

Some sixty or more structures occupy the site at present. Many of these date from the nineteenth century. The Greek Revival Main Building of 1825–8 still dominates the hill and faces a lawn to the south which forms an axis along which are many smaller edifices such as domes and dwelling houses, most dating from the Victorian period and forming a pleasant coherent whole. The only large modern building is inconspicuously located at the back (north) of the Main Building towards the northern end of the property.

The property is situated adjacent to the Cape Town suburb of Observatory, which grew up beside it, towards the east, in the late nineteenth century. Cape Town is the capital city of the Western Cape Province, Republic of South Africa. Founded by the Dutch East India Company in 1652, it is regarded as the ‘mother city’ of present-day South Africa.

The proximity to the centre of Cape Town and the availability of parking space makes the Royal Observatory site a convenient and valued meeting place for the astronomical and some other scientific communities.

Fig. 8.1. Google image of the Royal Observatory. The H-shaped main building was completed in 1828. North is at the top. To the north, north-east and east is swampy land. A canalised river runs along the western boundary and a mental institution lies to the south. © 2012 Google

Environment

The land in this area is underlain by greywacke, quartzitic limestone and shale. Before it was acquired for the Observatory, the landscape was rocky, treeless and windswept, but nonetheless supported a remarkable variety of seasonal grasses and bulbs. No longer barren, over the nearly two centuries of its existence the site has been planted extensively with shrubs and trees to act as windbreaks.

Although it is the habitat of many interesting flora and fauna, the site is particularly noted for being the last remaining natural habitat of a rare Iris *Moraea aristata* and the northern limit of the Western Leopard Toad *Bufo pantherinus*, an endangered species.

The site is no longer dark and rural. Beyond the boundaries of the Two Rivers Urban Park, which encircle it, the Observatory site is surrounded by freeways, major roads, office buildings etc.

Intangible heritage

For most of its existence the Royal Observatory was the major contributor to positional astronomy in the southern hemisphere. Among its most important achievements were:

- The first successful measurement of the distance of a star by Thomas Henderson (1832-3), announced in 1839. He detected the parallax of Alpha Centauri against the background of more distant objects as the earth moved around its orbit. The search for the parallax of the stars was almost the 'Holy Grail' of astronomy, having been a prediction of Copernicus's heliocentric theory of the Universe published in his *De Revolutionibus* of 1543. This discovery and the slightly later work of F.W. Bessel were described by Sir John Herschel in 1841 as 'the greatest and most glorious triumph which sidereal astronomy has ever witnessed'.
- Maclear's repeat and extension of the geodetic measurements carried out by N-L de La Caille that showed that his conclusion that the shape of the earth was significantly different in the southern and northern hemispheres was wrong.
- The first use of photography to make a systematic sky survey, by David Gill from 1885. From photographic experiments made around 1882 Gill realised that photography was the method of choice for mapping the sky. Photographic plates gave a permanent and impersonal record of star positions that could be consulted forever. Refused support from official sources, Gill financed at great personal sacrifice the Cape Photographic Durchmusterung, the first catalogue of stars observed by photographic means. A few years later, Gill was the leader of the Astrophotographic Congress with Admiral Mouchez of Paris. This meeting, which led to the international sky-mapping project known as the Carte du Ciel, is often regarded as the precursor of the International Astronomical Union.
- The measurement of the 'Astronomical Unit' made by Gill using observations of minor planets yielded the most accurate value of this fundamental quantity for several decades.
- The design and instruction of a new type of Transit Circle by Gill, which inspired many later instruments of this kind until the field was taken over by artificial earth satellites in the 1990s.
- The measurement of stellar angular diameters by means of Lunar occultations by David S. Evans in the 1950s.
- The measurement of standard star brightnesses (magnitudes) by Alan W.J. Cousins from the 1940s to the 1990s. This ultra-careful work is fundamental to many areas of astronomy including the cosmic distance scale. He was also responsible for introducing the current system of VRI photometry.
- Verification by J. Churms of the rings around the planet Uranus in 1977 by observation of the occultation event also seen by the Kuiper aeroplane.

It is also the location of the oldest photographs taken in South Africa and the photograph of the main building is the oldest of any observatory (excluding that of Herschel's outdoor telescope).

Fig. 8.2. The Main Building. Photograph © Ian Glass

Tangible heritage—a partial inventory

Immovable items—buildings and grounds

The property was for many years maintained to a very high standard by the local branch of the British Office of Works, which caused it to be regarded as a showpiece. Much remains of the general appearance of the campus is as it was around 1900 and many of the buildings—even the more peripheral ones such as the Victorian residences—have been classified by specialised heritage architects as worthy of preservation. Certain of them have considerable architectural merit.

- *The Royal Observatory complex as an entity in itself*

  The observatory campus forms a coherent enclave of scientific buildings. It was administered at first by the Royal Navy and, even following the Simonstown agreement (when the Royal Navy withdrew from South Africa), enjoyed extraterritorial rights. This led to a certain unique atmosphere and a feeling that it was a special outpost of empire. The buildings are all white-painted in the general style of Cape Town, with its Dutch colonial heritage. For much of the twentieth century there was little change or development, leading to a unique atmosphere preserved up to the present day. Many visitors comment on its 'rus in urbis' feel.

- *The Main Building*

  The Main Building of the Observatory (see Figs 8.1 and 8.2) was completed in 1828. The architect of this Greek Revival structure was John Rennie the Elder (1761–1821). He was born in East Lothian, Scotland and worked for James Watt at Soho before opening his own engineering business in 1791. He was considered to be 'a man of unbounded resource and originality'. He designed many canals, bridges, docks, breakwaters and even a lighthouse. Among his most famous works was Waterloo Bridge, London. Two of his sons also became notable engineers.

  His designs for the Royal Observatory, dated 1 March 1821, are located today in the Public Record Office (UK) and have been reproduced by Warner, B., 1979, in 'Astronomers

at the Royal Observatory, Cape of Good Hope', Balkema, Cape Town and Rotterdam. Some copies of these exist at the Observatory.

Rennie was Chief Engineer to the Admiralty. Unfortunately, he died before the construction commenced. The Admiralty sent out John Skirrow as Clerk of Works. Building commenced in 1825 and was completed early in 1828. The choice of building materials was left to Skirrow.

The walls are made of plastered-over uncut stone and the floors, doors, window frames, stairs and shutters, which still remain, were made of teak. The ironwork of the shutters is still in place. The impressive Doric pillars were constructed of brick with wooden cladding.

The upstairs window sashes of the residential wings are unusual in that they can be raised into the walls completely to allow free air circulation on hot days. The corners of the cornices feature small plaster flowers.

The first instruments, a mural circle and a transit telescope, were installed and ready for operation by the end of 1828. The only relics of these instruments still at the Observatory are their objective lenses. However, the Hardy clock that was used in connection with Right Ascension determinations is still there.

In 1829 the domes made of copper and brass arrived (see Fig. 8.12). However, they turned out to be unwieldy. Instruments within them were only supported by the roof and were subject to severe vibrations. They remained unused and were removed in 1883. The last instrument within the Main Building, an Airy Transit Circle similar to that at Greenwich, was removed in 1950, though its eye-end and objective have been preserved. The 'chases', or openings in he walls and roof, through which the Circle viewed the sky were also filled in at this time. The central 'lantern' structure was removed in 1961 and replaced by a skylight.

At the present time, the central rooms of the building are used to house the national library for astronomy. The bookcases date from the nineteenth century. The rooms in the wings, which were originally used as residences, are now mostly offices for the astronomers.

- *The McClean Building*

The next building of special architectural significance is the McClean, officially the Victoria, Telescope (Fig. 8.3). This was completed in 1896.

The building was designed by (later Sir) Herbert John Baker, the best-known colonial architect to have worked in South Africa. It is one of his earlier designs, following his rapid success after being patronised by the financier and politician Cecil Rhodes.

Baker executed several large projects, such as the Union Buildings in Pretoria. There are many examples of his work throughout South Africa, including private houses, churches and various government buildings. This observatory was an early project and one of a kind.

Baker combined some elements of Dutch colonial architecture with British ideas. His use of stone courses and his unusual door shapes are characteristic. He often specified artistic details such as the rainwater box-funnels above the downpipes, which carry the date 1896.

The Observatory possesses two of Baker's original drawings of this building.

The rotating dome was built by Cooke of York. The latter was originally rotated by a hydraulic motor, but this was later abandoned in favour of electricity. The dome features a rising floor, still powered hydraulically. The original 3-cylinder hydraulic pump (Fig. 8.4) is still in use, powered by an A.C. motor of 1920s vintage. The previous D.C. motor has been preserved. Adjacent to the dome is a battery house (1897) that stored energy generated during the day from a steam-powered plant for use at night.

Fig. 8.3. Exterior of the McClean Building (dome and laboratory). Photograph © Ian Glass

The telescope was made by Howard Grubb of Dublin. Considerable difficulties were experienced during the construction. These have been documented by Glass (1997).

As the McClean building was being constructed, it was decided to add an astrophysical laboratory. This still exists, with its original cupboards, benches and fittings. It was the first spectroscopic laboratory in South Africa. It saw use in the period 1972–1987 as an infrared instrument laboratory and has been used since then as a museum.

The telescope was used over the years for spectroscopy and parallax work, with many publications resulting. An item of special interest was the determination of the diameter of Arcturus in the 1950s by David S. Evans using high-speed photometry during a lunar occultation.

The telescope is nowadays used on open nights for public viewing and, very occasionally, for special occultation events.

- *The photo-heliograph building* of 1848 (see Fig. 8.5) was originally built to house a 7.5-inch Merz telescope. The most interesting feature of this building is that it has a pre-fabricated wooden dome that runs on cannon balls.

- *The old workshops and engine room*, though architecturally of little interest, originally contained a steam-powered electricity generating plant dating from 1888, one of the first such installations in South Africa.

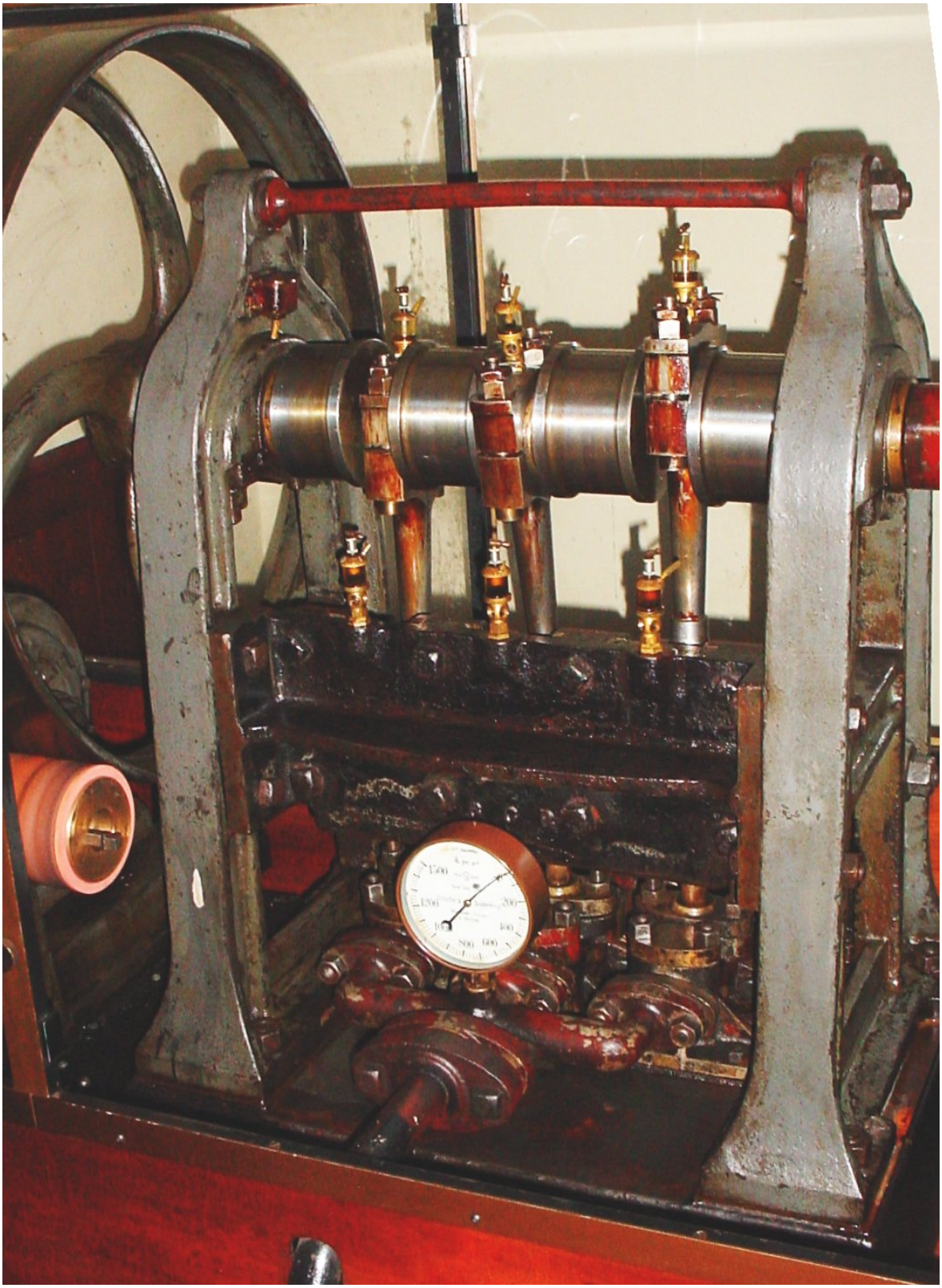

Fig. 8.4. McClean dome: the three-cylinder hydraulic pump (1896) that provides power for the rising floor. Photograph © Ian Glass

Fig. 8.5. Photoheliograph dome (1848). The wooden prefabricated dome, made in England, originally housed a Merz 7-inch telescope (1848) and now contains the De la Rue or Kew Pattern Photoheliograph made by Dallmeyer in 1875, mounted on a stand by Troughton and Simms (1874). Photograph © Ian Glass

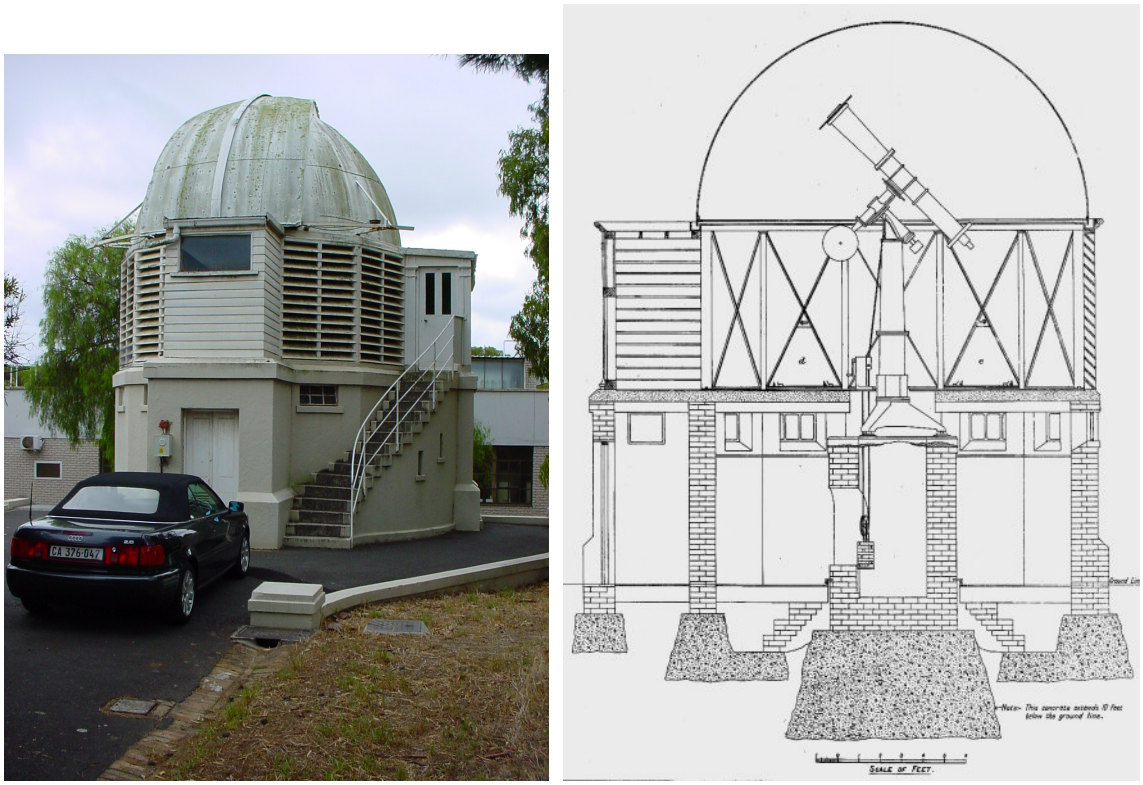

Fig. 8.6. Left: Heliometer dome with louvres for cooling and openable sides (1887). This dome houses the 18-inch reflector (1955), mounted on the original heliometer stand by Repsold. Photograph © Ian Glass. **Right:** Drawing of Heliometer dome as originally designed. Copyright © SAAO

- *The 18-inch building* (see Fig. 8.6), originally used for a Repsold heliometer, was designed by Gill with louvres and openable sides to allow for rapid equalization of inside and outside temperatures, a very modern idea. The metal skeleton of the upper part of the building and the dome were by Howard Grubb of Dublin. The only similar Grubb construction is a building at Armagh Observatory in Ireland of about the same period.

- *The Astrographic (Carte du Ciel) building* of 1890 still exists, with its telescope.

- *The Reversible Transit Circle building* of 1905 is in a double (inner and outer) steel building, designed to keep it cool during the day. It is accompanied by interesting collimator and mark houses.

- *Two nineteenth-century graves* of astronomers are located on the grounds: the first Royal Astronomer, Fearon Fallows, and that of Sir Thomas Maclear, together with his wife.

In addition, there are a number of 19th century observers' residences, meridian marks, small outbuildings, etc.

Movable heritage objects

Introductory note

The remainder of the tangible heritage consists of movable heritage objects, of which there are vast numbers given the length of time that the Royal Observatory has been functioning. Note, however, that the domes, and the rising floor of the McClean building, have not been included in

this list. They were taken to be parts of the buildings, even though strictly speaking they are movable.

Telescopes

- *7-inch (18cm) telescope* by Merz (1849). Used for the Transit of Venus 1882. Used also by RTA Innes (later the discoverer of the nearest star, Proxima Cen) who discovered with it 'Kapteyn's Star' and for double star work. Its Repsold stand was discarded at an early stage in its history as being too flimsy and it was probably then placed on the Troughton and Sims stand now used for the photoheliograph in its original dome. It is currently mounted as a guide telescope for the 18-inch described below.

- *'Kew Pattern Heliograph'* by Dallmeyer (1875). This telescope was used to take pictures of the Sun to monitor sunspots on behalf of the Royal Greenwich Observatory. Originally it was mounted on its own stand in a wooden revolving building whose foundation can be seen near the Astrographic building. It was moved to its present location in 1929.

- *6-inch (15cm) telescope* (Grubb, 1882). Though in a 1930s building, this telescope has an interesting history. It was with this that the bright comet of 1882 was first examined by Finlay, an assistant at the Observatory. The first astronomical photographs were taken on site with a camera mounted on this telescope so that it could be guided. It was also used by W. de Sitter for early photoelectric photometry.

- *Astrographic telescope* (Grubb, 1889). This was one of twelve telescopes of equal aperture (33cm) and 3.43m focal length, giving a plate scale of 1 arc min per mm, that were used for the international *Carte du Ciel* project. Its guider has an aperture of 10 inches.

- *McClean (Victoria) telescope* (Grubb, 1897). Three telescopes, a photographic refractor of 61cm aperture, a visual refractor of 46cm aperture and a guider of 20cm aperture, all having focal lengths of 6.8m, were provided. The first work with it used an objective prism for spectroscopy. Later, there was a 4-prism spectrograph and after 1925 it was devoted mainly to photographic parallax observations.

  The telescope is still functional and is used for public viewing.

  In 2011 the dome was extensively overhauled and parts of the hydraulic floor mechanism were renewed.

- *Gill transit circle* (15cm, 1905). Gill's design had a profound influence on later Transit Circles. The instrument was constructed by Troughton and Simms and the building was by Cooke of York. It was last used around 1980 and is complete, though in need of restoration.

- *18-inch telescope* (actually 49cm; Cox, Hargreaves and Thompson, 1955) on Heliometer mount by Repsold (1885). This telescope was used for setting up photometric standard stars by AWJ Cousins from the 1950s to the 1990s. His work was valued worldwide.

Small instruments

Very large numbers of small instruments remain in the possession of the Observatory and are displayed in a museum formed from the spectroscopy laboratory attached to the McClean Telescope building. Smaller numbers of antique measuring machines etc. are in storage on-site. A few items from the collection are listed below:

- A repeating transit by Dollond (see Fig. 8.7), described in a publication of 1820. (It was used by the first astronomer before the completion of the main building.)

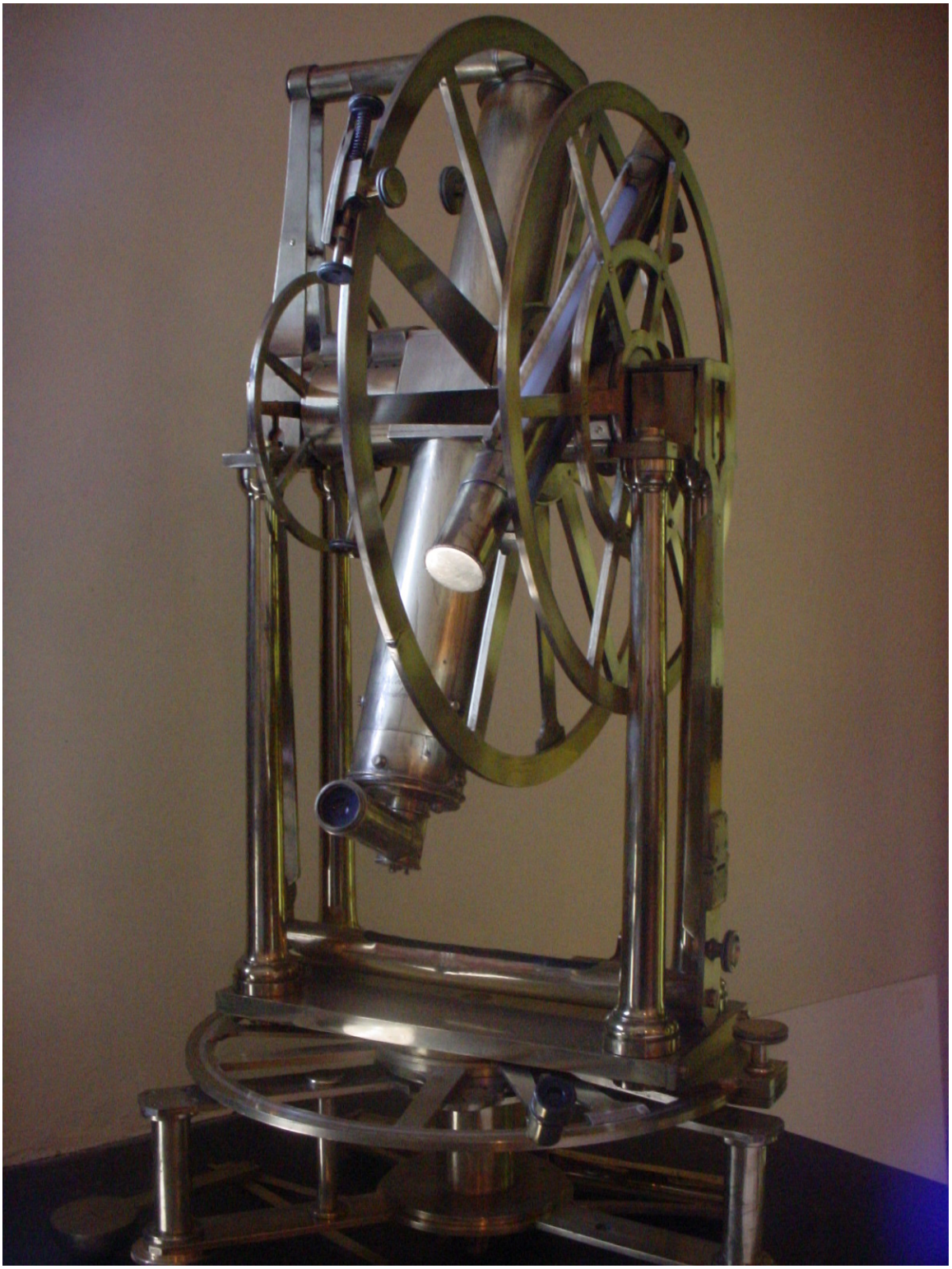

Fig. 8.7. Dollond Repeating Transit (ca 1820). Photograph © Ian Glass

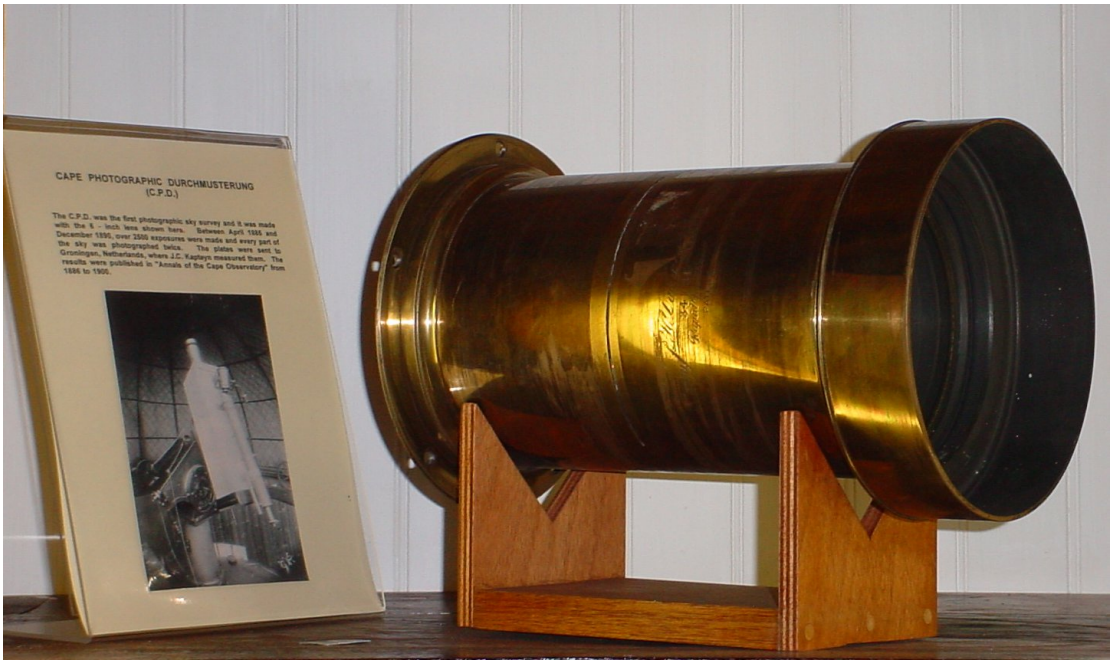

Fig. 8.8. Dallmeyer Portrait lens (1880s) used for making the Cape Photographic Durchmusterung, the first photographic sky survey. Photograph © Ian Glass

- A speculum metal mirror by W Herschel (1811). This, with a telescope that no longer exists, was purchased second-hand from Glasgow around 1820.
- Time signal pistol (ca 1833). This flare pistol was fired by the HM Astronomer from the roof of the Main Building at a set time each day to enable sea captains in Table Bay to set their chronometers.
- Regulator clocks by Molyneux, Hardy, Dent and Riefler (total: 9). The Hardy clock, which dates from the 1820s or slightly earlier, was in the Transit Room and was used by Henderson in his α Cen work; the Molyneux clocks (one each sidereal and mean) date from about the same time.
- Six nautical chronometers, by various 19th Century makers, some set to run on sidereal time.
- Ross lens used by Gill for his epoch-making photography of Great Comet of 1882.
- Large Dallmeyer portrait lens (see Fig. 8.8) used for Cape Photographic Durchmusterung – the first photographic sky survey.
- Eyepiece and lens of Airy Transit circle (installed 1854).
- Victorian Standard Weights and Measures Box (see Fig. 8.9—the contents are said to be in a storeroom of the Iziko South African Museum in Cape Town).

Books

The library (Fig. 8.10), which is the national library of astronomy, is the most comprehensive astronomical library in the country, both for antique and contemporary material. It occupies the central room of the Main Building.

An early inventory of library books dating from 1830 still exists and essentially all of these are still present. In addition some of the past directors collected interesting editions of antique books, which today form part of a special collection.

Fig. 8.9. Box that contained the standard weights and measures for the Cape Colony. Copyright © Ian Glass

The library contains many interesting series of journals, believed complete, such as the Royal Academy of Sciences (Paris, starting in the 17th century), The Royal Astronomical Society (Monthly Notices and Memoirs), The Observatory, Astrophysical Journal, Astronomical Journal, Royal Society, Philosophical Magazine etc. These series are unique in South Africa.

Archives

The Archive Room contains thousands of records dating from all periods of the Observatory's existence. Certain sections of these were removed and merged with the Royal Greenwich Observatory records (now in Cambridge University Library) when the site was transferred to the South African Astronomical Observatory in 1972.

Though the selection seems to have been somewhat haphazard, the main items to have been removed seem to have been the astronomical correspondence.

Pictures

The Observatory contains a number of original artworks. Especially noteworthy are a number by the early Cape artist Thomas Bowler, who worked for a time at the Observatory. In addition there are 27 ink and wash drawings of scenes encountered during a geodetic surveying project around 1842. They are by Charles Piazzi Smyth, one of the assistant astronomers, later Astronomer Royal for Scotland. A fine portrait in oils of Sir David Gill (see Fig. 8.11) is shown here.

In addition there are small numbers of prints – engravings, lithographs etc.

Fig. 8.10. The central room of the library, Main Building. Photograph © Ian Glass

Fig. 8.11. Portrait of Sir David Gill by G.M. Winkles (1897), 116cm × 97cm. Copyright © SAAO

Other movable heritage objects

- The observatory possesses large numbers of *mechanical drawings and blueprints* concerning the telescopes and accessories. Certain of these date from the 19th century and are from the Grubb firm of Dublin.
- Many original *architectural drawings* of the buildings and drawings of modifications are still present. Plans of almost all the buildings from the late nineteenth century are preserved.

Photographic records: paper prints and plates

Many of the glass stellar image plates were disposed of on the grounds that they were not being made use of and occupied space that could be used for current research. Only representative samples and images of some unique objects such as comets were retained. However, all the spectra taken with the McClean telescope are still extant. Plates from Radcliffe Observatory are also stored.

Large numbers of glass plates of scenes, people, buildings etc. dating from the Gill period are still extant. Many of these have been digitized at high resolution.

Photographic prints of scenes, people, observatories etc. also exist in large numbers. Some date from the nineteenth century. By and large these items are stored rather casually and are only partially catalogued.

2.b History and development

In pre-colonial times the site was probably used for grazing by the indigenous San (Khoina) pastoralists (also sometimes referred to as Bushmen) who preceded the Bantu peoples in Southern Africa. During the first decades of the Dutch East India Company Colony it was on the boundary of the secured area. Later, but before it was acquired for the Observatory, the area was farmland, though it remained rocky, treeless and windswept.

The Royal Observatory, Cape of Good Hope, was created on 20 October 1820 by an Order of King George IV of the United Kingdom, of which the Cape was by then a colony. The first building was completed in 1828.

It was the first scientific institution of the Cape Colony, which had been established by the Dutch East India Company in 1652 and taken over by the United Kingdom in the early nineteenth century without much attention being given at first to things such as education and scientific matters. Increasing numbers of immigrants stimulated the development of schools, libraries and a greater scientific interest in the environment.

Though intended to serve primarily the interests of the Royal Navy, by the mid-nineteenth century the Royal Observatory, Cape of Good Hope, had come to be regarded as a source of advice to the colonial government on scientific matters, mapping and standards. For much of the 19th century it occupied an important position in the Cape Colonial hierarchy, His or Her Majesty's Astronomer (HMA) being called upon to give advice and to serve on the boards of cultural and educational institutions. To the general public it was known as the supplier of time services, firing a noonday cannon in the harbour (as it still does) and time balls at various places in the Cape Colony. It was also the repository of standard weights and measures for the colony: the weather records are the longest-running in South Africa.

Development of the site proceeded slowly at first. Certain basic amenities were lacking thanks to a budget cutback in 1826 and items such as the provision of proper sanitation and security fencing were delayed by several years. In the fourth decade of the nineteenth century a number of buildings were erected to form a magnetic observatory of which nothing now remains. Two additional domes were erected around this time (of which one is still extant). However, dating from Gill's time, i.e. from 1879 to 1907, the site began to take on its present appearance.

The Heliometer, Astrographic, McClean and Reversible Transit Circle domes or housings, besides a number of the dwelling houses for staff, were built during his regime. The twentieth century saw the erection of a new office building around 1930 as well as buildings for a 0.75m telescope, a 1m telescope (since demolished), a Lyot Coronagraph, an engineering workshop and residences. The large 'Technical Building' was erected around 1987 to house the technical departments; today it also includes the headquarters of the South African Large Telescope at Sutherland (a separate legal entity from the South African Astronomical Observatory).

The observing rooms of the Main Building ceased to be used as such during the second half of the nineteenth century and the first half of the twentieth. The wings of this building, which were originally the residences of His or Her Majesty's (HM) Astronomer and the main assistants, were converted to office use in the second half of the twentieth century.

The main telescopes continued in research use until around 1980, by which time most observing activities had become concentrated at Sutherland. The increasing light pollution from the surrounding city was largely responsible for this. However, a notable exception was the 18-inch (49cm), where A.W.J. Cousins carried out photometric standard work on bright stars that found worldwide acceptance. Today, the telescopes are only rarely used for research but form a valuable resource for interesting the public in astronomy.

As time went on, it became possible for the successive astronomers to diversify away from the purely utilitarian measurement of star positions and the provision of a time service as envisaged by the Observatory's founders and take an interest in broad scientific questions. By the last quarter of the 19th century the Royal Observatory had become for the most part a research institution. Today it forms the headquarters of the South African Astronomical Observatory, where astronomers have their offices, data reductions are carried out and instruments are constructed. The current observational activities of the SAAO are centred in Sutherland, about 400km into the interior.

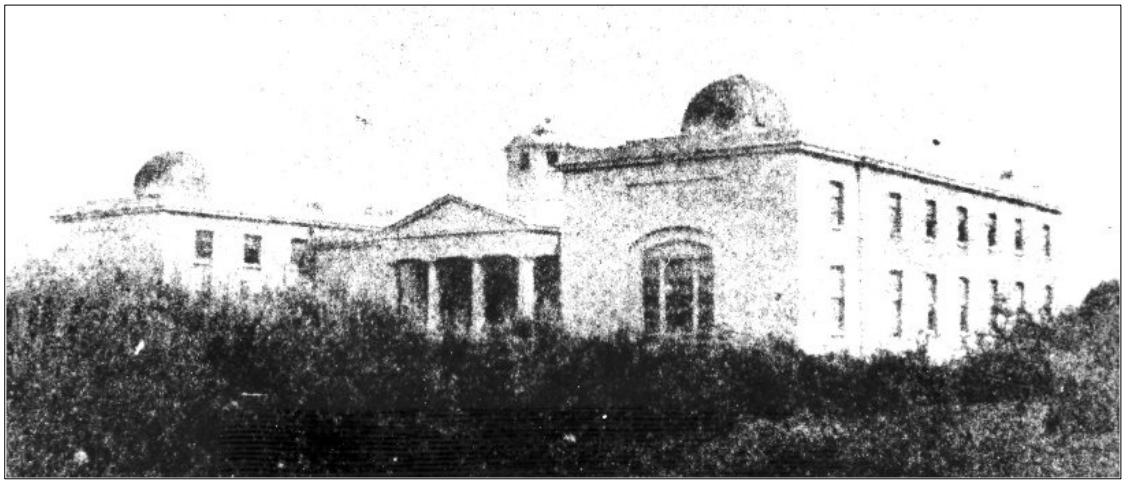

Fig. 8.12. Calotype of the Royal Observatory by C.P. Smyth, dated ca 1842. This is the oldest photo of an observatory and one of the oldest photographs taken in South Africa. It is owned today by the Royal Society of Edinburgh. Courtesy Brian Warner

Fig. 8.13. Map of the Royal Observatory dated 1888. Copyright © SAAO

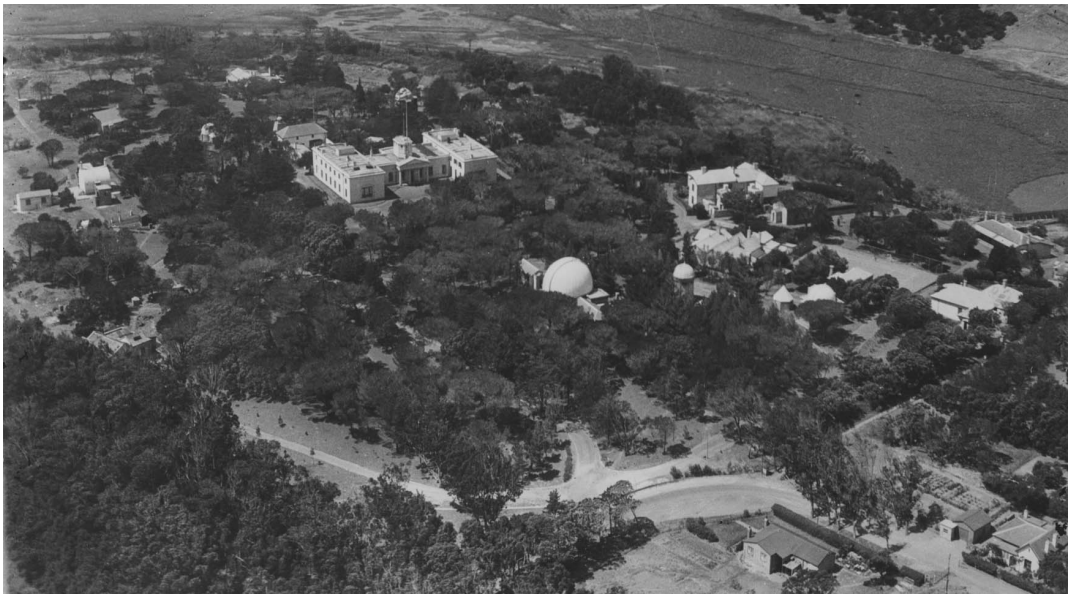

Fig. 8.14. The Royal Observatory in the early twentieth Century. Photograph © SAAO

3. Justification for inscription

3.c Comparative analysis

Initially, the tasks of the Royal Observatory Cape of Good Hope were largely similar to those of the Royal Observatory Greenwich (ROG) in England. Though to some extent a daughter institution, it was essentially parallel to it in purpose and fell, like ROG, under the direction of the Hydrographer of the Royal Navy. During his tenure as Astronomer Royal (head of ROG), the dominant G.B. Airy managed to exert considerable influence on the running of the Cape Observatory. However, the Hydrographer worked directly with Gill during his time as HMA, following perceived hostility (possibility originating from jealousy) on the part of Christie, the Astronomer Royal at Greenwich.

Like the ROG, the Royal Observatory Cape of Good Hope was usually—especially at first— directed by a graduate with mathematical knowledge and the remainder of the staff were not expected to be intellectually independent. While well-educated Assistant astronomers were appointed from time to time, most of the rest of the staff were expected to be routine workers, even 'harmless drudges'. A great many human computers were employed there over the years and several of these (usually temporary employees) found fame elsewhere in later life.

The Royal Observatory was similar in purpose to many others founded in the late eighteenth and early nineteenth centuries. That period saw a rapid improvement in sidereal position-measuring technology and the instruments that were installed in 1828 represented the state of the art. The astronomers and their assistants spent most of their time in 'grinding the meridian', i.e., in positional measurements, though at various times they had to conduct geodetic surveys in the field. This unusual feature of the Royal Observatory's work was conducted mainly under Thomas Maclear and David Gill. In the early 1900s, survey work was transferred to a separate institution.

Though other observatories were set up in the southern hemisphere, the Royal Observatory managed to attain a pre-eminent position by the end of the nineteenth century. This may partly have been due to its relative proximity to Europe and the clarity of the Cape atmosphere. However, by the end of its existence, its limited involvement in astrophysics and the increase of light pollution rendered it of less central relevance to astronomical research.

The visit of Sir John Herschel to the Cape for a few years in the 1830s involved considerable collaboration with Maclear's Royal Observatory, though he worked at a different site a few kilometres distant.

The productivity of the Royal Observatory in the late nineteenth century was relatively high when compared with many of its contemporaries, thanks to the energy of Gill as director. He was able to attract a number of eminent scientific collaborators, among whom can be mentioned von Auwers, de Sitter, Kapteyn, Innes, McClean and Franklin-Adams.

The obvious comparison from an architectural point of view is to the Cambridge Observatory of 1823, another building, similar to the Royal Observatory's Main Building, in neo-classical style. Both observatories housed transit-style instruments which looked through 'chases' in the walls and roofs and had wings that were used as residences for the astronomers. The Cambridge Observatory was founded by the University and was not a government institution.

In Australia, the Parramatta Observatory was established by Sir Thomas Brisbane in 1822 but existed only until 1848. It was a much smaller building, about 8.5m square, and did not enjoy significant official support.

3.d Integrity and/or authenticity

We are fortunate in having a number of drawings of the Observatory dating to ca 1833 by Thomas Bowler and even photographs dating from 1842 (see Fig. 8.12). The latter, taken by C.P. Smyth, are the oldest photographs originating in South Africa and the oldest of any observatory anywhere excepting J.F.W. Herschel's photograph of his father's 48-inch telescope.

Many of the buildings on the site are unaltered. The Main Building, commenced in 1825 and completed in 1828, is still extant and has been modified only marginally. Two copper domes, shown in the 1842 photograph, were removed in 1883 and the central lantern structure was removed in 1961.

The Royal Observatory, as a living institution, has evolved continuously since its foundation. The original instruments, consisting of a transit and a mural circle, were located in the Main Building. By 1855, these had been replaced by a transit circle designed by Airy. In 1849 a 7-inch Merz telescope with dome was added. A magnetic observatory, comprising several buildings, was established in 1841 but none of these survives today.

Still within the 19th century, a photo-heliograph designed by de la Rue was installed in 1876.

During the régime of David Gill, one of the greatest astronomers of the 19th century, activity on the site reached its zenith. Numerous buildings from Gill's time are extant, including the Astrographic dome (1888), the Heliometer dome (1888), the McClean dome (1895) and the Gill Transit Circle (1905). Also during this period several houses were constructed to house astronomers and their families.

The 20th century saw the New Offices (ca 1920), the WWII Optical Workshop (now lecture theatre), the Lyot coronagraph (1958) and the Technical Building (ca 1988).

Numerous other small buildings have come and gone during this period, including the Franklin-Adams telescope (ca 1909), the 40-inch (Elizabeth) Telescope (1964) and the Astrolabe Hut (ca 1960s).

3.a Potential criteria under which inscription might be proposed

Criterion (ii): The Cape Observatory represents a supreme example of the interchange of scientific and technological expertise that allowed 'state-of-the-art' working observatories to begin to be constructed around the world during the early nineteenth century. Its continuing connectivity with its European counterparts together with its location in the southern hemisphere and hence its unimpeded view of the southern sky ensured that the Cape Observatory rapidly established itself as *the* major contributor to positional astronomy in the southern hemisphere, a position it maintained until for over a century. The observations carried out here made an outstanding contribution to the fundamental celestial catalogues of successive epochs.

3.b Suggested statement of outstanding universal value

The Royal Observatory was the first major scientific institution to be erected on the continent of Africa. It is also the first permanent Observatory to have been constructed in the southern hemisphere. For most of its existence it has been *the* major contributor to positional astronomy in the southern hemisphere. Working in collaboration with its European counterparts, observations of the southern sky not possible from northern latitudes helped to complete several successive projects to map the entire celestial sphere, including the first systematic photographic sky survey instigated by David Gill in 1885.

The Cape Observatory has been the setting for a series of seminal scientific achievements, among them the first successful measurement of the distance of a star (by Thomas Henderson in 1832–3); the first use of photography to make a systematic sky survey

(by David Gill from 1885); the accurate measurement of the 'Astronomical Unit' (distance of the earth from the sun) made by Gill at around the same time; and, more recently, the measurement of stellar angular diameters by means of lunar occultations (by David S. Evans in the 1950s).

The Cape Observatory is an outstanding example of the buildings, telescopes, instruments and paraphernalia of the working 19th century observatory—an ensemble of immovable and movable items that, together, typify the 'machine of science' that was used at this time for the determination of time and the systematic mapping of the cosmos. It also includes some exceptional elements, most notably the Greek Revival Main Building, which is almost unique among observatories worldwide, and the McClean or Victoria building of 1896, designed by the famous colonial architect Sir Herbert Baker in his own unique style.

4. Factors affecting the property

4.a Present state of conservation

Most of the buildings are regularly maintained but certain of those not in use for current astronomical projects require restoration. In particular, the Gill Reversible Transit Circle building of iron and steel is in poor condition. The archives and retired instruments are generally well-protected from environmental damage.

Some workshop time is committed to maintaining the telescopes and domes, though a greater commitment would be desirable.

Certain of the old instruments have recently been restored. These include the Merz 7-inch telescope and the de la Rue photoheliograph.

Some of the buildings require reasonably frequent maintenance, particularly those (most of them) that have painted exterior walls. Obtaining funds for this purpose is usually difficult except for those used for current research, such as the Main Building. However, due to a fortunate combination of circumstances, it was possible recently to commission a major refurbishment of the McClean building, with special attention to its shutters and the hydraulic power storage cylinder.

A museum in the former McClean laboratory contains a selection of the smaller antique instruments no longer in use, ranging from the Dollond Repeating Transit (1820) (Fig. 8.7) used by Fearon Fallows to the photometry equipment of Alan Cousins, in use until about 2000.

4.b.i Developmental pressures

The main threat to the Royal Observatory site lies in the ever-increasing pressure on open urban land from real-estate developers.

4.b.ii Environmental pressures

The sky is already too bright for many types of astronomical work. However, it remains free of particulate pollution much of the time. This fact enabled bright standard star work to be carried out until the end of the 20th century. However, since most observing activities have been transferred to Sutherland, sky conditions have almost ceased to be relevant.

4.b.iii Natural disasters and risk preparedness

The most likely natural disaster would probably be flooding from the nearby rivers. Urban development upstream has increased the speed of water run-off after heavy rain and this leads to occasional flooding of the lower reaches of the Observatory property. Only the Victorian workshop and an uninspiring house of ca 1960s vintage are at risk. The tendency towards flooding can even be regarded as a form of protection against development.

Fires from dried-out reed beds close to the property are an occasional risk in summer. The site residents have been trained in fire protection and the vegetation near the buildings is kept low to prevent fires from approaching. There is an extensive network of fire hydrants.

Earthquakes are rare and have generally been quite weak.

4.b.iv Visitor/tourism pressures

The numbers are manageable at present.

4.b.v Number of inhabitants

The houses on the site typically accommodate about 30 people including spouses and children.

5. Protection and management

5.a Ownership

The property is owned at present by the National Research Foundation (NRF) of South Africa, the umbrella agency of which the SAAO and a number of other scientific institutes form part. The NRF itself is part of the Ministry of Science and Technology. It is expected that the NRF as the controlling agency will be replaced by a new astronomical agency in the near future.

The site is used exclusively for astronomical purposes.

5.b Protective designation

The property is surrounded by the Two Rivers Urban Park, a conservation area established by the City of Cape Town. This offers some degree of protection against urban development. The Observatory is bordered to the east and north by wetlands, and as such is protected in principle from encroachment, but a limited area of the site lies above the flood line.

Classification as a National Heritage Site is imminent.

Another type of protection is the requirement that heritage objects are secured from theft. While theft by ‘collectors’ has not yet become a significant problem, metal thieves are a threat, especially in a poor community. Alarms, protective measures and security staff are undergoing constant review.

5.h Visitor facilities and infrastructure

The principal facilities devoted to visitors at present are a lecture room with a seating capacity of about 100 persons, an Astronomical Museum, access to the McClean and 6-inch telescopes, and the library. Besides being of service for in-house lectures and seminars, the auditorium is useful venue for student courses. In the evenings various external societies including the local Astronomical Society and some other scientific societies meet there. The auditorium includes a display area suitable for poster presentations and a small kitchen. Small conferences are often held there. Daytime visitors have the opportunity to look at sunspots using the photoheliograph (equipped with a ground glass screen).

For many decades there has been a public outreach programme. Open nights are held twice monthly or more often, in which members of the public are given free of charge an introduction to the Observatory, a lecture on an astronomical topic and sky-viewing opportunities. In addition, many school and other groups tour the establishment during the daytime. Special tours including the technical workshops and other facilities are sometimes arranged. A ride on the rising floor of the McClean telescope is something that many Capetonians remember from their schooldays.

Typically there are at present about 6000 visitors per year (from schools and the general public) who specifically come to view the site. This does not include those whose purpose is only to attend meetings or conduct business etc.

5.i Presentation and promotion policies

There is a keen interest in the history of the site and recently an independent 'Friends of the Observatory' group has been organised, with restoration of old instruments and domes as a major theme.

An application to the South African National Heritage Agency is currently in progress. If approved it would be the first SA cultural property designated for its scientific research history.

7. Documentation

7.a Photos and other AV materials

Photographic inventories of heritage objects are in course of preparation, partly in order to increase awareness among the astronomical staff and partly for security reasons.

7.b Texts relating to protective designation

Baumann, N. and Winter, S., 2011 *The South African Astronomical Observatory: A Heritage Survey*, SAAO, Cape Town. This survey was commissioned from heritage architects primarily to understand the value of the built environment of the Observatory. The buildings have been classified in terms of the criteria employed by the South African Geritage Resources Agency.

Van der Walt, L., Strong, N., Mustart, P., 2010. *Observatory Landscape Framework*, SAAO, Cape Town. A study commissioned to identify the ecologically sensitive areas of the Observatory and the scope for further construction without causing environmental damage.

Glass, I.S., 2012. *Intangible Heritage of the South African Astronomical Observatory*, SAAO, Cape Town. Prepared in order to assist the South African Heritage Resources Agency.

7.c Most recent records or inventory

The Royal Observatory is well documented historically in books by David Gill and Brian Warner and by many articles in books and journals. Research on historical matters by various interested parties is fairly continuous.

The site has not been investigated archaeologically.

7e. Bibliography

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