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monthly notes of the astronomical society of southern africa
Volume 77 Nos 9 & 10 October 2018

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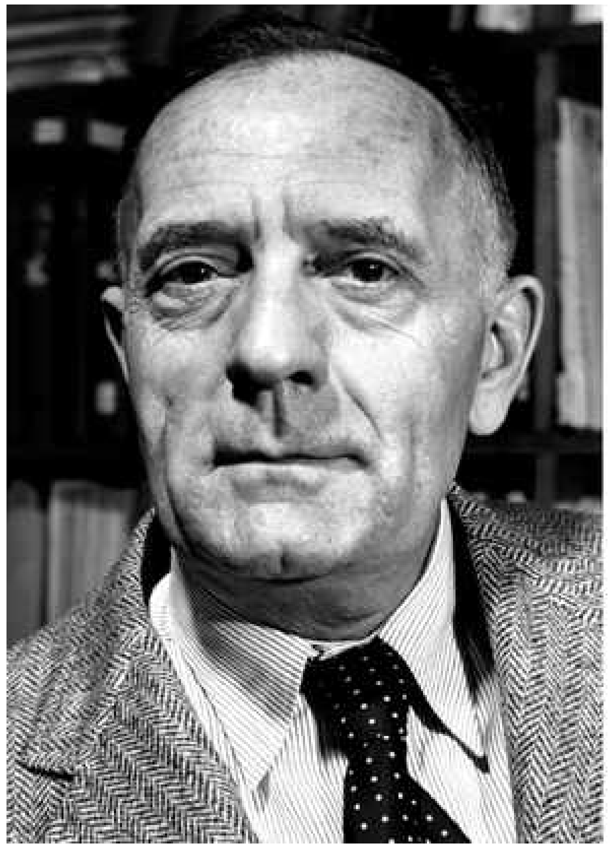

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Cover Photo: The renaming of Hubble's Law to the Hubble-Lemaître Law. Edwin Hubble (left); George Lemaître (right). See article on page 137.

The **Astronomical Society of Southern Africa** (ASSA) was formed in 1922 by the amalgamation of the Cape Astronomical Association (founded 1912) and the Johannesburg Astronomical Association (founded 1918). It is a body consisting of both amateur and professional astronomers.

Publications: The Society publishes its electronic journal, the *Monthly Notes of the Astronomical Society of Southern Africa (MNASSA)* bi-monthly as well as the annual *Sky Guide Africa South.*

Membership: Membership of the Society is open to all. Potential members should consult the Society's web page assa.saao.org.za for details. Joining is possible via one of the local Centres or as a Country Member.

Local Centres: Local Centres of the Society exist at Bloemfontein, Cape Town, Durban, Hermanus, Johannesburg, Natal Midlands, Pretoria and Sedgefield district (Garden Route Centre). Membership of any of these Centres automatically confers membership of the Society.

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mnassa

Vol 77 Nos 8 & 9 **October 2018**

Editor's Notes

The re-naming of Hubble's Law is nothing new, it was proposed before, and like the "demotion" of Pluto, there will no doubt be many years of argument for and against the IAU Resolution; see below.

In an arXiv paper received 31 October, 2018, entitled "Reasons in favour of a Hubble-Lemaître-Slipher's (HLS) law", the author Emilio Elizade mentions that earlier attempts were made to change the Hubble Law.

Based on historical facts, revisited from a present-day perspective, and on the documented opinions of the scientists involved in the discovery themselves, strong arguments are given in favour of a proposal to include the prominent astronomer Vesto Slipher to the suggested addition of Georges Lemaître's name to Hubble's law on the expansion of the Universe, and thus eventually call it Hubble-Lemaître-Slipher's (HLS) law.

The discussion on the Resolution B4 (see main article) was very lively but it had to be stopped in order to keep up with the schedule, in particular, the subsequent Closing Ceremony. Some additional questions were sent by email, as this one:

Q. Should other contributors to the data used in the early expansion law (Slipher, Leavitt, Stromgren, ...) be acknowledged as well?

A. No because they did not use their data nor invent new theory to discover the Universal Expansion.

The author (Elizade) is essentially in agreement with all the considerations above, as they were formulated; in particular, with the last one, which refers to Slipher and Leavitt. Sure, one cannot object the sentence, as formulated, that these prominent astronomers "did not use their data" (in particular, Slipher, even if he calculated practically all redshifts used subsequently both by Hubble and Lemaître) or methods (Leavitt's law) profusely used by Hubble as his main tool to obtain all his measures of distances, "in order to invent a new theory to discover the Universal Expansion." However, some crucial historical facts, which have been overlooked by almost everybody till now, and which the author has rescued, contain documented opinions of the scientists involved (Hubble, in particular, on several occasion), as well as more recent bibliographical studies (duly mentioned below), have led him to formulate strong arguments in favour of a proposal to include the prominent astronomer Vesto Slipher in the planned addition of Georges Lemaître's name to Hubble's law, to eventually call it Hubble-Lemaître-Slipher's (HLS) law.

The paper then lists in some detail evidence for his argument. He finally summed up his proposal:

1. I consider the role of Slipher in the derivation of Hubble's law to be of paramount importance, as recognized (implicitly and explicitly), to begin with, by the two other actors of this drama, and subsequently by an increasing number of reputed specialists. His role was invaluable, both in inspiring the whole development (Hubble's dixit) and in providing one of the two tables that are absolutely necessary for the formulation of the law, both by Hubble and Lemaître (what nobody can oppose).

2. I therefore propose to re-name the Hubble law as Hubble-Lemaître-Slipher (HLS) law. I do consider the IAU could improve the original idea and give due credit to the three main actors of this play.

3. I am absolutely sure that both Edwin Hubble and Georges Lemaître would have been extremely happy with this decision.

4. Further, I am also sure that, if the three brilliant cosmologists were alive now, under the standard criteria of the Nobel Academy, they would be the most perfect candidates for a shared Nobel Prize for their work that led to the discovery of the Universe's expansion law.

Reference

1 arXiv:1810.12416v1

Abstract: "Always Calling Home" explores matter wandering over the Earth, its landscapes, the skies and ultimately the Universe. Eternal matter that exists within, and outside its original body, from which they got expelled. Exobodies, asteroids, meteorites, and exoplanets. Rocks made of stories, material time records and data storages. Perhaps receivers or emitters, sometimes interfacing the invisible around us. The outside within; the storytellers of the yet-to-come. During this South African – Swiss exchange and Artists-in-labs residency I am interested in sharing knowledge with my future colleagues at the South African Astronomical Observatory SAAO in Cape Town/Sutherland and the South African artist George Mahashe hosted by the Astronomy Department in Versoix/Geneva while learning about how to make meaning out of data coming from the outer space. I imagine myself also exploring the mesmerising landscape inhabited by giant architectural machines in dialogue with the stars, rocks and other bodies that eventually reply.

Colloquia and Seminars

These form an important part of a research facility, often as a sort of pre-publication discussion or a discussion of an individual's current research, and as such it is virtually impossible to "publish" this material. However by recording the topics discussed in the form below does indicate to those, who are unable to attend, what current trends are and who has visited to do research: it keeps everyone 'in the loop' so to speak

Also included in this section are the colloquia/seminars at the SAAO, UWC, the Astrophysics, Cosmology and Gravity Centre at UCT, ACGC and the NASSP lectures, aimed the at the students and interested astronomers. In addition there are the SAAO Astro-coffees which are 15-20min informal discussions on just about any topic including but not limited to: recent astro-ph papers, seminal/classic publications, education/outreach ideas and initiatives, preliminary results, student progress reports, conference/workshop feedback and skills-transfer.

SAAO

Title: Optical and gamma-ray study of gamma-ray binaries
Speaker: Dr. Itumeleng Monageng (SAAO)
Date: 30 August
Time: 11h00 – 12h00
Venue: SAAO Auditorium

Abstract: Gamma-ray binary stars are intriguing members of the X-ray binary population which exhibit radiation across the entire electromagnetic spectrum, allowing for the study of extreme astrophysical conditions. These systems are composed of an early type star and compact object which, apart from one system, is of unknown nature. In this talk, I will present the results of long term optical spectroscopic monitoring of one system, LS I +61 303, to study the circumstellar disc variability. I will also describe the radial velocity study of another system, 1FGL J1018.6-5856, where we have derived the orbital parameters of this source and discuss the implications of the nature of the compact object. We have also studied the high energy emission in gamma-ray binaries, where we explored the Bethe-Heitler mechanism for the production of gamma-rays. I will present the calculations of the spectrum and the modulated flux.

Title: Always Calling Home
Speaker: Vanessa Lorenzo
Date: 27 September
Time: 11h00 – 12h00
Venue: SAAO Auditorium

Hubble's Law renamed – now Hubble-Lemaître law

1 The International Astronomical Union, IAU

The IAU is the international astronomical organisation that brings together more than 13 500 professional astronomers from more than 100 countries worldwide. Its mission is to promote and safeguard astronomy in all its aspects, including research, communication, education and development, through international cooperation. The IAU also serves as the internationally recognised authority for assigning designations to celestial bodies and the surface features on them. Founded in 1919, the IAU is the world's largest professional body for astronomers.

2 Background

An electronic vote has been conducted among all members of the International Astronomical Union, and the resolution to recommend renaming the Hubble law as the Hubble–Lemaître law has been accepted. The Hubble–Lemaître law describes the effect by which objects in an expanding Universe move away from each other with a velocity proportionally related to their distance. This resolution was proposed in order to pay tribute to both Lemaître and Hubble for their fundamental contributions to the development of modern cosmology.

The discovery of the apparent recession of galaxies is a founding pillar of modern cosmology and a major milestone of astronomical research. To acknowledge the scientific contributions of Belgian astronomer Georges Lemaître to the scientific theory of the expansion of the Universe, and by vote of its members, the International Astronomical Union (IAU) has decided to recommend the Hubble law to be renamed as the Hubble–Lemaître law.

Following a period of consultation with the astronomical community, the resolution to suggest renaming the Hubble law was presented and discussed at the XXX General Assembly of the IAU, held in Vienna (Austria) in August 2018. All Individual and Junior Members of the IAU (11072 individuals) were invited to participate in an electronic vote, which concluded at midnight UT on 26 October 2018. 4060 cast a vote by the deadline (37%).

The proposed resolution has been accepted with 78% of the votes in favour and 20% against (and 2% abstaining).

One of the IAU's roles is to foster exchanges of views and international discussions — and it strives to contribute to scientific discourses with historical facts. To honour the intellectual integrity and the supremely significant discovery by Georges Lemaître, the

IAU is pleased to recommend that the expansion of the Universe be referred to as the Hubble–Lemaître law.

3 Motivation for Resolution B4 on a suggested renaming of the Hubble Law

Considering

3.1 that the discovery of the apparent recession of the galaxies, which is usually referred to as the "Hubble law", is one of the major milestones in the development of the science of Astronomy during the last 100 years and can be considered one of the founding pillars of modern Cosmology;

3.2 that the Belgian astronomer Georges Lemaître, in 1927 published (in French) the paper entitled "*Un Univers homogène de masse constante et de rayon croissant rendant compte de la vitesse radiale des nébuleuses extra-galactiques"* [1]. In this he first rediscovers Friedman's dynamic solution to Einstein's general relativity equations that describes an expanding universe. He also derives that the expansion of the universe implies the spectra of distant galaxies are redshifted by an amount proportional to their distance. Finally he uses published data on the velocities and photometric distances of galaxies to derive the rate of expansion of the universe (assuming the linear relation he had found on theoretical grounds);

3.3 that, at the time of publication, the limited popularity of the Journal in which Lemaître's paper appeared and the language used made his remarkable discovery largely unperceived by the astronomical community;

3.4 that both Georges Lemaître (an IAU member since 1925 [2]) and the American astronomer Edwin Hubble (an IAU member since 1922 [3]) attended the 3rd IAU General Assembly in Leiden in July 1928 and exchanged views [4] about the relevance of the redshift vs distance observational data of the extragalactic nebulae to the emerging evolutionary model of the universe;

3.5 that Edwin Hubble, in 1929 published the paper entitled *"A Relation between Distance and Radial Velocity among Extra-Galactic Nebulae"* [5] in which he proposed and derived the linear distance-velocity relation for galaxies, ultimately including new velocity data in his 1931 paper with Humason [6]. Soon after the publication of his papers, the cosmic expansion became universally known as the "Hubble law";

3.6 that, in 1931, on invitation by the Journal *Monthly Notices of the Royal Astronomical Society*, G. Lemaître translated in English his original 1927 paper [7], deliberately omitting the section in which he derived the rate of expansion because he "did not find advisable to reprint the [his] provisional discussion of radial velocities

I thank Mr Greg Roberts for photographic material.

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The camera still exists in a junk room at SAAO, as do parts of the Dallmeyer mount. A few 16 cm x 16 cm photographic plates labeled “Wind Tower”, dating from 1960-61, have been found in the SAAO Archives.

In 1965 (Anon, 1965) it was discovered that the wooden stairs were badly affected by “beetle” or woodworm. Although repairs to the building were started, in August Richard Stoy (1910–1994), the HM Astronomer at the time, stopped the work and decided to demolish it.

The dome was used afterwards for a small telescope belonging to the Cape Centre of the Astronomical Society of South Africa. When this building was demolished it was purchased by an amateur, Mr Rainer Noack, who still owned it up to his recent death.

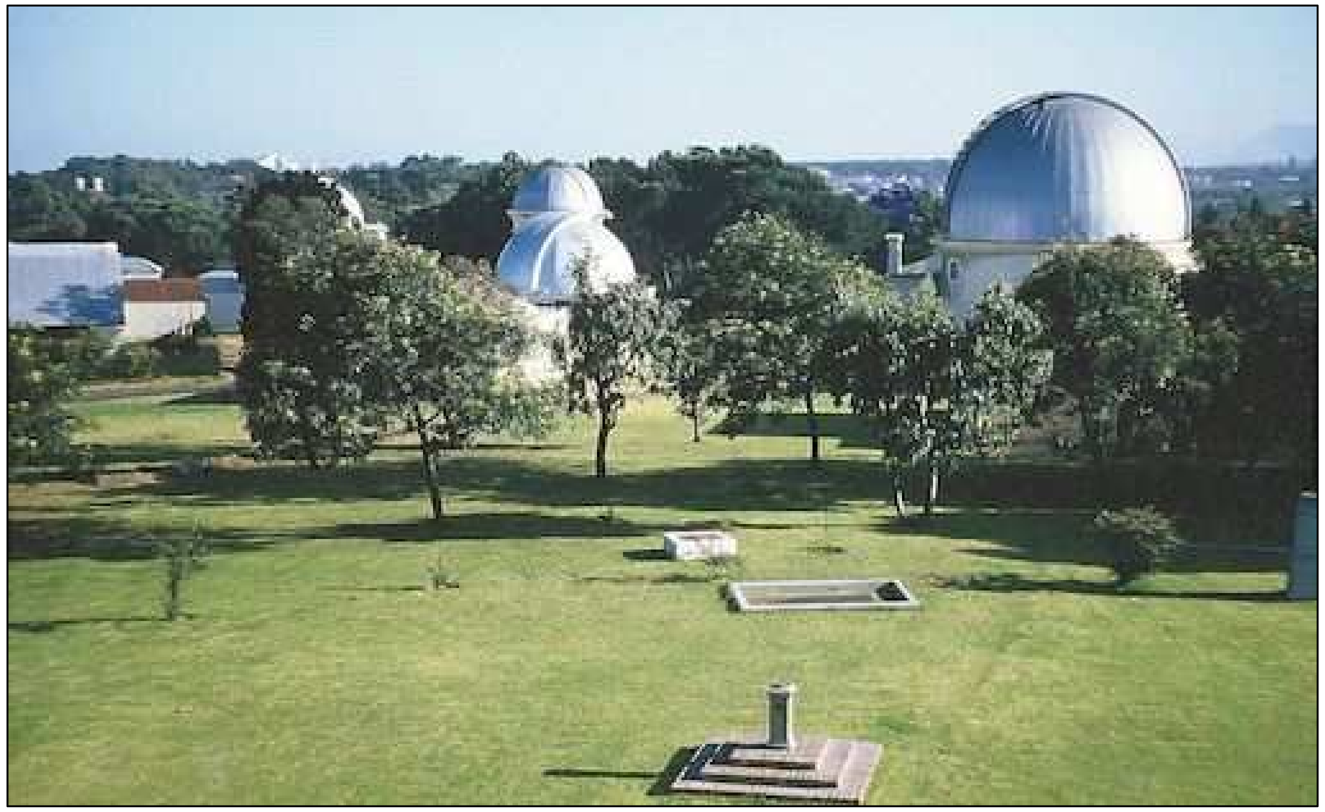


Fig 14. Last known photograph of the Wind Tower before its demolition, in the early 1960s, looking southwards. From left to right the domes are the Astrographic (largely hidden by a tree), the Wind Tower with the Steavenson 30-inch (0.75m) reflector in front of it and the McClean (Photo: Greg Roberts).

Acknowledgement

This paper is a formal version of a talk presented at a C3 History of Astronomy Session at the International Astronomical Union in Vienna, August 2018.

which is clearly of no actual interest, and also the geometrical note, which could be replaced by a small bibliography of ancient and new papers on the subject” [8];

desiring

3.7 to pay tribute to both Georges Lemaître and Edwin Hubble for their fundamental contributions to the development of modern cosmology;

3.8 to honour the intellectual integrity of Georges Lemaître that made him value more the progress of science rather than his own visibility;

3.9 to highlight the role of the IAU General Assemblies in fostering exchanges of views and international discussions;

3.10 to inform the future scientific discourses with historical facts;

resolves

2.11 to recommend that from now on the expansion of the universe be referred to as the **“Hubble-Lemaître law”.**

[1] Lemaître, G., 1927. *Ann. de la Société Scientifique de Bruxelles* Ser. A, **47**, 49-59.
[2] Lemaître, G. 1950, *Ann. d’ Ap.,* **13**, 344, as translated by David L Block, 2012, in *Georges Lemaître: Life, Science and Legacy,* eds. R.D. Holder and S. Mitton, Astrophysics and Space Science Library, Springer-Verlag: Berlin, **395**, 89.
[3] *IAU Transactions* Vol. 1, 1922.
[4] Humason, M.L., (https://www.aip.org/history-programs/niels-bohr-library/oral-histories/4686), as reported by Sidney van den Bergh, 2011, *JRASC*, **105**, 197.
[5] Hubble, E., 1929. *Proc. National Acad. Sci.*, USA, **15**, 168.
[6] Hubble, E., Humason, M.L., 1931. *Ap. J.,* **74**, 43-80.
[7] Lemaître, G., 1931. *MNRAS*, **91**, 483-490.
[8] Georges Lemaître, quoted by Mario Livio (2011) in *Nature,* **479**, Issue 7372, 171-173.

New Observatory for the UNW

The Minister of Science and Technology, Mmamoloko Kubayi-Ngubane, launched the Mahikeng Astronomical Observatory at North-West University's (NWU's) campus in Mahikeng, on 7 September 2018. The Mahikeng Astronomy Observatory houses the Mahikeng Astronomy Telescope (MAT).

The campus in Mahikeng is the first historically disadvantaged institution in South Africa to develop an observatory for astronomy research, putting the institution on par with well-established institutions such as the universities of the Western Cape and Cape Town.

The MAT is co-funded by the Department of Science and Technology (DST) and is led by Prof. Thebe Medupe, who is the current chair of the National Astrophysics and Space Science (NASSP) programme. The purpose of the MAT is to develop astronomy and related sciences at historically disadvantaged universities, and also to demonstrate the country's growing capabilities in the field.

The telescope is a 0.4-m Meade LX200 GPS and it is housed at the Mahikeng Astronomical Observatory. It will be used for bright star research 60% of the time, allowing astronomers at the campus to study the interiors and the evolution of stars. Since it can be operated remotely, it will also be used for outreach purposes across the country.

The establishment of the MAT follows recent developments in astronomy in the country, including the launch of the 64-dish MeerKAT, the HIRAX Telescope Project by a consortium led by the University of KwaZulu-Natal, and the MeerLICHT Telescope in Sutherland.

Speaking at the launch, Minister Kubayi-Ngubane said the vision for the department is to make South Africa a hub for astronomy sciences and facilities, as articulated in the National Strategy for Multi-wavelength Astronomy. The strategy has enabled South Africa to take maximum advantage of its historical strengths in astronomy, its clear southern skies in the Karoo, its engineering and scientific base, and our growing global ranking in astronomy.

The minister said it was for these reasons that South Africa has won the bid to host the General Assembly of the International Astronomical Union (IAU) in 2024. It will be the first time this global association of professional astronomers will meet in Africa in what will be its 105th year of existence. The opportunity for many African astronomers to take part in one of the world's biggest astronomy meetings will contribute to an enduring legacy of astronomy on the continent.

Prof. Medupe said the telescope would help the NWU to attract many young black students to science, producing more scientists for the future. The telescope will also be used to train postgraduate students in observational and data analysis techniques. As a result, the telescope will contribute towards building a more inclusive astronomy community, since most of the students being trained are black South Africans.

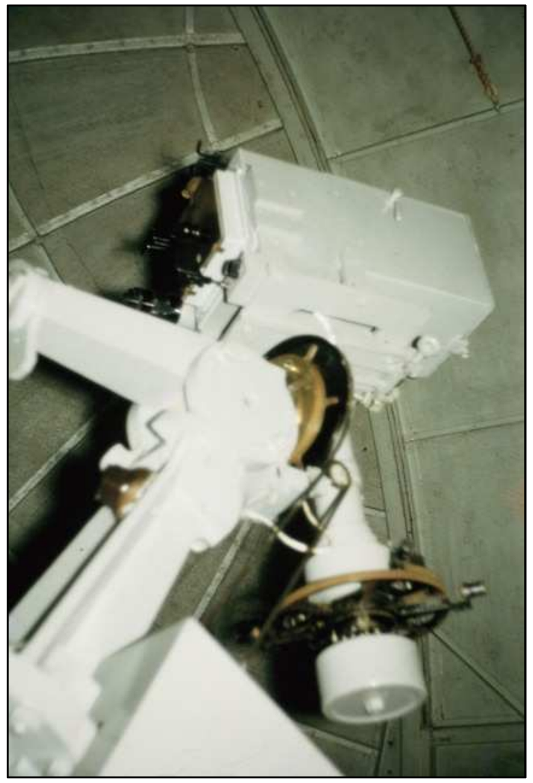
In the 1935 Annual Report it was stated that the 1885 mount was being used to carry two wide-angle lenses of 5 inches (127 mm) diameter and 35 inches (89 cm) focal length with a 6-inch (152 mm) guide telescope of 6½ feet (1.65 m) focal length. By the 1936 Annual Report both the mount and the 5-inch cameras had been moved to a new square building in 1935 [This is where the mount remains, though once again it carries the 6-inch Grubb telescope].

In 1937 the Observatory's Merz 7-inch (178 mm) telescope was placed on an old mount by J.H. Dallmeyer (1830-1883) that had been overhauled and installed in the Wind Tower. The mount in question had originally been part of a photoheliograph dating from 1875. Within a short time however the 7-inch was again moved and re-mounted in place of the Repsold heliometer on its stand in the NE dome.

In 1951 an "old Cooke 6-inch (152 mm) telescope" was placed in the Wind Tower on the Dallmeyer stand and was used for variable star work by A.G.F. Morrisby (? – 1988) who was then on the staff of the Royal Observatory. In the following year an S. Archer was mentioned.

In 1953, though it had been used for some occultation observations, the telescope was declared "not serviceable" as its lens needed re-polishing. There was no further mention of the dome until 1960.

Last Days (nights?)



In photographs taken around the early 1960s by Greg Roberts the Dallmeyer mount is seen carrying a small "box" telescope with a lens inscribed "Kodak AERO-EKTAR f:2.5 12 in. 305 mm 9x9N659 …". This type of lens was widely available as "surplus" after the Second World War, when it was used in aerial reconnaissance cameras. One of its unique features is that it makes use a radioactive thorium glass (emitting 2.6 MeV gamma rays!) for its useful optical properties of high refractive index and low dispersion.

Fig 14. The Aero-Ektar camera on the Dallmeyer mount in the Wind Tower in the early 1960s (Photo: Greg Roberts).

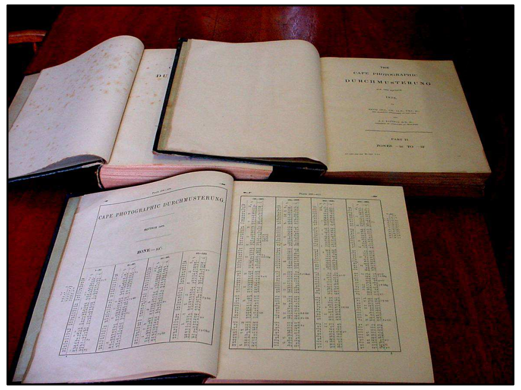


Fig 12. (Right) The CPD Catalogue (Photo: author).

Later history of the Wind Tower

Following the completion of the CPD in 1889 the 6-inch telescope was re-mounted in the Wind Tower.
Gill (1913) makes few references to it but it is clear that it was used for observations of comets and occultations. Finlay used it for the first observations of Comet 1886e (Comet 15P/Finlay) and also independently found Comet 1886f.

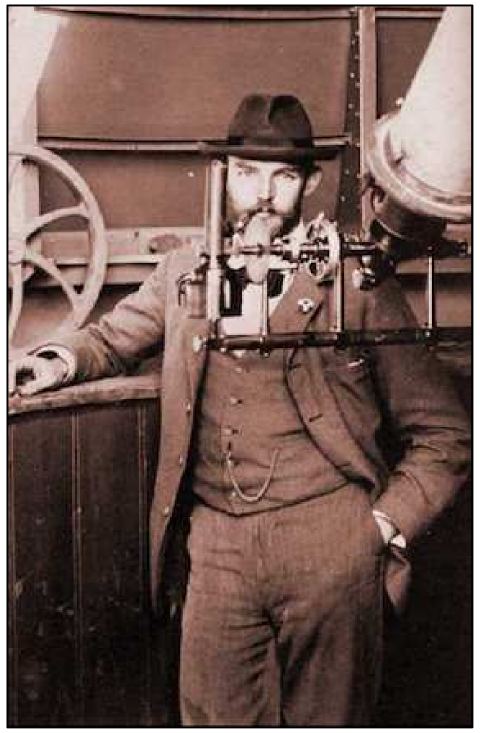


Fig 13. Willem de Sitter with a Zöllner photometer and the 6-inch telescope in the Wind Tower (Photo: unknown source).

In 1896 Willem de Sitter, a doctoral student of Kapteyn in Groningen, was invited by Gill to work at the Observatory to learn practical astronomy. During the years 1897 to 1899 he worked *inter alia* with a Zöllner photometer attached to the 6-inch telescope in order to compare the visual and photographic magnitudes of stars at different galactic latitudes. The effect being studied was a manifestation of interstellar extinction, then just beginning to be understood.

(The Zöllner photometer was an instrument used to compare the brightness of an artificial star with a real one).

Subsequent History

The *Reports of HM Astronomer at the Cape* for the remainder of the 19th century and the first half of the 20th make fairly frequent mention of the Wind Tower and the telescopes, starting with the 6-inch Grubb, that it contained.

"Searching for comets" and (Lunar) "occultations" were the most common entries. The two years of de Sitter's photometric observations were the main exception. Occasionally there is mention of something different such as the Transit of Mercury of 14 November 1907. From 1917 onwards the telescope was in use by various well-known amateurs of the time such as A.W. Long (1874-1939) and J.F. Skjellerup (1875-1952). After 1924 only Long's name appears and that for a few years.

Obituary: Sergio Colafrancesco (1957-2018)

It is with great sadness that we announce the passing of Professor Sergio Colafrancesco on Sunday, 30 September 2018, in Rome, Italy, following a battle with cancer. We offer our deepest condolences to his family, friends and colleagues.

Born in Rocca d'Arce, Italy, on 3 May 1957, Colafrancesco joined the University of the Witwatersrand in August 2011 from the University of Rome where he was a Professor of Astrophysics. Prior to that, he was a senior scientist with the Italian Institute for Astrophysics. He obtained his PhD in Astronomy at the University of Padua, Italy.

Fig: Sergio Colafrancesco (1957-2018).

He was the DST-NRF Square Kilometre Array (SKA) Research Chair in Radio Astronomy at the Wits School of Physics. His appointment heralded the beginning of distinguished research activity in Radio Astronomy and Astrophysics at Wits and the eventual establishment of a research group currently comprising five academics in the School, postdocs and postgraduate students.

The Chair is of local and international significance and provides closer alignment with the SKA project. It was established to contribute to the understanding of the structure, origin and evolution of the Universe and of its sub-structures, from the smallest galaxies to the largest galaxy clusters.

Colafrancesco was involved in a number of ground-breaking projects that showcased the country's leadership and competitiveness in science. He was a highly cited, internationally recognised expert in cosmology and astrophysics. In addition, he was a member of a number of international ground-based and space-based international multi-messenger astronomy projects that complement South Africa's own initiatives.

The South African Institute of Physics has conveyed its condolences, adding that Colafrancesco "made tremendous contributions to the development of radio and gamma-ray astronomy in South Africa and further afield on the African continent." "His passing at a time when MeerKAT comes online is heart-breaking," wrote Professor Patrick Woudt, President of the Institute and Head of Astronomy at UCT.

John Carter, University of the Witwatersrand.

Special Award for UCT Chair of Astronomy

Chair of Astronomy Professor Renee Kraan-Korteweg flew the flag with distinction for the University of Cape Town (UCT) when she won the Minister's Special Award in the field of astronomy at the South African Women in Science Awards (SAWISA) 2018.

Kraan-Korteweg was among a host of top women achievers in science, technology and innovation fêted by the national Department of Science and Technology at a glittering awards ceremony in Limpopo on 23 August.

The Minister's Special Award in the field of astronomy, the Commemorative MeerKAT Award, went to the UCT professor in recognition of her "outstanding contribution to building South Africa's scientific and research knowledge base in advancing the field of astronomy".

She was recognised for distinguishing herself "in the field of South African radio astronomy by advancing the science of radio astronomy through her scientific contributions".

Further, she was lauded for her success in respect of training the next generation of radio astronomers, and for helping to elevate radio astronomy as a strategic research field. This was achieved via contributions "beyond scientific output and the training of postgraduate students".

Fig: UCT Chair of Astronomy Prof Renee Kraan-Korteweg photographed in Vienna at the General Assembly of the International Astronomical Union the day after the SAWISA event. The MeerKAT image behind her was released at the MeerKAT launch, and featured at the MeerKAT exhibition booth in Vienna.

Kraan-Korteweg pioneered radio astronomy in the Western Cape when she took up the chair to head UCT's astronomy department in 2005. In 2006 she was behind the launch of an astronomy major, and she says she immediately offered the first radio astronomy research projects to young South African postgraduate students. She also brought the first radio astronomy Research Chairs to South Africa.

The theme for this year's event, "100 Years of Mama Albertina Sisulu: Women United in Moving South Africa Forward", honoured Sisulu's great courage as a unifying leader

Woods (1859-1920) as a photographer for the project in 1885. Though the photography took from 1885 to 1889, the grant was unfortunately not continued further and Gill had to finance the remainder from his own pocket (after getting his wife to agree!).

Fig 10: The Wind Tower in the late 1880s with the CPD camera just visible inside (photo: SAAO Archives P4295).

Measurement of the Plates

The measurement of the CPD plates was a formidable task and fortunately Jacobus Cornelius Kapteyn of Groningen came to Gill's rescue by offering to spend a few years on the project himself, not without Gill having dropped hints in his direction (van der Kruit, 2015).

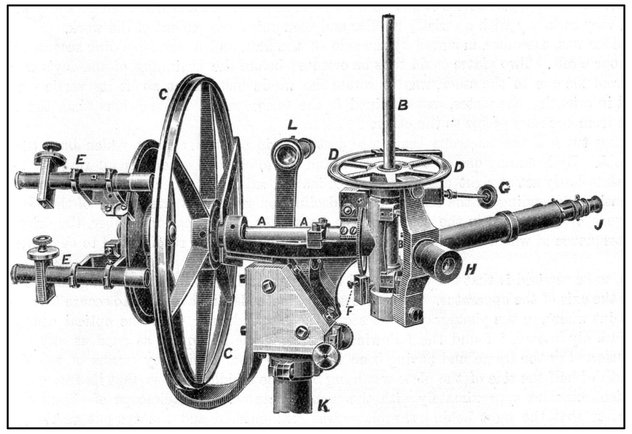


Fig 11. "Parallactic" measuring instrument devised by Kapteyn and Gill for the measurement of the CPD plates (Gill, 1913).

Kapteyn and Gill devised a unique instrument that was built by Repsold of Hamburg for measuring the CPD plates, which had been exposed in pairs. He mounted each pair of plates in a stand and placed the two-coordinate measuring device (Fig 11) at a distance from them equal to the focal length of the Dallmeyer lens. The position of each image as read on his instrument's circles then gave essentially the right ascension and declination directly, without having to do the extensive computational work that x,y coordinate measurements from the plates would have entailed.

To eliminate spurious images, the paired plates referred to were mounted slightly offset. Genuine images of stars were then distinguishable from false ones by being double. Measurement took from 1886 to 1898 and the results were published in the *Cape Annals* from 1896 to 1900. The total number of stars was 454875.

Gill prepared a large number of prints of 6 typical photographs, spanning the period 19 October to 14 November and these were circulated to astronomers far and wide as well as included in Finlay et al (1886).

The presence of stellar images on the plates encouraged Gill to propose making a star catalogue using photography. During a visit to England in 1884 he obtained from T.R. Dallmeyer (1859-1906) a stock “Rapid Rectilinear” lens of 6 inches (152 mm) aperture and 54 inches (1.37 m) focal length. Though he conducted several experiments with other lenses, this is the one that was used for production of the Cape Photographic Durchmusterung.

Fig 8. The Dallmeyer 6-inch diameter Rapid Rectilear lens that was adopted by Gill for the Cape Photographic Durchmusterung. (Astronomical Museum, SAAO; photo: author).

The Dallmeyer Rapid Rectilinear consisted of two identical meniscus achromats with their convex sides facing outwards. There was a stop placed centrally between them. It was one of the most successful lens designs of its time (1866) and was probably arrived at empirically by combining two Grubb landscape aplanats from his patent of 1857 (Kinglake, 1989).

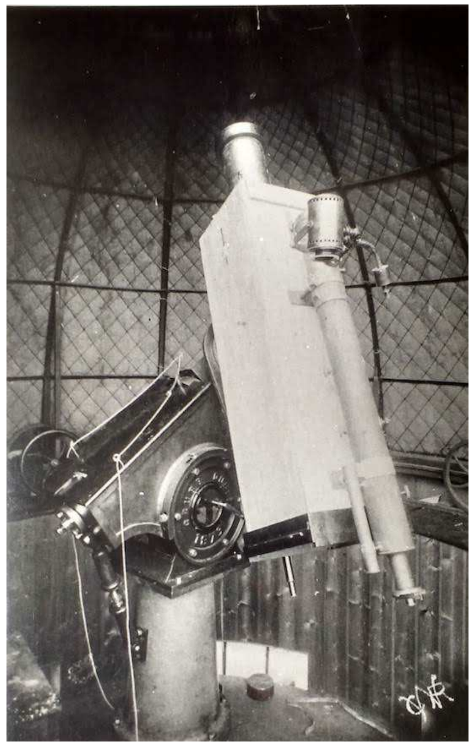


Fig 9: The CPD Camera in the Wind Tower, attached to the replacement Grubb mount. The body of the telescope was a wooden tube 12 inches (305mm) square. A versatile plateholder and focusing mechanism of Gill’s design was attached (not shown here).
The guide telescope was an old Dollond telescope of 3½ inches (89mm) diameter with a rotatable micrometer eyepiece. A lamp was used to illuminate a kind of graticule in its focal plane. This photograph was signed at bottom right by C. Ray Woods (photo: SAAO Archives P5636).

Gill applied for and received grant of £300 for two years from the Royal Society in London to carry out photographic work (including some attempts at coronography on behalf of the pioneering astrophysicist William Huggins (1824-1910). From this grant he was able to hire C. Ray

during the apartheid era. In 1956 Sisulu was instrumental in leading about 200 000 women in a march on the Union Buildings in Pretoria to protest the pass laws.

Minister of Science and Technology Seipati Makunyane said in her keynote address that the awards were not only prestigious but also inspiring.

“This occasion challenges us to reflect on the current situation in the world of science, research and technology in our country, and the strides made in bridging the gaps that exist,” she said.

The Department of Science and Technology recently launched the 64-antennae MeerKAT in what was hailed as a milestone of science and astronomy in South Africa. The award to Kraan-Korteweg was a commemorative one to celebrate the MeerKAT, given to “an outstanding woman astronomer”.

Kraan-Korteweg, who is also the chair of the South African Astronomy Advisory Council and vice-president of the International Astronomical Union, made international news in 2016 when she was one of only two South Africans on an international team of astronomers who managed to explore behind thick clouds of dust particles in the Milky Way. These had previously made it impossible to map large parts of the sky.

That team announced a ground-breaking discovery of 883 new galaxies following nearly two decades of painstaking research.

Later the same year Kraan-Korteweg led the team that announced their discovery of another massive supercluster of galaxies, also previously obscured behind dust and stars around the plane of the Milky Way.

The concentration of galaxies, which they dubbed the Vela supercluster, is located in the constellation Vela – in the largely unknown area rather aptly called the Zone of Avoidance (ZOA), for the challenge it poses in viewing distant objects.

At the time Kraan-Korteweg likened astronomers to “explorers of the universe”, saying that that their work was like that of geographers *in the past, when they started making maps of the Earth.* We are making maps of the sky.
She is also an active participant in various MeerKAT HI Large Survey Projects and, in preparation, is pursuing precursor projects that involve testing galaxy extraction pipelines based on a large ZOA WSRT (Westerbork Synthesis Radio Telescope) mosaic. This is a proposed MeerKAT early science project.

This will function as a pilot project for assessing the reliability of galaxy extraction and parameterisation tools that the MeerKAT Laduma and Fornax HI Large Survey Projects will apply.

UCT's astronomy department is the only dedicated, independent university department focused on astronomy in South Africa, with strong ties and joint positions with the South African Astronomical Observatory and significant interaction with the Square Kilometre Array (SKA) SA project office. Until the SKA is completed, the 10-year MeerKAT project offers one of the largest radio telescopes in the world for research.

Special IAU Prize Awarded to Carolina Ödman-Govender

Carolina Ödman-Govender has been recognised for her pioneering work in astronomy outreach, development and education with a Special IAU Prize by the International Astronomical Union (IAU) at the 2018 XXX IAU General Assembly in Vienna, Austria. She is Associate Professor at the University at the Western Cape and Associate Director, Development & Outreach for the Inter-University Institute for Data Intensive Astronomy in South Africa.

Fig: Carolina Ödman-Govender

This special EC Award reflects the IAU's new strategic action plan, as it intends to continue diversifying its portfolio of prizes to reflect changes in its priorities. The IAU also aims to have regular prizes in outreach, development and education, but needs further funding to support these prizes. This award is seen as an integral first step towards this vision.

Ödman was the first International Project Manager of Universe Awareness (UNAWE) at Leiden University from 2005 to 2010. UNAWE is an international programme that aims to inspire young children with the inspirational aspects of Astronomy. The programme's goals are to broaden children's minds, awaken their natural curiosity in science; empower them with independent thinking and to connect them with other children throughout the world. She successfully led the transformation of an idea into an active programme in more than 40 countries with national programmes and governmental support in 6 countries, reaching more than 200 000 children in that period.

The camera that they used had a 2¾-inch (7cms) diameter Ross rapid portrait lens of 11 inches (279 mm) focal length (made by Dallmeyer).

Fig 6. Ross lens borrowed from Allis and ultimately bought for the Observatory. (Astronomical Museum, SAAO; photo: author).

With it a number of photographs were taken, probably at first by Allis. Examples are shown in Fig 7. The originals of these photographs were sent to the Royal Astronomical Society in London and are now in the Science Museum (Plug, 2014). However, we have several positive copies made from Allis's negatives as lantern slides.

Fig 7. Examples of photographs taken with the Ross lens attached to the 6-inch telescope in the Wind Tower. The bottom left photograph was taken on 19th October 1882 (some of the blobs are artifacts); the top left on 21st, top right on 20th and bottom right on 7th November. The first three of these images are taken from lantern slides marked "From the original negative taken by E.H. Allis at the Royal Observatory C. of G. H." followed by the dates, Cape Mean Times and exposure times of 40-45 minutes (SAAO Archives, not yet catalogued).

According to Gill's narrative (Gill, 1913, p. xlviii), "On the early morning of the 8th of September 1882 (civil time), Mr W.H. Finlay … when on his way to his house after observing an occultation of the star 5 Cancri, saw a bright comet-like object in the constellation Hydra, which proved to be the afterwards celebrated comet of that year. It appears that the Comet was seen by various less responsible observers several days before its discovery by Mr Finlay; but the fact remains that the accurate observation of this object which he secured, by returning to the observatory on the morning in question, are the first of any scientific value that exist".

Gill was then concentrating on observations of the minor planets Victoria and Sappho in order to determine the distance to the Sun as well as work on the preparation of several expeditions for the Transit of Venus. He could not afford to spend much time on other matters (Gill 1882)

Finlay and William Lewis Elkin (1855-1933), a young American who visited Gill from 1881 to 1883 as an unpaid assistant, made numerous visual observations of the comet using the 6-inch telescope in the Wind Tower and made sketches of its tail and nucleus [Elkin was later director of the Yale Observatory]. These formed part of the observations of the comet published by Finlay, Elkin & Gill (1886).

A few weeks later the Observatory received a dramatic wake-up call. On 3rd October at 0440, an amateur photographer, Mr William Simpson of Aberdeen, Cape, succeeded in taking a surprisingly good image of the comet using the dry plate process. Until a few years before, photography had been very insensitive and relatively little astrophotography had been undertaken. It was now realised that a powerful new technique had emerged.

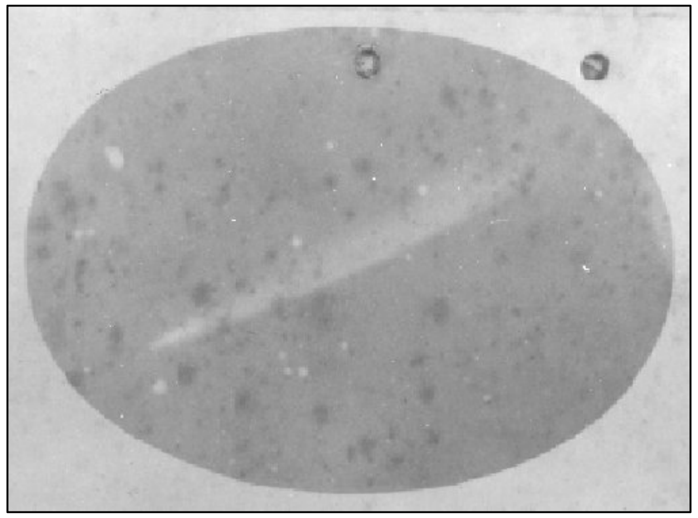


Fig 5. The photograph taken on 3 October 1882 by Mr William Simpson of Aberdeen and sent to Gill (SAAO Archives P4348).

Since he felt that he did not know enough about photography, Gill made contact with Mr Edward Haggar Allis (1849-1911), a professional photographer in the nearby village of Mowbray. Between them, they mounted a camera on the end of the declination axis of the 6-inch telescope so that the main telescope could be used as a guider to follow the diurnal motion of the comet. In this way they were able to take long time exposures without the danger of blurring.

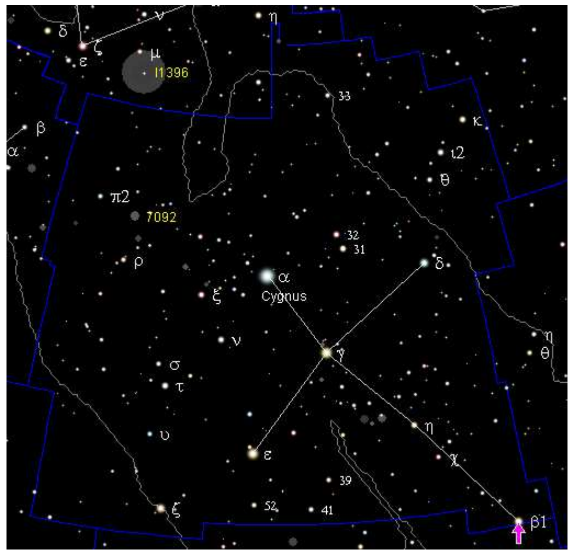
UNAWE was a global cornerstone of the International Year of Astronomy in 2009 and the programme's early success is in large part due to Dr Ödman's exceptional talent and leadership. Ödman has also contributed to various other outreach and education efforts in the field of astronomy. As the Director of Academic Development at the AIMS Next Einstein Initiative at the African Institute for Mathematical Sciences in Cape Town, she contributed greatly to the AIMS mission of giving young African scientists the opportunity to learn from recognised lecturers around the world. She also served as Chief Scientist at Thumzup, a South African company that pioneers the development of new technology for consumers.

Throughout her career, Carolina has received several awards for her accomplishments, including the SPORE Science Prize for Online Resources in Education Science Magazine from the American Association for the Advancement of Science. She has also held roles on various international advisory committees for science outreach and astronomy.

Although Ödman was not present to accept the award, the prize was presented to her husband, Kevin Govender, Director of the IAU Office of Astronomy for Development. The prize consists of €2 500 personal award plus €2 500 toward an outreach, development or education project of Dr. Ödman's choice.

Albireo – the Enigmatic Double Star

Spectroscopy by Percy Jacobs, text by Doug Bullis and Case Rijsdijk (ASSA)



Background

Albireo is the common name for the well-known double star, designated as Beta Cygni or β Cyg. Although designated 'beta' it is the 5th brightest point of light in Cygnus.

Fig 1: *Albireo's position, lower right corner. The cross-like figure is the Northern Cross. The blue line shows the boundaries of the constellation the Swan (Cygnus)*

Double stars or visual binaries are pairs of stars that appear close to each other as seen from Earth, but this could be for one of three reasons:

- Optical Doubles – unrelated stars that appear together through a chance arrangement

- Visual Binaries – these are gravitationally bound stars, separately visible with a telescope
- Non-visual Binaries – were found to be binaries using spectroscopy, proper motion or other means

Fig 2: Albireo, a beautiful Double Star

Ever since the Hipparcos satellite data came in, astronomers have doubted the traditional view that Albireo is a gravitationally bound system. Hipparcos showed that this is indeed not the case. Their proper motions are very different and if they were a true pair, their orbital period would be >75 000 years. [1,2] Given the exceedingly slow yet still tumultuous mass-energy interactions within the galactic disc, the probability of a pair that is so tenuously bound evading disruption is beyond calculation. Moreover, Hipparcos data was insufficiently fine-grained to assign a definitive separation distance.

Now that the GAIA data are in it turns out that Albireo is definitely not a bound system. The components are about 30 light years apart [3] and are purely a chance optical alignment. The first professional body to break the news was *The Astronomical Society of Edinburgh* [4] Their report was soon corroborated by others.

Even then there were moments of doubt. The GAIA data can be difficult to interpret. Source crowding – too many stars too close together – is a problem in astrometry. Bright stars give satellite eyes the same pixel-spillover problems that they present to the rods and cones in our eye. GAIA's eyes were tuned to algorithmically null-out brightness effects. The parallax data indicated the stars lie 100 and 119 parsecs from us. In 3-D, orbital calculations that put them about light 30 years apart.

The conclusive evidence is that their proper motions are irreconcilably different as well. The brighter red-orange star *Beta A* is moving at 9.45 milliarcsec per year (mas/yr) south by southeast, while the fainter blue *Beta B* is moving at 1.89 mas/yr west by southwest [5,6]. Two stars 30 ly apart moving in two different directions at two different velocities indicate that they simply form a very pretty optical double!

However, there is still some doubt about whether *Beta A* itself is not a binary! As far back as the 1970s, speckle interferometry indicated that the *Beta A* may actually be a spectroscopic double or even a triple system. This has never been confirmed by separate observations using different methods.

The Wind Tower under Gill

David Gill (1843-1914) arrived as HM Astronomer in May 1879 and immediately began to reorganize the Royal Observatory which had become somewhat disorganized and neglected.

One of his first actions was to order a new 6-inch (15-cm) telescope from Howard Grubb in Dublin for use during the Transit of Venus that was due to occur on 6 December 1882. The only other equatorially mounted telescope then at the Observatory was the 7-inch (18-cm) Merz of 1849 which was in poor condition and required extensive refurbishment.

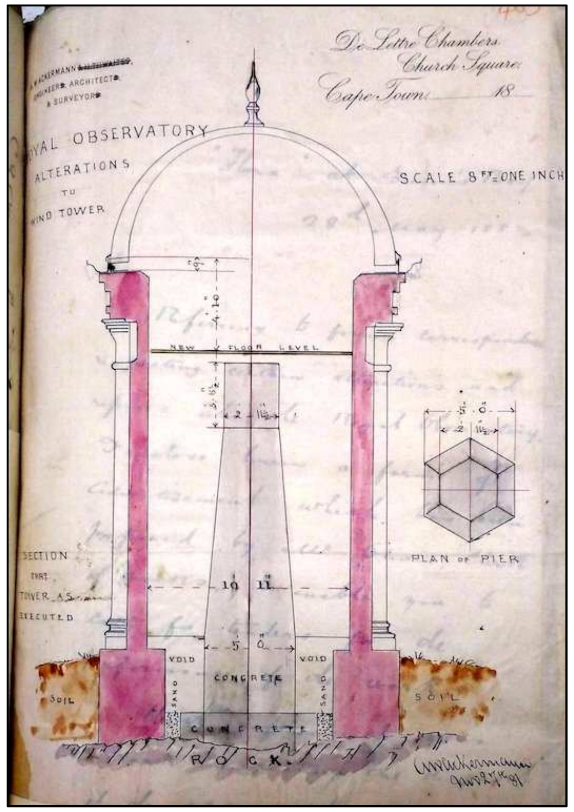


Fig 4. Ackermann's design for the modified Wind Tower, dated Nov 27, 1881 (SAAO Archives, A0011, p. 463).

To house the new telescope Gill decided to make use of the Wind Tower. He engaged a local engineer and architect, A.W Ackermann, who produced the accompanying design (Fig 4). The original flat lead roof was removed, a strong pier was built and a wooden floor was inserted. Access was by means of a spiral staircase leading to a trapdoor. From Grubb he ordered a dome and guttering with specially designed lion-head spouts (Gill, 1913)

The 6-inch Grubb telescope was one of several ordered from Grubb by British Transit of Venus expeditions. However, on trying it out, Gill was dissatisfied with the stability of its mounting. (After some acrimonious correspondence with the maker, the latter was replaced in 1885 by a heavier one designed for an 8-inch [203-mm] telescope). This mount is still used for the 6-inch telescope in its present square building.

The Great Comet of 1882

Gill's plans were disrupted on 8 September 1882 when William Henry Finlay, (1849-1924) the First Assistant astronomer (1873-1898), discovered what became known as the Great Comet of 1882.

In its original form, the Tower had a flat lead roof and was surmounted by a large wind vane connected to a frame with a diaphragm at one end. The diaphragm always faced the wind and was deflected by wind pressure. It was linked to a pencil that wrote on a moving piece of chart paper. Other pencils recorded the wind direction and the rainfall. This early automatic weather station was invented in 1835 by A.F. Osler (1808-1903).

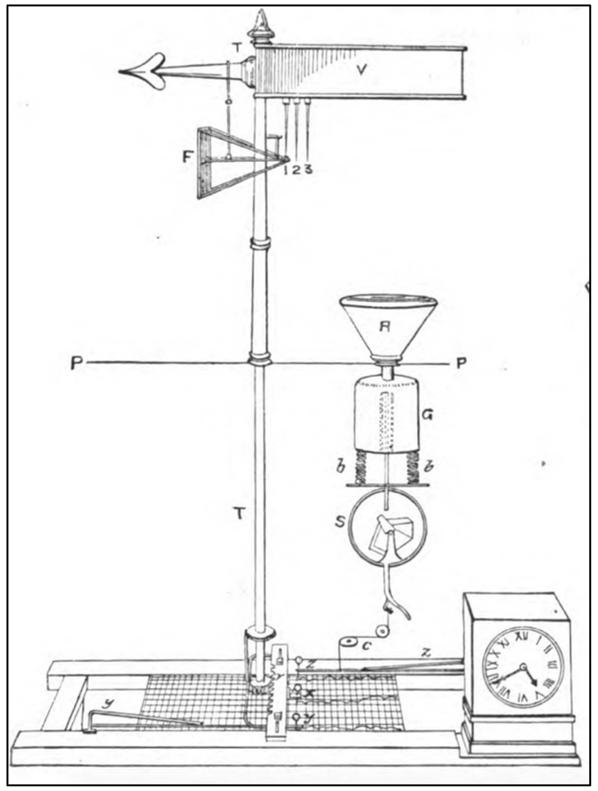


Fig 2. Osler self-recording wind and rain apparatus (Abbe, 1888, Fig 48).

After a few years the running of the Magnetic Observatory was handed over to the astronomical observatory, then under the direction of Thomas Maclear. It was regarded as a distraction from the proper activities of the staff and, unsurprisingly, less attention was paid to magnetic work thereafter. In fact, it was abandoned after about 1869 when Maclear retired (Warner, 1979), although meteorological observations continued.

It is presumably due to this that the Royal Observatory and its successor, the South African Astronomical Observatory, has the longest series of weather records in South Africa (Glass 2018).

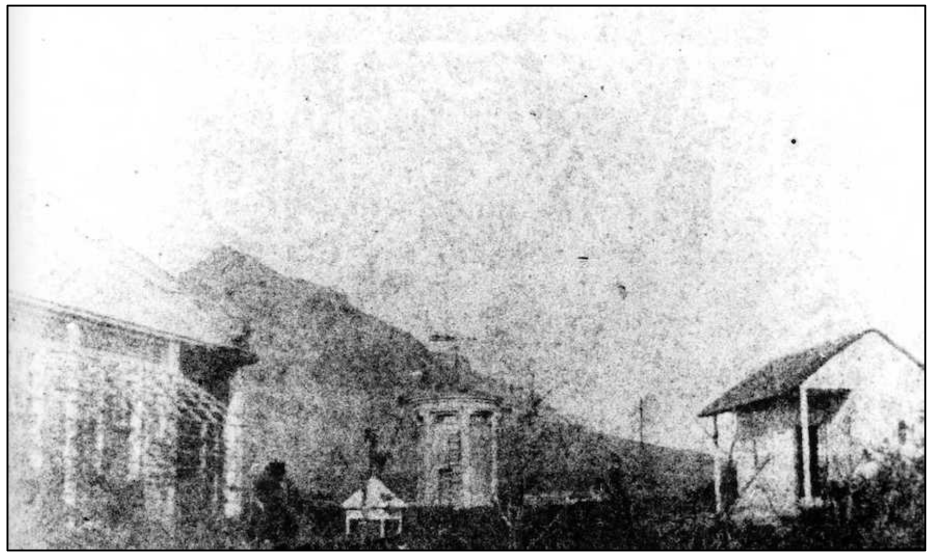


Fig 3. Calotype of the Magnetic Observatory taken by C P Smyth, from the East and with Devil's Peak in the background, shortly after its completion, around the end of 1841. Above the Wind Tower (in the centre) can be seen the large wind vane of the anemometer. This is one of the first photographs made in South Africa (SAAO Archives. P6702. Original: Museum of the History of Science, Oxford).

Albireo is still a an interesting object

The brighter and more massive star *Beta A* is an orange K giant of visual magnitude M_V = 3.1 and a surface temperature of 4 100 K. As a stellar class, K giants are about 10 times the diameter of the Sun, with commensurately high luminosity; in *Beta A*'s case; 100 times that of the Sun. If it is indeed a spectroscopic binary, *Beta A* is accompanied by a tiny B dwarf in a very tight orbit around the ageing giant.

Beta B is the more interesting of the two. It is a main-sequence Type B[e] star. B[e] stars are rapid rotators; their equatorial surface velocities are from 100 to 400 km per second; [7, 8] faster than the galactic disc gases in nearby space. The identifier [e] stands for "emission" which means they emit light in certain wavelengths rather than absorb specific wavebands. There are three classes of B[e] stars:

1. *Normal B-type stars* whose spectrum exhibits distinctive forbidden neutral or low ionization emission lines.
2. *Herbig Ae/Be stars* (H AeBe) are young (<10 Myr) pre-main-sequence stars of spectral type A or B. These stars are still embedded in their natal gas-dust clouds and are usually surrounded by circumstellar disks. They are identified by hydrogen and calcium emission lines in their spectra.
3. *Mass-transferring binary systems* are so close to each other that their mutual gravitational exchange orbits each star around a barycentre, not located within either object. This rules out planet–satellite systems. They are identified by the presence of one or more Balmer series lines in their emission.

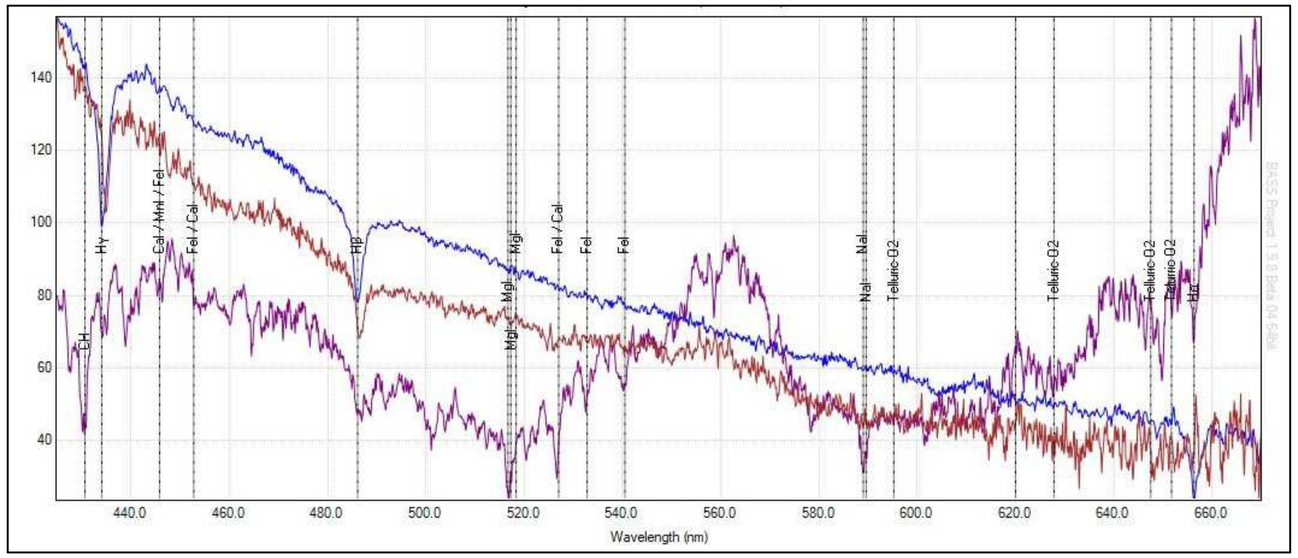
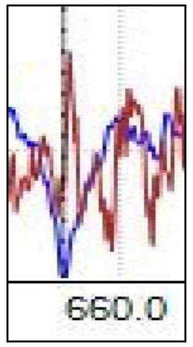


Fig 3: The Spectra of Albireo A (purple) and B (brown). The blue line is the calibration star Deneb (A1V).
(P Jacobs 25:09:2018)

Within the spectrum, notice that the energy on hotter Albireo B (blue star - brown line) is concentrated in the blue end of the spectrum. The energy of the A amber star, purple line, is towards the cooler red end, peaking in the amber/yellow region. Notice



The emission line, H Alpha, at 656.3nm, in the Abireo B star (brown line), see Fig. 4 below . In the other spectrum, Albireo A, it is absorption. That's from a glowing disk of gas surrounding Albireo, which is a "Be" star, of the second class above. Added, notice that the Amber Star of Albireo, the purple line, is very similar to the solar spectrum as shown by the labels which are from the solar spectrum.

Fig 4: Detail showing the Hα emission line

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The Wind Tower at the Royal Observatory, Cape of Good Hope

I.S. Glass, South African Astronomical Observatory

Abstract: A small building known as the "Wind Tower" existed at the Royal Observatory, Cape of Good Hope, from about 1840 to 1965. Though used for several purposes during its history, it is most famous for hosting the telescope used to make the Cape Photographic Durchmusterung, the first sky catalogue made using photography.

Early years as a magnetic observatory

Fig 1. The Wind Tower as it appeared after 1882. (SAAO Archives P3612)

The Wind Tower was built about 20 years after the foundation of the Royal Observatory as part of a Magnetic Observatory (Glass, 2015). It was one of a number set up in British colonies to study the nature of the Earth's magnetic field in space and time. It comprised several buildings. At first it did not form part of the Royal Observatory and was manned by members of the Royal Artillery

The main buildings of the Magnetic Observatory proper were made of non-magnetic materials. It was fully equipped with standard instruments for measuring the various components of the Earth's magnetic field. The Wind Tower was built as a weather station, presumably to see if weather conditions affected the magnetic readings. Its internal diameter was just 9 feet (2.7m).

The head of the small group that ran it was Lieut Frederick Marow Eardley-Wilmot (1812-1877). A two-room cottage, the only one of the buildings that still exists, though considerably extended, had been built for him to occupy but he ceded it in favour of Captain Clerk, an assistant, who had a family to take care of. He himself then lived in the Wind Tower. "I need hardly say that this, though apparently a small evil, is, when continued for four years, a very disagreeable sort of habitation" (Eardley-Wilmot, F.S., 1879).