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Cover image: *Composite of radio galaxies and MeerKAT telescope: Thousands of galaxies are visible in this radio image covering a square degree of sky, made by the MeerKAT radio telescope array (foreground) at Carnarvon. The brightest spots are luminous radio galaxies powered by supermassive black holes. The myriad faint dots are distant galaxies like our own Milky Way, too faint to have been detected before now. Credit: SARAO; NRAO/AUI/NSF*

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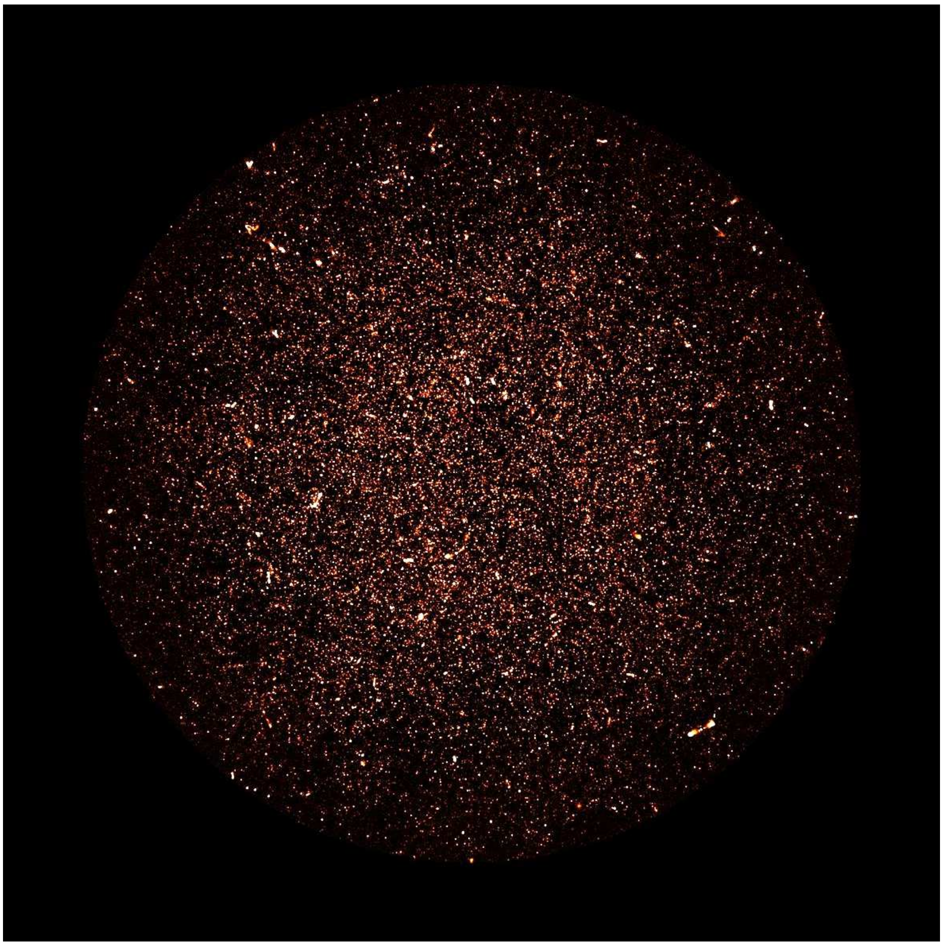
MeerKAT ultra-deep image reveals galaxies formed at "Cosmic Noon"



Each of the spots in this new radio image is a distant galaxy. The brightest ones are galaxies powered by supermassive black holes and are abnormally bright in radio light.

However, what makes this image special are the numerous faint dots that can be seen.

These are distant galaxies like our own that have never been observed in radio light before.

MeerKAT image of radio galaxies: Thousands of galaxies are visible in this radio image covering a square degree of sky near the south celestial pole, made by the MeerKAT array in Carnarvan. The brightest spots are luminous radio galaxies powered by supermassive black holes. The myriad faint dots are distant galaxies like our own Milky Way, too faint to have been detected before now, which reveal the star-formation history of the universe. Most galaxies are visible in the central part of the image, where the telescope is most sensitive. Credit: SARAO; NRAO/AUI/NSF

To learn about the star-formation history of the universe, we need to look back over billions of years. Though galaxies have been forming stars for the past 13 billion years, most were born between 8 and 11 billion years ago, during an era called “Cosmic Noon”.

It has been a challenge for astronomers to study the faint light coming from this era. Visible light telescopes, such as SALT in Sutherland, can see very distant galaxies, but new stars are largely hidden inside dusty clouds of gas. Radio telescopes can “see” through the dust and observe the rare, bright “starburst” galaxies, but until now have not been sensitive enough to detect the signals from distant galaxies more like the Milky Way that are responsible for most of the star formation in the universe.

The South African Astronomical Observatory 1972-2011

IS Glass, South African Astronomical Observatory

Abstract: I present a brief history of the SAAO from its beginning in 1972 to 2011. A later paper will cover its scientific output.

Introduction

The formation of the SAAO came about through contacts around 1969 between Sir Richard Woolley (Director of the Royal Greenwich Observatory and Astronomer Royal in the UK) and the President of the Council for Scientific and Industrial Research (CSIR), Dr Meiring Naudé (McCrea, 1988). These followed earlier discussions between JF Hosie of the Science Research Council (SRC) of the UK and FJ Hewitt of the CSIR during which a joint project was mooted. Woolley was of SA origin and was about to retire. He made himself available to direct the new institution, with the plan of setting up new observing facilities at Sutherland. An agreement was forged according to which SAAO would combine the Royal Observatory, Cape of Good Hope, and the Republic Observatory facilities in Johannesburg. One third of the running costs would be paid by the UK SRC and the remainder by the South African CSIR. The latter would also provide the capital needed for the Sutherland operation and would take over the Royal Observatory employees and pension obligations towards former staff members. UK observers would receive one third of the available telescope time (their work and that of other overseas visitors is not discussed here). This agreement was initially for 10 years but in fact remained in place until 1985, after which the SRC pulled out. Following a reorganization of the CSIR, the responsibility for SAAO passed to the newly-formed Foundation for Research Development (FRD) in 1990; this became the National Research Foundation (NRF) in 1999.

Sutherland

During the last few years of the existence of the Royal Observatory the need for an observing site remote from city lights had become obvious and seeing tests had been performed at a site near Sutherland in the Karoo. This area is on the border of the Summer and Winter rainfall regions and was expected to provide good observing conditions independent of season. When the SAAO project was formally decided upon land was purchased for a new field station a few km from where the seeing tests had been done.

Following the departure of RH Stoy, the last Royal Astronomer, in 1968 GA Harding of the Royal Greenwich Observatory had been appointed "Officer in Charge" at the Cape and it fell to him to organize the building of the new station at Sutherland, commencing in 1971. Apart from the 1m telescope, moved from Cape Town, and the 0.5m telescope from the Republic Observatory, completely new equipment and infrastructure (roads, water and electricity) had to be provided. Observations with the 0.5m and 1m telescopes commenced during 1972 and a ceremonial opening was held in March 1973. A dome had also been prepared to receive the MRM (Multiple Refractor Mount) from Cape Town and this with its refractors was installed a little later. A new 0.75 m reflecting telescope was ready in 1974 and this replaced two of the MRM refractors. The former 1.9m Radcliffe telescope (purchased with its turret from the Radcliffe Foundation) was moved from Pretoria and commenced working at Sutherland in January 1976.

A "Technical Building" contained a library, offices, a darkroom and workshops on site. The support staff was accommodated in six "non-white" houses and three "white" houses (in accordance with the Apartheid policies of the time). The astronomers lived at first in one of the "white" houses, which acted as a hostel and where they also ate their meals. The first Site Superintendent was Hennie Barnard and his wife Hettie was the Hostel Manageress. Barnard was the only technical person on site at first but additional support was provided by members of the Cape Town technical staff on an expeditionary basis. Six local people under a foreman Nicolas Witbooi provided site maintenance and further technical help. Several wives were employed as cleaners and domestic helpers. Electricity was generated on-site by a diesel driven alternator. The site staff also had to look after the water supplies from several boreholes and the small fleet of vehicles that included VW beetles for general use. In 1976 a larger hostel was completed.

Telescope time was usually allocated by the week. The astronomers would leave Cape Town on a Monday morning, have lunch at Matjiesfontein and arrive on site in the late afternoon. They started their observing on Tuesday evening and finished on the following Tuesday morning. Use of the telescopes was not restricted to SAAO staff members: many visitors came from the University of Cape Town, from the UK and other countries.

The staff of the Observatory has expanded greatly over the years, from about 80 in the mid-1970s about 180 (2019). The categories of staff today are Science, Technical/Engineering, IT/software, General including cleaners and hostel personnel, Administration and Outreach. The only areas of decrease have been in Scientific Assistants (formerly Lady Computers) and Cape Town Maintenance staff.

Sir R v d R Woolley Director (1972-1976)

Sir Richard Woolley started as Director on 1 January 1972. One of his first tasks was to recruit new astronomers. The remaining staff members of the Royal Observatory were mostly nearing retirement and were mainly routine observers on astrometric programmes under the leadership of J Churms. A few others were seconded from the Royal Greenwich Observatory. The only researchers when Woolley took over were Dr AWJ Cousins, TG Hawarden, Dr PR Warren (the latter based at Radcliffe), G Harvey and Dr IS Glass, the latter both seconded from the Royal Greenwich Observatory. Very soon he appointed J Penfold and Dr L Balona, recent PhD graduates of SA origin, as well as AJ Penny (1973-1981; also seconded from RGO) and Dr G Wegner. When the Radcliffe observatory closed towards the end of 1974, Dr MW Feast, Dr T Lloyd Evans and RM Catchpole were recruited. The relative youth and dedication of this active group ensured that the first few years of SAAO were highly productive.

On the technical side SAAO had soon to expand beyond the few people inherited from the Royal observatory. The electronic department in particular was increased from one to three in Cape Town and a drawing office was set up. The in-house development of new instruments now became possible. At Sutherland, resident electronic and mechanical technicians were employed. This review will not, however, give details of the essential contributions made by the technical staffs, so critical to the setting up of the Sutherland operation.

UBV photometry using photomultiplier detectors had been one of the most successful activities of the Royal Observatory under AWJ Cousins. While he carried on his work from the 49cm reflector in Cape Town, it became the main activity at Sutherland also. RE Nather and B Warner of the University of Cape Town introduced high-speed photometry under mini-computer control and this became a major theme both at the University and the SAAO. Cousins also established his UBVRI system during this period, using a GaAs photomultiplier. As time went on, the Sutherland photometers were converted to pulse-counting, though Cousins continued to use analogue recording via a chart recorder.

Spectroscopy was at first limited to the former Yapp grating spectrograph sent from the RGO and attached to the 1.0m telescope. This received limited use, mainly on a Cepheid programme. When the 1.9m telescope, purchased from the Radcliffe Trustees, arrived in 1976 its image-tube spectrograph (known as the “Unit

Spectrograph") accompanied it. Though it had been designed for use with three different detectors, photographic, 2-stage "Carnegie" image tube and Spectracon electronograph, it was re-equipped with a three-stage image tube (1976-1979) coupled to a borrowed Boksenberg image photon-counting system (1979-1981). Later on, a similar but simpler "Reticon"- based photon counting system (1981-1997) was installed and, since then, a CCD camera (August 1997). The CCD was many times more efficient than the older photoelectric devices.

Glass brought infrared technology to the SAAO, designing cryogenic photometers and spectrometers that enabled the SAAO to become highly competitive at wavelengths from 1.2 to 20 micrometres (for reference, the visual band is centred at about 0.5 micrometres).

Other important instrumental developments were the introduction of a new visual-region photometer (the Peoples' photometer) made at the RGO (Bingham, RGO) and another, the St Andrews Photometer (STAP) by Van Breda and Kelly (St Andrews). Van Breda later contributed a scanner for spectrophotometry. Continuous improvements were made to telescopes to improve their efficiency, especially as to pointing accuracy and drive mechanisms.

The mini-computers of the early 1970s, apart from enabling high-speed photometry to be introduced, were used for photoelectric radial-velocity measurements at the coudé focus of the 1.9m telescope [van Citters (UCT) and Balona (SAAO)].

Considerable effort was expended on an electronographic camera designed by D. McMullan (RGO). Two of the main problems of photographic films or plates are that they are insensitive and do not respond linearly to the incoming light intensity. In the pre-CCD (Charge-coupled Devices) era, electronic cameras such as those developed by JD McGee of Imperial College London and D McMullan seemed to offer a solution to the problems. Unfortunately these cameras were difficult to use and, at least initially, suffered from instability. The (commercial) recording film medium that they required also suffered from quality control problems. In addition, the data on the electronographic films had to be digitized using a (Joyce-Loebl) microdensitometer, a very slow process. This type of detector became obsolete rapidly with the advent of charge-coupled devices (CCDs).

Woolley was a strong director who believed that there should be large-scale observational programmes carried out by staff members. One of the most successful of these, which continued beyond his directorate, was a photometric study of Cepheid variables begun by Martin and Warren in the VRI (Visible – Red – Infrared) bands.

The traditional activities of the Royal Observatory such as observations with the Gill Reversible Transit Circle and parallax determinations using the McClean telescope were continued for some years but were phased out by about 1980. These had contributed to fundamental astrometry, such as the FK4 and FK5 Catalogues, for a number of years but few or no results seem to have been published during the SAAO period in spite of their consuming considerable resources.

MW Feast Director (1977-1991)

Woolley was succeeded as director in 1977 by MW Feast who had worked from 1951 to 1974 at the private Radcliffe Observatory in Pretoria. His regime was to be characterized by a strong dedication to scientific productivity. It can be said that the research activities during this period put the SAAO on the scientific map.

Appointments made by Feast included AR Walker, Dr P Barrett, Dr P Mack and J Spencer Jones. Drs JW Menzies and PA Whitelock, a husband-and-wife pair, were appointed in the late 1970s. Dr D Kilkenny was appointed in 1980. Other Feast appointees included Dr DA Buckley, Dr K Sekiguchi and Dr JAR Caldwell.

Peripheral activities conducted at the Cape Town site such as daily Photoheliograph photographs and the Lyot Coronagraph were discontinued in order to concentrate on pure research themes.

During the early years of SAAO, meetings with international participation were held in 1973 (in connection with the opening of Sutherland), in 1975 (retirement of AD Thackeray), in 1976 (re-opening of the 1.9m telescope) and in 1980. From 1987 to 1991 they were held annually in Cape Town to encourage the SA astronomical community to interact with one another. Thereafter this function was taken over by the SA Institute of Physics, which now includes an astronomy section. Several international symposia were also held: Variable Stars and Galaxies (1992, in honour of the retirement of MW Feast); Astrophysical Applications of Stellar Pulsation (1996, Colloquium of the International Astronomical Union No. 155); and Scientific Requirements for Extremely Large Telescopes (2005, Symposium of the International Astronomical Union No. 232).

The (formerly Radcliffe) 1.9m telescope was the largest available and was in heavy demand. Woolley had insisted that it be moved from Pretoria and re-erected without any upgrades, which he feared would be overly time-consuming. Its controls were clumsy and outdated and setting had to be done via large circles. New quick- and fine-motion motors were installed and 19-bit computerized encoders were attached to the axes, giving a resolution of about 2 arcsec and the ability to point the telescope much more accurately. Its turret housing was automated to follow the telescope.

A new era in astronomical imaging detectors began in the late 1970s and succeeded photographic plates. The latter had quantum efficiencies (probability of detecting a single photon) of only around 1-3%. Though the coming of image tubes had led to increased efficiencies of up to 20%, comparable to photomultipliers, the final registration was still photographic, with its problems of “reciprocity failure”, i.e. nonlinearity. As mentioned, electronographic cameras, in use only for a few years, offered somewhat improved efficiency and linear response but were only partially successful operationally.

CCDs, or Charge-Coupled Devices, revolutionized astronomical image detection. They offer almost prefect linearity in their response and now approach 100% quantum efficiency, which may be compared with the low values already mentioned of 2-3% for photography and <= 20% for photoelectric devices. They thus greatly improved the sensitivity of all the instruments with which they are used. Further significant increases in sensitivity can only be expected through increasing the collecting area of telescopes and increasing the efficiency of optical components. The first CCD to be used at SAAO appeared about 1981. This equipment was supplied as part of SRC support "in kind" by a group led by D Walker at University College, London. Later CCD detector systems were developed in-house. AR Walker was in charge of the astronomical implementation of the first CCD at SAAO and he developed the first such system used for all-sky photometry, where it was in many ways superior to photomultiplier-based systems.

Various infrared cameras were also built at SAAO. Multi-pixel infrared array devices were difficult or impossible to get hold of in South Africa at first because of international sanctions against the former regime. The Internet also came late to South Africa for this reason, but connectivity with the outside was obtained indirectly.

Astronomical establishments have always been dependent on computational work. During the Royal Observatory period, this was carried out by "Lady Computers" using mechanical calculating machines but, at about the time that SAAO opened, as mentioned, digital computers had become available. Apart from their utility in data reduction, mini-computers came to be used for data acquisition at the telescopes and for control of the telescopes themselves. Special interface boards for astronomical instrumentation were developed in-house. VAX computers and early image-processing work stations were used for image processing after the advent of CCD detectors. For several decades a "computer room" was located in the Main Building East Wing. Much use was made of the UK "Starlink" image processing software and later of "IRAF" from Kitt Peak National Observatory, USA. Nearly all the management of computers and data-acquisition programming during the first three decades was undertaken by LA Balona.

Towards the end of the period described in this paper, PCs, laptops and extensive networking replaced centralized computer installations. Hundreds of devices are now connected to the SAAO network and an IT department with several staff now exists, taking care *inter alia* of backup functions. Data processing packages are now available internationally.

A joint SAAO-UCT project to construct an Automatic Photometric Telescope (later known as the Alan Cousins Telescope) was initiated in the 1980s and was completed in 2003. This instrument was constructed in the Observatory's workshops under the leadership of D Kilkenny, with contributions from UCT and P Martinez (software).

The first of several foreign-controlled installations at Sutherland was the automatic University of Birmingham solar-oscillation monitoring instrument (BISON), one of a number placed around the world in order to get long series of observations suitable for Fourier analysis without 24-hour aliasing problems. SAAO and UCT also contributed to the Whole Earth Telescope (WET), a network of high-speed photometric telescopes spread around the world to obtain long continuous observations of variable stars in order to reduce the problems of “aliasing” in the subsequent analyses.

By the mid-eighties it was becoming apparent that the telescope facilities in South Africa were being out-gunned by other observatories, even in the southern hemisphere. In 1987 Glass proposed in an article in *MNASSA* that SA should consider the construction of a 3.5m alt-azimuth telescope similar to the ESO NTT. His article attracted the attention of the SAAO Advisory Committee, who requested that a proposal be laid before them. However, no action was taken until the appointment of the next director, RS Stobie, who was specifically mandated to set about acquiring a large telescope.

RS Stobie (Director 1992-2002) and the SALT Project

Robert S Stobie was appointed director from 1992. He had previously been Deputy Director of the Royal Observatory, Edinburgh and had been involved with the Edinburgh-Cape Blue Object Survey. Though the proposal for a 3.5m telescope was followed up, resulting in detailed costing and other documentation, it did not receive sufficient political support and was eventually superseded by the SALT project.

With the change in government in 1994 came pressure to devote more of the resources of the Observatory to outreach activities. C Rijsdijk was appointed to run the SAAO Outreach Programme in 1996 and formed the Science Education Initiative, SEI, with the aim of using Astronomy as a vehicle for science education. This led to the development of a wide variety of resources and to the SAAO Resources Centre that was opened officially by Capt Winston Scott, a well-known US astronaut, in 1997.

In 1998 the government declared the Year of Science and Technology, YEAST, and the SAAO was given R1 million to promote astronomy and the then planned Southern Africa Large Telescope, SALT. The Friends with the Universe project was launched. This initiative led to a much higher profile nationally for astronomy through visits by famous figures, distribution of posters and pamphlets, the “Starbus” project and workshops and lectures for National Science Week in Kimberley and other places. By the end of YEAST, it would be fair to comment that the SAAO Outreach had reached maturity and was nationally known.

The outreach programme has now grown to form a significant part of the SAAO, as shown by the SALT Collateral Benefits Programme, in addition to assorted workshops and other activities that are continuing, using the existing and new resources.

International collaborations also became easier after 1994. Several new telescopes were introduced at Sutherland during Stobie's time as director. These included the 1.4m Infrared Survey Facility (IRSF, in collaboration with the Universities of Tokyo and Nagoya) and the YSTAR all-sky monitoring telescope of Yonsei University (Korea). In addition, a seismograph forming part of the Global Seismograph Network (UC San Diego) has been at Sutherland since the early days and a superconducting gravimeter was installed by GFR, Potsdam. These projects merely make use of Sutherland as a convenient observing site and, with the exception of the IRSF, are not participated in scientifically by SAAO.

The most important instrumental development during Stobie's regime was the initiation of the SALT project, following an offer of cooperation from the Hobby-Eberly project of the University of Texas. Much of Stobie's effort went into laying the political groundwork to push SALT through the NRF, the Department of Science and Technology and eventually Parliament. Unfortunately, he died unexpectedly in 2002, shortly after construction commenced, but the initiation of the project must in great measure to be attributed to him.

SALT (Southern African Large Telescope) PROJECT

The SALT telescope was conceived as a clone of the Hobby-Eberly telescope of the University of Texas, offering a large collecting area at a small price compared to a fully steerable conventional telescope. A large project office was established for the duration of the construction.

SALT achieves fairly good sky coverage iby tracking the reflection of astronomical objects in a composite spherical mirror of 91 hexagonal segments that moves only in azimuth. The distorted image resulting from the spherical mirror is rectified by a complex "Spherical Aberration Corrector" (SAC). A portion of sky in the shape of a doughnut can be accessed with from 0 to 100% of the maximum entrance pupil of approximately 11m diameter. In essence, objects between declinations -10° and -80° can be observed when they pass through the doughnut region.

SALT, though initially conceived as part of the SAAO, became a financially separate consortium with partners from South Africa – NRF (34,4%), USA – five universities (41.5%), Poland - KBN, CAMK (11%), Germany – Göttingen University (4.9%) and New

Zealand – University of Canterbury (3.9%). SALT is now operated by SAAO under an agreement with the SALT Consortium. The South African share was financed by a grant of R50 million.

Dr D O'Donoghue, formerly of UCT, was appointed to the SAAO staff in 1997. In addition to his astronomical work, he acquired expertise in optical design and, in particular, designed a much improved Spherical Aberration Corrector (SAC) for the SALT telescope. O'Donoghue's unique 5-reflection design offered a much larger field of high resolution than the original device used on the Hobby-Eberly telescope though it required a much more precise support system than was realized initially, leading to severe problems that had to be circumvented.

PA Charles Director (2004-2011)

Following two interim directors (PA Whitelock [2002-3] and P Martinez [2003-4]), PA Charles of the University of Southampton was appointed as director from October 2004 for a fixed term of 5 years [afterwards extended by another two].

For several years following, SAAO was dominated by the commissioning of SALT and its shake-down process, even though SALT is nominally a separate entity. Some of the senior staff members, though past the official retirement age of 60 and employed on contract, devoted much of their time to programming and instrumental matters. Operations at the smaller SAAO telescopes had to be simplified or reduced to release effort to the SALT project.

At the time of its nominal completion and official opening in 2005, SALT did not function correctly. A major effort was required in order to diagnose and correct its two main problems. One of these was poor image quality, traced in essence to inadequate support for the SAC components. The other was that edge sensors intended to measure and keep in adjustment the positions of the 91 segmented mirrors were too sensitive to changing temperature and humidity. These issues have now been resolved and the telescope has performed as predicted since 2010.

SAAO has been highly involved in the NASSP (National Astrophysics and Space Science Programme) to provide introductory graduate-level courses as an introduction to Masters and Doctoral degree students affiliated to various universities.

The SCBD or SALT Collateral Benefits Division was established to make sure that the maximum collateral benefits from the project are used to advance society by promoting education in mathematics, science, engineering and technology.

SAAO won a competition to host the International Astronomical Union’s Office of Astronomy for Development (OAD) that now has offices in a number of developing countries. The office in Cape Town was opened by the Minister for Science and Technology in April 2011.

The SALT spectrograph was used to study the metal abundances in planetary nebulae within the Sagittarius dwarf galaxy, showing that it contains a young stellar population. The other telescopes of the SAAO have of course continued in active use. The SA-Japanese IRSF has produced a number of multi-epoch surveys of particular areas such as the Magellanic Clouds and other local galaxies, leading to an understanding of their content of Mira variables and other AGB stars.

Successful searches for extra-solar planets were carried out using the SuperWASP wide-angle telescope of a UK University Consortium. This system monitors precisely the brightness of large numbers of stars to detect dips caused by planetary transits. Another search method was that of the international PLANET collaboration that required intensive and continuous monitoring of a dense field for variations of star brightness caused by gravitational lensing. Planets give rise to short-term perturbations of the light curves. The SAAO 1m telescope was used for this programme.

High-speed photometry of polars have allowed us to find the masses of the component stars, the orbital inclination of the system and the co-latitudes of the accretion spots.

Charles's directorship was marred by his gratuitous suspension in January 2010 by the NRF on ill-defined charges of having released confidential management information. This apparently related to a secretive attempt to move the SAAO to another location and take a dictatorial approach to the government of astronomy. The international reaction to this heavy-handed action was very considerable and could have affected South Africa's application to host the SKA. In the event, a commission of enquiry completed exonerated Charles.

Some interesting statistics of this period are that the staff increased between 2004 (pre-SALT) to 2009 from 73 to 113. There was a concerted effort to promote affirmative action. By 2009 the black staff amounted to 63% of the work force. During the same period the budget of the SAAO (excluding SALT) rose from R21M to R24M. Separate contracts, mainly SALT-related, increased the total from R28M to R52M over this time.

Note: An informal account of the first few years has been written by Glass (2001).

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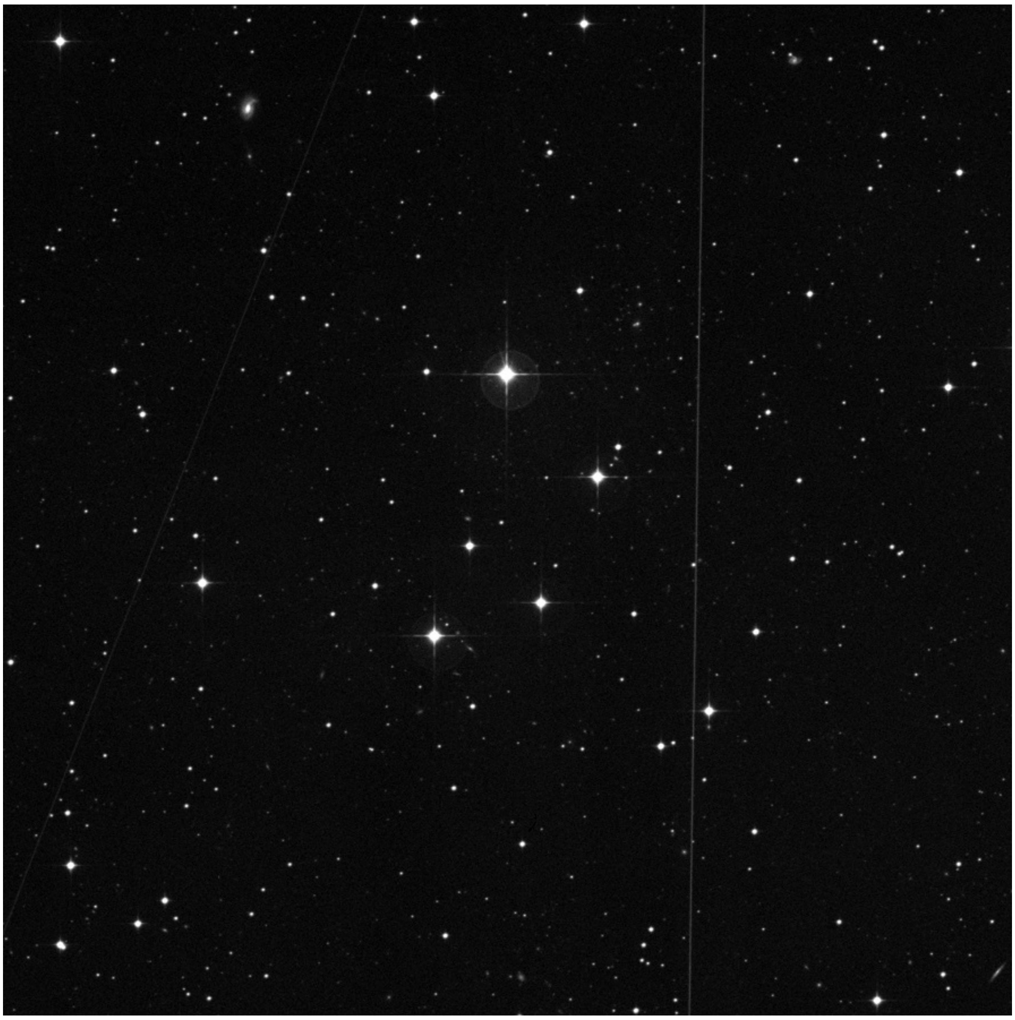
Streicher Asterisms 18-21

Magda Streicher

Streicher 18 - Caelum

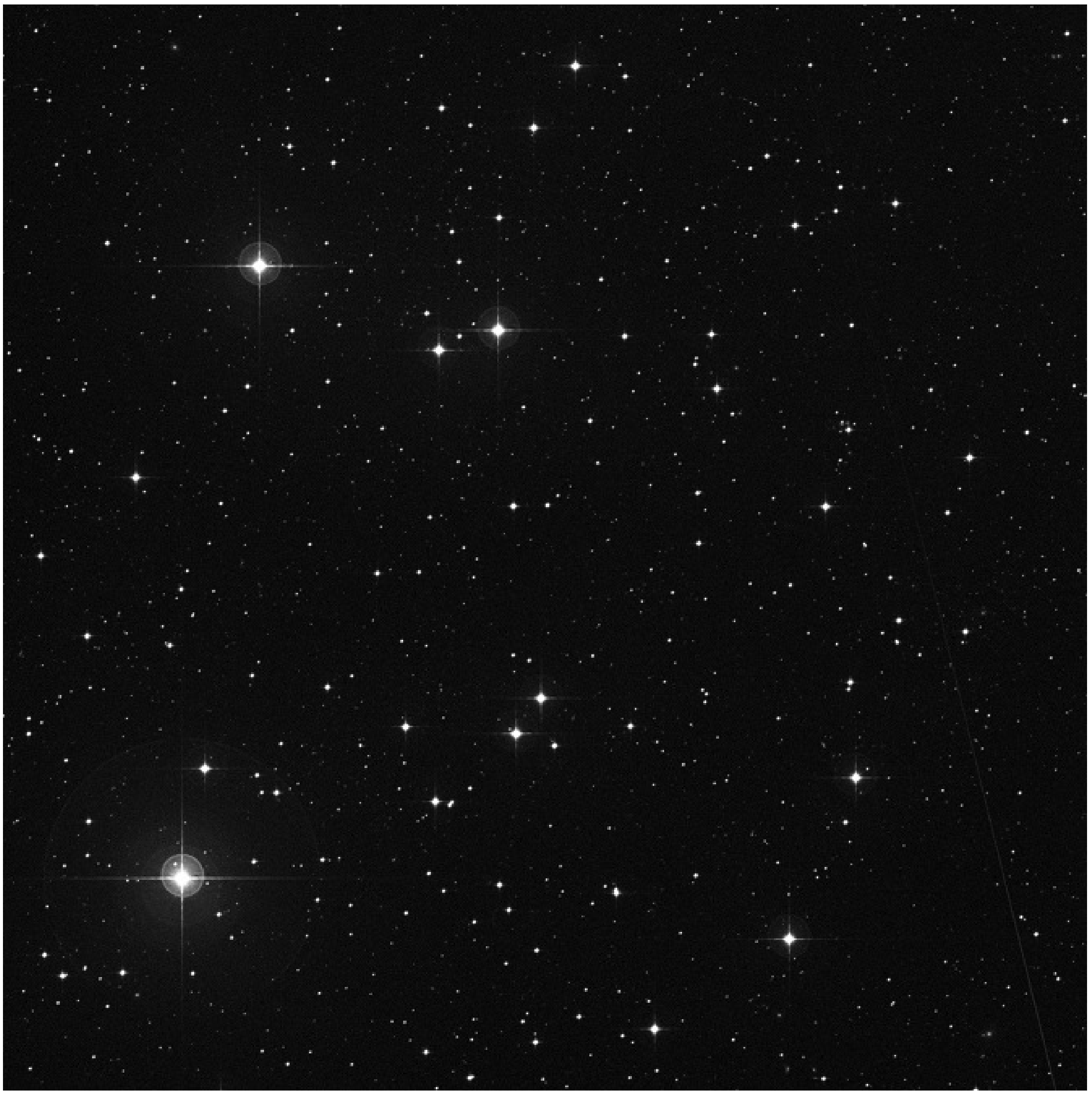


A group of five stars in a half-circle, with the circle convex to the west. Not commendable but worthy of an observation. High power is needed to appreciate the stars, which are between 8 to 10 magnitude. The field of view is ill-defined, with only faint stars. With closer investigation on DSS a very very small and faint galaxy is situated north-west of the group of stars, as can be seen on the upper edge of the photograph.

OBJECT	TYPE	RA	DEC	MAG	SIZE
Streicher 18 DSH J0428.4-3740	Asterism	04h28m28"	-37°40'.48"	8.2	9'

Picture Credit: DSS

Streicher 19 – Caelum

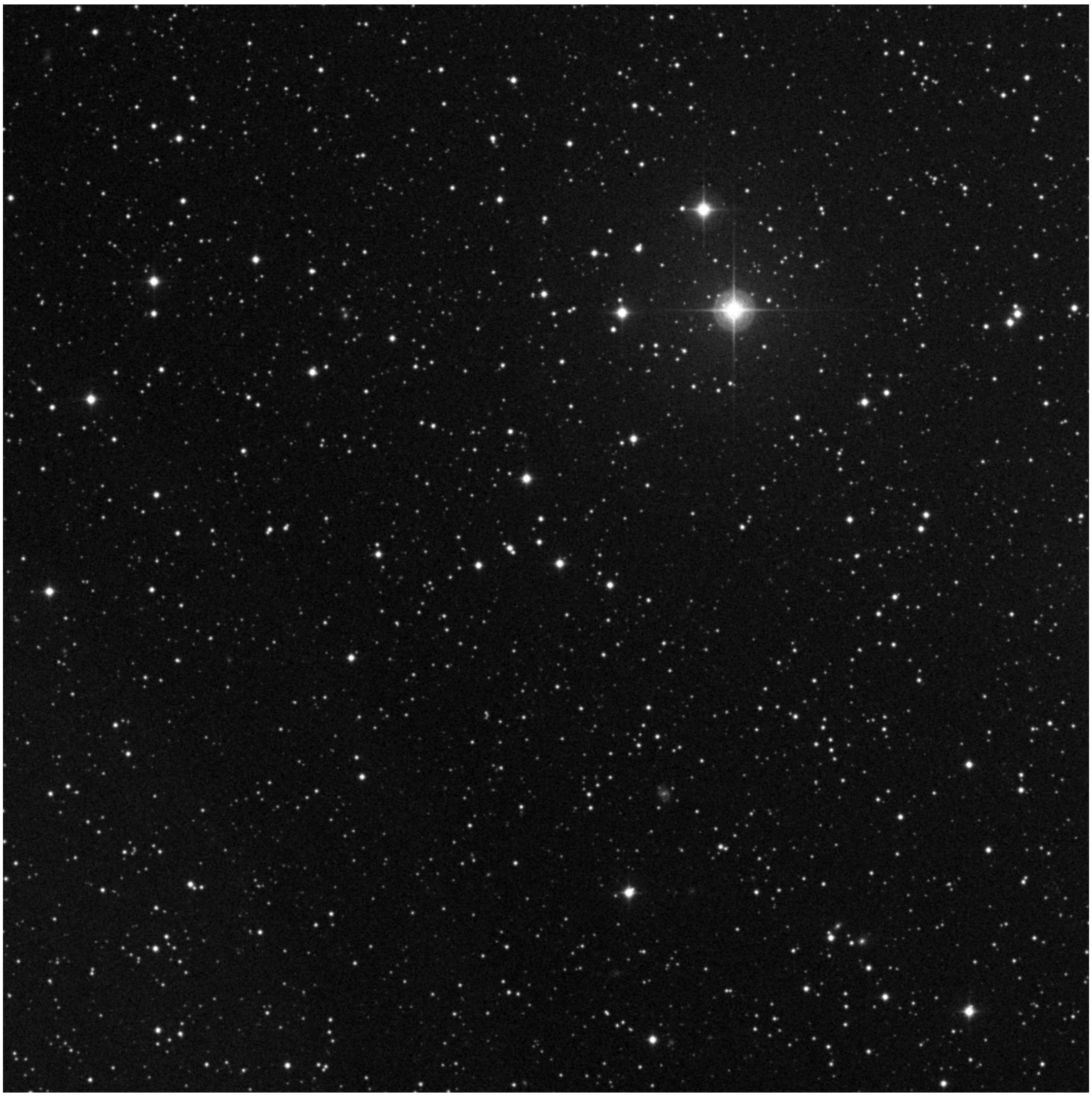


A wide semi-circle of stars which, although faint, stands out quite well as a large group against a large and wide field of view. It is made up of a handfull of stars varying in brightness from 7 to 10 magnitude. Two prominent brighter stars can be seen towards the eastern edge of the group.

OBJECT	TYPE	RA	DEC	MAG	SIZE
Streicher 19 DSH J0501.2-3132	Asterism	05h01.m12	-31°32'.36"	6.8	28'

Picture Credit: DSS

Streicher 20 – Canis Minor

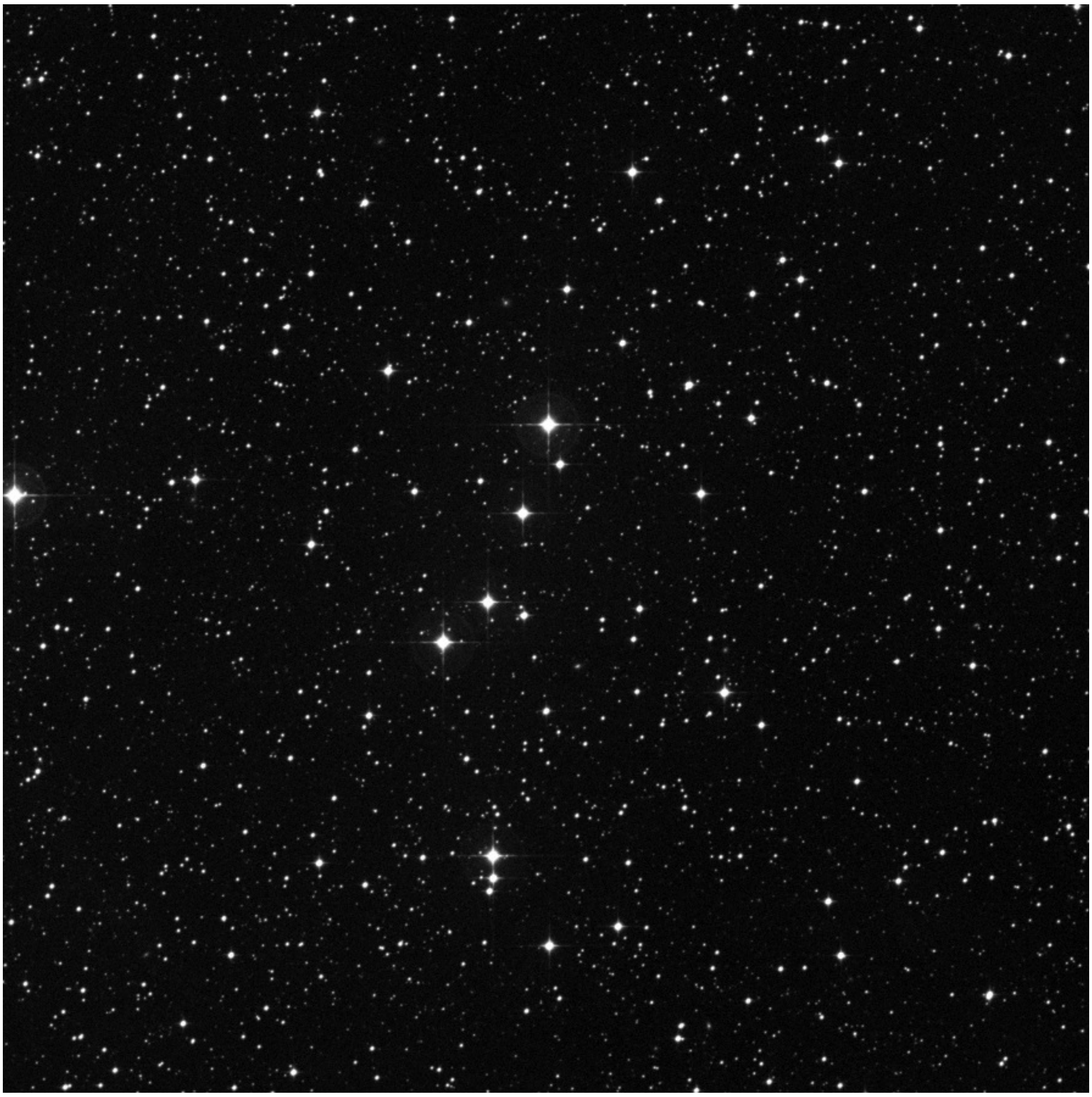


Very faint but well-formed Y shape, comprising of nine tenth magnitude starlets seen in a wide field of view. The open end of the Y faces northeast. Three prominent bright stars are situated snugly together in a triangle to the north of the field of view.

OBJECT	TYPE	RA	DEC	MAG	SIZE
Streicher 20 DSH J0743.7+0450	Asterism	07h43m.42	+04°50’.12”	11	4.2’

Picture Credit: DSS

Streicher 21 – Chamaeleon



A few stars in a well-formed line from north to south that stands out beautifully against the background star field. Perhaps a snake or some sort of insect can be imagined if looking at it with an open mind!

OBJECT	TYPE	RA	DEC	MAG	SIZE
Streicher 21 DSH J0851.0-8009	Asterism	08h51m.00	-80°09'.30"	9	22'

Picture Credit: DSS

Annual Index 2019

News Notes

Obituary

Articles

Annual General Meeting of ASSA 2019

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.
Sky & Telescope: Members may subscribe to Sky & Telescope at a significant discount (proof of membership is required). Please contact the Membership Secretary for details.
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