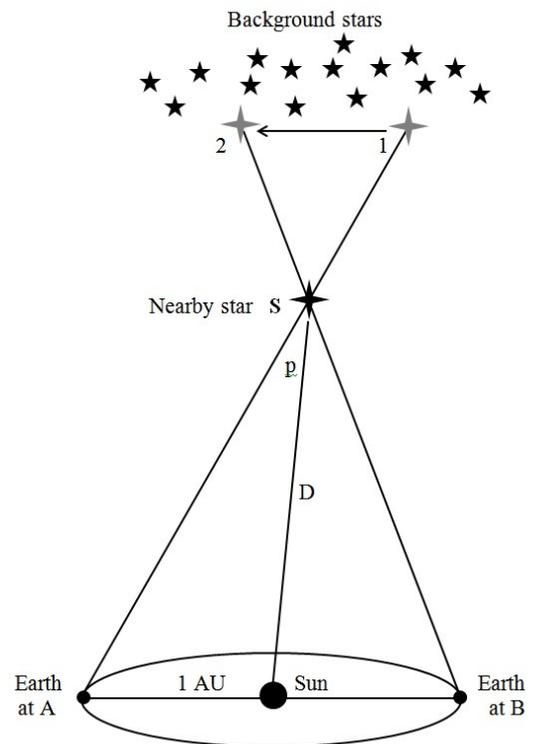


A Stellar Highway

1 Stellar Parallax

Parallax is the apparent movement of a nearby object relative to a distant background when the observer changes his/her position. For example put your arm out in front of yourself and stick up your thumb. Then see how your thumb appears to move relative to the background as you first close one eye and then the other.

Astronomers use this effect to calculate the distance to nearby stars. If a nearby star S is observed as the Earth orbits the Sun from A to B (6 months later), then S appears to move from 1 to 2 against the background stars. This enables astronomers to measure the angle p . Then knowing the distance from Earth to the Sun to be 150 million km or 1 AU (Astronomical Unit) the distance D can be calculated using $D = 1/p$. If the angle $p = 1''$ (1 arcsecond or $1/3600^{\text{th}}$ of a degree) then $D = 1$ parsec or 1 pc = 3.26 light years. The largest parallax measured $0.7692'' = 1.3000$ pc or 4.2400 ly, the distance to Proxima Centauri!



2 The First Stellar Parallax Measurement

The early Greek geometers knew about parallax and today it is used regularly on Earth by surveyors. But the Greek, Babylonian and Egyptian astronomers knew that the stars were far away because they were unable to detect any parallax. Henderson, at the then Royal Observatory at the Cape, now SAAO, knew of α -Centauri's large proper motion, and suspected that it was close to the Sun. He observed α -Centauri from the Royal Observatory at the Cape from 1832 to 1833. Unhappiness caused him to return to England, where he was appointed to be the first Astronomer Royal in Scotland.

In 1834, using his data from the Cape, he calculated that α -Centauri was 3.25 light years away. He wasn't confident of this distance and as a result didn't publish his results. Justified in a way, as the distance later turned out to be 26% too small. However in the race to be the first to measure the distance to a star, the German astronomer Friedrich Wilhelm Bessel, measured, and published, the distance to 61 Cygni as 10.3 light years in 1838, 10% too small!

Henderson then published his results in 1839, but his lack of confidence put him into second place in the measurement race!

But the fact remains that the first measurement of the distance to a star was made from the then Royal Observatory at the Cape – a South African first!

3 Discovery of Proxima Centauri

Robert Thorburn Ayton Innes took up the position of Director of the Transvaal Meteorological Observatory in 1903 which became the Transvaal Observatory in 1906, and he was later appointed the first Union Astronomer of the new Union Observatory in 1912. He had acquired a 9" Grubb refractor in 1909, and in the same year, British amateur John Franklin-Adams donated his 10" astrographic camera to the Union Observatory.

Innes was aware of the large proper motion of α -Centauri and was interested in finding others stars with similar high proper motions, in the belief that often stars were accompanied by one or several more stars nearby.

Using the Franklin-Adams camera Innes found another star with a similar proper motion to α -Centauri in 1915 and reasoned that this group of stars was the closest to the Sun. With not too much evidence he felt that his newly discovered star was closer than α -Centauri, and in 1917 he named it Proxima Centauri – the closest star to the Sun. This was later confirmed in 1928 by Harold Lee Alden at the Yale observatory station in Johannesburg. No closer star has been found to date, so Proxima Centauri remains the closest star to the Sun – another South African first.

3 A Stellar Highway

The South African Agency for Science and Technology Advancement, SAASTA, a business unit of the National Research Foundation, NRF, decided to commemorate the Centenary of this significant South African astronomical discovery. As a part of the Centenary celebrations, several different activities were held throughout the country leading up to the main event on 8 October 2015.

As Henderson worked at the Observatory in Cape Town and Innes at the Observatory in Johannesburg it seemed to be an ideal opportunity use the two Observatories to create a Stellar Highway. The Astronomical Society of Southern Africa, ASSA, found that it was possible to construct a scale model of Proxima Centauri and the Sun using the distance between Johannesburg and Cape Town as a baseline. Granite plaques were made with a 6 cm stainless steel hemisphere to represent the Sun and a 0.9 cm hemisphere for Proxima, since Proxima was about $1/7^{\text{th}}$ the size of the Sun. Another plaque briefly said what Henderson and Innes had done, whilst a smaller plaque could give details of the ASSA project.

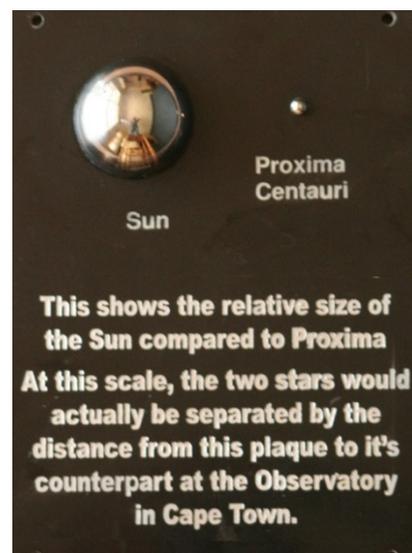
The plaques were mounted in Cape Town and Johannesburg, giving visitors to either site an idea of the distance to the nearest star to the Sun using the relevant sizes and distances of the Sun and Proxima, to scale from each site. These could then each mark the Proxima Centenary in a lasting manner.

4 The Plaques in Cape Town and Johannesburg

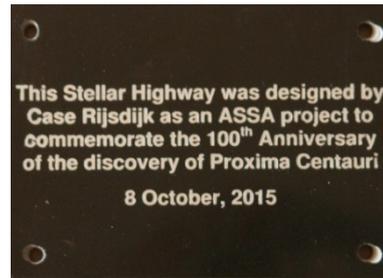
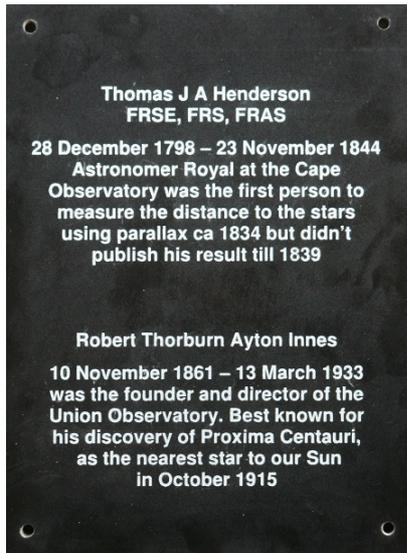


The above shows the relative size of the Sun compared to Proxima.
At this scale, the two stars would actually be separated by the distance from this plaque to it's counterpart at the Observatory in Johannesburg.

Plaque 1 in Cape Town . . .



. . . and in Johannesburg



Images of the plaques mounted in Cape Town and Johannesburg, nearly 1 600 km apart.

5 Educational and Outreach potential

There is a module on how to model the Solar System or creating a Planetary Highway using a simple print-out on A4 sheets. A copy of these can be obtained from the Observatory for use by teachers.

6 Acknowledgements

Shadrack Mkansi, Hubert Mathebula and Vanessa Naidoo of the South African Agency for Science and Technology Advancement, SAASTA, a business unit of the National Research Foundation, NRF, were instrumental in initiating the Centenary celebrations. At the SAAO Prof Ted Williams, Dr Lisa Crause, Martin Visser and Noel Miller, ASSA Council for giving their whole-hearted support to the project, and approving the funding and finally Eddy Nijeboer and Jerome Jooste of the Cape and Johannesburg ASSA Centres respectively, are thanked for their support.

Case Rijdsdijk
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