Recollections of William S. Finsen

Former Director of the Republic Observatory

"When Finsen retired (1965) we thought that many of his reminiscences, going back to the days of Innes, might be lost, so it was suggested that we should take him to lunch, and just let him talk. I don't quite remember whose idea it was, nor exactly when it was – probably just after F was retired, and he and Hewitt [Vice-President of the CSIR] were still on speaking terms. Anyway, F and I and someone from the CSIR (whose name I have forgotten) with a tape recorder were there, and everything was most successful. A typed copy was later produced by the CSIR in Pretoria, and this is what I now have..." — *Jan Hers*

Robert Thorburn Ayton Innes (1861 – 1933) Director 1903 – 1927

The first director of the Observatory, and we owe a lot to him. He was born in 1861. He started life as an amateur astronomer.

There is a story told that he had a small telescope and one night was watching the planet Venus as it descended low in the Western sky. Then as he followed it, an apartment house came into view of the telescope, and he saw a girl in a window there, upside down. The story goes that as soon as he saw her, he said: 'That's the girl I'm going to marry.'

And he did marry her. And while we're on the subject, she was a wonderful girl. We called her mum, and the big house down there, where the Director stayed, was always open house to the staff.

Very little has been written about the history of the Transvaal/Union/Republic Observatory, Johannesburg, or about its last Director, W.S. Finsen (1905 – 1979) (see Overbeek, *MNASSA*, 56, pp. 74-75, 1997). Thus, the eds. were very interested to receive this piece of 'Oral History' from Jan Hers. It has been edited lightly in places and a few dates have been added.

Innes had a job at a firm in London as office boy or clerk. There is a story that he was once asked to order envelopes. He had been doing astronomical arithmetic, and instead of ordering a thousand, he ordered a million. He used envelopes for scrap paper for years afterwards.

He was looking for an opportunity to better himself and he had two offers for two jobs. One was an offer to go to Canada as an agent for Rose's Lime Juice, and the other was to go to Sidney, Australia, to enter a wine business. He eventually decided to go to Sydney. If he had gone to Canada, he would certainly have gotten into the astronomical pole there, and we would have lost him. He went to Sydney and built up quite a big business as a wine merchant there. There is a story that even today you can still ask for Innes' babies, a small bottle of wine which holds about two glasses.

Anyway, he did well, and his main interest was double stars, and he was working now in the southern sky with a relatively small telescope, 3-inch or 4-inch, which he borrowed from another amateur astronomer. And he found quite a few pairs which were new. New pairs are called after the discoverer, and today there are a number named after Innes. Although we don't say "Innes 55" they are known as 'I 55'. He found quite a few, and wrote a number of papers, some of which were published. He had correspondence with Sir David Gill (1843 – 1914), a brilliant astronomer and at that time (Queen Victoria's days) Her Majesty's Astronomer at the Cape.

The streets around the Republic Observatory are still named after astronomers. It is in fact, situated in Gill Street, after Sir David. There is also a street leading up to the house of Innes, and this street was called, in extreme modesty, Innes Street. Clerke Street was named after Agnes Clerke [1842 – 1907], an astronomical historian. Innes came to the notice of Gill who offered him a job at the Cape Observatory as Secretary. Now in those days the paper work and red tape was not as much as it has become now, and Innes would have time to do astronomy in his free time. The salary was something of the order of £300 per year. Innes immediately left his job in Australia, which was paying him very well, and came to the Cape with a wife and three sons. (Just before the turn of the century).

He made full use of his time in astronomy. He said that his clerical duties amounted to regularly counting the cakes of soap. He did a lot of good work, working with a 7-inch telescope. He had a fantastic eye. In addition he revised a photographic catalogue which had been printed at the Cape, which was a breakthrough because Gill was the first to use photography in a big way in astronomy for cataloguing, and had published this catalogue a couple of years before in collaboration with J.C. Kapteyn [1851 – 1922] of Holland.

R. T. A. Innes (Photo: SAAO Collection)

The plates were taken in the Cape and they were measured by Kapteyn in Holland, published as the Cape Photographic Durchmusterung (CPD). Those three volumes are the Bible of the Southern sky. Those volumes list all stars in the southern sky, south of –19° to magnitude 9 or fainter. What Innes did was to revise this, go through it, edit it.

Furthermore, at that time there was working at the Cape a young man by the name of Willem de Sitter [1872–1934], who had a great effect on Innes and consequently also on us. De Sitter eventually became Director of the Leiden Observatory. He was one of the great astronomers of the first part of this century. He was a great expert in relativity. When Einstein published his theory of relativity, de Sitter crossed the t's and dotted the i's and in the general theory, for instance, you will get the pro's and cons of the de Sitter universe and of the Einstein universe. The one has matter and no motion and the other has motion and no matter, and somewhere in between lies the truth. De Sitter happened to write Innes' obituary when he died.

The Transvaal, after the South African war, decided that it needed a meteorological service for the farmers, and Gill suggested Innes. Now, Innes was not interested in meteorology, and Gill knew that. But he also knew that if he could get Innes up here, he would do his met. duties in the same way as he had done his clerical duties in the Cape, quickly, efficiently, and then get on to astronomy. Apparently, Lord Milner [1854–1925] saw the point. He wasn't bluffed. The outcome was, however, that Innes was appointed as Director of the Transvaal Meteorological Department. And that is why our history starts in 1903 as the Transvaal Observatory, with the emphasis on meteorology. A building was erected on the top of the hill here. The architect was Sir Herbert Baker [1862–1946]. It is the landmark which you can see from all round.

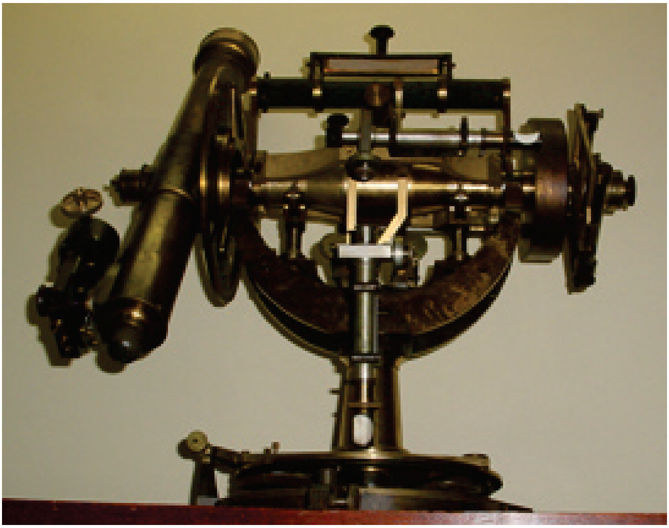
It wasn't a very good building: it had no passage and you had to walk out on the open veranda to go from office to office, which meant of course that you had a very good idea of what the weather was doing. The only other building was a wood and iron cottage which is still here and which has been condemned for a number of years, and which was pinched from Voortrekkerhoogte or Roberts' Heights as it was called at that time.

As there was no qualified meteorologist here, a student was unearthed and recruited from England. He was H.E. Wood [1881–1946], an MSc. from Manchester University and he was second only to Arthur Stanley Eddington (Sir) [1882–1944] who was one of the great astronomers of this century and who was also much concerned with relativity. The first scientific popularization of Einstein's theory was by Eddington. So Wood was quite a student. He was selected to be Innes' chief assistant. He was first sent to the British Meteorological Service which was then run by Sir Napier Shaw [1854–1945], also very famous. Wood did a course under him and came out in 1906 as a trained, qualified meteorologist to assist Innes. In 1907 Innes managed to get hold of a telescope, through the good offices of Dr Theodore Reunert [1856–1943] (of Reunert and Lenz) and the Council of Education. This was a 9-inch telescope.

This telescope had been used by Sir David Gill for an astronomical programme on Ascension Island.

[Note: The mounting was Gill's private property, but the telescope was bought by the Observatory]

Innes had, in a sense, a rather unsystematic mind. He was not in any sense Teutonic. In searching for double stars, he would say: Well, the thing to do is to examine brightish stars close to very bright stars because other people would have looked at a very bright star for quite a while, and then when they got tired of it, they'd move quite a distance to a star further away.



The latitude instrument, now in the Astronomical Museum at SAAO, made by Carl Bamberg and borrowed from the Imperial Russian Observatory about 1910. (Photo: I S Glass)

In 1909, or thereabouts, when Union was in the offing, Innes realized that this was a good time to chisel some money out of the Government. He requested the Government to buy a big telescope. Now this is very funny, because you do not need a big telescope to do your meteorological work. In any case, there was a meeting where [J.C.] Smuts [1870 – 1950] and no doubt Johan Rissik [1857 – 1926] were present, and Innes stated his case. Smuts wanted to know whether this big telescope was really necessary. Innes looked him in the eye and said: "Well, no sir, but it will be such fun".

The story then goes that Smuts turned to Rissik and conferred for a moment.

"What size telescope will you want?"

Innes thought that he had better aim high and accordingly said a twenty-six inch telescope. This was immediately agreed to, so much to Innes' surprise that he was kicking himself all the way back home that he did not ask for a thirty or a thirty-six inch telescope.

A lens was ordered from Grubb, famous lens [telescope] manufacturer in England [actually Ireland] for a twenty-six inch visual telescope specially designed for double star research. Because of the First World War, the telescope was not mounted until 1925. This was at that stage the largest telescope in the southern hemisphere, being 26½ inches in diameter.

Round about the turn of the century there was a Mr Franklin Adams [1843 – 1912], who was an insurance broker. It is said that he insured the British forces in South Africa against fire or something, and as there were no fires he is said to have made a fortune. He was a very wealthy amateur astronomer. He had two telescopes made for him. One was a photographic telescope, called the Franklin Adams star camera (a photographic telescope 10 inches in diameter, 45 inch focal length on a very fine mounting) which Franklin Adams planned to use to photograph the whole sky on large glass plates. Franklin Adams later donated it to the Observatory and this was the third telescope at the Observatory. A little later he donated a second telescope to the Observatory, called the Twin Telescope, which is a 6-inch photo-visual and 7-inch visual.

There is also the latitude instrument [photo opposite] which was lent to the Observatory during the International Latitude Programme by the Imperial Russian Government and which has never been asked back [now in the Astronomical Museum at SAAO].

Innes was a very versatile man. He had no real formal schooling as an astronomer, but taught himself whatever he wanted to know in advanced fields. A number of his early papers are in connection with very advanced theories about dynamical astronomy, that is to say the movement of the celestial bodies.

Now we come to Proxima Centauri. It was about 1914 or 1915 that he got the idea that this star was the nearest to the solar system. I mentioned earlier that he had this habit of examining stars near bright stars. It had been known for a long time that the star Alpha Centauri, apart from being a double star and a fine double star at that, was also at that time, the nearest star to the solar system, with a distance of about 25,000,000,000,000 miles. There is always the question whether a double star is not in fact a multiple star, i.e. whether it has other components. [E.] Hertzsprung [1873 – 1967] was later very interested in Alpha Centauri from the point of whether it had planets. Innes got the idea that Alpha Centauri was a triple. Now, no other star had been found in the neighbourhood of Alpha Centauri which could qualify it for this at all.

Innes decided to employ a blink microscope, and in this he was an absolute pioneer. Any observatory which may be called that uses a blink microscope, which is simply a double periscope with an eyepiece in the centre. In front of the periscopes you place photographic plates of a region of the sky. Previously you had to use tedious methods to determine whether a star had moved or not.

The blink microscope was used right from the start for examining variable stars and minor planets and the study of proper motions. The stars are not all fixed, they are travelling with high velocities in a not altogether random direction and it is only their enormous distance which makes them seem motionless.

Innes said if we were to look for a star in the neighbourhood of Alpha Centauri we may be able to find it, but we must look for a star which is moving parallel to Alpha Centauri. This star, because it is near, has a large proper motion. If we could find a star, probably a faint star which has been overlooked before, and which is moving with Alpha Centauri through the stars, then it is most probably part of its system. So Innes got hold of two photographs, both taken here with the Franklin Adams camera. This is something which is often overlooked. Small-scale photographs, not big-scale photographs. Not at intervals of 30 or 20 years as they often do for the study of proper motions, but five years. They were both taken by Wood, mentioned above. And Innes put these plates in the blink microscope and he said afterwards that it took 40 hours to blink that plate. In the course of the work he found a little faint star of about the eleventh magnitude which was moving in the same direction and at the same speed among the other stars as Alpha Centauri. So he promptly published a note in our circular, giving its proper motion and suggested that it was a physical companion of Alpha Centauri and that it was closer to us. He then started a programme of parallax observations with the 9-inch telescope. Parallax observations depend on noticing the parallactic displacement of a star as the Earth moves through its orbit.

In the case of even the nearest star, the parallactic displacement is only ¾ of a second of arc. This programme was cheeky, as astronomers today use large photographic telescopes and every possible means of metrology.

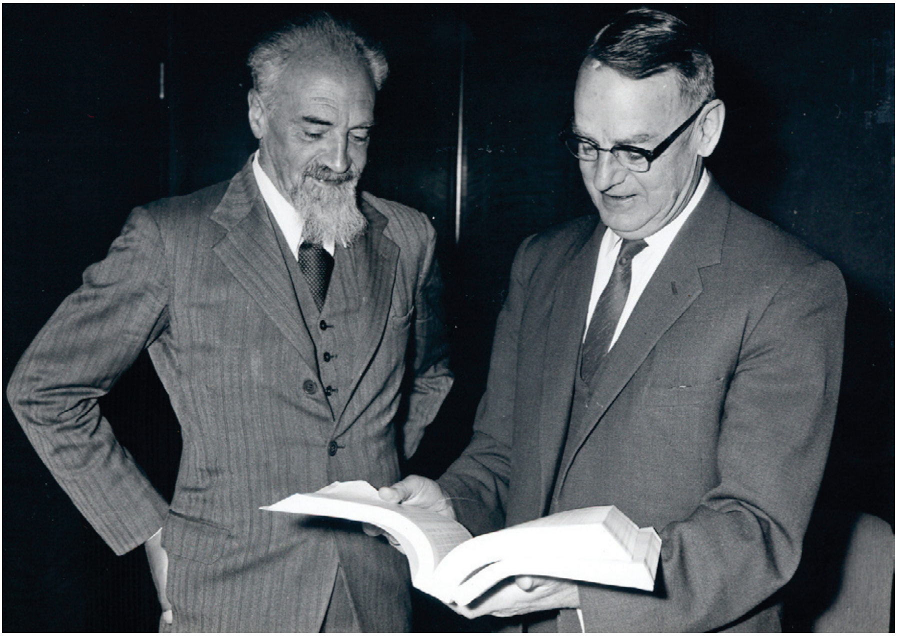
The parallax was calculated and they found it to be .90 of a second of arc. (Alpha Centauri had a parallax of about .75). This would indicate that Proxima Centauri is a little bit nearer. A Cape astronomer [J. G. E. G.] Voûte [1879 – 1963], a Dutch volunteer worker, followed the same programme and got a parallax of .755.

Proxima has a presumed period of rotation around Alpha Centauri of a million years, but it is a different system. Innes suggested that it should be called Proxima Centauri because it means the nearest (proxima). That was one of Innes most celebrated discoveries and it is a discovery which has not been superseded. No other star is known to be nearer than this.

Innes and the rotation of the Earth

Now what made Innes interested in this I do not know. He started two programmes of observation directed towards the same end. One was the observation of the satellites of the planet Jupiter. Jupiter has a number of satellites which move comparatively quickly round the planet and they undergo eclipses, occultations and transits across the disc. These happen frequently. These satellites are of value because they can almost be regarded as the hands of a celestial clock, not very accurate in the observation, but over the long run it would keep good time.

Innes started a long programme of observation of these satellites of more than a revolution of Jupiter round the Sun, which is almost 12 years. The other programme was the observation of the occultations of stars by the Moon. The Moon is also a clock; it moves round the Earth once a month and in the process it passes in front of stars, which are then obliterated. They just flash out instantaneously because the Moon has no atmosphere. The positions of the stars being known, the time at which a star disappears is therefore an indication of the Moon's position and it therefore acts as a sort of clock.



W. H. van den Bos (left) with S. Meiring Naude, President of the CSIR. (Photo: SAAO)

Innes started his programme of observing occultations about 1922. He had it made known that he was prepared to reduce the results of all astronomers engaged on the same project throughout the world. Now he was the only man here who could do it, but that did not deter him. He had the assistance of a Mrs Human, but they did not have a computer.

Innes then started another programme, and that was to use the planet Mercury as another clock, independent of the Earth's rotation. He made use of the fact that Mercury every now and then passes in front of the Sun's disc, and one can time when this transit starts and finishes. In 1923/24 he collected all the observations of the transits of Mercury and re-reduced them. He had to work out precisely the position of the Earth in its orbit and that of Mercury, and work out what the predicted time of her transit would be, and he observed. And from the difference between the prediction and the observation, he found that Mercury wasn't running according to timetable. From the occultations he also found the same thing for the Moon. The moons of Jupiter were the same. This was not news as there had been conjecture about the reliability of the Earth as a clock. Innes published a curve and said that the only solution would be that the Earth is wrong and not the three celestial clocks. This seems to be forgotten when papers are published now about the rotation of the Earth.

Innes was never anything else but genial. He was often spoken of as the "genial Union Astronomer". He decided to exchange the stiff collar for open-neck shirts and then wore nothing else, even with a dinner jacket. On one occasion of an S2A3 [South African Association for the Advancement of Science] meeting the Governor General sat next to him and it was frightfully hot. Clarendon was in his cut-away coat and striped trousers and Innes was wearing an open-neck shirt. Clarendon turned to him and said: "Innes, you lucky dog'."

He was a very good chess player. He was a philatelist: his collection was really worth money.

He was very good friends with Willem de Sitter of Leiden Observatory and round about 1922 he made an arrangement with de Sitter, at Cabinet level, whereby there would always be a Leiden observer working here for a couple of years, and in return we would send an observer to Leiden. As a matter of fact, there was never a two-way traffic. But we received observers here who made a very big impact on the Observatory because they brought their know-how and their training. E.g. Hertzsprung arrived in 1923 and stayed for a year and a half. He is one of the great figures of astronomy.

[W.H.] Van den Bos [1896–1974] came out in 1925, and he had already made a name for himself as a double star worker at Leiden.

Amongst others Hertzsprung was responsible for the Hertzsprung-Russell diagram: a relationship between the colour and the real brightness of stars. It was such an important discovery that it was said in Berkeley in 1961 that he made a discovery which we are still trying to explain.

The Leiden astronomers used our instruments until they put up their own Rockefeller telescope just before the war. Now the Leiden Southern Station is out at Hartebeestpoort. This moving out to Hartebeestpoort was in a sense a loss to us as we lost contact with them.

I forgot to mention that Innes had produced a second catalogue of Southern double stars in 1927. I also did not mention that Innes discovered 1628 new double stars.

Harry Edwin Wood (1881–1946) Union Astronomer 1928–1941

Now we come to Wood. Where Innes had been unorthodox, Wood was orthodox of the orthodox, always correct, always meticulous, always very careful; and like all people who are always all these things, sometimes made a bit of a fool of himself.

The observatory became an astronomical institution in 1912. Wood used to say that he was a meteorologist by trade and became an astronomer by act of Parliament. He specialized particularly in photographic work with the Franklin Adams telescope and in observing comets and minor planets. He was also very active as a computer of orbits.

Between Mars and Jupiter there are minor planets or asteroids; some 2,000 are known now. Up to 1938, when the last statistics were available, our Observatory had discovered 579 new ones, of which 69 were named. They were not all named.

The first one was called Transvaalia, found in 1911 by Wood, then too there are Pretoria, Majuba, Pongola, Impala etc. etc. One can possibly say that that put South Africa on the astronomical map. That was Wood's main work, but he was also meticulous in observing eclipses and occultations, the satellites of Jupiter. Wood, like Innes, was President of the S2A3 [South African Association for the Advancement of Science], but Wood was also General Secretary for many years.

H. E. Wood (Photo: Dirk Vermeulen)

He was a very touchy person. A reporter once addressed him as Mr Woods and thereafter he would not speak to him. He was very fond of his dog and cat, but once, when the cat had killed a bird, Wood did not speak to the cat for a week.

He attended a meeting of the IAU in Stockholm in 1938 and when he got back we asked him what it was like. He replied that one shouldn't waste one's time going to these meetings because they were very social.

Innes was given his doctorate by Leiden Observatory at the instigation of Willem de Sitter. It was perfectly justified. Wood was given his doctorate by Wits in 1937. He was also the first broadcaster of a scientific talk and that happened in 1924 when he did it under the auspices of the S2A3.

Van den Bos became assistant at the Leiden Observatory in 1921. He was here in 1925 and immediately became busy on a very systematic programme which involved a systematic examination of all stars in the southern sky south of –19° declination down to 9th magnitude. He discovered a lot of new double stars.

He is credited with 2895 new discoveries, which beats Innes. He also during his career made 71,929 measurements, which is easily a world record. The nearest are [R.G.] Aitken [1864 – 1951] and [E.K.] Rabe [1893 – 1958] who have about 40,000 each. Aitken, on the other hand, made more discoveries than he, but that was done in the northern skies.

But he also did a great deal in the theoretical approach to double star astronomy. In fact, there is a method for computing double star orbits which is very generally used and which is known as the Thiele-Innes method. [T.H.] Thiele [1838 – 1910] was a Danish astronomer who developed a method very many years ago. Innes, in one of his flashes of genius, came in one day and said: "You know, these formulae could be simplified". They could be, and van den Bos and I took over and finished the calculations.

Today it is generally referred to as the Thiele-Innes method, but it should at best be referred to as the Thiele-Innes-Van den Bos method. He biggest work in recent years was the comprehensive, authoritative, definitive, thorough, complete catalogue of southern double stars, south of –19°. It was done in the form of a file catalogue which is still upstairs in the library. The information contained in this card catalogue was microfilmed and sent overseas to the Lick Observatory and was incorporated in the Great Lick Index Catalogue of double stars

To show you what the standing of the Observatory was some years ago, I have a note here of the little astronomical exhibition in Barcelona some years ago. It was all written up in Spanish, and there is reference to "the celebrated Union Observatory".

With the Franklin Adams telescope, we had a very powerful instrument for making star maps. (Wood was behind this, and Innes too, although Innes did not really concern himself with this project). The scale on the photographs is not too large while the original plates were quite large, 15 inch square. There are as many as 250,000 stars on such a map, and it was clear that this was a very good way of making star maps. Now, Franklin Adams himself had made these charts which are known as the Franklin Adams charts and which are deposited at the Greenwich Observatory. But those were glass plates, and Innes and Wood decided that what was needed was an atlas on paper for office use. It was begun about 1912. Wood took many of the plates. Mr E. L. Johnson [d. ~1977] also spent a lot of his time on these charts. Bromide prints had to be made and the co-ordinates put on. This had to be done with great exactitude, and then the blocks had to be made. The total number of individual maps in the atlas is 556 plus three special ones. Each dot represents a star and the size of the dot indicates its brightness. Lines for declination and right ascension were ruled in, and then the Government Printer had to reproduce them.

Round about 1937 I was asked to do the time service, having been given the assurance that it would only be for a short while. It turned out to be a long while as the war intervened and the time service had to be done.

We have a very fine library here. It does not start with the date of the establishment of the Observatory, but we have back numbers here which you would not expect us to have. For instance, we have *Nature* back to Volume 1; a complete set of the *Nautical Almanac* to 1770-odd, of the *Berliner Jahrbuch* and the *Bodes Jahrbuch.*

We had no workshop. Till the end of the war we had a small amateur mechanician's Drummond lathe, a screw driver and a hammer and spanner combined.

In 1925, Innes wasn't satisfied with having only Van den Bos here, he got a German astronomer out, one of the famous Struve family, to observe the satellites of Saturn.

One point not mentioned about Innes, was that when he first began observing with the 9-inch telescope, he was astonished with the viewing, the clarity. He told this to various astronomers abroad, and that is how the Transvaal Highveld first became famous for astronomical observations.

Nova Pictoris: the so-called "split star of 1928"

The press clippings were a pile. The astronomers overseas at first wouldn't believe it; in England it was said that the information our Observatory had given wasn't quite correct, and all that had happened was that a bright star had gone down in brightness next to a faint star. What I liked about it was that it was the only time that our Observatory was the subject of the main political cartoon in *Punch*. There was a picture of a British statesman looking up at the sky and watching a split star which represented a split in the party. In 1935 there was a meeting of the IAU in Paris, and a cable arrived announcing that the star Nova Hercules (a nova in the constellation Hercules) had also been observed to consist of two nuclei, a so-called split. This cable was shown to Eddington (mentioned earlier) and he wanted to know where the observation was made. It turned out to have been made in the USA and Eddington then said that it was in order as long as it wasn't a Johannesburg discovery because "they see everything double".

In 1930/31 the minor planet Eros was predicted to make a close approach to the Earth. This was made the subject of an international programme to determine the distance of the Sun. If we could determine the distance of Eros exactly, we could, by means of dynamical astronomy, infer the distance of the Sun. Photographs were taken with the Franklin Adams and we tried to observe visually with the 26-inch. Eros is a pinpoint of light. It is a chunk of rock, but it is jagged and that is why its brightness varies as it spins along. I suggested that when it was at its closest we should put the high power on and observe it as if it were a double star to see if it were distorted in shape. We observed it one night and found it to be elongated. We measured it, and it was moving along very rapidly. There is always a difficulty in finding out in which direction it is moving, as there is a 180° ambiguity. When dawn came, we still hadn't sorted this business out and we decided that our observations were no good. So we made a note on a piece of paper and decided to leave it at that. Now Hertzsprung was here on a second visit. And when we came to the Observatory at about eleven that morning, we found that Hertzsprung had seen the note. He had taken our observing books, reduced the observations and had plotted the results against the known light variation period of Eros and it fitted perfectly. The peculiar thing was that it was not seen by any other astronomer in the world. The information was cabled overseas and only an amateur Japanese observatory saw the elongation of Eros, moving in a clockwise direction. The joke of course was that their telescope, a 9-inch one, was much too small and that Eros was moving in the other direction. A German astronomer checked this three years later and it fitted with Van den Bos' and my theory.

Innes used to say: "Never write a diary, Finsen, only crooks write diaries" and "Always go to a dentist or a barber first thing in the morning before he's tired"

When I arrived here in 1924, there were Innes, Hertzsprung and Mrs Human. Hertzsprung was trained as a photographic chemist and was an amateur astronomer. He got hold of some published information about the colour of stars and their brightness, and he related the two in a way that no other professional astronomer had done up till that time, and he discovered an interesting relationship between the absolute magnitude, which is the intrinsic brightness of a star, and its colour. This was published in a photographic journal, so very few astronomers saw it. At the same time, Professor [Henry Norris] Russell [1877 – 1957] of America was working on the same lines and discovered this independently. It was suggested that this be known as the Hertzsprung-Russell diagram.

In 1961, which was some 50 odd years after this was first published there was an invited address by Martin Schwarzschild [1912 – 1997] at the IAU meeting in Berkeley, and he said that this Hertzsprung-Russell diagram, which we have been working on for almost 50 years, and we are still a long way from explaining, and which is the key to our knowledge of the evolution of the stars, was of course discovered by our mentor etc. etc. Professor Hertzsprung whom we have the honour to have present with us in the audience this evening.

Hertzsprung, who was pretty old and used to go to sleep most of the time when he wasn't terribly interested, suddenly woke up, saw everyone looking at him and got up and bowed. The roof almost came off with the applause, and when it had died down, Schwarzschild had disappeared from the platform.

Schwarzschild's father was a famous German astronomer and he had invited Hertzsprung to work under him at Göttingen. From there Hertzsprung went to Berlin. Then he went to Leiden and eventually became Director of the Leiden Observatory after having worked as adjunct Director under Willem de Sitter. He spoke very good Dutch, French, English and German of course, so he was quite a linguist too.

So when Innes didn't use me, I used to tag on to Hertzsprung when he was working here. Hertzsprung was the completely honest text book scientist. He was so honest that he was incapable of diplomacy or tact. There was only one thing, he said, and that was the truth, however painful it might be. He was not a self seeker, he didn't care two hoots for publicity. He was completely absorbed in science, and any time not used in the interests of astronomy, was time wasted. But not on cloudy nights. On cloudy nights he used to go to the cinema and if there was any reference to Denmark (he was a Dane) he would actually stand up and clap, to the great astonishment of the audience. He was a very hard taskmaster, he did not believe that sleep was at all necessary.

One night we were busy at the 26-inch, photographing a double star. It was very makeshift apparatus, in fact, it was strictly cardboard. When I finished the plate he was booking at the desk, I said: "I'm very sorry, Professor, but the shutter was closed when we took the trail". He was very cross. The next day he would come to me with suggestions as to how we could still save that plate if we did this or that. A couple of nights later, he was working the telescope and I was booking. And when it was all over, I said to him: "Professor, the shutter was closed for the trail".

It was about midnight. He stamped his foot, swore in Danish and walked out under the trees. The door was open, and I could see him in the light of the dome walking up and down and stamping his foot every few paces

One night we were taking photographs of a cluster with the telescope. The telescope had a very rudimentary plate holder and was very difficult to operate. These exposures were forty minutes each and one minute was allowed for Hertzsprung to take the plate holder from me in the dark more or less, develop the plate and put a new plate in, bring it back, put it on the telescope, and leave a few moments for the telescope's vibration to die down, and then start off with the next exposure. This went on all right for a bit, and then I fumbled once or twice. It was very awkward to do these things in the dark. So we missed the minute. Hertzsprung decided that we had to wait five minutes, and start again. So we waited. In the meantime, he was telling me: "Can't you do something about it? Can't you put this plateholder on properly? What's wrong? Can't you operate the telescope? Don't you know how to work the telescope?" Anyway, we put the new plate on, and then it happened again. I went to him and told him that I was helping him in my own time, that I was doing the best I can and that I could assure him that I wasn't doing it deliberately. "Shall we carry on or shall I go home?" Much to my surprise, he meekly turned to me and said: "You know, Mr Finsen, I think we'll carry on". That was the only way to treat him.

He got married, to everybody's surprise, to J.C. Kapteyn's daughter [Henrietta Hertzsprung-Kapteyn, b. 1881], who was a society type, very keen on social life. Hertzsprung couldn't care two hoots about this. It is said that shortly after they were married, if not exactly during their honeymoon, they were dressed up to go to a concert. They opened the door and he looked up at the sky and saw the stars shining. He quietly said: "I must go and observe". Off he went to the telescope, and there was no concert as far as he was concerned. Of course, the marriage didn't last. He was a fine chap to work for, especially if he was 6,000 miles away. Then he would send me problems, but always in a disguised form. For instance he asked me something about a formula for the coefficients of expansion, and it was very tricky. You could never admit to him that you couldn't solve it. You solved it, then sent it back rather offhandedly. He wouldn't make any remark on that. One day he sent me a problem which read something like this:

"What is the distribution of sine alpha plus sine beta if alpha and beta are arbitrary?" It was a most formidable problem. I had a go at it. I got the theoretical solution and then we tested it by means of an experiment, and it agreed. So I sent it to him and we got a reply. "Yes", he said, "I put that on the board to my students at Leiden. Next day I found a revolver hanging next to it".

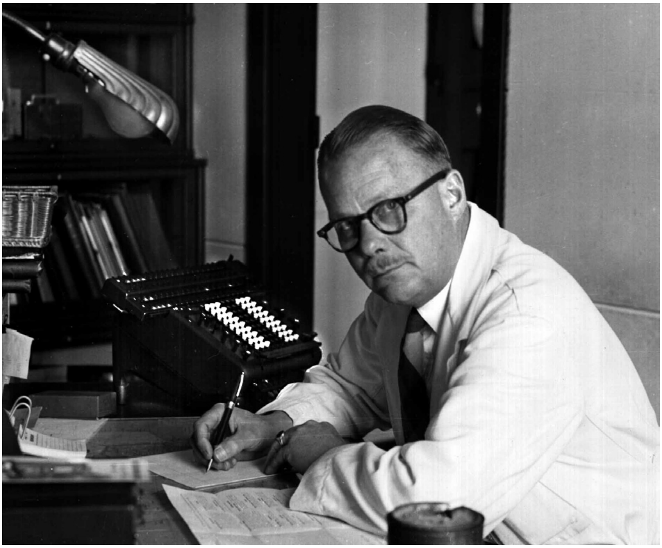
He afterwards recommended a young astronomer to us, and although he thought that this chap was very intelligent, he regretted to inform us that he did not succeed in solving the sine alpha plus sine beta problem.

The reason why he put that problem to me was simply because it could be translated to a variable star on two photographs, varying in sine curve, for simplicity.

William Stephan Finsen (1905–1979) Director 1956–1965

I was at the King Edward School in Johannesburg, and was the only first class in Johannesburg. For some reason or another, I got it into my head that I wanted to take up astronomy. My headmaster at King Edward made an appointment for me to see Innes. This was right in the middle of the matric examination. I wanted to go to university, but Innes wouldn't hear of it. He said they would spoil me and that I could learn all the astronomy I needed at the Observatory. This was Innes, the self-made man. I was going down to the Cape and got a letter of introduction to His Majesty's Astronomer, Dr [H.] Spencer Jones [1890–1960]. He couldn't very well contradict Innes so he also said that he thought it was in order not to go to University. Then I came back and saw Mr Jan Hofmeyr [1894–1948], then principal of Wits University. He finally decided that Innes' idea wasn't so bad after all.

So I came to the observatory in mid-January 1924 as an unpaid volunteer assistant. I worked for fourteen months on that basis. When Mrs Human left, I got her job. I was appointed in 1925, 23rd April, as a second grade clerk, at £15 per month. The 26-inch had begun to arrive in bits. The dome was up. Mr Wood was in charge of the erection and he had the assistance of Mr Chandler of the PWD. I was rapped over the knuckles. Hertzsprung was still here. I was working in the dome because I was supposed to help. There was a crash and I got up. I found that an enormous gear had come down and crashed onto the platform just missing Mr Wood. Hertzsprung was into the dome like a flash enquiring whether anything had happened to it. I explained to him that a gear had fallen, whereupon Hertzsprung started interfering. Wood was upset because he was in charge and later in the day he pulled me aside and said icily: "Mr Finsen, understand, if anyone is to report about the progress of the assembly of this dome, it will be me!"



W. S. Finsen (Photo: Dirk Vermeulen)

About this time I decided that I did have to go to university and so I enrolled at the University of South Africa, taking the most useful subjects for a budding astronomer: pure mathematics, applied mathematics, two courses in astronomy and German. There were no correspondence courses. The University was purely an examining body. All you got were references to textbooks, which you had to study by yourself. Well, I got a scrape pass. A BSc. We finally twisted Wood's arm into submitting a request for better remuneration for graduates, and it was approved by the Government.

About 1935 a message came to me that [A. E. H.] Bleksley [1908 – 1984], who was then senior lecturer at Wits under Prof Le May, would be very happy to start an honours course with particular emphasis on astronomical subjects, and that I was invited to attend these classes. I took them under Prof Le May in wave mechanics and Bleksley on the total constitution of the stars for two years. I took the exam and did well. I had already published a few papers, and I was working on some statistical work on double stars, and was informed that this would be suitable for an M.Sc. I put it up and got the degree the same year as Wood was awarded his D.Sc. *honoris causa*. Later, I applied for registration for a doctorate at the University of Cape Town. I applied for registration for their Ph.D. in 1951. They told me that I was too senior for that and that I must put up my papers and they would consider it for a D.Sc. My examiners were Spencer

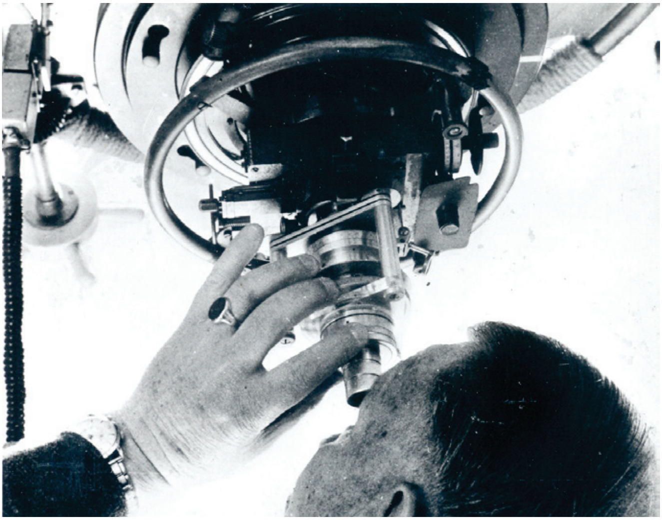
Jones, (who was the Astronomer Royal then), amongst others. Well, Jones told the Committee that most of the recent double star work in South Africa was done by Finsen, a gross exaggeration. But I got my D.Sc.

During the war, essential jobs at the Observatory had to go on. Two members were released for active duty, but I was told to stay on. I then offered my services as a fitter and turner, but nothing came of that, so I joined the National Volunteer Brigade (NVB) and I was a sergeant in charge of a guard. I then offered to make a film for the troops in North Africa to instruct them in finding their position in the desert. Within six or seven weeks, my wife and I had done all the work, scenario and animation included, and we had a two-reeler ready for the soundtrack. It had the purpose of teaching the troops elementary astronomy, so that if you were lost, you had something to fall back on. This film was eventually redubbed, and released throughout the country by the Department of Education, Arts and Science.

Then another problem arose. One morning, a major and two captains rolled up with a crude sort of a Sun compass. In the desert, and especially in the Western desert, it is a serious matter if you get lost. A magnetic compass doesn't work well in those circumstances as there is so much steel around, what with the tanks and cars. It consisted of a chart with various lines for the shadow of the Sun at different hours, and these charts had to be prepared for the latitude at which the instrument is used, and for the time of the year. The officers wanted to know whether we could produce these charts for troops training in the Western Transvaal. I said that we could, and also said that I was sure that we could produce something better than these crude instruments. I made a mock-up of the compass in wood and when I showed it to them to demonstrate the principle, they immediately wanted to try it out. I insisted that this was not the real thing, but they wanted to try it out. So we took three days and went down to the west of Mafeking. A route was chosen between two places on the map. We travelled through bush. This compass had no level so I had to judge it with my eye. Eventually we had travelled what we thought was the distance we had to travel, and there was no sign of the two bluegum trees which were our mark. We looked to the right and to the left, but nothing could be seen. Then I looked straight ahead with the field glasses and there they were. We had erred about 300 yards over a distance of 32 miles. They wanted to produce it immediately, but I persuaded them that it still needed a lens for days when the Sun was obscured, and it had to be properly engineered.

It was then made. Suddenly they thought they had discovered an expert lens designer. However, we then started designing dial sights for the Army, and in the meantime I kept on doing the time service at the Observatory. It all boils down to one thing: that for a number of years any optical work that had to be done came down on our shoulders.

The Sun compass we had made was assembled here. It was accurate to within ¼º. That is to say that they would give the true bearing, the true azimuth, to within a ¼º without knowledge of time. You didn't have to have a watch or know the longitude. Then another interesting problem cropped up. They wanted to use this Sun compass to get a more accurate bearing for laying a barrage. If you were drawing up guns in a line on a definite bearing, they wanted a Sun compass to obviate the need for surveying from gun to gun. We did this and we came up with a sight which gave true bearings to within a minute or two of arc. Just after that, the war finished.


Finsen at his eyepiece interferometer. (Photo: SAAO Collection)

The Interferometer [Finsen's Eyepiece Interferometer]

This goes back to about 1922 when one of the most famous astronomers of the first quarter of this century, [A.A.] Michelson [1852–1931], introduced an idea in America, an interferometer device. Its real interest was to do something which had never been done before, and that was to measure star diameters. Michelson extended his interferometer and called it the beam interferometer, and succeeded in measuring the diameter of three or four stars. This was a brilliant achievement and one of the stars he measured, Betelgeuse, was found to be so big that if one placed the Sun in the centre of it, the orbits of the Earth and Mars would be engulfed in the star. There was great excitement. Then an Italian astronomer, [M.] Maggini, [1890–1941] got hold of it and made an interferometer and put it onto a small telescope, which was rather a wrong way of doing it. He had a spate of papers published over three or four years. Then, on the basis of his observations, Dr Innes decided to order an interferometer for the 26-inch which had not been delivered here yet. When Innes and others started to use these observations, they were horrified, because the observations were useless. Innes then cancelled our order. The point is that it was the interferometer that lost reputation whereas it should have been the user. The interferometer then fell into disrepute for a number of years until about 1932 when we, in the course of our survey, discovered a couple of fast moving pairs which were very close to each other. Very difficult to separate. There were also a number of binaries which in their elliptical orbits, had become very close and could not easily be observed. So I said to Van den Bos one morning: "Let's try the interferometer". Van den Bos referred to Maggini and wasn't keen on this.

So I made up a very rough model and tried it on the 26-inch and it worked like a charm. Sir Frank Dyson [1868 – 1939], the Astronomer Royal was here at the time and I showed him this and he was thrilled and said that it ought to be brought to the notice of the Royal Astronomical Society. Our programme was keeping us busy and the interferometer was only used occasionally for particularly annoying cases.

It was only after the war that I got back to astronomy. I had by now also become an instrument maker and optical designer. I was looking for a programme which I could complete within 20 years, as that was the time when I would retire. The interferometer occurred to me. I got busy designing a better interferometer, as the instrument used in America and by Maggini were not very sophisticated.

I experimented with various interferometers and finally came up with one which was as near ideal as one can reasonably expect, and it has been in use now for 17 years, and I have still no reason to change the instrument. I called it the eyepiece interferometer because it can be screwed onto the telescope in place of the usual eyepiece. That makes it very convenient to use. Having the instrument was one thing, the next was to exploit it. What I did was that I decided to examine systematically all stars down to magnitude 6.5. That was originally. Eventually I extended it down to 7.5. It was complete to 6.5, which is fainter than the naked eye can see, for +20° north declination to –75°. Then I extended it to fainter stars and proper motion stars. They were about 8,000 stars, and they have been examined at least twice each. So I have made about 13,000 examinations of just more than 8,100 stars. There was a lot of speculation as to whether this programme would be useful. It turned out that just under 1 per cent of the stars examined were double stars never before discovered, which were very close. And because they were very close to each other, they were very interesting, as it was likely that they would revolve around each other in periods of a few years only, instead of perhaps hundreds of years. I found about 73, and I have calculated the orbits for about 12 of these.

In 1939, Mars came very close to the Earth, what we call a favourable opposition. I had for many years had an interest in photography, and more specifically cinematography, and it occurred to me that we should do something because when Mars is in favourable opposition it is in the southern sky and passes nearly overhead in Johannesburg.

Observatories placed in less favourable geographical positions also expected us to do something about it. The usual way of observing Mars was to get a sketch pad and make drawings, but I am no artist. But apart from that I feel that drawings are very personal things, and you get two people drawing the same thing in a vastly different manner.

Four directors of the Union Observatory (left to right) Finsen, Innes, van den Bos and Wood. (Photo: SAAO Collection)

So I made a gadget for putting the cine-camera onto the telescope and we made some experiments. But then the war came and put a stop to it. But the same thing was due to happen in 1954 and 1956. So I fixed the cine-camera to the telescope and used it to take photographs frame by frame. The minimum exposure was 2 to 3 seconds in 1954 and one second in 1956. My idea was to take 100 frames at a time every now and then during the night. Some of those frames were then sure to have been taken accidentally, as it were, when the seeing was good. Sometimes if the seeing is good for so little as one second, you're very fortunate. As the exposure time was so short, we had to choose a magnification which was not too large. The result was that the images of Mars was of the order of 2 millimetres in diameter, and when that was blown up, you'd get a lot of grain. The idea was thus to take about 25 frames which were good, and fuse them together in this way: You put them in the enlarger with a magnification of say 10, and then expose each frame for only a twenty-fifth of the normal exposure. The grain washes out but anything that is persistent on the frames will be accentuated. This had been done before, but not with as many as 25 frames. On one occasion I went so far as to fuse 162 frames to bring out some detail. In the course of this project, I took about 54,000 exposures and they all had to be examined and graded and noted. It all culminated in a dozen nice colour pictures of Mars.

It was quite easy, of course to make black and white pictures from the colour.

Now we come to the IGY [International Geophysical Year]. One of the events predicted for the IGY was the launching of satellites. Then Russia launched the first on October 4, 1957. The great public wanted predictions of where and when this could be seen, and we were inundated by calls from newspapers. In any case, we had no real information concerning the orbit of the satellite, but I managed to arrive at an orbit by strictly unscientific means, and we could at least satisfy the callers.

In 1958 when Alpha was being observed, the tracking Station at Olifantsfontein was trying hard to photograph it, with predictions coming from the telex from America, which were completely haywire. I was producing predictions, and my moonwatch team actually picked it up two or three times before they got it. They had a braaivleis there to open the place up, and while I was standing with a piece of boerewors in my hand, a message came through on the telex and it was shown me. It ran something like this: "Predictions for 1958 Alpha". Then a whole string of figures. But before the signature, Smithsonian, was "but rely heavily on Finsen's predictions".

Time service

Observatories were the obvious places to get a time service. That is why a time service was started here. They had some clocks and these were checked from time to time with the stars.

We were supplied with a clock by the PWD. Then we got Riefler 203 [Riefler 304? – now at SAAO], and that was put on the line, signals were sent. And the only observations that were made were made with the same instrument that was used here for the latitude observations. It is a very tedious business to observe time astronomically and the instrument wasn't really any good for it, and it was a job getting anything better than half a second. Then radio came to the fore, and they got a Marconi receiver, which wasn't very successful for receiving signals from Bordeaux. Then one was made here. It was a typical amateur job, spread out on a table about 8 feet by 3 feet. It was never permanent, and if there was a thunderstorm, the chances were that half the set would be destroyed. We could get a very faint signal from Rugby and Bordeaux, in the middle of the day, when static was at its worst. This set was later boxed up and we managed to keep it going for a time. This was done until 1939 when war came. I told Dr Wood, who was Director then, that I could not guarantee continuity of time signals during the war. And this shook him. He asked the Chief Engineer of the Post Office to come here and inspect the set. The engineer took one look at the set and decided that we needed something better than that. Wood was taken aback. So an order was placed for a Standard Telephone receiver, but they couldn't supply it. Then an order was placed for a Marconi receiver. It was very much better, but it wasn't really satisfactory. Then the WWV transmissions from America started to arrive here and that was very satisfactory.

The SABC was sending the blips on the hour, and the way did it was to open

(**left**) Riefler 304 at SAAO. (Photo: I S Glass) (**right**) Jan Hers at Time Control (Photo: Peter Smits Collection)

the window of the office and listen for the Post Office clock chiming, and then set their clock to that. I heard years afterwards that the Post Office in turn set their clock by the blips heard on the radio.

Sometimes the radio people, once we started sending the signal from here, forgot to take the signal on the hour, and then half a minute later somebody went to the transmission apparatus and pressed the button six times. It also happened that the staff at the Observatory noticed this. They'd be aware that the signal had gone off to the Broadcasting Company, and then hear it come back to them on the radio half a minute later.

Then we got Mr Hers. He built, very quickly, a quartz clock, which was our first really reliable time instrument. After that it was just a matter of continually improving accuracy by switching to modern methods, e.g. valves to transistors. There came a call for time signals to be continually available so that it would not be necessary to wait for the six blips of the SABC. So we borrowed a transmitter from the Bernard Price Institute and started sending out time signals. We built our own transmitter , then bought one and now we have three transmitters: two here and one at Olifantsfontein.

When we made our first quartz clock, the improvement was quite spectacular, because before that we had only aimed at keeping the pendulum clocks within 1/10 second per day. When we started using the quartz clock (Ql), we were immediately working with milliseconds, 1/1000 second per day. Nowadays we are working with microseconds. Now the man in the street is not interested in milliseconds and microseconds, but this is demanded today. And this relates to the rotation of the Earth again, with which this Observatory was associated 40 years before.

Part of the original scheme was a special device known as a Photographic Zenith Tube (PZT), which is intended to photograph stars over a very limited band of the sky in order to check up on the clocks. We intended to use this PZT but we never got round to it, mainly because there was no money for it. So instead we improved our clocks. The stage has now been reached where the rotation of the Earth is no longer a standard of time because we can make clocks which are so much more accurate. We now have a caesium time standard, which has been adopted internationally as the standard of time interval. What we can do now is to check up far more accurately on the rotation of the Earth, and also on the position of the pole, which shifts. We can also study continental drift over a period of years to an accuracy of a metre. The important part to note is that the Earth has been demoted as a short term clock.

Miscellaneous comments

The moons of Mars

Jonathan Swift [1667-1745] wrote in one of his books [Gulliver's Travels] about the astronomer who had observed Mars and found two satellites, revolving around the planet very quickly because they were very near to it. This was an amazing shot in the dark because the satellites had not been discovered yet. And to make it more uncanny, the prediction of the time the satellites took to complete a revolution around the planet, were exceptionally close.

A visitor in the dark

I had an unnerving experience once on a visitor's night at the Observatory. A native came and asked whether he could see the Observatory. I went to Innes and told him about this and he said: "Finsen, you're not a snob, are you?"

Of course I wasn't a snob. So I took the man to the telescope and told him that this was a tube that was used for studying the skies, and if you looked through here you would see what was up there very much larger. He looked and then turned to me and said: "Yes, baas, and that's the declination axis and that's the polar axis" and so on.

He was working as a servant in Doornfontein, but he was B.A. at Lovedale.