trying to find a single formation channel or explosion mechanism may be a utopian endeavour. However Type Ia SNe are still very good distance indicators and as such have led to the best determination of the Hubble constant, and have helped to confirm the existence of dark energy. Further progress in this area will require good data at $z > 1$, but mostly more infrared data at $z > 0.5$. It is nevertheless rather annoying that the origin of such important objects is still unknown.

The state of our current knowledge was summarised in the final talk of the conference by Noam Soker: "If WDs knew theory, they would not have exploded as SN Ia". Soker stressed that the main open questions in stellar evolution are related to angular momentum (AM) evolution, as AM is crucial both at the birth and at the death of stars. In this regard, the most important source of AM is either the contraction of a cloud/envelope — important during birth and core collapse SNe — or a binary companion (including brown dwarfs and planets). Binarity seemed to be a major ingredient to the many topics discussed during the workshop, and is perhaps the underlying *fil rouge*.

Most of the workshop talks are available on the meeting webpage[1].

Acknowledgements

It is a pleasure to thank all the speakers, and more particularly the invited ones, for highly inspiring talks that allowed us to fulfil the aim of this cross-disciplinary workshop to bring together specialists in quite different areas and have them share their expertise. Many thanks also to all the participants and we apologise that the lack of space did not allow us to discuss the numerous and very interesting posters that were presented. We would also like to warmly thank Maria Eugenia Gomez, Paulina Jirón, Amy Tyndall and Catherine McEvoy for their enthusiastic and efficient logistical help in making this workshop a success.

Links

[1] Workshop web page: http://www.eso.org/sci/meetings/2013/dslg2013/program.html

ESO's Early Seeing Expedition to South Africa

Kristen Rohlfs[1]

[1] Institut für Astrophysik, Universität Bochum, Germany

Site-testing for a joint European observatory in the south began in the 1950s in South Africa, following the declaration of the intent to build a large optical telescope in the southern hemisphere. First hand reflections of one of the early site-testing teams working in South Africa, based at the Boyden Station, are described. Practical problems related to seeing measurement and site assessment are discussed.

The long-term result of the meeting of leading European astronomers with Walter Baade in Leiden in 1953 was the foundation of ESO in 1962. One of its immediate consequences, however, was the decision to send an expedition to South Africa with the aim of finding a suitable place for a large astronomical observatory. The foundation and early history of ESO have been described by Blaauw (1991) and in the more recent history in Madsen (2012). This article recalls an aspect only touched on in Blaauw's monograph (p. 23).

I joined the South African seeing expedition in November 1956 when I had just finished my Staatsexamen fur das Höhere Lehramt with a thesis on cosmology with Prof. Otto Heckmann at Hamburg as advisor. At that time the plans for the European Southern Observatory were still very informal, and nothing had been definitely decided yet. Not even the name of the enterprise was definite, and we were known at the time by the garage that serviced the expedition cars as "Joint European".

Observing conditions in South Africa

At that time very little was known about seeing and seeing conditions in South Africa, only that the number of clear nights in that country was much larger than in Europe and several observatories had been established there: the Cape Observatory at Cape Town; the Radcliffe Observatory with a 74-inch telescope at Pretoria; and the Boyden Observatory with a 60-inch telescope at Bloemfontein. The seeing expedition had the task of finding a fully satisfactory place for a modern observatory, but it was not clear what the meteorological conditions were that had to be fulfilled to meet the request.

The climate of South Africa is divided into two different regimes: in the southern part there is a Mediterranean-type climate with winter rain, and the more northern subtropical region has rain in the summer season. Therefore it was decided to split the expedition into two groups; one was to investigate the winter rain region, the other the summer rain region further north. Both regions have a large number of clear nights when compared to European conditions.

The group that worked in the south (under J. Dommanget) chose Oudtshoorn as their headquarters, while the other group (under H. Elsässer) selected Boyden Station near Bloemfontein. Starting from

Dawid van Jaarsveldt

Figure 1. Photograph of the Harvard Observatory's Boyden Station in South Africa in the 1950s during the time when ESO site-testing was taking place.

these locations sites were selected that looked promising for a closer inspection. For this the seeing quality and the zenith extinction were estimated several times per night for periods of about 14 days. After about one year, with more than 200 nights on duty and about 100 000 kilometres covered with the cars, a new crew was needed, and this was the situation when I joined the seeing expedition.

Site-testing instrumentation

In order to be able to investigate the astronomical quality of a site two different types of instruments were provided to the expedition. One was a very rugged, high quality 25-centimetre reflector on an azimuthal mount, quite similar to a Dobson mounting, that could be tracked manually and exceedingly smoothly so that a magnification of 700 times could be used on a routine basis. The seeing could then be judged by a method invented by Danjon, based on the visibility and quality of the diffraction rings of the telescopic stellar images. The other type of instrument was a small refractor on an equatorial mounting with a simple photoelectric photometer using an 1P21 photomultiplier. Because of the then available electronic valve technique with photographic registration of the measurements, its use was exceedingly bothersome under field conditions. Experience in South Africa quickly showed that the difference in the extinction at different places is quite small if the sky is clear, and so extinction was no longer a strong criterion for site selection and extinction measurements could be dropped safely.

The seeing expeditions

During my stay in South Africa the seeing expedition consisted of Dr Walther Tripp from Göttingen, Father Bertiau SJ from Belgium and myself, and for a short time we were reinforced by a retired gentleman, whose name I unfortunately don't remember, who had been occupied during his active time by taking plates for the Franklin–Adams charts. We had our headquarters at the Boyden Observatory, which at that time had been closed down by Harvard Observatory and was rented by a consortium from the Hamburg Observatory, Sweden and Northern Ireland (see Figure 1).

At that time the southern group had boiled down their search to a single place — Zeekoegat, just north of the Swartberg Mountains in the southern part of the Great Karroo — and therefore we dropped the Oudtshoorn headquarters and served Zeekoegat from Boyden station. In the northern region there were still several places to be investigated. We even decided to include another site in our investigation: a place on a mountain range close to Calvinia in the northwest part of the Cape Province. Atmospheric conditions similar to those at the Californian astronomical observatories could hopefully be expected in this area, caused by the cold Benguela current. Since the mountains were not accessible by car, we arranged an exploratory stay with the help of local people and the South African Air Force, who provided us with helicopter transport. W. Tripp and I stayed on the mountain for 14 days and made seeing estimates. While the seeing was reasonable, the weather was impaired by high ranging cirrostratus. Since the sky was clear at Boyden at the same time, we dropped Calvinia from the agenda.

It turned out to be fortunate that Boyden was a working observatory. At that time Jürgen Stock from the Hamburg Observatory was the local supervisor, and he was doing photoelectric photometry with the 60-inch telescope, while we were doing our routine seeing estimates. Quite naturally we discussed our seeing problems with him and compared our seeing estimates with his estimates at the 60-inch at midnight tea. The results were confusing — sometimes they agreed and sometimes we obtained different results and so we decided to investigate this more closely. The 60-inch telescope had a rather thin mirror blank, and the mirror cell had three supporting pads whose pressure could be adjusted from the eyepiece so that the mirror shape could be adjusted manually. This was an art and a kind of active optics *avant le temps*. J. Stock was quite good at this and at the same time he obtained a good impression of the seeing. When he did this, he gave us notice so that we could do our seeing estimates at the same time.

The seeing measurements

Plotting the seeing estimates for our 10-inch telescopes against those of the 60-inch we obtained a generally positive correlation, but one with a peculiar scatter. When we found a medium value for the 10-inch seeing, the 60-inch showed mostly medium-quality seeing too. It could, however, just as well give bad seeing. The same was true if the 10-inch seeing was excellent. But we never found the situation that a bad or medium 10-inch seeing was accompanied by an excellent 60-inch seeing. In long discussions with J. Stock and the members of the seeing expedition, we arrived at a simple explanation of this result.

The air in front of the telescope is not uniform, but shows minute temperature fluctuations that result in similar variations of the index of refraction. If the linear scale of these variations is smaller than the telescope diameter, they will produce a loss in the sharpness of the stellar images, scales larger than the telescope diameter, on the other hand, will produce a lateral shift of the image, and when the fluctuating density field is moving, the stellar images will move too. Therefore, if we want to obtain good estimates for large-telescope seeing, we have to be able to measure both the small-telescope seeing and the image motion.

The problem in measuring the image motion is that it is exceedingly difficult to distinguish the part that is caused by the atmospheric disturbance from that caused by mechanical vibrations of the telescope. Either one needs a telescope with a very stable mounting and an exceedingly smooth drive, or one has to utilise a differential procedure, where two separate telescopes on a single mounting have common vibrations, so that the separation of their images is only affected by the atmospheric image motions. Quite naturally we discussed ways to make these measurements, but under expedition conditions it turned out not to be possible to provide an appropriate instrument.

Another problem connected with the seeing in South Africa could however be solved. According to astronomical folklore at Boyden Observatory, the seeing quite often deteriorates markedly after midnight, so that the observers could go to bed safely at convenient times. We had to do our regular seeing runs at midnight and at four o'clock irrespective of the prevailing seeing and so we noticed, as had other observers before, that the failing seeing is connected with falling temperatures. This occurred mainly in the winter months with quiet clear skies, when an inversion layer was forming in the air close to the ground. As soon as the telescope is covered by this cold air, the seeing deteriorates dramatically. We tested this by observing along the roads leading up to Boyden Kopje, rising by about 50 metres and then going to Naval Hill in Bloemfontein, rising about 100 metres. A hill with an elevation of more than 100 metres above its surroundings and the facility to drain the cold air downhill should therefore be a suitable place for an observatory. Just a few kilometres north of Bloemfontein we found a suitable *kopje* and we did some seeing observations from the top and found it quite suitable. Later on we heard that Walter Baade had already pointed out this very place as a possible site for an observatory some years earlier.

Aftermath

As 1957 drew to a close it was decided to end the seeing expedition to South Africa in its then-present form and so we sat down to convert our experience into a report. At that time Xerox copy machines were not yet available, and it was not a trivial matter to produce several copies. We tried to do this with the help of a printing shop, but then their copy machine broke down, and therefore only very few copies were eventually made. I do not know who got them and I did not have one myself.

The seeing expedition to South Africa continued using a different setup. At two sites — Zeekoegat and at Klavervlei near Beaufort West at the northern border of the Great Karroo — semi-permanent small observatories with medium-sized telescopes were set up and used for regular astronomical programmes. By these means, longer-term experience with the seeing quality could be obtained.

The members of the first seeing expedition all returned to Europe. Father Bertiau returned to his congregation, Tripp became a personal assistant to Heckmann for some time, and after that he left astronomy for a consulting firm. I returned to Hamburg and helped Stock for some time as a student assistant and worked on my PhD thesis. After its completion I switched to radio astronomy and eventually became involved in the construction of the Effelsberg 100-metre telescope; I have never been concerned with ESO matters since. Unfortunately my photographs from the time of the seeing expedition have been lost in the course of several removals, as well as my notes and letters. So I have to rely on my memories. But because I am one of the very few of those active in the seeing expedition who is still alive, I thought it might be worthwhile to put my memories to print.

Acknowledgements

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