T16 #178277: a life of travel and tacheometry

Leica Geosystems' worldwide reputation for quality precision instruments stems from the legacy of research and development left by forefathers Kern Swiss and WILD Heerbrugg. Most surveyors would have begun their professional careers using Wild instruments and for many years, a Wild T2 was synonymous with precision work. Today, the foundation of Leica Geosystems is based on this legacy - on the commitment of quality and precision and on the continuous application of the most modern technology. Customers know and trust Leica Geosystems' quality precision instruments and are confident that they will stand the test of time. One such example is that of a T16 optical theodolite, used for optical distance measurement, and now owned by archaeological surveyor, Dr Hans Barnard. Nearly 3-decades old, this instrument has certainly done its share of work. Yet Barnard continues to use it in the field despite the accession of new models. Here is its story.....

My best photograph, taken in 1999 in Cairo between the medieval city and the encroaching high-rises.

The Roman fort in Wadi Umm Wikala (Wadi Semna) as it could still be seen in the Summer of 1998.

Allow me to introduce myself: my serial number is 178277 and I am a T16 optical theodolite. Back in 1975, I left my home of manufacture in Heerbrugg, Switzerland to begin my working life in the Netherlands. In 1979, I was sold to the municipality of Purmerend, which was a growing community just north of Amsterdam. Most of my work had to do with laying out the streets and houses that were going to be built in the existing agricultural land. It was honest work and, apart from the rain, not very difficult. After a while I was replaced with more advanced, electronic equipment even though I had been outfitted with a heavy DI4 Distomat. Being from a generation of durable all-metal theodolites, with not too many moving parts and without vulnerable electronics, there were still many things I could do - maybe not as fast or as accurate as the younger generation - but certainly more straightforward and reliable. The first to appreciate this was a company called Passepartout in Gouda, who undertook contract survey work and the maintenance and trading of survey instruments. They also trained construction workers in various survey techniques, and it was for these classes that I became the practice instrument.

A career as archaeological surveyor

When I was about to retire from this job, my life took the dramatic turn that justifies my claim to fame. In 1993, a young medical doctor named Hans Barnard, used most of his life savings to purchase me in pursuit of his second vocation: archaeology. He had been to Egypt a couple of times as a member of the British expedition to Qasr Ibrim. Once an eagle's nest high above the Nile Valley, this city is now on an island in Lake Nasser, as a result of the construction of the Aswan High Dam in the early 1960's. Hans' first responsibility was the health and safety of the foreign archaeologists and the Egyptian workmen. Fortunately this was not a full time job, and in his spare time he studied the excavated human bones, whilst at the same time teaching himself planning and surveying. Soon he was able to not only expertly use the line level, plumbob and planning frame, but also the plane table and tacheometry. At the time we became partners, he had decided to pursue a career as an archaeological surveyor and consequently he needed to own the tools of that trade.

Mapping in Egypt

From this time on my life was filled with adventure. Hans took me all over Egypt to map fascinating places and meet interesting people. First was Abu Sha'ar on the Red Sea just north of Hurghada, the site of a Roman fort that was subsequently transformed into a monastery. Here we met Brian Cannon, an American surveyor who worked for the court, but had previously surveyed the route of an oil pipeline in Alaska and had a short spell of selling survey equipment. Next we visited Berenike, the most important harbour on the Egyptian Red Sea coast in Graeco-Roman times (between the 3rd century BC and the 6th century AD), and worked with British surveyor Fred Aldsworth, a former Ordnance Survey surveyor who now specialised in archaeological survey work and conservation. Fred, Brian and Hans drew a detailed plan of Berenike and of a number of the ancient settlements and road stations nearby.
Soon after the potential of a small team in the desert was established, my life became even more interesting, but

also more difficult than before. Together with Steve Sidebotham and Hans, I started planning ancient settlements in the Egyptian Eastern Desert. Steve is a professor of Ancient History and Classical Archaeology at the University of Delaware (USA), with a particular interest in the ancient Red Sea trade and the Egyptian Eastern Desert. He directed the excavations at Abu Sha'ar and co-directed those at Berenike. He also traced the Graeco-Roman trade routes through the desert and planned the way stations associated with these. When he decided to start mapping the ancient settlements in the desert he asked for our help. As there was only time for this during the summer holidays we went out when the desert was at its most inhospitable. The project had no budget, and so I usually travelled in the back of an old Toyota Hilux pick-up truck, and I was even loaded on a camel a couple of times to go places that could not be reached by car!
Most of the settlements we visited were associated with

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ancient gold mines or stone quarries. Others were related to the ancient road system or served a still unknown function. All consisted of simple structures of local un-worked stone, built without the use of mortar. The roofs must have been made of cloth or mats over a wooden frame and the buildings may have looked more like tents than like houses. They had all been abandoned 1500 years before and had since been slowly reclaimed by the desert, a process aided by the removal of useful parts, the occasional flash floods, treasure hunters and tourists. After all these years we were the first to once more spend a couple of nights in the settlement that we studied during the day. These nights were silent under an impressive dome of stars at which I sometimes had a look to establish North. The days were hot and more than once my spirit levels followed the sunlight rather than gravity.

Taping and tacheometry in the desert

Survey work in the desert is seriously hampered by the lack of electric power. Ordinary batteries can be brought in large quantities, but recharging battery packs is impossible without bringing special equipment or driving long distances. As the environment is harsh to delicate electronics as well as to the human brain, simple non-electronic survey methods are the preferred methods anyway. The loss in accuracy is irrelevant as the objects to be surveyed are usually too poorly constructed and too damaged to allow extreme precision. A possible loss in speed is more than compensated for by the additional information that can be gathered during the extra time on site. I was therefore mostly used to lay out a grid for taping or involved in tacheometry on the site.
For the first method I was only needed to construct a grid of 50 x 50 m squares. After this I could rest in the shade while a tape was laid out along one of the grid lines. A second tape perpendicular to the first allowed Hans to measure the co-ordinates of whatever needed to be surveyed and draw this directly to scale. Square angels were obtained by either a third tape parallel to the first one or, more often, by an optical square. For the task of tacheometry I was required to work all the time. The method used required a stadia rod to measure both angle and distance between the surveyor and the point to be surveyed. Depending on

Travelling rough, in the back of an old Toyota Hilux pick-up truck (photograph S.E. Sidebotham, August 1997.

the local situation these two methods were often combined, or supplemented with data from trigonometry or GPS-receivers. All these measurements had then to be converted into a drawing. At first Hans did so on site, using ruler and protractor, enabling him to immediately check the final result. As he became more confident he started working at home, using sketches and notes to explain his long lists of measurements. From ruler and protractor he moved on to Excel and AutoCad. The final drawing was, however, always made by hand using a Rotring pen on drawing film. PhotoShop was then used to clean the drawing and add the necessary captions. Many sites were mapped this way and many of the resulting plans were published, or will be soon. One of the nicest projects we worked on is the plan of the Roman fort in Wadi Umm Wikala that was destroyed only a short while after this plan was drawn.

To Iceland and back

Hans was rewarded now and again by seeing his name in print, and I also got some compensation for my hard work - not only did I see places that few have visited, but also from time to time I was cleaned and calibrated. At some point I also got a new set of legs, bought second hand from a foreign company involved in the construction of several tunnels in Cairo, both for sewage and traffic.
Less fortunate were the times when Hans left me to use different instruments elsewhere. At one stage he went to Yemen to survey the environments of Baynun using a Wild RDS (serial # 218107) belonging to the German Institute in Sana'a.
More recently he was in Iceland to find early structures in Skagafjörður, in the north of the island, with geophysical methods. At one stage, the use of a Wild T1000 (serial # 333638) with attached DI1000 Distomat and GRE4 datalogger was required. When he contacted the Leica Geosystems' helpdesk, to ask for the necessary software to run this combination, he not only promptly received technical support, but was also asked to share some of his adventures. As so, here we are....

T16 #178277
& Hans Barnard

Further information about Hans Barnard's work can be found at http://www.barnard.nl/desert/ and associated pages.