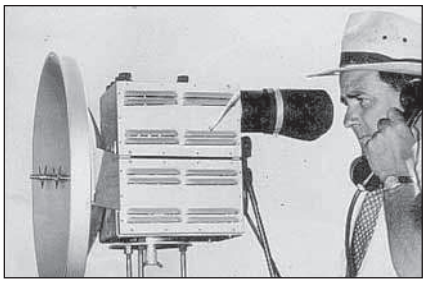
The Tellurometer

The background of invention of the Tellurometer on the occasion of its 50th birthday



Dr Wadley with the prototype Tellurometer

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It was in the late 1950s that the Tellurometer hit the surveying profession. Certainly it was not the first EDM instrument on the market, that title goes to the Geodimeter which appeared in 1947, but there was a difference. The Geodimeter worked on a light source and as such its maximum range was limited by visibility. The Tellurometer operated on a radiowave which could penetrate most weather conditions and achieved distances up to 100 miles. Since the early 1900s any long distance that was required to be measured as accurately as possible, e.g. a survey baseline, was determined using long tapes or wires suspended in catenary. Numerous baselines around the world were measured this way with each requiring 20 to 40 personnel over a period of several weeks. Then, suddenly, the profession had new tools that would allow such a task to be completed in 20 minutes by two persons. It was a revolution that completely changed the manner in which surveying operated.

Recently the Tellurometer passed its 50th birthday and so it is opportune to record the background to its invention.[3]. The 2nd World War saw developments in radar for detection purposes based on speed and time to determine distance. The speed element here was the "known" value for the velocity of propagation of the waves. At that time the accepted value was around 299776 km/s but the uncertainly in this was such that the figure was not suitable for surveying purposes. By 1944 Shoran was active in the location of bombing targets and this soon developed into a system for use in areas where traditional triangulation was not possible. An example was the measurement in Italy of a line of 618 km from 22 flight passes across the line between the terminals. Such was the interest in this that it was found to highlight an error in the accepted velocity value of some 18 km/s. By the mid 1950s Shoran and its development, Hiran, were used for geodetic purposes including the measurements over the Mediterranean to connect the triangulations of Southern Europe to those of North Africa and in particular complete a connection between the Struve Geodetic Arc and the Arc of the 30th meridian.

In 1954 Col. Baumann, then Director of Surveys at the Trigonometrical Survey of South Africa, and a member of the Council for Scientific and Industrial Research (C.S.I.R.), put in a plea for an instrument to be developed that – (a) would have an accuracy suitable for first order triangulation, (b) was simple to operate by surveyors unfamiliar with electronics, (c) would achieve an accuracy of better than 1 in 105 at over 30 miles with resolution of a few inches and (d) would be light, portable, rugged and versatile. A very tall order it would seem. However later the same year Trevor Wadley who was at the Telecommunications Research Laboratory (T.R.L.) within the C.S.I.R., became available and was put to work on developing the idea.

In a matter of little more than two months he was making measurements on a test site north of Johannesburg, with a first "routine" measurement on 14 June 1955. This was followed by close cooperation with the Trigonometrical Survey Office to make further test measures over lines for which accurate results were known. Various sites were chosen around South Africa and the results calculated on the basis of a velocity value of 299792.0 km/s. The results were good but raised some doubts. There appeared to be a 15 ppm discrepancy against a baseline that had been measured in catenary in 1903. Over half of this was later accounted for by virtue of the difference between the South African Geodetic foot and the British foot. Much of the residue was laid at the door of the velocity figure which, it was calculated, probably needed to be increased by near 2 pm to 299792.6 km/s. In 1956 the Director of the Survey and Mapping Branch, Dept. of Mines and Technical Surveys in Canada heard rumours about this new

The control panel of the MRA2 Tellurometer

instrument and sought a demonstration. They were welcomed to South Africa on the understanding that it would not then be able to discuss the working principles. The Canadians were suitably impressed and departed with the comment "I will give you a firm order for the first six you produce and I don't mind the cost."

By 22 January 1957 a demonstration was given at a hotel in Constantia, south of Cape Town, to an audience of notable national and international members of the surveying fraternity. The instrument was launched and in a matter of months was being tested out around the world. In March-April that year Wadley was involved in tests in England over the Ridgeway baseline and its extension figure. These suggested, as had the tests in South Africa, that the velocity figure should be 299792.6 rather than the then accepted value of 299792.0 km/s. The same year the International Scientific Radio Union adopted a figure of 299792.5 and in 1973 the recommended value for practical use was 299792.458 km/s. It is interesting to note here that there was a further third occasion when the survey profession assisted in the determination of the value for the velocity. In 1926 Albert Michelson had requested the U.S. Coast & Geodetic Survey to supply a highly accurate line for his velocity experiments and this task fell to William Bowie.[1]. Michelson's result was 299798 km/s.

The effect of the introduction of this new tool was graphically illustrated in Kenya. At that time, 1957, the Directorate of Colonial Surveys (D.C.S.) of the U.K. was involved in major triangulation and traversing schemes within the country both involving the use of catenary measurements. Some few days after completing the tedious measurement of the baselines at Malindi and Isiolo (of 13 and 21 km respectively) along came representatives to demonstrate this new EDM instrument. They were able to measure in 20 minutes to comparable accuracy one of the baselines that had taken some six weeks and numerous personnel to measure by catenary. How soul destroying that must have been. Then the D.C.S. surveyors were able to complete in 28 days the traversing for which the estimate had been 2 to 2½ years. So fifty years ago surveyors had to begin turning away from triangulation to trilateration and traverse. The added complication was that mechanical equipment was replaced by electronic black boxes and the traditional use of a screwdriver to cure many of the surveyors' problems was replaced by a technology that was not screwdriver friendly.

So who was Dr Wadley? [2]. Born in 1920, he was the seventh of ten children of a former Mayor of Durban. He attended Durban Boys' High School and then Natal University. He was a brilliant, if somewhat unorthodox, student and graduated in Electrical Engineering in 1940. During World War II he served in the Special Signals Services of the South African Corps of Signals where he was involved in various secret activities. After the War he joined the National Institute for Telecommunication Research (N.I.T.R.) as a designer of radio equipment.

He developed an Ionosonde, which was a form of frequency scanning radar. Later his interests turned underground for a while with research into communications underground for the deep mines. After this, and just prior to his involvement in the Tellurometer he developed a very successful radio receiver, the RA17, manufactured in conjunction with Racal. This was sold in large numbers worldwide.Wadley left C.S.I.R. in 1964 and turned his interest back to the successful radio. He died at Warner Beach in Natal in 1981 aged 61.

Among the many academic and other recognitions of his talents was the issue in 1979 of a commemorative stamp. Since those early days of the Tellurometer the firm that manufactures it is now called Tellumat. Whilst their core business ranges far and wide in the electronics field they still produce Tellurometers with the latest model as the MRA 7. This has found a very useful niche in the deep mines of South Africa. There it operates in a safety role in relation to the movement of the cages in the various very deep shafts.

Acknowledgement

The illustrations are all courtesy of Tellumat (PTY)Ltd, Cape Town

References

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YOUR COORDINATES

Impressive

The articles particularly on BWSL, Sustainable Land Governance, in Coordinates are very interesting. More particularly BWSL where I have been on the Technical Advisory Committee of BWSL right from Conception to its Implementation. The article is written in an impressive manner, although we could have created a much bigger land mark / signature structure. Each one of the authors has contributed immensely as they have been deeply involved and contributed sincerely for the completion of the project and must need a loud applause.

For "sustainable Land Governance" probably they have to learn systems concept with inter woven components of the total system, particularly component interrelationships with each other to meet the over all set objectives of the society as a whole. Congratulations and good wishes to authors and editors.

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Correction

The correct email address of Mr Len Gower is len.gower@gmail.com. It was printed wrongly in November issue of Coordinates on page 12. The error is regretted.
-Editor