

# A Tribute to Dr Dirk Baker

on the occasion of the presentation of a lifetime  
achievement award at

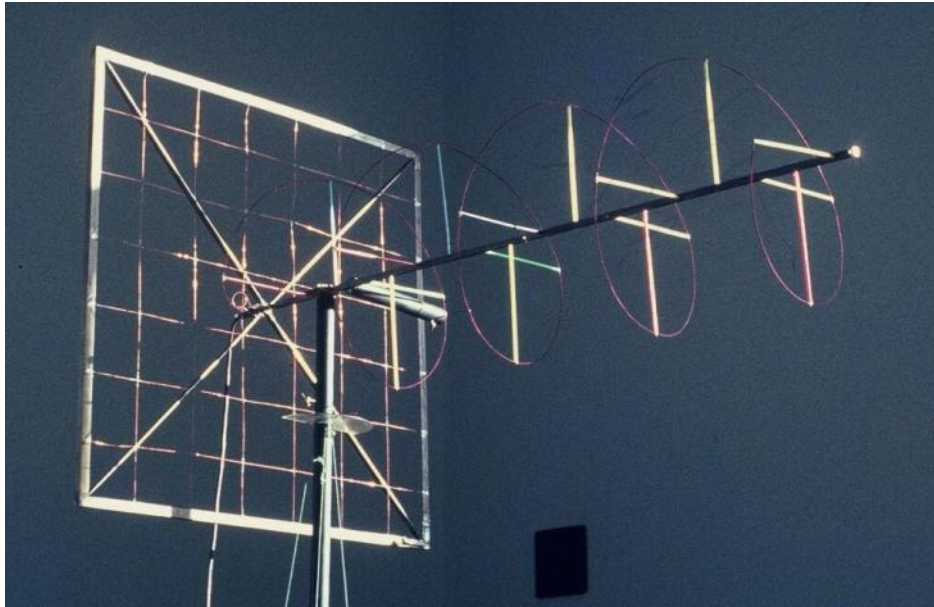
The SA IEEE AP / MTT Conference  
26 and 27 March 2007  
Stellenbosch, South Africa

Presented by Dr AJ Booysen  
Saab Avitronics

# Brief history

- 1945: Born 28 March in Grahamstown, South Africa.
- 1962: Head boy of Graeme College in Grahamstown.
- 1969: Master of Science Degree in Physics (with distinction) from Rhodes University, Grahamstown.
- 1970: Could not pursue PhD in antenna engineering in South Africa, was accepted by Prof John D. Kraus for PhD programme at The Ohio State University, Columbus, Ohio on the basis of the quality of Dirk's radio astronomy/helix antenna work in his M.Sc. (John D. Kraus invented the helix antenna).

# Helix antennas at Rhodes University 1968/69



Helix scale model 1:10, 250-450 MHz



25 to 45 MHz helix at radio observatory  
'antenna farm'

- No high frequency test equipment available at Rhodes.
- Developed own valve oscillator, manually tunable, as well as receiver, **early manifestation of his broad interest in all technologies associated with antenna engineering.**

# Ground-arrayed LPDA antenna at Rhodes University 1968/69



- 15-45 MHz horizontally polarized LPDA antenna.
- Want to look at the stars?
- Point the antenna to the ground!

- Had met **Penny Waddington**, his future wife, before his departure to the USA.
- Obtained **PhD from The Ohio State University** 1970-1974, see John Kraus [Big Ear Two, Cygnus-Quasar Books, 1995]:

*“My student Dirk Baker, who received his PhD in electrical engineering in 1974... Dirk was talented, handsome and athletic and soon after coming to Columbus joined the OSU rugby club becoming its star roving wing”.*

- 24-hour advance booking was required for long distance call with Ohio Bell, used OSU ham radio club to phone home.
- 1974 Worked as lecturer in physics at Rhodes while Penny completed her MSc in Microbiology.



- Married **Penny** 1974 and she has supported him throughout his career.



- 1975 Joined the National Institute for Defence Research (NIDR) – expanded antenna capability and played cricket.



- 1979: **Registered as a Professional Engineer** after long battle because his “first degree was not in Engineering”.
- 1983-87: Headed 80 people in Electronics Laboratory at NIDR, changing circumstances and preference for practical applications caused him to resign and to establish in 1987 the Antenna Division of **EMLab (The Electromagnetics Laboratory)**, headed by Johan Pretorius.
- Was highly esteemed **Director** of EMLab/ Avitronics/ Saab Grintek Technologies from 1987. During this time he remained technically active and developed many antennas and antenna systems.
- 2005: **Retired at age 60**, now Specialist Technical Consultant to Saab Avitronics (Antennas) and other local and international organizations.



# Outstanding Contributions

- Has become known as the expert on antennas for electronic warfare applications (EW) in South Africa both locally and internationally.
- Developed and maintained a high tech antenna capability in SA and established international credibility and markets for SA antenna products, opening the door for others to export.
- Designed, supervised construction and commissioned Paardefontein National Antenna Ground Reflection Test Range 1978-1982 [Lo & Lee, Antenna Handbook, Van Nostrand Reinhold Company, 1988, p. 32-22]:  
*“[17] contains an excellent example of a ground reflection range”*. This is Dirk’s 1984 AMTA paper.

# Paardefontein 500m Ground Reflection Range

View down 500m range 2007



Aerial view of ranges 2007



Site works *circa* 1980



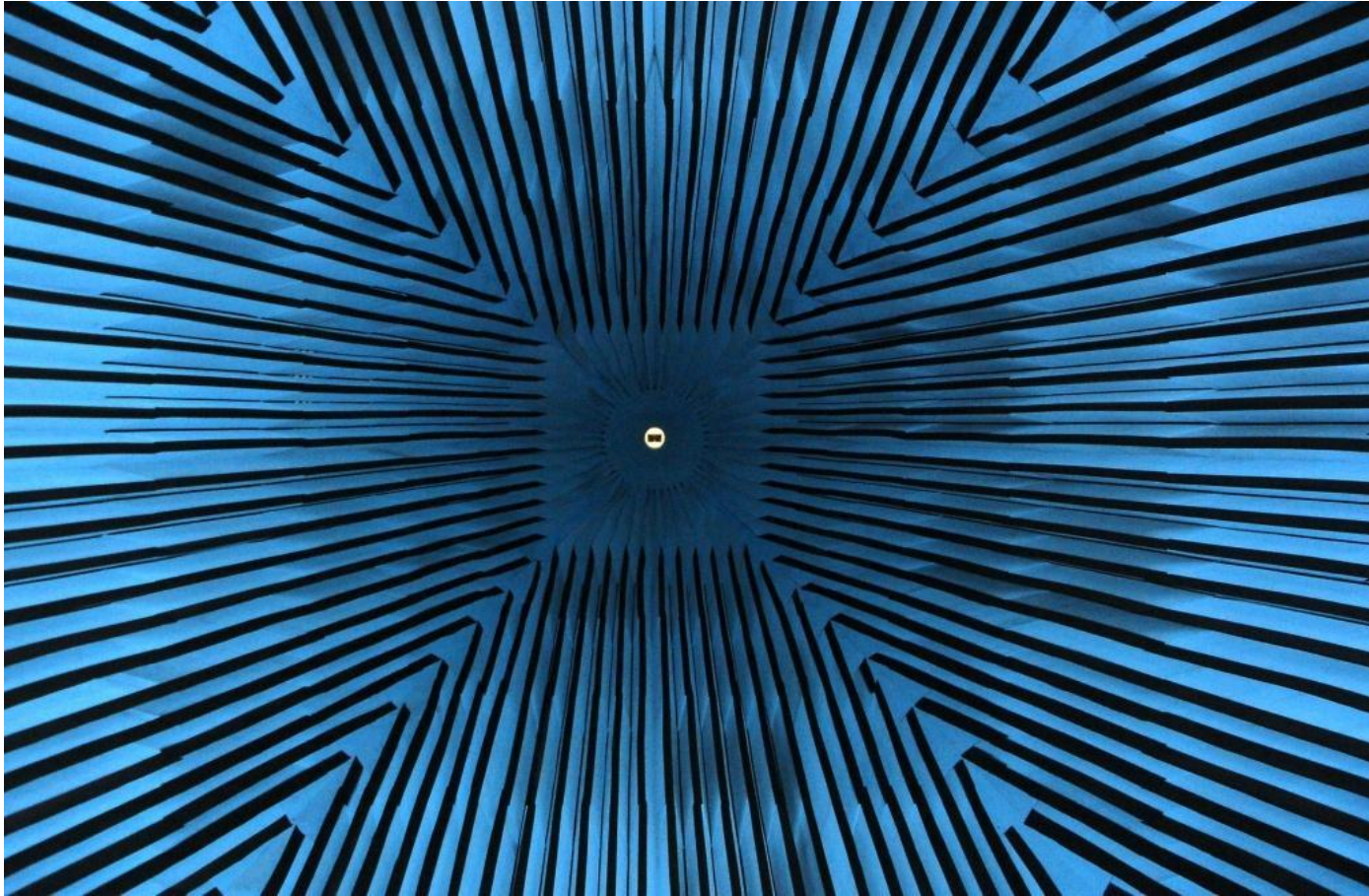
- Designed, constructed and commissioned anechoic chambers for SAAB Avitronics as well as other companies.



Anechoic chamber knock-down kit fully assembled



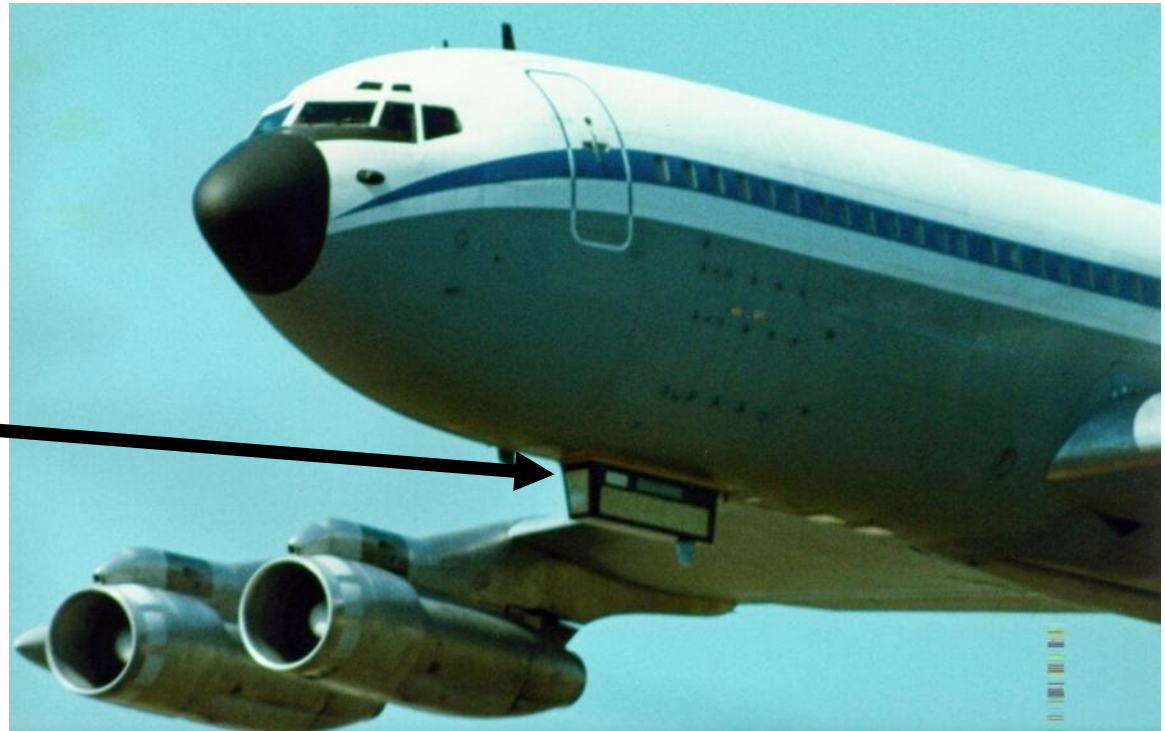
View towards funnel end of tapered anechoic chamber





# 0.5-18 GHz Spiral Antenna Interferometer DF Pod with 360° FOV and slant 45 deg omni monitoring antenna

- At the time of international isolation, developed comprehensive suite of outstanding EW antennas for SA Air Force, SA Navy and specific SA Army requirements.



# 30–100 MHz 1.5 kW Twin-Whip Jammer Antenna



# Transport Aircraft with ELINT, Spinning DF and VHF interferometer antenna systems





Helicopter borne stand off jammers  
integrated on azimuth rotating  
platform with ELINT DF system



1500 kW CW LPDA on Helicopter





# Awards

- Numerous citations and awards: *“in recognition of exceptional development of antenna technology at the Council for Scientific and Industrial Research (CSIR) and in South Africa”*.
- Registered Professional Engineer and Senior Member of the IEEE A&P Society.
- 1985: SAIEE silver medal and certificate for best paper in Trans. SAIEE: *“Measured performance of broadband matching section for peripherally fed helical antennas”*.
- 1986: Received the Merit Award of the President of the CSIR for: *“leading edge technology developments in microwave measurements and microwave antennas”*.

# Personal Characteristics

- Good enough is when there is no room left for improvement, it has to be on time and world class.
- When asked about a topic, he will typically reply: “It’s in that textbook, that paper, that catalogue, that report...” the most phenomenal memory!
- No substitute for experience – 40 years of active involvement, complements his outstanding technical knowledge with insight and ‘gut feel’.
- A ‘generalist’ – expert on every aspect of EW antenna design, manufacture and measurement, also numerous associated technologies – radome manufacture, materials.

# Personal Characteristics

- Knowledgeable not only on antennas but also on **associated electronics**, like amplifiers, limiters, power combiners, TWTs, ferrites, circulators and other related microwave components **(applications and limitations)**.
- Excellent programme manager – often involved in and also led joint developments between several companies.
- Excellent business manager and strategist.

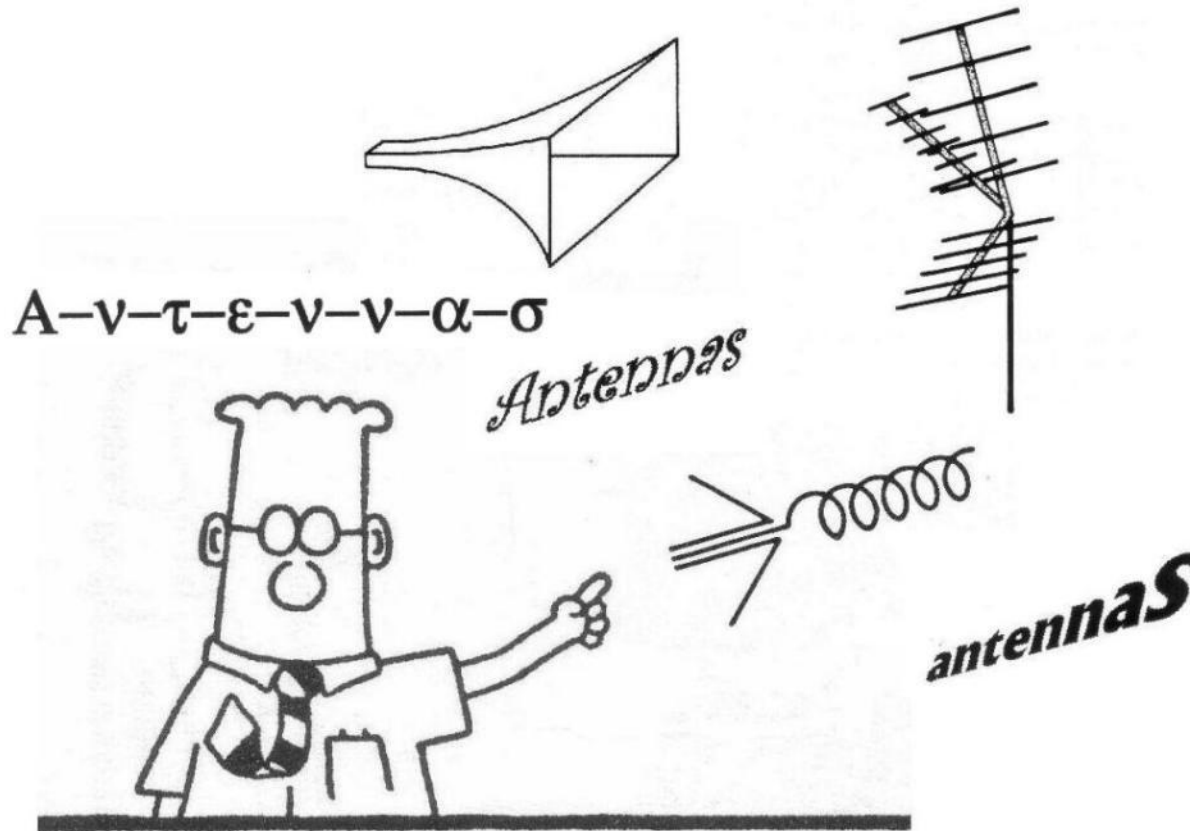
# Personal Characteristics

- Has an extraordinary ability to cultivate **loyalty and enthusiasm** in his team.
- He has mentored many young engineers and passed on the benefits of his experience [e.g., David B. Davidson, Computational EM for RF and Microwave Engineering, Cambridge University Press, 2005]:

*“Dirk Baker gave me my first job at the CSIR in 1984; he is an outstanding antenna engineer and his scepticism of computed results was an invaluable baptism of fire.”*



# A passionate affair



© Scott Adams (Teacher only)

Loves to teach and talk

*Antennas*  
ANTENNAS

*Antennas*

*Antennas*

*antennas*

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A-V-T-E-V-V-Α-σ

*Antennas*



© Scott Adams (Mostly)

**His customers find it mind boggling**

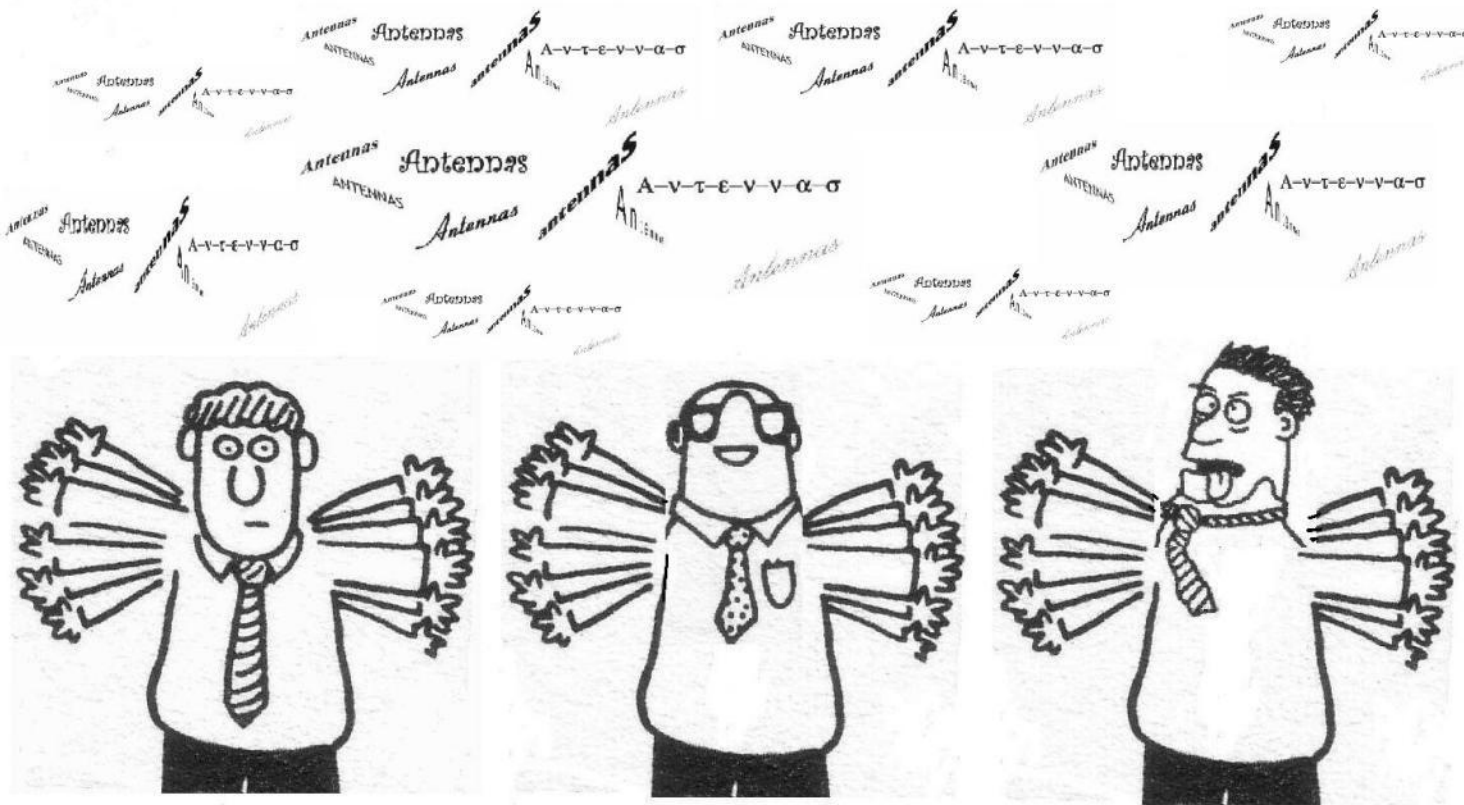
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© Scott Adams (Verbatim)

**Tough on co-workers who have heard it all before**



© Scott Adams (Repeatedly)

**Is totally impervious to “hurry up” hints  
– a true enthusiast**



# Technical Highlights

- In 1975 made key breakthrough in the development of high performance 2 to 18 GHz and 2 to 40 GHz spiral antennas.
- From 1975 onwards developed many of the key antenna technologies and antennas still in use in South Africa today.
- From 1979 to 1982 designed and developed the Paardefontein National Antenna Test Range (NATR).
- In 1991 developed 0.7 to 40 GHz ultra-compact spiral antenna with integrated diplexer for airborne applications— still unique in the world today.
- In the 1990s design-to-cost of mass-produced DECT antennas for assembly by lower-skilled workers.

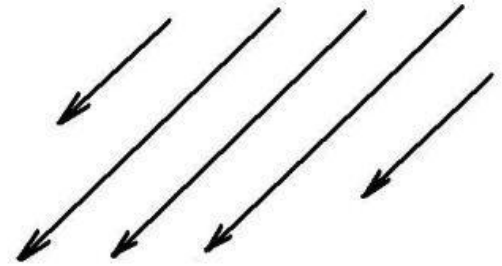
# Technical Highlights (continued)

- In 2005/06 he led the design studies for the 15 m diameter dish as part of the South African team for the Square Kilometer Array (SKA) bid.
- Design and construction of a high performance tapered anechoic chamber (4.3 m x 4.3 m x 17.4 m) operating from 0.5 to 40 GHz (usable down to 200 MHz).
- Ongoing design and development of products produced by very few companies in the world, including Spinning DF antennas and Submarine Antennas.
- High pressure spirals, omni and GPS antennas in the 1 to 18 GHz range for submarine applications.

# Submarine COMINT Antenna

- A recent submarine project required a radome to withstand 78 bar (780m depth), the UHF frequencies are radically affected by the radome.
- First order radome was cylindrical design with a 16mm thick fiberglass solid wall – degrades UHF performance and interferes with ELINT antenna system on top.
- Needed better structural design and improved RF performance - even most powerful FEM software struggled to analyze.
- **Near-total disaster for project timescales**, so Dirk resorted to an **old-fashioned technique**, not commonly used anymore because of time and physical insight required...

Ray



Tracing

© Scott Adams (With Trepidation)

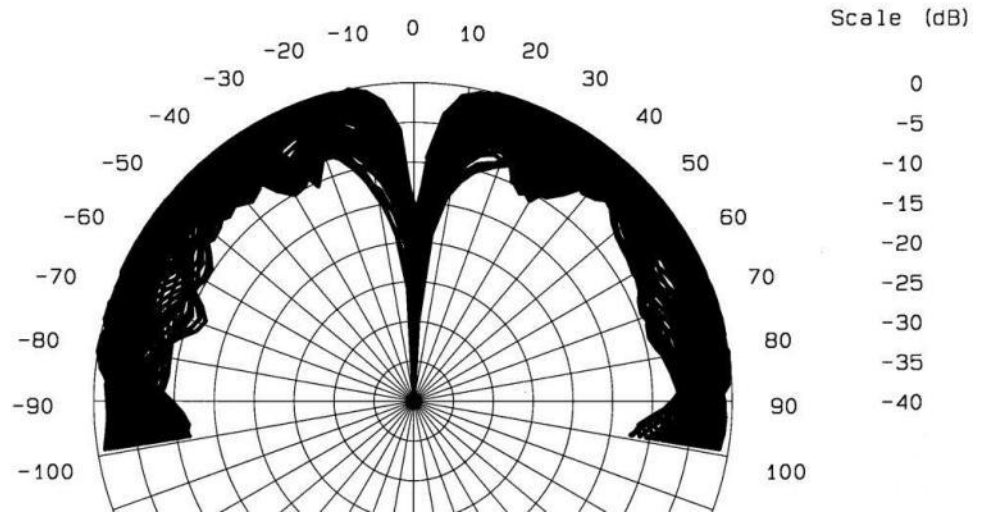
# Ray tracing made easy ... the wine glass design!

(Laser beam shows critical internal and external reflections  
leading to shaped radome design)



# The result ...

HF to 18 GHz COMINT/ELINT system  
for submarines



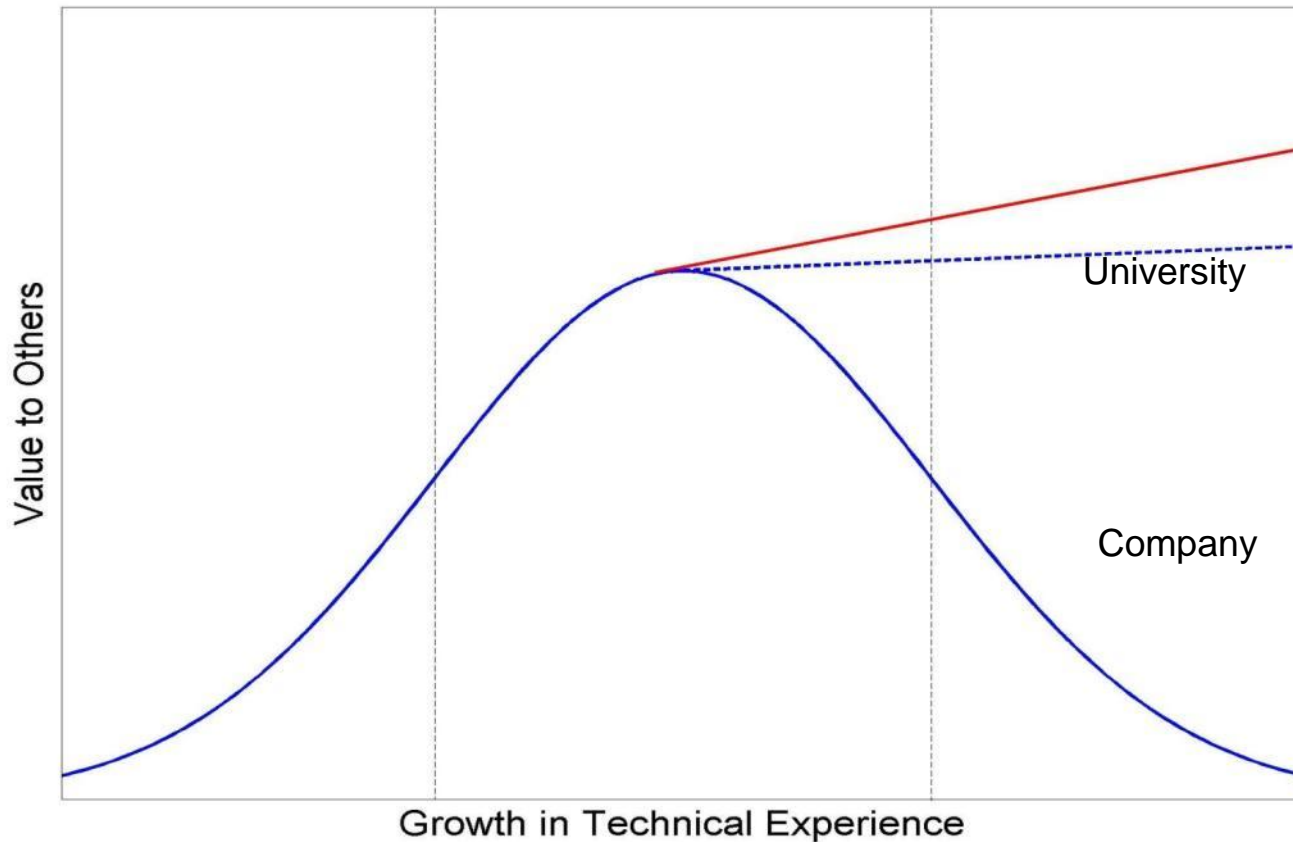
‘Out-of-this-world’ elevation plane coverage (elevation patterns at 25 frequencies in the UHF band).

Shipyard Programme Manager stated that this is: *‘a market breakthrough, a label should be added to the inside of the radome stating: Designed by Dirk Baker’.*



# Value to SA Antenna Community

His value to others has not peaked nor has his impact declined as is often the case. His experience continues to add value to various organizations as shown by the upward red slope.



# Value to SA Antenna Community

- Master of a very wide range of aspects and techniques in practical antenna engineering. Throughout his career he has stayed intimately involved with the practical aspects of antenna design and measurement.
- A key attribute is his ongoing interest in training and mentoring young engineers and scientists – he shares his knowledge.
- Dirk has ability to write a practical antenna design handbook in unmatched practical detail covering not only the antenna performance but also such aspects as materials selection, environmental performance, corrosion resistance, etc.
- “The Complete Antenna Engineer”
- J.D. Kraus – published 3<sup>rd</sup> edition of “Antennas” at age 90.  
R.C. Hanson – active consultant to this day.  
D.E. Baker – of the same stock.

# Citation

Ladies and gentlemen, the foregoing submission motivates and supports the decision of the SA IEEE AP/MTT Chapter for making this lifetime achievement award to Dirk Baker for:

***“Contributions to the establishment and maintenance of a world-class antenna industry in South Africa and for sharing his expertise and insight with fellow workers in the field”.***