wattnow

SAIEE SUPPORTS SKILLS DEVELOPMENT AND PROFESSIONALISATION OF ELECTRICAL ENGINEERS

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FEATURING

COMMUNICATION : RADAR

SAIEE THE OFFICIAL PUBLICATION OF THE SOUTH AFRICAN INSTITUTE OF ELECTRICAL ENGINEERS | NOVEMBER 2014

contents

wattnow magazine

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November is upon us, and with it comes Christmas jingles in shops and a certain frenzy in the air – people winding down to enjoy a well-deserved December holiday and overspending on unnecessary Christmas gifts. I say, instead of spending thousands on gifts, rather donate money to a charity of your choice, like the Sunflower fund (page 5) – the feeling is ethereal.

This being the last issue of **watt**now for 2014 – I would like to use this opportunity to thank each and every person who contributed to the success of this magazine during 2014. This year had its up's and downs – we laughed over a glass of wine, we cried at the loss of SAIEE members, but never did we waver in our efforts to follow the SAIEE President in his vision – in making a world class South Africa.

This issue of **watt**now focuses on Communications and Radar. We are celebrating the 75th anniversary of the first Radar Echo, which took place on the 16th of December 1939 between the Bernard Price Institute at Wits and the Northcliff Water tower.

Dudley Basson did it again – my old *'staatmaker'* has written a brilliant historical piece on the Industrialization of South Africa. It makes for a very interesting read. Find this on page 50.

This issue will be distributed late, due to the ongoing postal strike. It will be available online at www.saiee.org.za on the 21st of November.

Herewith your November issue.

Until 2015 - Enjoy the holidays – safe travels.

Earn CPD Credits

*Visit www.**watt**now.co.za to answer the questions related to these articles to earn your CPD points.*

Greetings to all our Members from SAIEE House, Johannesburg.

Thank you to Professor Ian Jandrell for his sterling delivery of the 63rd Bernard Price Memorial Lecture. Professor Jandrell and the South African Engineers are certainly in the world class category of lightning knowledge and of man's understanding of the air breakdown mechanism during electric storms. Thank you to our members for their warm reception and excellent support of the event. I am sure that Professor Jandrell increased your appetite for further research and investigations in your own area of expertise and interest. Long live the vision of Dr. Bernard Price in promoting the economic application of science, engineering and electrical energy for a better quality of life for all our people.

The budget for the 2015/2016 financial year was approved by Council. Thank you to the administration for your diligent efforts in planning and managing the Institute to be World Class. Do visit SAIEE House and Innes House as you walk through the gardens, you will realise that you are in the company of the world's best.

The Annual Banquet signals the end of Calendar Year 2014. The banquet took place on the 1st of November 2014, at the Wanderers, Johannesburg. At the Banquet, we recognised and awarded our outstanding members whilst we toast another great innings by our Institute. Since 1909, SAIEE has served members and our country with distinction.

2015 approaches and let us start with our resolutions to push South Africa into the category of World Class. We all have to collectively push harder. The economy lags when it should be leading. Let us continue to invest in our student members, in our own further study, research and investigations and in preparing innovative engineering solutions for society. Engineers can make that difference towards a better quality of life for all.

To all our members, advertisers, staff and affiliates, enjoy a blessed festive season. Be safe and return energised for a productive 2015.

Thank you.

Dr Pat Naidoo | Pr. Eng | FSAIEE
2014 SAIEE President

The FACTS about Schuko plugs and sockets.

Legal and Safe are not always the same thing.

Legal and Safe

The South African SANS164-2 standard allows the introduction of both the 3 pin and 2 pin plug. Here the 'Europlug' (EN 50075) that has also been adopted by the country as SANS 164-5, is shown being plugged into a standard socket. These configurations are both safe and legally used in SA.

Legal but Unsafe

In this case the 'unearthed' socket, legal in SA and compliant to SANS 164-6, allows the entry of an 'earthed' Schuko plug because of the poor design of the protruding plastic rim at the top of the socket. The consequence of this, may lead to electric shocks as the appliance at the end of the plug requires the protective earth as its safety measure and the installation Earth Leakage Protection may not pick up the internal fault due to the lack of earthing.

Illegal but Safe

These are examples of the Schuko system (DIN49441) where both the plug and the socket-outlet are earthed. The National Regulator for Compulsory Specifications has banned this configuration for sale or installation in SA in VC8008, for over 30 years. The system is perfectly safe when used correctly, in those countries that allow it.

Illegal and Unsafe

The adaptor shown has been banned since around 2005. The 'open' two pin sockets are now enclosed in a 12mm deep trapezoidal well. The situation where an earthed Schuko plug can be plugged into this type of 'open' faced 2 pin socket is not only illegal but also dangerous due to the lack of earth connection to the appliance. This raises the risk of electric shock and lack of earth protection for a possible failure of the appliance, which without it, can cause a fire.

Be Safe. Always ask for and use SAFEhouse members' products and services:

SAFE house™

Suppliers you can trust

The South African Safehouse Association is an independent, registered, non-profit organization established by the electrical industry and committed to communicating with customers.

The South African Safehouse Association has been established to combat this proliferation of dangerous products and services by:

- Making the market aware of the risks in using such products and services
- Exposing sub-standard products and services
- Persuading specifiers, suppliers and distribution channels not to recommend or to offer such products and services for sale

For more information contact: Pierre Nothard
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*For the most up to date list of members please go to **www.safehousesa.co.za**

As at 20/09/2014

WATTSUP

SAIEE Annual Banquet

The Naidoo family

The Bromfield family from Impact Energy

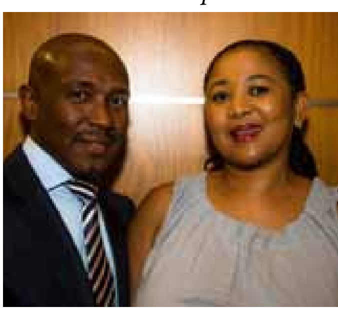
Janine & André Hoffmann

Robbie & Sonja Evans, Chairman, Southern Cape Centre

Ben & Elseri Kotze, Chairman, Bloemfontein Centre

Craig Smith & Kiki Meneses

Jan & Elma de Kock



TC & Mahle Madikane

Paul & Liz van Niekerk

John & Priscila Gosling

Mzwandile & Refilwe Buthelezi

The 2014 SAIEE Annual Banquet was yet again a succesful event, which took place at the Wanderer's Club in Johannesburg.

Our MC for the evening was the ever enthusiastic Ian McKehnie who had the guests in stitches with his jabs of commentory on certain national events.

The Keith Plowden Young Achiever's Award, sponsored by Powertech Transformers were handed over by Bernard Meyer, CEO of Powertech, to Elyssa Spreeth.

The SAIEE Engineer of the Year award, sponsored by Actom were handed over by Jack Rowan, CEO of Actom, to Wayne Fisher.

The SAIEE Engineering Excellence Award, sponsored by SAIEE, was presented by Pat Naidoo, 2014 SAIEE President, to Prudence Madiba.

The SAIEE President's Award, sponsored by ABB and presented by Moses Lekoro of ABB, to Prof Ian Keith Craig.

The **watt**now 2014 Advertiser of the Year award went to Impact Energy and was presented to Den & Wayne Bromfield by Viv Crone & Minx Avrabos.

The SAIEE awarded 25 SAIEE members with their 50 year membership certificates. Ian McKehnie, on behalf of the SAIEE thanked the sponsors for their contribution towards the success of the evening. They are, in no particular order: PPS for the flowers and programmes, Impact Energy for the wine, ABB SA (Pty) Ltd, Actom and Powertech Transformers for the awards.

Jack Rowan (Actom), Wayne Fisher and Pat Naidoo

Stan Bridgens, Prudence Madiba and Pat Naidoo

Stan Bridgens, Prof Ian Craig & Pat Naidoo

Bernard Meyer (Powertech), Elyssa Spreeth & Pat Naidoo

***watt**now Advertiser of the year award winners. From left: Wayne & Den Bromfield, Minx Avrabos, Pat Naidoo & Hylton Dettmer*

Phumie & Lusanda Ngxonono, Chairman Western Cape Centre

Wayne & Liz Fisher with Maureen & Pat Naidoo

Jacob Machinjike, Maureen Naidoo, Gladys Machinjike & Pat Naidoo.

Stan Bridgens, Ian McKehnie (MC) and Pat Naidoo.

*SAIEE lauded a few staff members who each received a Certificate of Recognition. They are from left: Sue Moseley (CPD), Gerda Geyer (Events), Stan Bridgens (CEO), Minx Avrabos (**watt**now) and Craig Smith (SAIEE Website)*

WATTSUP

Infrared technology in F&B industry

Keeping production strictly on schedule in any facet of the food and beverage industry - whether it's pumps, conveyors or electrical connections - means downtime is not an option. Comtest, Fluke's local representative advocates including infrared inspections (IR) into the maintenance mix. Their range of high performance, thermal imagers makes year-round spot-testing possible, on-site, specifically troubleshooting and monitoring transformers, switches, disconnects and MCCs; pumps, motors and compressors; valve operation; tank and sludge levels; level control performance; pipe blockages and integrity; operating temperature; conveyors and roller bearings; boilers and chillers; HVACR; and roof moisture, air leaks and insulation issues.

By performing quick infrared spot checks, maintenance tech's can uncover potential failures, thus allowing for timeous, repairs when convenient. The line can be kept moving by frequently scanning and troubleshooting critical equipment. Traditional troubleshooting using trial and error can be effective, but time consuming and costly. What is critically important, is to pinpoint an issue within a mass of sprawling production lines, quickly, because every second of downtime is expensive!

Equipment cost has historically forced plant managers to outsource annual infrared inspections, and in many cases, limit the scope of work. Annual scans certainly uncover problems, but users shouldn't have to 'hope for the best' until next year's scan. Food and beverage production demands reliability, so yearly spot checks just aren't enough. The production line monitor can narrow down and rule out possible problem-causes faster by seeing the whole picture with infrared, allowing varying temperatures of components to tell the 'inside' story.

To see a Fluke thermal imager being put to the test, watch the videolink: www.fluke.com/rugged or to speak to a SNELL registered thermographer by contacting Comtest on 011 608 8520 or visit www.comtest.co.za

TomTom enables local search capabilities for mobile phones

TomTom Africa, a leader in mapping data, together with Location Based Services partner, deCarta, is proud to announce that they will be supplying a local search application to a top 5 mobile handset manufacturer.

deCarta, one of the world's leading spatial data integration specialist companies has been hosting and running the search service since early August 2014 using its advanced geosearch engine – L2, and has replaced the search service previously provided by Google. The service delivers millions of responses per day to this handset manufacturer's local search and mapping application to users in over 120 countries.

deCarta's L2 is a high performance, scalable local search engine with single line input and intuitive user interface. deCarta sources and indexes map and POI (Points of Interest) content from a wide variety of sources globally but also enables customers to easily index, control and search on their own content. The deCarta service utilises TomTom map and POI content.

"TomTom is thrilled that our partner deCarta is able to provide their sophisticated L2 service to mobile phone users which have been part of our and their business strategy for some time now" says Etienne Louw, General Manager of TomTom Africa. Louw added "We are seeing large mobile, telematics and automotive customers switch to L2 from other local search engines and geocoders such as Google and Bing".

L2 enables deCarta's customers to offer flexible, advanced local search capabilities that are on par with Google Maps but beyond other search engines.

Eaton Integrated Power Management Solutions Now Certified

Power management company Eaton recently announced that its integrated power management solutions suite is now certified as Vblock Ready through the VCE Technology Alliance Partner (TAP) program. Eaton can now deliver advanced power monitoring, management and control solutions for Vblock Systems, which are pre-integrated, pre-tested and pre-validated converged infrastructures for next-generation cloud environments in Africa.

Vblock Systems combine best-in-class compute, network, storage, data protection and virtualisation technologies from Cisco, EMC and VMware, delivered and supported by VCE as a single product customised for African customers. Providing robust power protection and monitoring options for advanced converged infrastructure deployment, Eaton's solutions suite provides IT and data centre end-users with a cohesive solution to maintain uptime and enhance business continuity. *"VCE is pleased to welcome Eaton as a Technology Alliance Partner for Vblock Systems,"* said DJ Long, senior director, Technology Alliances, VCE.

"Eaton can now integrate its products with Vblock Systems, delivering transformative data centre solutions for mutual customers that enable the agility, simplicity and economics of converged infrastructure with Eaton's expertise in power management technologies." VCE works with Superna™ to conduct and administer Vblock System certifications for VCE TAP program members.

This certification enables mutual channel partners and customers to accelerate adoption of VblockSystems while leveraging certified products and solutions of different vendors for seamless data centre operations management.

Eaton's new Vblock Ready solutions enable VblockSystem customers to consolidate non-criticalworkloads to extend battery runtime and deploy automatic live migration of virtual machines and movement of critical workloads.

UJ launches Postgraduate School for Engineering Management

With a long history of offering programmes in engineering management, the University of Johannesburg's (UJ) Faculty of Engineering and the Built Environment (FEBE) has formally launched a Postgraduate School for Engineering Management.

The 2012 Infrastructure Sector Research Report indicates: *"SA firms in South Africa are reporting a shortage of engineers, engineering managers and project management skills."* Aligned to the requirements of the infrastructure sector and the broader fields of engineering, one finds that the overall demand for engineering managers remains yet to be addressed. Given the long history of engineering management at UJ, and UJ's vision of becoming an "An international university of choice, anchored in Africa, dynamically shaping the future," UJ has focused its resources along some of its strengths. One such strength, reflected by the exponential growth in the programme, is its engineering management flagship programme.

The postgraduate programmes of the school caters for part-time and full-time students. A number of part-time students from Johannesburg as well as the broader continent benefit through the after-hours presentation of the programme.

The programme is led by Prof Jan-Harm Pretorius, Acting Head: Postgraduate School of Engineering Management, supported by a number of industrial experts. The programme is also supported by positive feedback from its alumni and reflected by the uptake at both the master's and doctoral level. The master's programme is offered as a 1:1 combination between course-work and a research project (a mini dissertation).

Prof Saurabh Sinha, Executive Dean: FEBE said: *"Frequently students align their mini-dissertation work to strengths of those offering the programme, but also to the interest of a given industrial sector. The approach helps to explore, in depth, the shortcomings of a given sector and develop solutions based on best practices world-wide."*

To build the strength of the programme, the school will recruit further international and national expertise. In this regard, a senior lecturer was recently recruited. The school will soon advertise the post of another associate professor / senior lecturer. Regarding international expertise: the school has recruited one distinguished professor, supported by three distinguished visiting professors, who together cross-cut various engineering disciplines.
From more information, please contact:

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Office: 011 559 3834

WATTSUP

UJ Solar Team Wins In 2014 Sasol Solar Challenge

The University of Johannesburg's (UJ) Solar Team was awarded the Technology and Innovation Award at the end of the 2014 Sasol Solar Challenge in Cape Town in October. Their vehicle, Ilanga II (Zulu word for SUN), was admired by observers and fellow participants as one of the best looking cars in this year's challenge and received special recognition for its innovative use of advanced technology.

The solar cells, used in the array of Ilanga II are commercial cells imported from Germany for space grade applications. The car has Gallium Arsenide (GaAs) solar panels, which are the same type of panels as those used on the Mars Rovers. Due to the efficiency of these panels, the team could build one of the smallest solar vehicles to participate in this solar challenge. At 185kg, Ilanga II was the smallest and lightest vehicle that participated in the Challenge. It was also the first time that a GaAs array has been raced in a solar challenge.

Ultra-lightweight materials such as Carbon fibre, Kevlar and Airex foam core were used for the body and suspension system of the vehicle. The battery pack, consisting of over 400 individual Lithium-Ion cells weighed less than 20% of the total weight of the car.

Ilanga II also featured an axial flux brushless DC hub motor which is designed for solar racing and was chosen for its efficiency as well as a high peak power output.

The car's 3D printed steering wheel included a unique electronics board and LCD display and several buttons, including a booster button, for a quick boost of acceleration when needed.

The vehicle also contains a full telemetry system, which allows the team member responsible for the race strategy and optimisation of the vehicle to monitor the power output of the solar panels and the available power in the battery pack remotely. Considering the terrain and weather conditions, he could then advise the driver on how to manage the available power optimally.

Sasol Solar Challenge Race Convenor Winstone Jordaan praised the UJ Solar team for their advanced technology and their willingness to show other teams and interested people how this technology works. *"This is what will take us forward"* Jordaan said during the awards ceremony.

The technology and innovation award was partly voted for by other participating teams. It is the second time the UJ Solar team was recognised for their innovation. They also received the innovation award in the 2012 Sasol Solar Challenge.

The UJ Solar team

"We are very proud of the excellent team work and achievement of the UJ Solar Team in this year's challenge and we are grateful to all our sponsors, particularly Eskom, Siemens and RS Components, and partners who have helped us to foster research and innovation and equip students with both academic and practical skills through this project." said Nickey Janse van Rensburg, programme manager of the UJ Energy Movement.

The solar car project is the flagship project of the UJ Energy Movement, a programme promoting research, education and industry participation on alternative energy issues at UJ in collaboration with Resolution Circle (a UJ owned research, development and training initiative).

SAIEE and ESKOM Engineering Expo

From left: Boitumelo Tlholakae, Dr Pat Naidoo (SAIEE President), Prudence Madiba and Refilwe Buthelezi.

The Power and Energy Section (PES) of SAIEE organized an expo aimed at showcasing the role of SAIEE and other Voluntary Associations (VA) in engineering. It focused on the benefits of becoming a member of a VA.

The event was held at the Eskom headquarters in Megawatt Park during August. The South African Institute of Welding (SAIW) and the South African Institute of Mechanical Engineering (SAIMechE) was also present on the day.

The day started with a vibrant and enthusiastic welcoming by two of the Eskom-employees-turned-MCs. The Eskom Technology Engineering Senior General Manager, Mr. Willy Majola, did the official opening.

The Eskom Power Delivery General Manager, Mr. Prince Moyo, spoke about the role VAs play in Engineering. As chairman of the Technology and Knowledge Leadership committee of the SAIEE, he encouraged engineers to take part in technology and thought leadership.

SAIEE President Dr. Pat Naidoo shared his vision of a World Class South Africa. He mentioned the unlimited opportunities that exist in South Africa such as the abundance of natural resources, constitutionally embedded human rights and best weather conditions. He added: *"Engineers are trained to deliver a better quality of life for all South Africans and our challenge is to grow world class, customer focused, electrical engineers"*. Dr. Naidoo encouraged engineers to take ownership of South Africa's challenges, to always work in teams, to do their work with excellence and passion, to assist in growing engineers from school to university, from university to industry and then onto global opportunities.

Thank you for making dreams come true!

Tarryn Corlett
CEO | The Sunflower Fund

The Sunflower Fund offers heartfelt thanks to everyone who bought a Sunflower Bandana and wore it on the 12th October to show their support for patients suffering from life-threatening blood disorders such as leukaemia.

Tarryn Corlett, CEO of The Sunflower Fund added, *"I am humbled that, even though life is chaotic and busy, each and every one of you has taken the time out of your demanding schedules to show that you care. By wearing your bandana you are honouring the lives lost and celebrating the lives saved. Thank you for helping The Sunflower Fund continue in its journey, to beat the odds and save more lives. I'm honoured to be surrounded by such generous and compassionate people".*

National Bandana Day is The Sunflower Fund's largest fundraising campaign of the year and the backing of South Africans and Namibians have ensured another very successful campaign. Special thanks go to Pick n Pay, Round Table Southern Africa and our sponsors, patrons, ambassadors and supporters. *"It's still not too late to buy your bandanas which are awesome for Team Building exercises or even civvies day at schools. Please help us sell the remaining stock and make an impact in the lives of the people who really need it most,"* implores Corlett.

Funds raised from the sale of bandanas will go towards educating, recruiting and testing new donors onto the South African Bone Marrow Registry. The more donors we have, the faster these matches can be found and the more lives can be saved.

For more information on The Sunflower Fund and how to become a donor, please phone toll free 0800 12 10 82 or +27 21 701 0661 or visit www.sunflowerfund.org.za.

WATTSUP

The NWU Solar Car fills up on sunshine

The North West University (NWU) put up a good fight during the 2014 Sasol Solar Challenge, which takes place every second year. Not only does this challenge showcase the progress of research into sustainable transport, it also promotes advanced science, technologies and engineering. In 2012, the NWU brought home the title of joint winners, together with the Japanese team from Tokai. This year the NWU entered the Sasol Solar Challenge for a second time, prepared to defend their title.

This years' race, however, kicked off in bad weather – heavy winds and cloudy skies. Although this made the challenge more difficult, the NWU wasn't discouraged. On the sixth day the team had another setback when there were problems with the batteries, but the team managed to solve the problem and watched the Sirius X25 take off flawlessly on the next day. Throughout the race the NWU performed best of the South African teams, and maintained an overall third place on the leader board.

As this race draws competitors with expertise in science, technology and engineering, the other teams weren't that far behind. The NWU's runner up was UKZN, who made sure the 2014 Sasol Solar Challenge will be remembered for its nail-biting end, for on the very last day the NWU was defeated by UKZN. The NWU therefore ended the race in overall fourth place, which is still an enormous accomplishment to drive 2360,6 km (more than double what the team did in 2012) only on power from the sun. The team received prizes in the following categories:

- Furthest distance travelled by a South African per day in the history of the Sasol Solar Challenge;
- Team Communications award for excellent social media engagement.

SAIEE team visits NWU

The SAIEE team meets up with visiting parents to the regional finals at NWU. From left: Gerda Geyer, Francioette Fourie, Eulanie Fourie, Pat Naidoo & Stan Bridgens. Back: Coen Fourie Sr & Coen Fourie Jr.

The SAIEE team, comprising of Dr Pat Naidoo (President), Stan Bridgens (CEO), Gerda Geyer (Events Organiser) and Minx Avrabos (Managing Editor, **watt**now) were invited by North West University (NWU) to visit the School for Electrical, Electronic & Computer Engineering at the Potchefstroom Campus during their district finals of the SAIEE Student Project Competition.

Tinus van den Heever

The competition was extremely well organized and the projects world class.

The winners were as follows: The Prize of Engineering Excellence, and the SAIEE Project Competition Candidate who will represent NWU in Port Elizabeth, is Tinus van den Heever for his project, Mobile Video Live Streaming.

The prize for the "Most Innovative Product" went to Miquette Minnie for Development of an automated hand rehabilitation system for stroke victims. In the category for "Most marketable product", the prize went to Ruan Olwagen for his Energy Monitoring and Management System. The Safety Award went to Stephan Coetzee for Autonomous Window Cleaning Device.

A live-line repair story with a lesson on theft prevention for utilities

Lenasia residents woke on 6 June to no power in their area. The cause was the collapse of two 88 kV lattice towers after the sabotage and theft of critical supporting cross members. City Power was on site to address the residents and media who had gathered to obtain answers from the utility.

Quanta Services Africa, specialists in live lines and experience in the emergency restoration of power and breakdowns, was brought to site to restore power in the shortest possible time. The toppling of the towers affected the entire double circuit 88 kV power network of the Orlando/ Nancefield/Nirvana substations. The breakdown on the radial feed affected power across the whole of Lenasia.

Work began by ensuring the site which transversed a busy main road was safe for the public. The Johannesburg JMPD under the watchful eye of Inspector Raj directed traffic so ensure there was as little disruption as possible for Lenasia residents and so that work on the lines could continue safely and uninterrupted.

QSA began by erecting temporary wooden poles in the place of the two collapsed lattice towers then to transfer the conductor from the collapsed towers to the newly erected wooden poles using their specialized robotic arm technology.

Once this temporary installation was complete the power was restored. All within 48 hours after the initial reports surfaced regarding the blackout. Work then began on the permanent solution by laying out the foundations for two new transmission mono-pole structures to replace the damaged steel lattice towers. These structures have no extremities with a single steel shaft impervious to theft.

Due to the terrain, which consisted mostly of wetlands, specialised foundations for this area had to be designed and installed by the QSA team. The concrete bases of the mono-poles measured 70 cubic meters with 8 tons of re-enforced steel. All work was performed under energised conditions using specialised tools, equipment and technicians supplied by QSA. The whole project took 36 days to complete including 21 days for the curing of the foundation concrete. In addition this took place during the NUMSA strike action for wage negotiations which impacted on the delivery of materials.

According to the managing director of QSA, Fred Visser, *"These mono-poles would be the ideal solution to prevent sabotage of power line towers in all high theft areas around the country"*. He went on to say, *"The municipalities and utilities should include this in their planned maintenance budgets as a preventative measure. Replacing the lattice structures with the mono-poles can be done with no interruption to supply and at a fraction of the cost when using the right technology"*.

The residents of Lenasia were very happy to have their power restored and QSA would like to thank City Power, Structa Technology, Inspector Raj of the JMPD and the residents of Lenasia for their understanding and support during the entire project.

Eskom Honours winners of the 2014 Energy Efficient Lighting Design Competition

With South Africans facing the challenge of reducing electricity consumption, Eskom honoured the winners of a biennial competition aimed at efficient lighting design. The 2014 Eskom Energy Efficient Lighting Design Competition (EELDC) received a record number of school entries and the second highest number of overall entries in the history of the competition.

The competition received 506 entries from competitors who took on Eskom's challenge to integrate energy efficient light sources with outstanding design solutions. In order to draw on the full breadth and depth of talent and skill in South Africa, the Eskom EELDC was open to learners, students and professionals in the fields of architecture, interior design, lighting, engineering and to anyone else with a passion for designing energy efficient lighting. The primary goal of the competition was to demonstrate that efficient lighting technologies, such as fluorescent technology and LEDs can be used in ultramodern and attractive luminaires for residential lighting. It was also intended to encourage the design of creative and cost-effective luminaires, while promoting the use of compact fluorescent lamps (CFLs) and LEDs in the residential sector.

The total prize value was R200 000 and entrants competed in three categories:

CATEGORY A

Full-time students from tertiary institutions (universities, colleges, design centres and schools of design) in South Africa were invited to submit a luminaire design using an energy efficient light source, suitable for use in the home. The submission had to be innovative, original and unique, in other words, it should hot have been implemented before. The winners were Ashley Adami, Minette Martiz and Holly Hamlyn.

CATEGORY B

In Category B, graphic designers, architects, electrical engineers, product designers, researchers and anyone with a passion for design were invited to submit innovative energy efficient designs, systems or products, suitable for residential application. The submission had to be innovative, original and unique, in other words, it should hot have been implemented before. The winner was Stephen Pikus.

CATEGORY C

Promising young designers from secondary schools and FET or independent colleges, between the ages of 14 and 20, were invited to submit innovative energy innovative energy efficient designs, systems or products, suitable for residential application. The winner was Megan Laughton.

SPECIAL AWARD

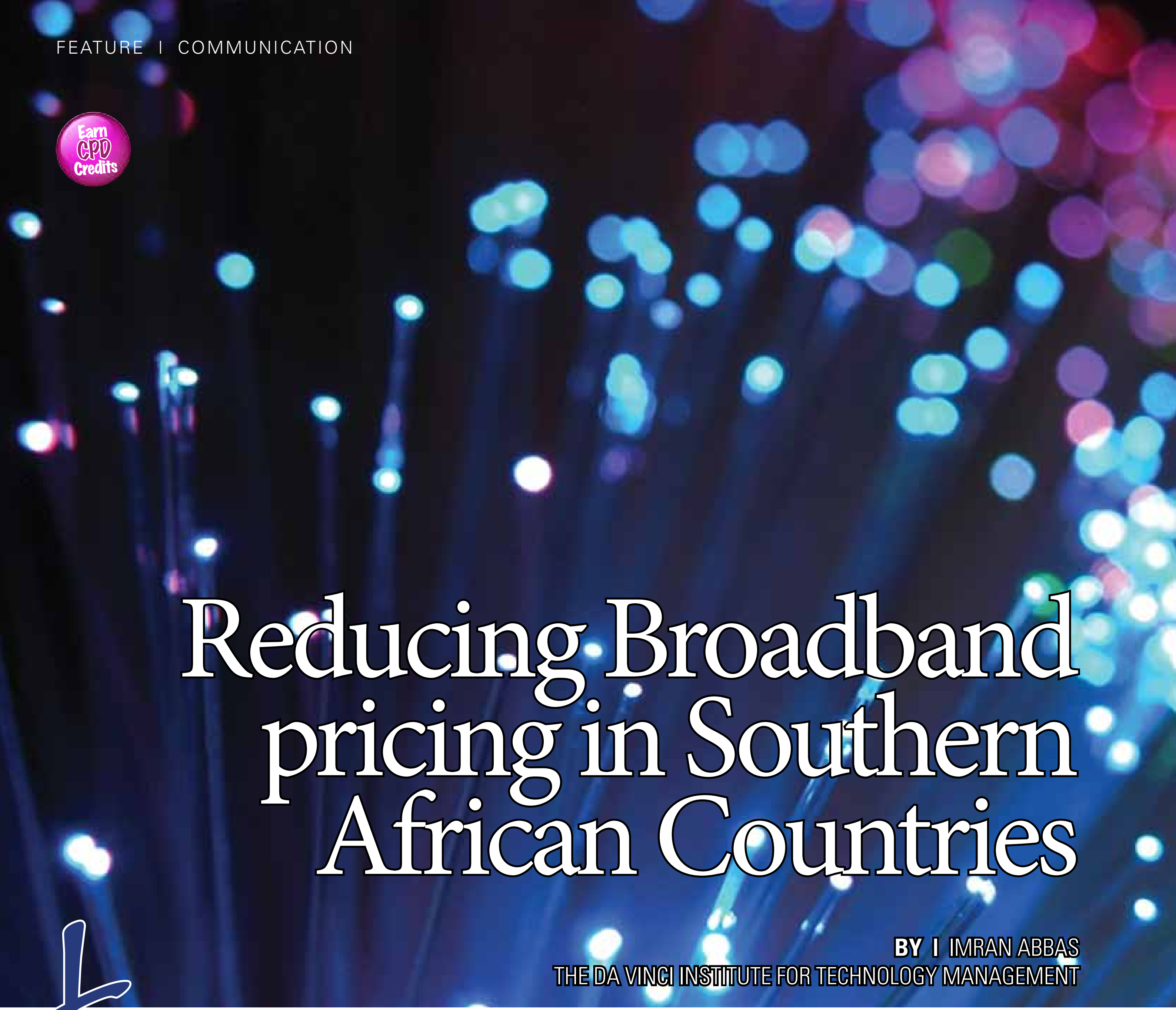
A special award was made to a promising Previously Disadvantaged Individual (PDI) designer who submitted an energy efficient lighting design, system or product, suitable for residential application. The submission had be innovative, original and unique, in other words, it should not have been implemented before. This award was a discretionary award and the winner was Esther Shaidi from Nelson Mandela Metropolitan University with Ubuntu Lamp.

Category B winner, Stephen Pikus.

Category C winner, Megan Laughton.

Special Award winner, Esther Shaidi.

Category A winner, Ashley Adami.



Reducing Broadband pricing in Southern African Countries

BY I IMRAN ABBAS
THE DA VINCI INSTITUTE FOR TECHNOLOGY MANAGEMENT

The goal is to reveal the prevailing pattern of Internet penetration and develop a theoretical model toward guidelines that address the problem. To do this, the research explores Internet penetration amongst South African university students, investigates core policy issues through conversations with policymakers, and examines important policy documents on Internet access. This research study locates Internet as a social resource that can facilitate social change in South Africa and enhance the capabilities of the citizens to participate effectively in society. The concept of digital citizenship - a citizenry that frequently applies and utilizes the potentials of the Internet - is applied, re-contextualized from its seminal use, and theoretically developed as an approach for universal Internet access in South Africa. Background of Study and Overview of Internet Access in South Africa There is very limited access to the Internet in South Africa. Recent data show that there is 10.10% penetration of household Internet access, and fixed broadband penetration is 1.48% (ABC, 2009, n.d.).

Until this recent data, household Internet stagnated around the 7.3% penetration as recorded by Statistics South Africa – Community Survey of 2007. The slow growth of household Internet and fixed broadband is problematic for a country that aspires to be "an advanced information society in which information and ICT tools are key drivers of economic and societal development" (Abrahams et al., 2007, pp. 136-153). Fixed broadband penetration is particularly significant considering the penetration rates in similar newly industrialized countries and advanced emerging economies such as South Africa. For example, Turkey has a penetration of 9.4%, Mexico 10.1% and Chile 10.2% (Africa & Middle East Telecomm News, 2011, n.d.). However, there is an increasing

This research tackles the problem of low and skewed penetration of Internet in South Africa. It engages this problem within the context of citizenship and the framework of social inequalities in South Africa.

growth in mobile broadband in South Africa, albeit with limited penetration. Currently, mobile broadband is 16.60% (Afrographique, 2011, n.d.).

The problem of low Internet penetration is complex, multifaceted, and it is a problem that hinders social, economic and political developments. It is a problem that resides within the context of seemingly entrenched societal inequalities, a problem that is exacerbated by many factors of economics, inappropriate policy framework, and many social ills of illiteracy and absence of social and cultural capital toward technology (Benjamin, 2001a, pp. 78-88). There is increasingly unprecedented growth in the use of the Internet for economic and social developments in many developed countries. It is an incontestable assertion that the Internet will become one of the main driving forces of the twenty-first century global economy. It is shaping political, economic and socio-cultural participations of people globally (Benjamin, 2001b, pp. 111-115).

While millions of people in developed regions of the world cruise on the ethereal platform of digital (increasingly broadband) highway, the rest of the world's population, mostly in developing regions, trudge along and reside on the fringe of the digital world. While many people in developed countries are 'digital citizens', because of their ability to use the Internet on a daily basis for economic activities, connect with a community for civic interests, and political participations, the rest of the world remains outside the electronic border of the digital world. Arguably the Internet is one of the most powerful media of information and communication in human history; it has opened massive opportunities for economic development across the globe. With Africa lagging behind in its social and economic developments, there are hopes that the information revolution may offer

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Africa a tremendous leverage to leapfrog into the future, and tap the benefits of new technologies for social, political and economic developments (Bellah et al., 1985, pp. 30-38).

However, if Africa does not seize this opportunity, African countries may further lag behind in socio-economic developments. The concept of 'digital divide' is normally used to describe this wide disparity in access to the Internet globally. It describes how the affluent countries of the OECD (Organization for Economic Co-operation Development) are increasingly reinforcing their lead in the new knowledge economy, while billions of the world's population largely in developing regions of the world lag behind due to limited access to Internet.

Thus in its basic interpretation, the 'digital divide' illustrates the significant separation between the 'haves' and the 'have-nots', between the information rich and information poor, increasingly along lines of race, socioeconomic status, education level, household type, and geographical location (Akpan-Obong, 2009, pp. 25-30).

LITERATURE REVIEW

In South Africa access to Internet is skewed by many social categorizations that reveal a pattern of digital inequalities. The data from a 2007 Household ICT (Information & Communication Technology) survey in South Africa by Research ICT Africa (RIA) show only 15% of 16 years and older population use the Internet and only 12.6% of them have email address. The data also reveal that 4.76% of households have home Internet and only 14.78% of households have home computer. A 2011 data from the International Telecommunications Union (ITU) also shows a low penetration rate with only 10.10% households having Internet access in South Africa. Beyond this obvious limited penetration of Internet in South Africa, the data raise critical sociological questions regarding who belongs to this select class of population with access and what does this reveal about social structures in South Africa? Specifically, it raises questions about technology access, policy issues, and social inequality in South Africa. One of the aims of this research study is to engage these sociological issues (BBC, 2008, n.d.).

In an annual global Broadband Quality Study (BQS) conducted by Oxford University and Universidad de Oviedo (Spain), South Africa's Broadband Quality Score (BQS) – measured using download, upload and latency values - is 21, significantly lower than the international average of 31. South Africa finished 60th out of the 66 countries surveyed, with a broadband quality assessment that is below today's application threshold. This means that South African Internet users are not able to take advantage of the most common web applications available on the Internet. Increasingly most Internet users in South Africa are connecting through mobile broadband, which uses High-Speed Downlink Packet Access (HSDPA, aka 3G) offered by mobile phone companies.

Mobile Internet connection is used as primary connection technology, unlike what entails in advanced countries, where wireless connection is usually used as a second or third layer of access, mostly for mobility. The arguments for mobile Internet connection in developing countries are understandable to some extents: the lack of fixed cable connection and the abundance of rural / remote areas without connection to telecom cables. The cost of building and extending communication infrastructure, such as telecom cables, leave many rural areas in developing countries unconnected to communication networks (Bell, 2008, pp. 20-25).

Although mobile broadband access in South Africa is easily available due to fierce competition amongst mobile operators, it has some disadvantages. The cost is extremely restrictive, especially for downloading multi-media contents, consumers pay per kilobits or megabits per second (kbps/mbps) and do not usually know how to calculate bit per seconds needed for certain Internet tasks (which is really unnecessary). As a consequence they do not benefit from an 'always-on' capability of fixed broadband Internet connection (Baudrillard, 2004, pp. 233-235).

The limited penetration of Internet implies that access is skewed according to certain demographics in the country. This research study focuses on an important population, the university students, and examines the pattern of Internet penetration amongst this group. Although most students have access to the Internet on campuses, the limited rates of Internet users, fixed and mobile broadband, and household Internet in South Africa are bound to have some serious effects on this relevant population group (Bailur, 2008, pp. 73-82).

Many policy interventions have been made by the South African government to address the skewed access to ICTs and foster the growth of the telecommunications sector. The process of reforming the telecommunication sector resulted in the Telecommunications Act of 1996, the

liberalization of the sector, and a universal access policy was adopted in providing access to millions of South Africans. Realizing the Internet/broadband access problem, the South African government issued a National Broadband Policy. The South African Broadband Policy of 2010 sets as its vision the achievement of a "universal access to Broadband by 2019 by ensuring that South Africans are able to access Broadband either individually, or as a household, subscribe to a Broadband service, or are able to access a Broadband service directly or indirectly at a private or public access point" (Beck & Lau, 2005, pp. 525-557). This research project examines the discourse of Internet and the framing of access problems and solutions in selected policies developed to address the low Internet penetration in South Africa. It can be argued that the failure of many access policies is a result of the narrow conceptual framing and adoption of 'digital divide' approach. The term denotes that the issue of digital inequality is a problem of physical access; consequently many policy agendas have been geared towards mere provision of access as the solution.

The resultant effect is that many of the access policies have failed. Many critics (Audet & d'Amboise, 2001, 45-50) have questioned this narrow conceptual adoption of 'digital divide' and have expanded and redefined the concept to reveal many other divides that play within the concept of a digital divide: skills, access, economic, opportunity and other divides.

METHODOLOGY

This research employs qualitative methods and tools to investigate the research problems and questions. It explores the elements identified in the theoretical framework of digital citizenship. These research tools are (1) interviews; (2) observations; (3) online and paper surveys; (4) an experiment to measure digital skills; (5) analysis of telecommunications policy documents; (6) analysis of government data sources, namely social statistical databases such as the Quarterly Labour Force Survey (QLFS) and census data provided by Statistics South Africa, the government agency that provides national statistical services for the country (Babbie, 2007, pp. 201-211).

The various research tools utilized in this study allow the researchers to test the theory of digital citizenship with its proposed elements, and concurrently allows for theory building. This implies that both deductive and inductive logics are followed at different phases of the research (Audet & d'Amboise, 2001, 45-50). An approach of this type allows the gathering of data to test and study the elements of digital citizenship, and also to observe and refine the data as they expand and integrate the various elements of the theoretical framework. The data collection process took place within a period of 10 months, starting in February 2010 through to November 2010.

FINDINGS

Coding and Categorization – Using the Grounded Theory Approach the five interviews were recorded using a digital audio recorder. I analyzed this transcribed data, field notes from observations, and comments from the survey using the process of coding and categorization. This process lead to developing a Grounded Theory Approach to research methodology. Grounded Theory, pioneered by (Akpan-Obong, 2009, pp. 25-30), is a research method that leads to the generation of theory from the research data. The first stage in this process is coding. This involves going through the transcriptions line-by-line, and identifying key concepts, phrases, and groups of texts as anchors to be coded. The second stage involves putting the codes into separate categories. (Afrographique, 2011, n.d.) elaborates on this approach and identifies three basic elements of grounded theory: concepts, categories and propositions. Conceptualizations of data is where theory begins to develop. Categories form the cornerstone of the Grounded Theory Approach, groupings of concepts to form categories is very important in this approach. Further propositions indicate generalized relationships between a category, its concepts and between distinct categories (Ayyad, 2009, pp. 148-153).

The five elements were identified as components of a digital citizenship framework, namely, citizenship rights, Internet access, digital skills, Internet use and technology policy. These concepts were used as the basic categories in which coded texts from the transcriptions, the observation notes, the policy documents and comments from the survey were put. The groups of relevant texts and phrases formed codes in which the relationship that exist between them informed the process of putting these codes in to categories.

However, in the true nature of a Grounded Theory Approach, many other sub -categories were developed from the codes which expanded the numbers of categories as well as deepen the significance of existing categories. For example phrases and texts that talk about Internet access were identified from the data as codes, such as cell phone access, mobile access,

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household access, public access, dial up access, broadband access, ADSL connections, definitions of forms of access and so forth. These disparate categories of access also involved various issues that are sub-categorized as policy concerns, opinions, social dynamics, demographical dynamics and so forth that affect each of the categories of access (Aufderheide, 1999, pp. 110-120).

RESULTS

This study identifies the limited access to the Internet in South Africa and sets out to investigate the pattern of Internet penetration whilst teasing out the issues that hinder a widespread access and use of the Internet in South Africa. The concept of digital citizenship is engaged as a citizenry with the fulfilled rights to regular and flexible access to the Internet, implicitly individual and household forms of access, the skills to apply Internet technology, and the regular use of Internet to participate in all spheres of society.

This concept is developed as a theoretical framework that comprises of five elements, namely citizenship rights, Internet access, digital skills, Internet use and effective policy framework that makes all the other elements possible. These elements are subsequently used as measures to study pattern of Internet penetration in South Africa through the population of university students. Theoretically, the study is engaged within the backdrop of citizenship and social inequalities in South Africa. Arguments are made that the generational pattern of inequalities in South Africa and current pattern of social inequalities impact technology diffusion in the country (APC, 2014, n.d.). Concurrently these inequalities are further exacerbated by limited and skewed access to the Internet in South Africa. As a result, citizenship is compromised for many people, they are deprived a relevant resource to participate in the social and economic spheres of the country.

CONCLUSION

Based on the findings in this study, I claim that most university students in South Africa are partially digitally connected, due to their limited access to the Internet, the limited use of the Internet and their inadequate skills in applying this technology. I argue that digital citizenship does not exist in South Africa at this time, at least amongst university students. This assertion is supported by findings from this research. In order to achieve a digital future in South Africa and aspire for digital citizenship, critical attention needs to be paid to addressing social inequalities in South Africa. In addition, the elements of digital citizenship discussed in this study need to be engaged effectively if South Africa hopes to empower its citizenry to participate in a digital society that portends the nature of 21st century.

I hope these studies impacts policy makers to engage issue of Internet penetration more deeply from a social, rights-based perspective rather than from a market approach, I believe this study contributes to the discussion of social inequalities and their implications on South Africans, and I believe this study contributes to literature on technology penetration in South Africa.

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The First Radar Echo

The 16th of December 1939 was in those days known as "Dingaan's Day" and, apart from being a public holiday in South Africa, it was the day on which the first radar signal was transmitted and reflected back to a receiver at the Bernard Price Institute of Geophysical Research (BPI) at the University of the Witwatersrand (Wits). This experimental system, originally called RDF, soon became known as "Radio Detection and Ranging" or simply "RADAR".

M A CROUCH I BSC (ELEC) ENG. (WITS) I FSAIEE. PRENG I PAST PRESIDENT SAIEE

It was also significant that only a few weeks prior to this, Britain and her allies declared war on Germany. Radar, first demonstrated in England in 1935, was to become vital in giving early warning of German bombers attacking London. The activities on the 16th December 1939 are aptly described by the following quote from Dr Brian Austin of Liverpool University and previously of Wits.

"On that day Schonland and Bozzoli, respectively the commanding officer and chief engineering officer of the Special Signals Services (SSS), went into Wits especially to do the final 'tune-up' of the JB0 radar transmitter and receiver that were on the point of working the day before (JB0 signified Johannesburg Mk0). The receiving antenna was on the roof of the Bernard Price Institute (BPI) building, while the transmitting antenna was on top of the Central Block. Boz was looking after the transmitter while Schonland watched the CRT screen of the receiver. Each had some sort of control over the direction in which the antennas above them were pointing and they used the university's telephone system to communicate between each other. After some fiddling about, to get the transmitter stable, Boz. told Schonland it was operating and so Schonland looked at the CRT while both rotated their antennas slowly in the same direction from a common starting point. Then Schonland shouted down the line that he was seeing an echo. Boz rushed over and they both saw it on the screen so they then shot onto the roof to see where the antennas were pointing. It turned out to be Northcliff Hill and its water tower. To check, they went back to the receiver and turned the antenna away and the signal disappeared. On returning it to the previous heading back came the echo. So it was real. And so the first radar target ever seen in South Africa was Northcliff Hill and that water tower."

Brigadier BFJ Schonland (Later Sir Basil Schonland)

The photographs in this presentation are mostly taken from a magnificent leather bound photograph album titled: "RADAR AT THE BERNARD PRICE INSTITUTE. WORLD WAR 2 1939-1945" compiled in 1945 by Major Bozzoli at the request of Brigadier Schonland.

The target Northcliff water tower which reflected the first echo.

Major GR Bozzoli
(Later Professor GR Bozzoli aka "Boz")

The experimental "breadboard" set, used for the first echo, was coded "JB0" for Johannesburg Mk0. This is no longer available whereas the first completed set was known as JB1. It consisted of a transmitter, a modulator, a receiver plus its CRT display and a power supply. All have survived and will soon be on display in the SAIEE museum in Johannesburg. *(See photos on page 20.)*

The operating frequency was 90 megacycles/second (MHz) and the peak power in the pulse was about 5 kilowatts. Judging from the echoes, received from the nearby hills and other objects, the performance seemed promising but it was felt that a better opinion could be formed only after a field test in a more realistic locality. Since the radar was intended for coastal defence arrangements were consequently made for field trials at the coast, and a testing party left Johannesburg in May 1940 for Avoca in Durban North where shipping and aircraft were successfully detected.

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SSS photo album: Prof GR Bozzoli
"South African RADAR in World War II": Peter Brain 1993. Sponsored by the SAIEE.

For further study refer to the biography of Sir Basil Schonland CBE, FRS by Dr Brian Austin of Liverpool University "Schonland-Scientist and Soldier", (Taylor and Francis), 2001. wn

The research team in Jan/Feb 1940 at the door of the BPI.
Back: JA Keiler, C Anderson, PG Gane and FJ Hewitt. Front: GR Bozzoli, BFJ Schonland and NH Roberts.

The First Radar Echo

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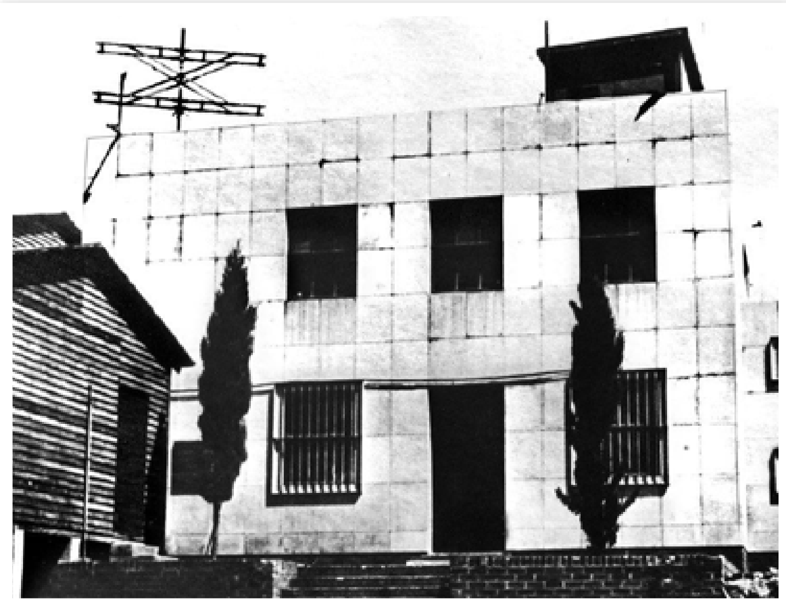
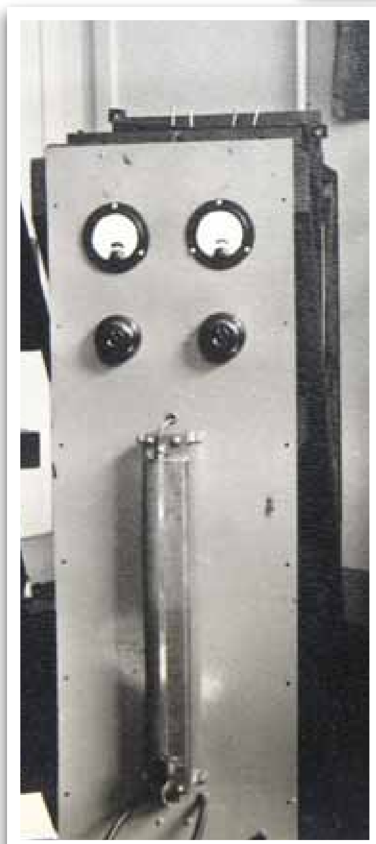


The old Bernard Price Institute of Geophysical Research at which the Radar work was carried out. This building was rebuilt in 1978.

JB1 Transmitter

Receiver rack



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Radar in World War II: *The South African contribution*

The science and engineering of radar are not much more than seventy-five years old and recently that brief history has been the subject of much examination. Although the contributions of the major powers towards the development and use of radar are well known, very little has been published about the pioneering work done in other countries, particularly those in the southern hemisphere. This paper describes the development and operational use of a radar system by the South Africans at the outbreak of World War II. The success of that major undertaking was due to the key people involved and their role in this saga is emphasised.

BY I B A AUSTIN I PR ENG I FSAIEE (RET)

B.F. J. Schonland, the driving force behind South Africa's radar developments.

The significant role played by radar in World War II is well known and the technical details have recently been extensively documented [1-3]. What is not generally known though is that radar equipment was designed and developed in great haste under a shroud of secrecy at the very early stages of the war in countries not usually associated with such activities. The impetus for this work came from an official disclosure, which Britain made early in 1939, to countries of her Commonwealth on the existence of a system of radio direction finding, or RDF as it was then known [3,4]. The text of the secret telegram sent on the 27th February 1939 from South Africa's High Commissioner in London, announcing this to his Department of Foreign Affairs in Pretoria, read [4]: *'Please inform Minister of Defence that Sir Kingsley Wood and Air Marshal Sir Cyril Newall disclosed to High Commissioner under promise of absolute secrecy certain technical developments which are of vital importance against air attack …'*

It went on to request that someone from South Africa, 'possessing the highest qualifications in physics', should be sent to London for a period of two to three months to become fully acquainted with these new principles. This would enable the technicians and operators to be trained to use the equipment as and when it became available[4,5].

As it transpired nobody was sent from South Africa; instead a Major Wilmott, a Union Defence Force (UDF) officer serving in London, was ordered to liaise with the British authorities. Meanwhile, Dr Ernest Marsden, the Secretary of the New Zealand Department of Scientific and Industrial Research, had been briefed on this new technique in England. It was arranged that he would in turn brief the South Africans on his return to New Zealand via Cape Town [4].

The choice of the South African scientist to meet Marsden was an inspired one. Professor B F J Schonland FRS (Fellow of the Royal Society) was Professor of Geophysics at the Bernard Price Institute of Geophysical Research (BPI) at the University of the Witwatersrand in Johannesburg. A brilliant physicist, as well as a man of immense drive and personality, Schonland was born in Grahamstown, graduated in physics at Rhodes University College there and then was a research student at Cambridge under Rutherford. He joined the British Army in 1915 and served with distinction as a signals officer in France throughout the First World War. On his return to South Africa he was a

Radar in World War II

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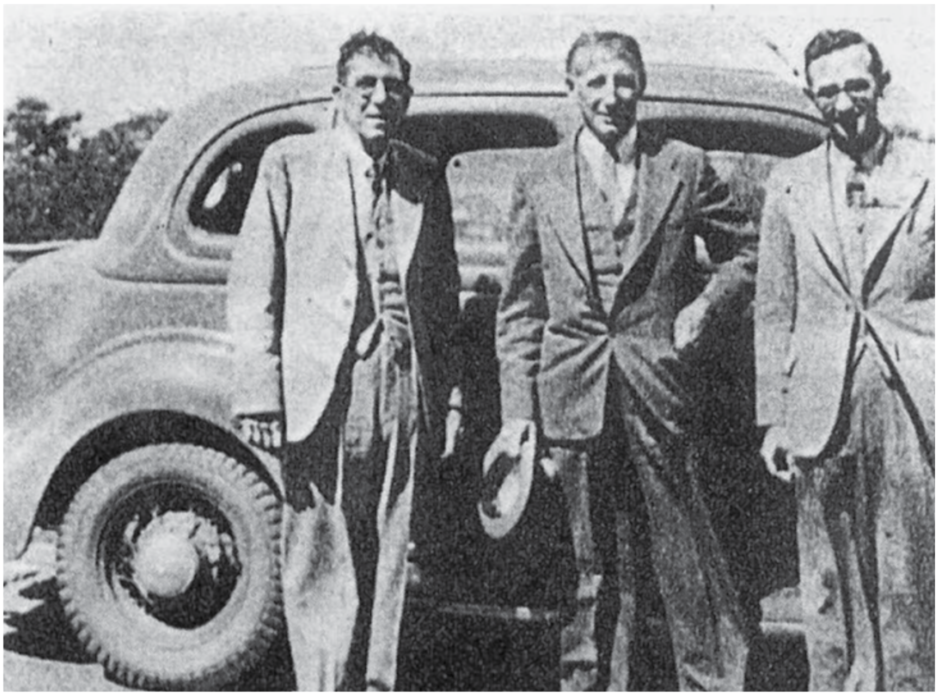

D.B. Hodges, B.F.J. schonland and W.E. Phillips in Dirban, September 1939.

pioneer in the study of lightning and it was with this background that he went to Cape Town to meet Marsden on 14th September 1939 [4]. They then travelled together by sea to Durban, a journey of some two to three days at that time, during which they had detailed discussions. Schonland made notes from the 'RDF Manual' which Marsden had brought with him from England. In Durban, Schonland enlisted the assistance of a close colleague, D B Hodges (Professor of Physics at the Natal University College), who, with W E Phillips (senior lecturer in electrical engineering), made glass photographic slides from Marsden's RDF Manual [4,6].

When Schonland returned to Johannesburg, his report caused the South African Prime Minister, General J.C. Smuts, to request that the resources of the BPI be devoted entirely to 'work of a special nature' for the duration of the war [7]. The obvious need for close co-operation with the military authorities meant that the project fell under the jurisdiction of the South African Corps of Signals (SACS). Schonland was officially authorised to proceed on 18th September 1939 [4]. It was envisaged that the first British radars, which were to be used for coastal defence, would only arrive in South Africa early in 1940. Therefore, in order for the scientists to gain some familiarity and experience with the principles involved, a South African radar would be designed and constructed based on Schonland's notes and the precious glass photographic slides.

BACKGROUND

At this point it is useful to examine the state of radar development as it was at this stage of the war in England [1,3]. This will help to understand the thought processes of Schonland and his team when they commenced their design. It would seem reasonable to assume that those notes and slides from Marsden's RDF Manual would have contained the essence of this information. Unfortunately, few of these artefacts have survived the secrecy of war for this to be confirmed.

The Chain Home (CH) radar in England had been developed as an early warning system, following Watson-Watt's famous Daventry experiment in February 1935. It was operational around the south and east coasts of the country by late 1938. Of particular importance, when the specification of the South African radar is examined, is the fact that all CH radars operated on the so-called flood-lighting principle. This is a fixed region in front of the stationary transmitting antenna was illuminated by the radar energy.

Any target within that area of space would cause a reflection of energy from which a goniometer system, associated with a separate receiving antenna, could determine the target's bearing. Noteworthy too is the frequency range within which the CH radars operated. This was from 22 to 27 MHz [1,3]. The benefits of using both a rotating beam to scan an area, as well as a higher frequency for better target resolution with a given antenna size, had been considered from the outset in 1935. The need for a proven and reliable radar in the shortest possible time was the overriding reason for using the low-frequency, fixed-beam approach [3]. It should be noted too that the CH radar was not capable of detecting low-flying aircraft since its antenna system produced very little radiation below about 2 degrees of elevation. Hence it was also ineffective against shipping.

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Radar in World War II

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To overcome this problem the development commenced in Britain, late in 1938, of a Coast Defence (CD) radar. This system operated at 200 MHz and used a four-tier array of horizontal, full-wave dipoles, with five dipoles per tier spaced a distance of one-eighth of a wave length in front of a wire mesh reflector. During development both Yagi and Sterba-type antenna arrays had also been used with this radar. Initially separate antennas were used on the transmitter and the receiver. Subsequently though, a common antenna with transmit-receive (TR) switching was introduced when this equipment came into service as the Chain Home Low or CHL radar [3].

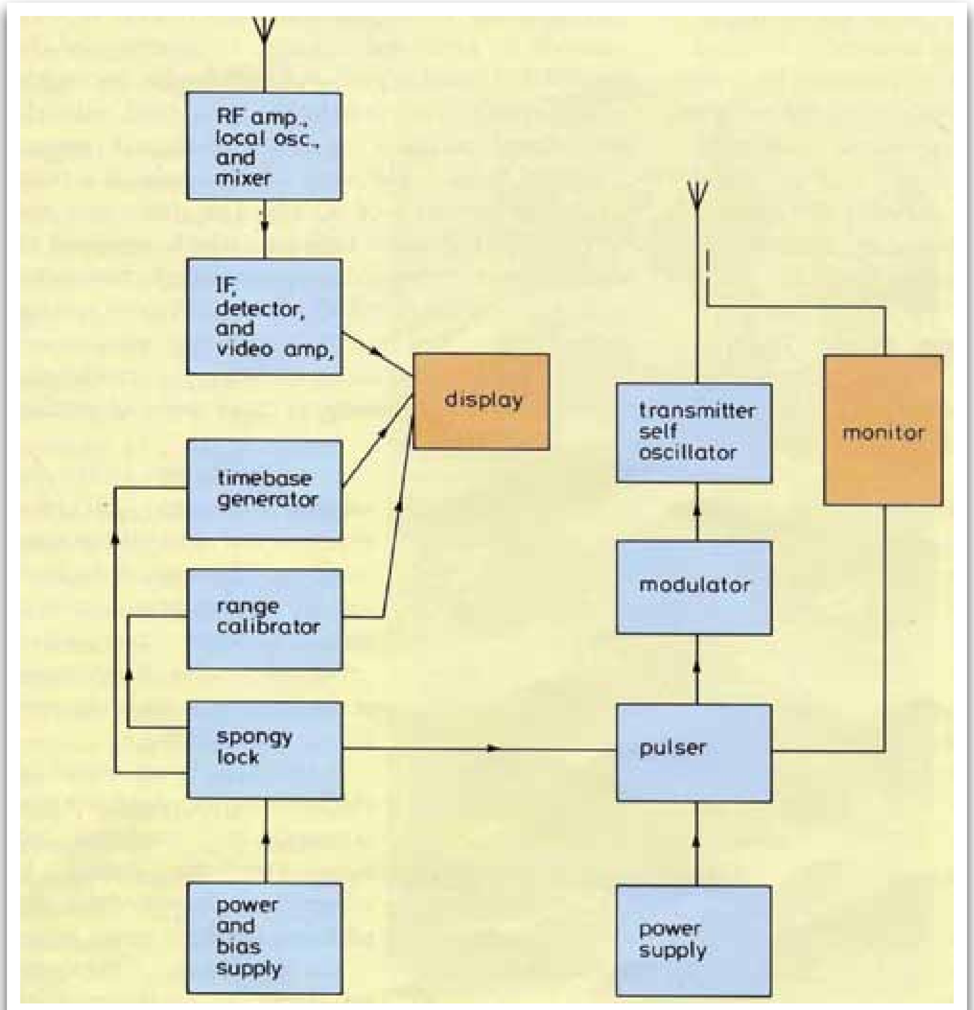
The effects of antenna polarisation had been examined in experiments at Orford Ness, Suffolk, UK, as early as 1936. The orientation of the aircraft suggested that they would behave predominantly as horizontally polarised scatterers of radar energy. The experiments showed, though, that the radar range obtained was not a function of polarisation, but that considerably more ground and sea clutter occurred with vertical polarisation. Thus the horizontal mode was chosen for these early British radars.

Finally, the modulator circuits in the CH radar were designed to produce pulse lengths from 5 to 45 microseconds at pulse repetition frequencies of 50, 25 or 12.5 Hz. The time-base (which controlled the horizontal deflection of the display and its range markers, and which also triggered the transmitter) was loosely locked to a preset point on the 50 Hz mains supply waveform by what was known as a 'spongy lock' [3]. This ensured that small frequency and amplitude variations in the supply were absorbed without affecting the lock. Whereas this was vital to the operation of a multi-station CH system it was to prove a major problem in the South African radar in the field, as we shall see.

THE SOUTH AFRICAN RADAR

With this as the presumed state of his knowledge of British radar, Schonland assembled his design team to commence work on producing South Africa's own radar. The members were GR Bozzoli from the University of the Witwatersrand, WE Phillips from the Natal University College, NH Roberts from the University of Cape Town – all senior lecturers in Electrical Engineering – and PG Gane, a geophysicist and senior research officer at the BPI. Clear areas of design responsibility were assigned to each and these were as follows: Schonland, as well as maintaining overall administrative control, designed the antenna system; Bozzoli designed the RF stages and Phillips the IF (Intermediate Frequency) stages of the receiver; Roberts produced the display unit and the time-base system while Gane designed the transmitter [4].

A frequency of 90 MHz was used. Why this should have been chosen has been a subject of some conjecture. Bearing in mind that the application of radar in South Africa at this stage of the war was for coastal defence



Block Diagram of the JB Radar.

against possible hostile shipping as well as the possibility of low-flying Japanese aircraft. A radar of this type was expected to arrive in the country from England only in early 1940 [4,6]. These sets operated at 200 MHz and were semi-tropicalised versions of the CHL known as the COL, or Chain Overseas Low, radar.

In order to gain some experience of the undoubtedly novel techniques involved, Schonland decided to use the time available to construct his own radar. The decision was made to use the highest frequency possible with the components available to them. The main source of these, such as high-frequency valves, was the local amateur radio supplier in Johannesburg. Many of the circuit, antenna and transmission line ideas were gleaned from The Radio Amateur's Handbook [5,8]. Fortunately, at that time, RCA 'acorn' valves were becoming available.

The type 956 pentode and 955 triode were capable of operation at frequencies above 300 MHz as amplifiers, mixers and oscillators in receivers. The most suitable transmitter valve available was the Eimac 250TH, a triode with an anode dissipation of 250W and a maximum quoted operating frequency, at full rating, of 40 MHz. Somewhat later the Gammatron 354E triode with its higher dissipation rating of 150W, at a maximum frequency of 30 MHz, was used [8].

Clearly, therefore, it was the transmitter power amplifier which imposed the upper frequency limitation on this first experimental radar system.

Bozzoli's RF stage used two of the 956 pentodes as amplifiers followed by another as the mixer with a 955 triode as the local oscillator. The IF amplifier, which Phillips designed drew heavily on the techniques used in television receivers of the day. Both RF and IF circuits were of conventional design. However, the time-base generator designed by Roberts was a complicated system which used a thyratron, with the same 'spongy lock' technique as in the CH radar to synchronise the time-base, range calibrator and transmitter pulser, each with its own manually-set phase shifter.

Northcliff Hill and water tower: the first radar target in South Africa.

Gane's transmitter used the two 250TH valves in push-pull with Lecher lines made of copper tubing in a tuned-plate tuned-grid, relatively low-voltage, oscillator. Its output, initially, was unknown but was estimated to be some hundreds of watts of peak power with a 20 microsecond pulse at a pulse repetition frequency of 50 Hz. The transmitter and receiver used separate antennas consisting of three pairs of centre-fed, one wavelength, horizontal elements, stacked vertically with halfwave spacing and all fed in phase by 600 ohm open-wire transmission line. Behind them, at about an eighth of a wavelength, was a reflector consisting of three pairs of similar, parasitic elements [8].

By December 1939 the various sections of this experimental radar system were operating. However, a lack of suitable test equipment, such as an oscilloscope and signal generator capable of operating at this high frequency, made rigorous calibration and testing impossible [5].

A test flight by an aircraft of the South African Air Force was arranged but produced no signals on the display. It subsequently transpired that the pilot had not been made aware of the significance of his route, no doubt in the interests of security, and so had flown one of his own choosing rather than that which had been carefully selected for him! Soon afterwards, an attempt to use a target consisting of a mesh of copper wires suspended beneath hydrogen-filled balloons, and launched from about 10 km from the BPI, was also unsuccessful. Then it happened.

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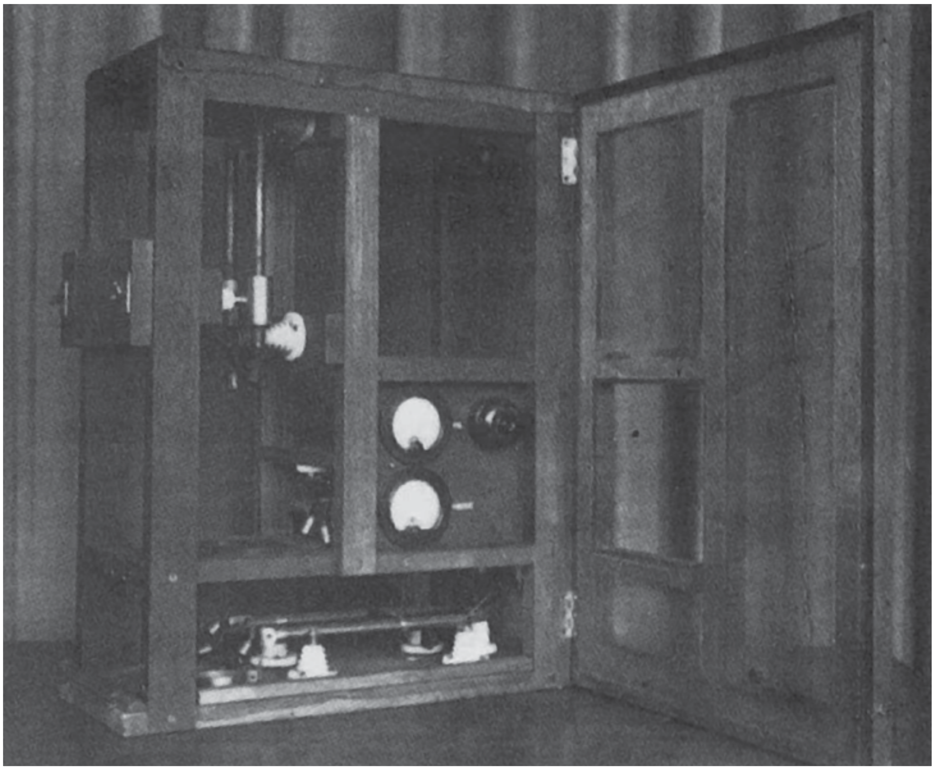

JB1 radar transmitter without its valves.

On 16th December 1939, after further work on the equipment, the first radar echo was received [4,5]. The 'target', quite by chance, was a well-known Johannesburg landmark known as the Northcliff Water Tower at a distance of about 8km from the BPI. With a target and a fixed one at that on which to adjust the radar, further tuning was possible and soon strong echoes were received from a range of mountains 100 km away.

The first South African designed radar was called the JB0. It was the product of Schonland's vision and drive and of the design skills and ingenuity of his team of Bozzoli, Gane, Phillips and Roberts. Remarkably, it was operating within three months of Schonland's meeting with Marsden.

In January 1940 the team was joined by a young physics graduate, FJ Hewitt, from Schonland's alma mater, originally recruited by him some time before to work on lightning research. Hewitt was destined to become a key member of the team. By this time it had become clear that the arrival of any British equipment in South Africa would be delayed indefinitely. So in March 1940, the army's Director of Signals gave permission for the design and development of an improved, operational version of this radar to commence in earnest [4,6]. Hewitt was assigned to assist Gane with the transmitter and also designed a monitor for it, while Bozzoli re-designed the receiver's IF amplifier in the light of the test results achieved by that stage. He simplified it considerably by using just three type-1852 pentodes in a stagger-tuned circuit which gave a 1 MHz bandwidth at an IF of about 9 MHz.

The BPI's first operational radar was called the JB1 and it was tested in its actual role over the sea at Avoca north of Durban in July 1940. The transmitter and receiver were equipped with their own antennas which were linked by a 16 m steel cable and bicycle chain arrangement allowing simultaneous rotation by hand. These first coastal tests were most successful. Trials using aircraft, as well as ships, were seen on the cathode ray tube. The radar was found to have an effective range of about 50 km, with some targets actually beyond the optical horizon due to the phenomenon of super-refraction [5,10]. There was also a mobile version of the radar. Again the transmitter and receiver were separated from each other with the transmitter in one vehicle and the receiver in the other. The antenna used on each was soon to become the standard approach for all JB installations. It was known as a Sterba array and will be described later. At this stage it was decided that the members of the special radar development team would form into a military unit. They therefore became members of the South African Corps of Signals (SACS) [4], with Major Schonland as the CO, the rank he had held in 1919 [9].

ACTIVE SERVICE IN EAST AFRICA

By mid 1940 operational requirements in the East African campaign, in the form of a threat from Italian air attack and the non-availability of British radar for that theatre, caused the Chief of the General Staff to order the deployment of the JB1 radar to a site north of Mombasa in Kenya. Schonland flew up while Captain Gane and Lieutenant Hewitt moved a JB1 by sea from Durban.

The equipment was sited at Mambrui, about 160 km north of Mombasa, on 27th July 1940 and it was operational by 1st of August, supporting the anti-aircraft guns manned by the 1st AA Brigade [5]. This installation was followed soon after by four others in the vicinity of Mombasa with the last being deployed on 16th February 1941 [4]. This first use of the JB1 in anger, as it were, was not without its problems. One of the first of these occurred when the radar was powered from a diesel generator with an inherently unstable supply frequency. The 'spongy lock' was incapable of operating under such conditions which caused the range calibrator to vary wildly. This problem forced Hewitt to do some drastic re-design in the field to overcome it [5,10].

No high-altitude calibration flights could be arranged therefore the performance of the radar could only be assessed by observing a scheduled flight by an aged aircraft which was tracked daily as it flew along the coast at a height of 150 m for about 35 km. However, when two Italian bombers strayed further south than usual after bombing an airstrip near Malindi, the JB1 tracked them going out to sea for some 55 km, not having detected their approach because of the limited coverage of the antenna. The problem was later solved when a fully rotatable, dual antenna system, developed by Bozzoli in Johannesburg, was installed. However, soon breaking feeder cables became the problem! Gane's original low-voltage transmitter performed very well when set up by its designer. However, other users reported great difficulty with it and so Bozzoli re-designed it to operate at a higher voltage and it was then much more docile. Much of the original JB0 had since been re-designed by Bozzoli at the BPI and the success which the radar now achieved was a tribute to his engineering skill [5].

By this time the specific role being played in the war effort by this group of engineers, scientists and their supporting technicians and operators had been recognised with their designation, within the South African Corps of Signals, as the Special Signals Services or SSS as they were subsequently known. Major DB Hodges had by now been appointed as Schonland's second in command and proceeded to recruit young graduates for special training in this new field of radar. Meanwhile a programme of construction of new equipment commenced under Major Bozzoli at the BPI [4].

THE MIDDLE EAST

In December 1940 Schonland flew to Cairo for discussions with the RAF Chief Radio Officer in the Middle East, Wing Commander JA Tester [4]. Evidently there was a requirement in Crete, Greece, Aden and elsewhere for 'a more portable type of equipment … in compact units such as might go on the back of a mule' [11]! Captain Gane was ordered to take one of the JB1 radars to Cairo for trails in February 1941 and it was reported that it performed well when used by RAF operators, though quite in what role and with what mode of transport is not clear [4].

The Suez Canal was a prime target for German and Italian air raids and, therefore, there was a need to set up radar cover along the Sinai coast. In March 1941 Schonland gone to Enganf to attempt to improve the supply of British radars and spares to Soith Africa. During that time Hodges assu,ed command of SSS.

The intensity of the East African campaign was declining so Hodges was ordered to move the rest of the JB1 radars from East Africa to the Middle East after Hewitt had surveyed suitable sites with the RAF [10]. The JB1s were all in place by 18th

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June 1941. They were established along the northern Sinai coast at El Arish, Rafah and El Midan and were operational by August in support of the RAF installations in the area [4].

The South African equipment underwent its baptism of fire over the period of the 4th and 5th September 1941. They were required to provide complete cover for the region for an unbroken 27 hour period while the antenna masts at the RAF radar stations were refurbished. Inspite of the JBI's homemade appearance, they performed so well plotting hostile bombers out to 120km that the entire RAF network of MRU (Mobile Radar Unit) 40 MHz radars at El Arish and 60 MHz GL (Gun Laying) radars at El Midan were withdrawn by October 1941 [4,8]. The SSS covered that coastline with a small filter room at El Arish until 13th August 1942 when, finally, all personnel were withdrawn for coastal defence duties back home. Their JB radars were then taken over by the RAF.

COASTAL DEFENCE AROUND SOUTH AFRICA

The first British radars in fact arrived in South Africa on 15th May 1940 [4]. Some, though, were damaged and there were no spare parts, hence Schonland's visit to England, in March 1941. In order to provide adequate radar cover against enemy aircraft and ships around South Africa's 3000 km coastline and to provide replacements for the battle-weary JB1s in the Middle East, a further 25 JB sets were ordered from the BPI on 12th June 1941 [4]. These new radars were known as the JB3 and operated at the slightly higher frequency of 120 MHz using two 354E triodes in the transmitter [8]. A single antenna served both the transmitter and receiver and was the outcome of much work done at the BPI, to develop an effective TR system which ultimately used two spark gaps in a transmission line duplexer as in the CHL radar. Rotation through 360 degrees was now also possible because an inductive coupler, which consisted of two 200 mm copper rings (about 25 mm apart), had been inserted into a rigid section of the feedline. In addition, a Sterba array plus reflector had replaced the original stacked dipole antenna configuration. It became the standard antenna for all JB3 radars deployed around the coast of South Africa. Somewhat surprisingly in the light of all this upgrading of the system, the spongy lock was retained even though there was no operational need for it. The display, though, was improved and the range calibrator provided markers at '1000 yard' and '10 000 yard' intervals.

These new radars had a range of 150km for bomber aircraft and 30 km for small ships. Their bearing accuracy was about 1 or 2 degrees with a range accuracy of a few hundred metres. Twelve of these JB3s were installed around the South African coast and they worked into filter rooms in Cape Town, Port Elizabeth and Durban [4]. By far the largest percentage of radar operators at these stations were female members of the SSS, especially recruited from the universities for this task. Although the specific reason for the radar's existence was to provide surveillance in the event of enemy activity there was an unexpected bonus as well. The coastline of southern Africa is notoriously dangerous for shipping, and in wartime it was made doubly so by the radio silence of the usual navigation beacons. The JB radars assisted in the saving of many thousands of tonnes of shipping by alerting the harbour authorities when vessels were observed to be clearly steering dangerous courses [4,10].

The expansion of the Special Signals Services (SSS) to cope with the coastal defence requirements was virtually the first task confronting Lt Col Hodges when he returned to South Africa from the Middle East in November 1941 as its new commanding officer with Lt Col Schonland having been retained in England for other duties at the request of the Ministry of Supply. From a position in December 1941 of 71 officers and 724 other ranks, with no women, the projected numbers approved by the Adjutant General in November 1942 had risen to 317 officers, of whom 91 were to be women, with 3767 other ranks, 737 being women. In fact these numbers were never actually reached. The peak occurred in December 1944 with 145 officers (28 women) and 1476 other ranks (507 women) were serving in the SSS [4]. The exacting but frequently tedious task of monitoring the screens of the cathode ray tubes was done with great skill by these women and made all the more difficult, by the absolute secrecy to which they were sworn. They served from late 1942 until the end of hostilities and were under the command of Major Nancy Blue, now commemorated by a special plaque in present BPI building at the University of the Witwatersrand [12].

In April 1942 the promised British (and some American) radar equipment started to arrive in South Africa and finally replaced the JB-series that had rendered such outstanding service by the end of 1943. Two Royal Navy type-273 (3 GHz) radars were installed on Signal Hill and at Cape Point, near Cape Town, early in 1943 after Schonland had used his not inconsiderable influence in England to persuade the RN to make them available [5,10]. These radars had been developed specifically for defence against surfaced submarines and they


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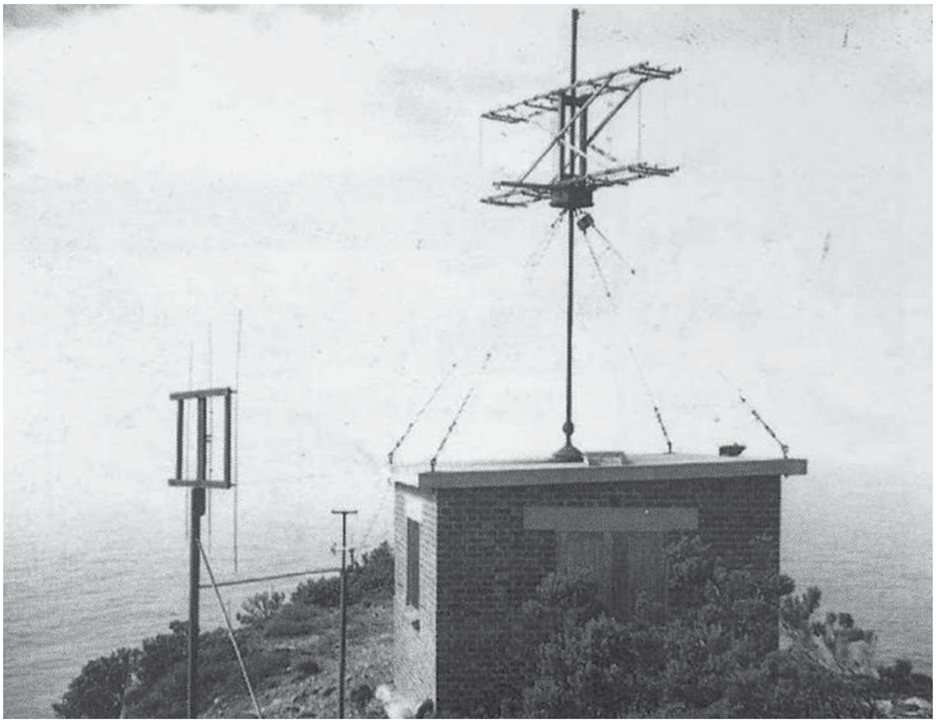

JB3 Sterba antenna array at the Cape Point coastal site.

performed excellently in tracking shipping from their ideal vantage points, thus greatly strengthening the coverage previously provided by the JB radars.

With the invasion of Italy, two SACS Field Radar Sections (FRSs), which had been training at No.3 Signal Depot at Helwan in Egypt, left for Taranto. No. 70 FRS manned the AMES 899 radar station at San Fernando near Naples on 1st August 1944 and was followed on 3rd October 1944 by No.71 FRS who took over the AMES 8044 station at Ripalto from the RAF [4]. They served throughout the campaign in Italy during which they also operated the RAF Ground Control Interception (GCI) radars in support of the Allied air forces.

THE PERSONALITIES

Before closing this account of the South African contribution to wartime radar it is worth commenting on the subsequent careers of some of the personalities who played such a major part in it. As mentioned, Schonland went to England in March 1941. There he was soon seconded to the Army Operational Research Group (AORG) within the Air Defence Research and Development Establishment (ADRDE) at Petersham, in the rank of Colonel. This group was responsible for a significant improvement in the accuracy of radar-controlled anti-aircraft guns [3,10].

It was here too, that Schonland trained the Royal Engineers sappers who took part in the famous Bruneval Raid, in February 1942, during with they captured a German Würzburg radar from its cliff top site overlooking the English Channel. Once returned to England that captured radar set yielded considerable scientific intelligence [9]. In 1944, Schonland, now a Brigadier, became Scientific Adviser to General Montgomery's 21 Army Group. At the end of 1944, at the behest of his Prime Minister, Field Marshal Smuts, Schonland returned to South Africa to begin work on setting up the Council for Scientific and Industrial Research (CSIR). He served as its first President from 1945 until 1951. In 1954, after a brief period back at the BPI, he returned to England to become Deputy Director of the Atomic Energy Research Establishment (AERE) in Harwell, and he then succeeded Sir John Cockcroft as its Director in 1958. Schonland was knighted for his services in 1960 and retired as Director of the Research Group of the AERE in 1961. In 1962 he received the Faraday Medal of the IEE, one of its most prestigious awards.

Professor Bozolli became head of the Department of Electrical Engineering at the University of the Witwatersrand and subsequently Vice-Chancellor of the university in 1969. He also served as President of the South African Institute of Electrical Engineers (SAIEE). Dr Hewitt joined the CSIR immediately after the war and set up the Telecommunications Research Laboratory (TRL) which later became the National Institute of Telecommunications Research (NITR). Subsequently he was appointed Vice-President of the CSIR. Professor Phillips went on to become Deputy Vice-Chancellor of the University of Natal.

Two members of the SSS whose names have not yet been mentioned are T L Wadley and J A Fejer. Both played important parts in the later stages of the war, particularly when airborne radar was introduced. Like so many other ex-members of this group they joined the TRL after the war and went on to make considerable names for themselves. Dr Wadley produced one of the first analytical studies of the feasibility of radio communications underground in mines. Then, in the early 1950s, he developed a system of RF frequency-generation based on an ingenious use of a 1 MHz crystal-controlled oscillator, interpolation oscillators and mixers which became known as the Wadley triple mix system. It provided an unprecedented degree of frequency stability, and resetability, in a continuously tuneable system. Subsequently Wadley used the technique to develop what became the most advanced high-frequency radio receiver in the world at the time. It was manufactured under licence to the CSIR by the British company Racal. Probably Wadley's most significant contribution to the electronic engineering art was his invention of a form of distance measurement based not on conventional radar but rather on a master-slave system in which accurate measurement of phase provided an unprecedented degree of range accuracy. This equipment was subsequently manufactured in Cape Town as the Tellurometer.

In December 1957 Jules Fejer published, in Nature magazine, the first prediction of the lifetimes of the world's first artificial satellite, Sputnik 1 and its carrier rocket by using their orbital orbital characteristics that had been established within two days of the satellite's launch by the former SSS group at the TRL. Fejer subsequently emigrated, first to Canada, and then to the USA where he became one of the world's leading experts on ionospheric physics.

CONCLUSION

This paper has presented some of the details of a little-known story of great enterprise and initiative in the development and use of radar during World War II. It represents, along with original work done in Australia, Canada and New Zealand, a small but by no means insignificant Commonwealth contribution to the Allied cause in the war. The key contributions made by this small group of South African engineers and scientists in designing, constructing and operating their own radar, virtually independently of the work done elsewhere has been emphasized.

ACKNOWLEDGEMENT

Considerable assistance was provided by Dr F J Hewitt in the preparation of this paper and also by Miss Joan Biddles, archivist at the University of the Witwatersrand. In addition, Mrs Pam Stevens (one of those SSS operators) provided photographic material and opened up the communications channels. Mr Pat Rose, another former SSS member, supplied the circuit diagrams from a 1942 SSS radar course. The author is grateful to the SAIEE for permission to use their photographic material and to Dr S M Sara for the photograph of Northcliff Hill and its water tower.

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SA RADAR IN WORLD WAR II

Earn CPD Credits

"the outside story"

I have chosen the title "the outside story" firstly because I was not in at the very beginning - as was Prof Bozzoli, and secondly because for most of the war I was outside South Africa and not closely in touch with the Unit as a whole. The records of the outside story seem to be even sparser than the local story. Much of what I have to say will be limited to my own experiences.

BY I F.J. HEWITT

Seeing that I did not join the team until just after the famous "first echo" had been received I can say a few things about the team which modesty did not allow Boz to say. It was no mean achievement by any standard. In a couple of months the team developed from scratch a 20 microsecond pulse transmitter at 90 Mc/s of about 5kw, a wide band receiver and associated display with range calibrator etc and a rotatable aerial system.

Easy stuff now but try and do it with No VHF signal generator NO power measuring equipment and NO adequate cathode ray oscilloscope. The only components available were those that could be purchased in the radio shops catering for the radio amateur. And yet the team got their first echo from Northcliff in late December 1939. The first echo was from a water tower, the set was not an operational one.

To head the team, Schonland was an inspired choice. One of the leading South African scientists of all time, he matriculated at the age of 14, received his first degree from Rhodes in physics, was a junior signals officer in France in World War I and by 1939 was world famous for his work on lightning discharge. The Bernard Price Institute for Geophysical Research reflected Dr Bernard Price's esteem for Schonland's ability. He had the drive, the imagination and the personality necessary to work with military who held the purse strings. I thought everyone knew all this until two weeks ago in the Cape when a young engineer asked me to spell Schonland's name as he had never heard of it.

I joined the team at the BPI on 2 January 1940, I was a physics graduate and had been going to the BPI anyway. I of course missed the excitement of the first echo and believe it or not it was a week before I was told what in fact was being done. Boz it

was who introduced it all to me and what a revelation it proved to be.

In the initial stage each member had been responsible for a particular element of the system that produced the first echo - but after I had joined and we started making a set for the field it was Boz who completely redesigned the IF amplifier, greatly simplifying it.

A few months later he did the same to the transmitter. Thus as the RF amplifier/mixer had been Boz's original responsibility all the critical signal channel elements of the eventual JB were Boz's design.

I must reluctantly admit that at that time my imagination failed completely to suggest to me that this new RDF with such potential for defence would in the course of a few years find offensive applications of shattering effect.

We spent the next four months refining and developing a station for deployment in the field, the air defence of Mombasa becoming the first priority with the lst Div destined to go to Kenya and Abyssinia through Mombasa. We were all civilians at that time. Schonland, Gane and I were hastily put into uniform and alone with an ex Post Office technician S/Sgt Anderson we went to Natal for some hurried tests at Avoca north of Durban. Besides our few test aircraft we saw lots of ships and experienced superrefraction for the first time, many echoes from beyond the horizon and a convoy in the roadstead. Next morning, Schonland was so elated with these results that he took us to dinner at the Cumberland. It was the weather he really had to thank.

My guess is that it was these impressive results on shipping even without superrefraction that led to the decision to deploy JB radars around the whole coast of South Africa as soon as possible.

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On June 16 1940 Gane Anderson and I sailed with part of the lst Div, the Dukes, the Natal Carbineers and the lst Transvaal Scottish. It was all a bit hilarious. Gane was deaf, stuttered badly and had had no military training at all. I at least had done three years ACF ending up as a corporal. Rumour had it we travelled on the wrong ship. What is certain is that when we got to Mombasa, despite much protest from Gane, we were put on the troop train to Nairobi and had, of course, to catch the first train back. To give the authorities their due they were very touchy about the Italian air force a little to the north and wanted the troops out of the harbour area as soon as possible.

In Mombasa we were attached to the lst Anti-Aircraft Brigade - equipped with one battery of semi obsolete 3 inch guns and two batteries of twin Lewises. The O C was that dynamic character S.H. Jeffrey, who later headed the Tellurometer company in Cape Town, a direct result of this association. After the usual delays we moved up to Mambrui a dirty Arab village north of Malindi the now famous pleasure resort, and set up our station. Schonland had flown up and joined us. Less than 10 miles away was the barbed wire, the only barrier between us and Italian occupied Somaliland. Schonland had been worried before we left about circuit diagrams. I had refused to take any with me and when he queried this I told him I knew the position and value of every circuit component. He tried me on a few and decided that I did. I had made absolutely no conscious effort to do this. I had wired up all the chasses with the exception of the RF and IF which had been done by Boz.

We had never run on a diesel generator before and the very considerable supply frequency wobble played havoc with the system; the components of which were all phased from a sine wave loosely locked to the supply mains. In the end I did a drastic redesign of the range calibrator and we were on the air. Schonland was greatly relieved and I think this was the basis of my future relationship with him.

The station operated at Mambrui for some six months or more. We had five signallers drafted to us and with them we worked into the SAAF at Mombasa by radio. We just could not get high flying aircraft for test flights and did no operational tests with the Hurricanes with which the SAAF was equipped. At that time we were really thinking only of early warning, - get some planes off the ground - and not controlled interception. About all we saw was the morning and evening flight of an ex SAA Junkers along the coast at about 500 ft and we saw these to, at best, say 20 miles. We had a good system of identification - if there were two or more they must be hostile!

Our best performance was on two Italian bombers, presumably flying as high and as fast as they could. It was the only time I think that they ever came that far south. There had been a rumour about this possibility and two Gladiators had been moved to Malindi airfield, and a telephone line to us was installed. They stayed for a fortnight and were then withdrawn. Two days later we heard the bombs explode on the airfield 10 miles away to the south. We had seen nothing but within a couple of minutes we knew why. They were flying straight out to sea and we tracked the strongly beating echo to 35 miles where they suddenly faded.

What had happened was that we had only 180 degree coverage centred on the coast line. I am sure they came south well out to sea and approached Malindi behind us but on the way out they took a bit of a short cut and just entered our coverage. Gane had, I think, by then returned to SA and he very quickly sent us new feeders to allow all round cover. They used to break about every second night at 3 am.

At that station we had the famous Gane low voltage transmitter. He was the only person who could set it up but when it was right it was very good indeed. It was, however, quite impracticable and Boz designed one which gave about the same output but required three times the HT. It was docile and practical. He also sorted out the breaking feeders for the SA stations. I mention the transmitter and the generator to illustrate how unmilitary our approach was. However, it did work and all in record time.

After a few months I was replaced at Malindi by a Lieut Johnson. I was pleased to leave, the fun was over, it was a mosquito and snake ridden environment. Every one of the AA gunners placed there to protect the station went down with malaria frequently but believe it or not, we signallers never contracted it. The gunners, however, were out at night on the exposed gunsites and had a hard time.

I spent the next few months between Nairobi and Mombasa. At Thika near Nairobi I helped Lieut Street instal a JB at the first of three stations around Nairobi for which I think our first filter room was set up. Technical problems had been ironed out by now but the station performance was disappointing. It was our first experience of

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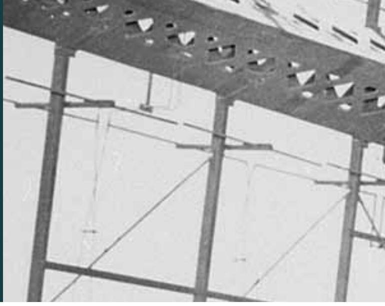

SA radar in World War II

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operating over a flat land site. Geometry beat us Anyway by then the threat was over. I then spent a few months in Mombasa with an experimental searchlight and gunnery set built by Major Roberts. It had potential but was far too experimental for a field set and eventually it was abandoned.

I was sent to Egypt to select sites with the RAF. Can you imagine it the head of RAF radar in the Middle East was a man named TESTER and his title was CRO, Chief Radio Officer. For siting I was accompanied by a Squadron Leader Atherton. He was a civilian scientist disguised as an RAF officer with thus no executive responsibilities. How I envied that. Before the end of the war I had found myself in positions for which I was totally unequipped like dealing with Italian prisoners of war when returning later to SA and, worse still, trying to set some order into a bunch of Royal Marines on another troop ship on which I found myself.

We sited our stations on the coast of Sinai. Northern Sinai was just wind blown sand with the occasional saltpan. One site we had to accept had been occupied by a British army GL (Gun layer) in early warning mode. They could not get in with vehicles except on a steel mesh mat laid from the railway to the site a mile or so away.

Within a few days our South African crew had found a way along the coast from our HQ at El Arish. It was an exciting but quite practical drive and they never used the railways.

After the usual delays we had our three sets installed and operating – so well in fact that the RAF pulled out without much delay. I must admit we four technical officers, Street, Logie, Katz and I were greatly relieved after the Nairobi experience. But we were now operating from good over-water sites with elevated aerials thanks again to Gane. At times we were plotting high flying Itie bombers attempting to lay mines in the Suez canal. Ranges of 60-70 miles were commonplace. We operated our small filter room at EL Arish and had an indifferent telephone line to Ismailia on the Canal where the fighters were based. The nearest we came to action was when a stray bomb was dropped on a large Egyptian Police Post a few miles away. In the desert air it made quite a noise and I was out of bed in a flash but the only reaction from Gane who shared a tent with Hodges was to ask him to stop swatting flies at 5 am. Typical of the Egyptians, the whole post was evacuated immediately and never reoccupied whilst I was in Sinai.

Again our technical approach had been most unmilitary. Atherton at first was horrified at the home made appearance of our equipment. When it came on line and repeatedly out-performed the elaborately engineered MRU - solely because of limitations of the MRU imposed by its wavelenglh and its aerial system, crossed dipole receiver with goniometer for example, he changed his tune. We became good friends and many years later when he was Chief Supt of TRE, the UK radar holy of holies, he told me an interesting tale - how in 1940 he had been sent to Mombasa to select sites for RAF radar stations as a long term plan. In Mombasa the Fortress Commander had referred him to the AA Commander I mentioned earlier, Col Jeffrey but 100% secrecy had to be maintained and he could not say what the sites were for. Jeff quickly put two and two together and in the end decided to ask an astonished Atherton if he was siting RDF stations and if he was, he ought to know that there was already a South African station at Malindi. He had returned to the Middle East somewhat deflated but saw the funny side of it. Later I heard the same story from Jeffrey. With time the essence it shows there can be a case for improvisation. It was two years before a RAF station was installed near Mombasa – strangely enough with Doug Forte ex-SSS in charge.

I was recalled in November 1941 to go the UK for training in centrimetric wave techniques. I did only a few short courses on microwaves but all that was necessary to install the sets in South Africa in due course. For the rest of my four months in the UK Schonland put me in South Africa House to handle the paper side of what he was still doing for South Africa despite his responsibilities to the Ministry of Supply. My work at South Africa House was the start of the permanent appointment there later known as MA/SSS, the SSS representative on the Military Advisor's staff. It was a lucky break for me because it made me the obvious successor to Major Roberts when he was recalled at the beginning of 1944.

I ought to say something about Sir Basil Schonland's work in England because he started the radar story in South Africa and kept a watchful eye on it throughout the war and helped in many ways behind the scenes.

Schonland had worked some time previously with the distinguished physicist Sir John Cockroft. With the war Sir John had set up ADRDE (Air Defence Research and Development Establishment) of the Ministry of Supply. A cover name for army radar research initially of course

for AA guns and searchlights. Britain had pioneered operations research and it quickly became clear that there ought to be an operation research group within ADRDE. Sir John invited Schonland to head such a group and that is why he went to UK. ADRDE (ORG) was set up at Petersham near London and I spent quite a bit of my time there on courses and seminars - courtesy of my connection with Schonland. Later the group became the independent AORG – Army Operations Research Group and went far beyond radar. Schonland's group's big success was in increasing the accuracy of radar controlled AA guns. I remember figures such as 60 000 rounds per bird without radar coming down eventually to something like 2 000 rounds per bird with the GL2 thanks very much to operations research. Then with centimetric radar fire control the figure was further reduced to a few hundred.

Later on the straight flying constant height flying bomb was, with centrimetric radar electronic predictor and proximity fuse, a sitting duck if within range. The early progress here prior to automatic control was very much thanks to Schonland's group and their relationship with AA command. This remarkable scientist/serviceman cooperation in all three services was a remarkable feature of World War 2 and was unique to Britain. I understand that things have long since returned to normal.

Later Schonland left to become scientific advisor to 2l Army Group till the end of the war in Europe.

During this time I again experienced Schonland's "get things done" attitude. One day I received a call from Schonland to accompany him to a meeting of the newly formed RDF allocations committee of the London Munitions Assignment Board. In the car from Petersham to London, a bit of a treat in those days, I still recall him saying to me; "Hewitt we are going to be asked how many sets we want and we have had no instructions from SA", and so, on his fingers he started counting - TRUs, three for the Cape one each for PE and East London and two for Durban, seven in all. GCIs one each and one for flying training inland, five in all. COLs 12 this last was a bit arbitrary I thought. Anyway when our turn came Sir Stafford Cripps turned to him for South Africa's bid and with great dignity Schonland give these figures. On the way back in the car he gave a chuckle and said "Hewitt, you had better cable Freddie Collins and tell him what we've done and ask for financial authority".

They were confirmed suspiciously quickly. Later in South Africa it proved virtually impossible to change them because Schonland "had said so". An interesting aftermath of all this was Brig Collins telling me after the war that he had got into trouble because he had confirmed without getting financial authority. Fortunately it was too large an amount to worry about and he solved it by lumping it all into the Abyssinian campaign where SA signals & RAF costs had got so mixed up that it had been decided to write them off.

To those of you who remember Freddie Collins let me tell you he was a favourite over there too. Nearing the end of the Italian campaign he was in Italy and he sent me a signal asking if I could arrange an invitation for him to visit the UK. I hadn't a clue how to do this but I had recently met the RAF Director General of Signals at some function and he had been very friendly so I asked for an appointrnent – being a South African opened all doors in those days. His reaction was "Freddie Collins, I'd do anything for him after the way he helped us in Abyssinia", and did they lay on a fabulous tour for him. I was lucky to be included.

I then spent a year back in South Africa. I will only mention two incidents as they illustrate important shortcomings in our system. In my first two weeks as company commander at the age of 23 of 6l CD Co three ships went aground around the Peninsula, and all had been tracked by radar. In the first case the tracking had been very erratic. Bearings were notoriously bad on the JB on a rapidly fading target like a ship and the ops people just blamed us for producing what had looked like an aircraft track.

The second time there was no such excuse but it required a third neatly tracked all the way onto the rocks at Camps Bay for a real shake up in procedures. Methods of warning such ships were devised and I don't know of another "tracked onto the rocks" incident. During my time while waiting for a new centimetric radar from the UK, the City of Hankow carrying two of them, went straight ashore at Saldanha Bay within a mile of the already selected site.

They were salvaged after a fortnight submerged in sea water with a companion cargo of Potassium Permanganate. Dave Henkel and others managed to get one going half heartedly. I don't think it was used operationally. This apparently suicidal behaviour of much of the merchant shipping was difficult to understand.

I was told that many of the skippers were inexperienced in our kind of waters and

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anxious to make a landfall - no lighthouses etc. This I am sure applied only to the small to medium sized vessel. I am somewhat dubious about claims to have saved some of the larger troopships. These surely with echo sounders and perhaps even their own radar were fully aware of their position.

The failure to use the radar data at first was not entirely the fault of the ops people. We were so darned secretive that we could not even tell them how we were getting the data. If they had been given even a fraction of what our operators were told they might have reacted very differently to our plots. It must also be remembered that there really was no other effective source of such information so the system just was not geared for handling up-to-date real time plots.

Looking back I just cannot believe how I allowed myself so little contact with ops. It was just lack of experience. There was one amusing incident. A new Gl arrived and summoned me to see him at the Castle. No such interest had ever been expressed before.

What shook us both (him much more than me) was that he was my ex maths master. He was worried about the submarine danger off Cape Point and wanted to know if we could not improve our cover. I told him we had a set in store but the site would not be ready for some time. We discussed possible improvisations and to cut a long story short with his energetic support we had a 273s working at Cape Point within two weeks and it ran there for about a year before the proper site at Rooikrans was ready.

In late '43 I was sent back urgently to the UK to take over as MA/SSS from Major Roberts. Urgently meant thirteen days in a variety of aircraft with an indefinite hold at Marakesh where the Yank Movement Control had never heard of South Africa but in the end the uniqueness of the situation prevailed and I was given the necessary priority and flew on to the UK in a blacked out DC4, the only major in a plane load of generals and brigadiers. In London I dealt mainly with developments now coming thick and fast, and orders for equipment. We experienced some things at first hand. Walking to work through the parks one morning after a night raid the whole place was strewn with untidy bundles of metal foil/paper strips the first use of "window" over London by the Germans. This "window" was directed at the 1,5 metre GCIs and while clumsy to handle was devastatingly effective on the wide beam GCIs. If the centimetric radars had not been coming in it would have been no joke. The longer wave length GL2s and CHs were unaffected. Britain was lucky in having so much frequency diversity. In SA we never experienced any jamming.

We also encountered the first flying bombs and I saw just about the first V2 from the roof of South Africa House. The authorities tried to explain them as exploding gas mains at first but the public were not impressed and for a few days they were referred to as flying gas mains. Incidentally I saw the echo on a CH radar of a V2 being launched well over a hundred miles away, remarkable in that the CH was the first operational radar in the UK and it was, at the end of the war, the only radar that could consistently and easily see these launchings.

The technical aspects of these new devices were obviously very interesting. The flying bombs necessitated a major change in strategy and after a week or so of apparent chaos the London AA guns were rapidly moved to the coast and before long they had the upper hand. Again, as in the battle of the Atlantic, it was radar that was indispensable.

The supersonic long range V2 was a different proposition. It was detectable at long range and trackable, and a scheme was proposed for putting up a dense layer of shrapnel in the region through which the V2 would descend. It was not tried because there would be no time for any warning to the public and the falling shrapnel over a wide area without warning would have been unacceptable.

SSS also released a number of technical officers into R&D positions. Schefferman into the Admiralty Signals Establishment, Henkel and Randall into ADRDE (later RRDE) and Yelland into TRE. I have already mentioned six into the RAF one of whom died in a POW camp in the Far East I believe. Somewhat later some twelve officers were transferred to the Royal Navy and were posted mainly as radar officers on naval escort duties - all this at a time when such people were not that plentiful here. Dave Henkel had a particularly interesting time. He worked at RRDE firstly on the very elegant three centimetre coastal artillery fire control radar set. It scanned the target giving high accuracy range and bearing and showed fall of shot directly i.e. shell splash in relation to the target's position. This set never came here. It really was too late for coastal artillery. It was also mounted on a tracked vehicle and investigated for field artillery fire control and for mortar location. RRDE sent one to ltaly for use in the field and Dave being a military officer in a mainly civilian establishment was ideal for the purpose. He went to Italy with the first set.

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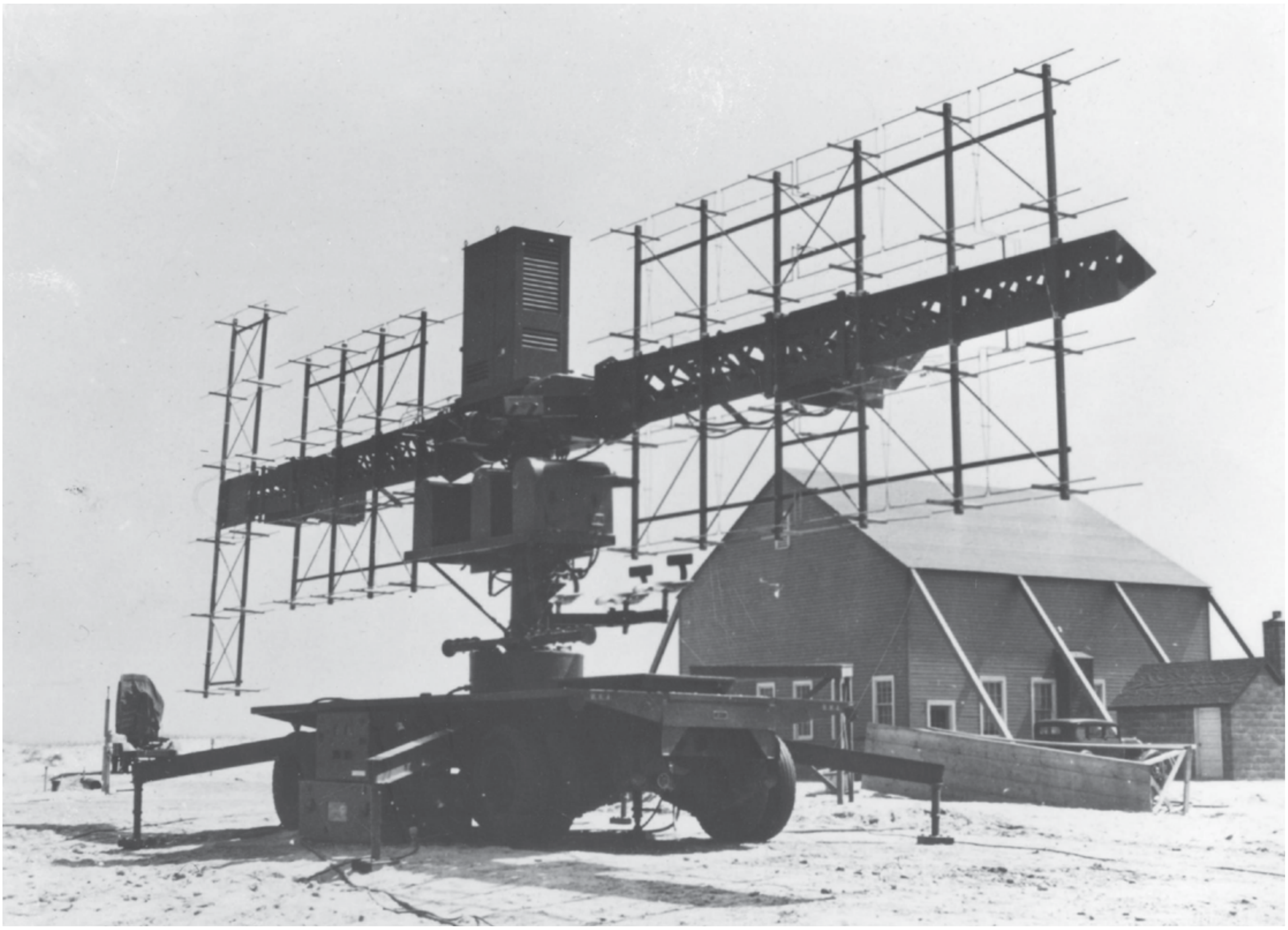

Most of what I have mentioned occurred outside South Africa but it is not the whole "outside" story. I have said nothing about the operation of RAF GCIs by SSS crews in Italy or of our involvement in Italy with the radar system for precision bombing control. I had no contact at all with these.

A very considerable technical effort was devoted to airborne radar for the SAAF. ASVMk2 were installed and operated to the north on a considerable scale and when the Lockheed PV1s arrived already fitted with the 3 cm ASD were presented with a most up-to-date radar to maintain. Bob Meerholz was involved fitting one into Smut's York for thunderstorm avoidance in the tropics. I have a feeling that the work with airborne radar was one of the most exacting tasks performed by our personnel usually under difficult circumstances.

Unfortunately no official comprehensive account of our radar activities exists. One reason is that at the end of the war the unit was disbanded and there was no coherent transfer of activities to the Permanent Force. Thus there was no continuing peacetime body in the then UDF proud to remember their wartime achievements.

On the technical side the setting up by Schonland of the TRL entirely with ex SSS personnel at the start preserved some continuity on the technical side but such people are by their very nature enthusiastic historians. This is sad because the South African story is unique. wn

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Industrialization of South Africa

The opening years of the 20th century were a momentous time for South Africa. The world was poised to enter a new industrial revolution such as had never before been seen. The automotive and aircraft industries were in their infancy and Tesla had started to power the world with alternating current.

BY | DUDLEY BASSON

The second Anglo-Boer war was over, but it left a legacy of resentment and bitterness which would endure for generations. The plight of South Africa caused the war to come under international condemnation. France, Holland, Germany, Russia and other countries were sympathetic but there was no foreign intervention. Kitchener, finding it impossible to defeat the Boer kommandos, took the war to the civilian population by introducing the infamous concentration camps and destroying the farm homesteads. Concentration camp fatalities far exceeded the battlefield losses of both sides. There was some sympathy in Britain, in particular from Emily Hobhouse, but the war inevitably ended in capitulation. Emily started a system of Tuisnywerheid (Home industry) to assist Boer families who had been left destitute by the ravages of war. Writer Arthur Conan Doyle, author of the 'Sherlock Holmes' stories, wrote a booklet in favour of the war, possibly easing the British conscience, for which he was knighted by King Edward VII.

The world was in political turmoil. Two pistol shots fired in Sarajevo in July 1914 plunged the world into the most horrific war that had ever been seen. The European countries and England declared war in rapid succession. The war which was expected to be over in a few weeks continued for four years. By 1917 anti-German sentiment in England had reached fever pitch. Hanoverian King George V issued a public proclamation that the Royal Family had renounced all their German titles and that the family name had been changed from "von Sachsen-Coburg und Gotha" to "Windsor". This had a nice association with the Berkshire town of Windsor and Windsor Castle. Kaiser Wilhelm II responded jokingly that he would attend a performance of Shakespeare's play "The Merry Wives of Saxe-Coburg-Gotha". The family name "von Battenberg" was discreetly Anglicized to "Mountbatten".

The 100th anniversary of the war has been commemorated around the globe. A most remarkable commemoration at the Tower of London consists of 888 246 bright red ceramic poppies seeming to flow from the tower and around the dry moat as a great river, each poppy representing a British life lost in the war. The full horror of the war can be gauged if it is considered that

globally, each poppy represents 20 lives lost. The casualties of the Second World War were very much higher.

Before proceeding with the giants of South African Industry let us take a look at some remarkable geological phenomena which played a huge role in the development of South Africa.

Cratons are huge deep seated parts of the Earth's crust which reach deep into the mantle. They are typically twice as thick as the lithosphere and can extend down to the asthenosphere. The continental crust is typically 35 km thick and oceanic crust about 7 km.

These crusts rest on the upper mantle which extends to about 100 km below the surface. Below this comes the asthenosphere which extends another 100 km deeper. There are many cratons which form core parts of the continental crusts - there are three in the African plate.

Of particular interest is the Kaapvaal craton which includes the whole of Gauteng, much of KwaZulu Natal, much of the Northern Cape and OFS and part of southern Zimbabwe.

Some 2023 million years ago (nearly half the age of the Earth) a meteorite slammed kilometers deep into the basement granite of the Kaapvaal craton. This bolide, known as the Vredefort meteorite, more than ten kilometers across, and containing about 1000 cubic kilometers of rock, is the largest known meteorite to have struck the Earth. The Moon has evidence of very much larger meteorite impacts. The Vredefort impact resulted in an astrobleme (star wound) some 300 km across and excavated about 70 000 cubic kilometers of rock. Ejecta were scattered over an area 700 km across which included individual blocks of rock up to 4 km in size. The extreme temperature generated would have evaporated as much as 70 cubic kilometers of rock. It is estimated that the impact was a magnitude 14 seismic event. The Richter scale is logarithmic, so that a magnitude of 14 would be 100 million times as violent as a magnitude 6 event which may occur a few times a year around the globe. Seismic events greater than magnitude 10 can only be caused by major impacts from space. At the time of impact the Kaapvaal was on the other side of the globe from where it is now. This was in the palaeo-proterozoic era, well before multicellular life had evolved on Earth. The craton drifted slowly south,

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over the South Pole and then northwards. When the African continent arrived at its present position it was still joined to South America, Antarctica, Australia and India. A most remarkable aspect of the meteorite impact was that it uplifted the overlying strata vertically to form a ring of mountains some 300 km in diameter, containing gold bearing granite which appeared as outcrops. Little remains of the mountains which have eroded away but the central uplift dome is still prominent. It is a site of great geological interest, and has been declared a UNESCO World Heritage site. The uplifted strata have presented the richest series of goldfields on Earth which have yielded about half of all the gold that has ever been produced.

Currently South Africa produces more than 400 tons of gold per annum. The quantity of gold in the Earth's core is staggering – it is estimated that it could cover the surface of the Earth by about half a metre thick. The granite also has uranium content which can be refined as a byproduct of the gold. Currently, uranium production exceeds that of gold in quantity but not in value.

A northern part of the crater outer rim appears as a ridge some 56 km in length. Streams cascading over this ridge caused it to become known as the Witwatersrand.

The Witwatersrand plateau forms a continental divide with the run-off to the north draining into the Indian Ocean via the Crocodile and Limpopo Rivers, while the run-off to the south drains via the Vaal into the Orange River and ultimately into the Atlantic Ocean.

Another geological event, also from the palaeo-proterozoic era, which was to have huge implications for South Africa was the formation of Kimberlite pipes in the Kaapvaal craton. These are carrot shaped pipes of volcanic origin from magma kilometers deep below the craton. There is a range of temperatures and pressures which make a boundary between two states of carbon – diamond or graphite. Diamonds formed deep beneath the craton would be carried up the Kimberlite pipes by volcanic action to the surface. At the Kimberley pipe, some two tons of diamonds were excavated. Diamonds in the volcanic peak were scattered by erosion and much of this was carried to the Orange and Vaal rivers. The largest diamond ever discovered was found at Cullinan near Pretoria. Its shape indicated that it could have been a fragment of a much larger stone. Despite the scarcity of diamonds, the quantity beneath the craton must be huge. The quantity of diamond in the cosmos is immense – there are many stars which have reached the end of their life cycles with diamond content many times the mass of the Earth. There really are diamonds twinkling in the sky.

Diamonds were first discovered in 1866 and Witwatersrand gold in 1886. These discoveries resulted in an influx of foreign miners and prospectors seeking fabulous easy wealth. A large population of 'uitlanders', flush with money and starved of women, inevitably led to social degradation. This stood in stark contrast to the strictly religious Dutch and Huguenot farming communities. A lack of political rights for the 'uitlanders' and control of the gold mining eventually paved the way for inevitable conflict and war. The war, fomented by Rhodes, and off to a feeble start with the Jameson raid, would become a traumatic episode in the country's history. Geologically, South Africa has a very rich and complex history. When at the South Pole it was covered with glacial ice. When below sea level the many sedimentary layers were formed. When above sea level the vast lush wetlands laid down peat bogs which later metamorphosed into coal. Currently, South Africa is globally the chief producer of manganese, chromium, platinum group metals, gold and vanadium, and a major producer of many other minerals. The possibilities for South Africa to become one of the foremost industrial countries of the world were tremendous.

FIELD MARSHAL JAN SMUTS (1870-1950)

Jan Christiaan Smuts was born on 24 May 1870 to Jacobus Abraham Smuts and Catharina Petronella (neé de Vries) on the family farm Bovenplaats near Malmsbury.

As a child he would explore the countryside, having a strong passion for nature, which he would retain for life. In 1938 he wrote the introduction to the first edition of Roberts Birds of South Africa.

Smuts was a 7th generation descendant of Michiel Cornelis Smuts (1666-1711). The family line has marriage links to many other South African families including van der Bijl, Mostert and Versfeld. Hendrik van der Bijl was a 7th generation descendant of Gerhard Pieterzoon van der Bijl (1640-1698). The Versfelds trace back to Field Marshal Gerard van Varsvelde van Gelderland (ca 1200). The custom of South African youngsters to address their elders, all and sundry, as “Oom” or “Tannie” is not only a token of respect, it is also indicative of the complex genealogical network of South African families.

Smuts attended school in Riebeeck West and went to Victoria College in Stellenbosch in 1886 where he studied Dutch, German and Ancient Greek. He graduated in 1891 with honours in Literature and Science.

On being awarded the Ebden scholarship for overseas study he went to read Law at Christ’s College, Cambridge. Professor J Marais of Victoria College generously assisted Smuts with his university expenses. He was awarded numerous academic prizes and graduated 1893. Professor Maitland described Smuts as the most brilliant student that he had ever met. Lord Todd, Master of Christ’s College, said that of all its members in 500 years of the College’s history, three had been truly outstanding: John Milton, Charles Darwin and Jan Smuts.

In London in 1894 he read for the Bar and was admitted to the Middle Temple. He was offered a Fellowship in Law but chose to return to the Cape in 1895.

Smuts practised law in Cape Town but began to divert his time to politics and journalism, writing for the Cape Times. Smuts was intrigued by the prospect of a united South Africa and joined the Afrikaner Bond led by Jan Hofmeyer, who recommended Smuts to Cecil Rhodes, owner of the De Beers mining company. Smuts became a supporter of Rhodes but was outraged when Rhodes launched the Jameson Raid in 1895-96, which resulted in the Second Anglo-Boer War (1899-1902). Smuts resigned from De Beers and became State Attorney in Pretoria.

On 30 April 1897 Smuts married Sybella (Issie) Margaretha Krige whom he had met earlier in Stellenbosch. They moved to Johannesburg and then later to Pretoria.

The Afrikaner Bond ceased to be an independent party after the formation of the Union of South Africa. Smuts strongly disapproved when the secret Afrikaner Broederbond, with a more extreme ideology, was formed in 1918.

After the war, the two Boer Republics became British Colonies. The four colonies were unified on 31 May 1910 as the Union of South Africa. Generals Jan Smuts and Louis Botha felt that in order to take South Africa into the 20th Century along with the other industrialized nations, it would be necessary to collaborate with Britain – much to the chagrin of those who had been bereaved and ruined by the war.

Smuts, as Minister of Defence, formed the South African Defence Force. Smuts and Botha sent 133 000 SA troops to fight on the Western Front and the Middle East, despite the feelings of many who felt that fighting against their former German allies was unthinkable.

The battle of Delville Wood took a terrible toll. The memorial to more than 2000 South Africans who perished in battle was designed

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by Sir Herbert Baker. There is also a Delville Wood memorial in Pretoria, in front of the Union Buildings designed by Baker.

Prime Minister Louis Botha had to deal with the pro-German Maritz rebellion. Smuts later wrote: *He lost friendships of a lifetime, friendships that perhaps he valued more than anything in life. But Botha's line remained absolutely consistent. No one else in South Africa could have stuck it out. You wanted a man for that.*

In 1917 Smuts arrived in Britain as head of the SA delegation to the Imperial War Conference. He was warmly received by Lloyd George who offered him a place in the War Cabinet. He became a Privy Councillor and in 1918 was largely responsible for the establishment of the Royal Air Force.

Smuts and Prime Minister Louis Botha took part in the negotiations at the Versailles Peace Treaty near Paris, in June 1919, five years after the start of the war. When the treaty was signed Smuts saw problems ahead saying: *"This treaty is not peace; it is the last echo of the war. It closes the war and armistice stage. The real peace must still come and must be made by the peoples".* These were prophetic words – peace would remain elusive for two decades until Europe would again erupt into the Second World War.

In the early 1920s, Germany experienced hyper inflation – the number of Marks to the Pound or Dollar ran up like the SI prefix scale – kilo, mega, giga, tera. The value of a postage stamp became more than the cost of an up-market house a few years before.

Following the death of Louis Botha, Smuts served a first term of office, as Prime Minister of South Africa, from 1919 to 1924. He saw the need to put the country on a sound footing for industrialization to keep pace with the other industrialized countries and, in 1920, summoned Dr. Hendrik van der Bijl to return from America to become scientific advisor to the Government. This marked a turning point in the prosperity of the country with the establishment of ESCOM and ISCOR.

The League of Nations was formed in January 1920 with the purpose of preventing the occurrence of any future wars. Smuts took part in drawing up the covenant.

In 1930 Smuts became a Fellow of the Royal Society and later Rector of St. Andrews University (Scotland).

An audacious proposal was made in 1940 that Smuts be appointed as Prime Minister of the UK in the event of Churchill becoming incapacitated before the end of the war. This was the only time that a non-British resident was proposed as prime minister.

In July 1941 Smuts received a letter from King George VI congratulating him on rising to the rank of Field Marshal and regretting that he was unable to hand him his baton in person.

It seems ironic that the man who fought against the British as a Boer general (1899-1902) would one day rise to the highest rank in the British Army.

Smuts became Prime Minister of South Africa for a second term of office from 1939 to 1948.

Jan Smuts with his wife, Isie.

He was on friendly terms with King Paul and Queen Frederika of Greece and offered them the hospitality of South Africa in 1941. He became godfather of their daughter Princess Irene.

In 1945 Smuts felt that South Africa had an urgent need for a scientific research capability and summoned Dr Basil Schonland to return from the UK to establish the South African Council for Scientific and Industrial Research (CSIR).

The United Nations officially came into existence on 24 October 1945, when the Charter had finally been fully ratified. Smuts originally wrote the opening lines of the Preamble as: *"The High Contracting Parties, determined to prevent a recurrence of the fratricidal strife which twice in our generation has brought untold sorrow and loss upon mankind. . ."* The World War II peace treaty was signed in Paris in February 1947. Smuts was the only statesman to be present at the signing of the peace treaties of both World Wars.

In 1947 Smuts took great pleasure in the British Royal Family tour, staying in South Africa for two months. Smuts introduced them to the Drakensberg mountains and on one occasion walked with King George VI on Table Mountain. The most informal occasion of the visit was afternoon tea at the Smuts farm Doornkloof near Pretoria. Princess Elizabeth celebrated her 21st birthday while in South Africa.

Smuts and Einstein were on friendly terms with Chaim Weizmann who was to become the first president of the new state of Israel. Smuts supported the Balfour declaration for establishing Israel but foresaw 'stormy weather' ahead.

Smuts's political career came to an end in 1948 when he lost his seat in the General Election despite his party receiving a majority of the popular vote. Smuts was in favour of a measure of racial segregation but despaired of the new National Party's radical racial legislation and establishment of tribal homelands which he thought were unworkable.

He commented: *"The idea that the Natives must all be removed and confined to their own kraals is in my opinion the greatest nonsense that I have ever heard".* These policies resulted in steadily worsening social unrest, but calamity was averted in 1994 when two giants of political magnanimity brought the country to full democracy. They were jointly awarded the Nobel Peace Prize for their achievement. This was the first time in history that a transfer of political power on this scale was peacefully achieved.

Smuts achieved the pinnacle of his academic career when he was installed in splendid ceremony and pageantry as Chancellor of the University of Cambridge in June 1948. He died on 11 September 1950 at his farm Doornkloof in Irene, Pretoria. He was given a splendid military funeral. The funeral service was conducted by Ds. J Reyneke who delivered a stirring oration in the Groote Kerk near Church Square in Pretoria.

I can remember seeing, from a high vantage point, the extensive military cortege moving slowly up Paul Kruger Street towards the railway station, the coffin, with Field Marshal's cap, being borne on an artillery piece and Smuts's horse, draped in mourning, being led behind. King George VI cabled to Mrs Smuts saying: *"... the force of his intellect has enriched the wisdom of the whole human race".*

A bronze statue of Smuts by Epstein was unveiled in Parliament Square, London, on 7 November 1956. The statue has an unusual angle due to the armature slipping during manufacture but the result was considered acceptable. When I went, as an apprentice millwright, to work in the ISCOR HQ Drawing Office, two of Smuts's grandchildren, Hannelie Smuts and Jan Smuts Weyers were also working there.

Phyllis Scarnell Lean published an informative pictorial biography of Smuts, *"One Man in his Time"*, in 1964 and gave me a treasured autographed copy. Phyllis was a journalist and a phenomenal public speaker. She gave motivational talks to troops during WW2.

SIR BASIL SCHONLAND (1896-1972)

Basil Ferdinand Jamieson Schonland was born on 2 February 1896 in Grahamstown to Selmar Schönland and Flora (neé MacOwan). His father was a botanist and founder of Rhodes University. Basil matriculated at St. Andrew's College, Grahamstown, aged 14 and was the top pupil in the Cape. His small stature at school gained him the nickname "Mighty Atom". He studied at Rhodes University where he gained a BA in physics and then

Industrialization of South Africa

continues from page 55

in 1914-1915 and 1919-1920 studied at Gonville and Caius College, Cambridge. (Caius is pronounced 'keys').

During the First World War he volunteered for service with the Signal Service of the Royal Engineers in France in 1915-1918. He was wounded at Arras, mentioned in dispatches and awarded the Order of the British Empire (OBE).

He became a research student at the Cavendish Laboratory of Cambridge University studying the scattering of beta particles.

He returned to South Africa in 1922 and took up a post as lecturer at the University of Cape Town and was later appointed as Professor of Physics.

Schonland married Isabel Marian (Ismay) Craib in 1923, who bore him a son and two daughters.

In 1927-1928 Schonland spent a scholarship year at Cambridge. He was appointed as a Fellow of the Royal Society in 1938 – a most prestigious honour.

In 1937 he left the Cape to become the founding director of the Bernard Price Institute of Geophysics at the University of the Witwatersrand. He made significant contributions to the study of atmospheric electricity, photographing lightning and investigating the electric fields generated by thunderclouds. The South African Highveld with its exceptionally high incidence of lightning provided abundant material for his work. He also made a contribution to the phenomenon of ball lightning. His pioneering work on lightning was received with international acclaim.

Dr. Bernard Price became President of the SAIEE in 1915 and was awarded Honorary Life Membership in 1940. The Bernard Price Institute of Palaeontological Research is part of the School of Geosciences in the Faculty of Science of the University of the Witwatersrand.

As a Lt Col. Schonland commanded the South African Special Signals Services at the outbreak of WW2, he led the development of South Africa's radar system.

Schonland and his team developed a fully functional radar system three months before the outbreak of war. He went to England in 1941 to acquire more equipment for South Africa but was requested by Sir John Cockcroft to become superintendent of the Army Operational Research Group (AORG) of the Air Defence Research and Development Establishment at Richmond, Surrey, also known as the "Blackett Circus".

Under his leadership the AORG made significant contributions to the use of radar. By 1944 he was the scientific adviser to Field Marshal Montgomery with the 21st Army group in England, France and Belgium. He was promoted to the rank of brigadier.

In 1945 he was summoned by Prime Minister Smuts to return to South Africa to establish the Council for Scientific and Industrial Research (CSIR) of which he became the founding President. He also resumed his post as Director of the Bernard Price Institute at Wits and in 1951 became Chancellor of Rhodes University.

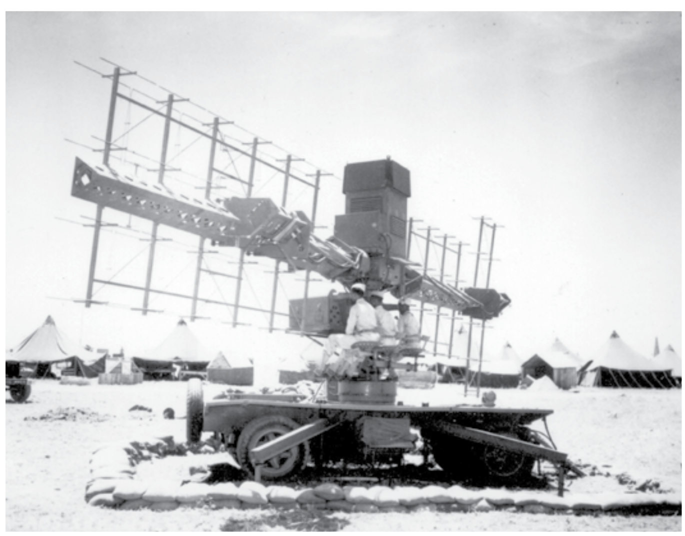
In 1954 he became deputy director and then director of the Atomic Energy Research Establishment at Harwell, Oxfordshire. Schonland became an honorary Fellow of Gonville and Caius College in 1959.

He was knighted in 1960 by Queen Elizabeth II for his services to British science. Schonland and his wife Ismay retired to the family home near Winchester in Hampshire in 1960.

Sir Basil died on 24 November 1972 after a long illness.

The Nuclear Physics Research Centre of the University of the Witwatersrand was renamed the Schonland Research Centre in 1984. Schonland's research papers were donated to the Churchill Archives Centre by Lady Schonland in 1973.

He was nominated as "Scientist of the Century" in South Africa in 1999.



November

November is the best month to travel to South Africa. Sunbathe to your heart's content - just don't forget the sunscreen!

COMPILED BY I JANE BUISSON-STREET
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1 November

1896 For the first time, a picture of a bare woman's breast (Zulu) appeared in National Geographic Magazine.

2 November

1955 The first of Jim Henson's muppet characters, "Kermit the Frog", was copyright registered.

3 November

1903 Listerine Mouthwash was trademark registered.

4 November

1977 The United Nations' Security Council proclaims a weapon embargo against South Africa.

5 November

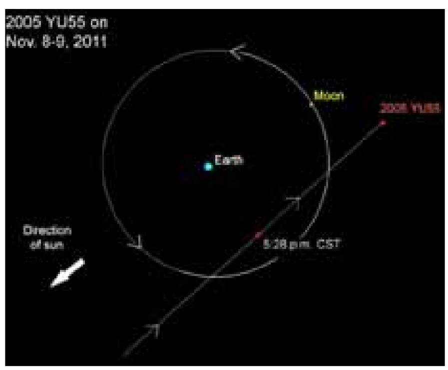
1492 Christopher Columbus learns of maize from Indians of Cuba.

6 November

1928 The first electric razor was patented by Colonel Jacob.

7 November

1492 The Ensisheim meteorite, the oldest meteorite with a known date of impact, strikes the earth around noon in a wheat field outside a village in France.



8 November

2011 We all experienced a near miss! A potentially hazardous asteroid, 2005 YU55, passed about 0.85 lunar distances from Earth (about 324,600 kilometres), the closest known approach by an asteroid of its brightness since 2010 XC15 in 1976.

9 November

1907 The Cullinan Diamond was presented to King Edward VII on his birthday.

10 November

1991 South Africa's national cricket team played its official first international game since 1970, a one-day 50-over match vs. India, at Eden Gardens, Calcutta. India won by 3 wickets (with 38 balls remaining). This match was South Africa's first-ever ODI and their first cricket match of any sort against India.

11 November

1790 Chrysanthemums are introduced to England from China.

12 November

1974 South Africa was suspended from The United Nations' General Assembly over its racial policies.

13 November

1998 World Kindness Day was introduced in 1998 by the World Kindness Movement, a coalition of kindness non-governmental organisations around the world.

14 November

1889 Pioneering female journalist Nellie Bly (aka Elizabeth Cochrane) begins a successful attempt to travel around the world in less than 80 days. She completed the trip in seventy-two days.

15 November

1904 King C. Gillette was granted Patent #775,134 for a safety razor in 1904.

16 November

1963 The Bell System in the United States officially introduced dual-tone multi-frequency (DTMF) technology under its registered Touch-Tone® mark. This eventually became a world-wide standard for telecommunication signalling.

17 November

1891 Emile Berliner, who also invented the disc record gramophone (the phonograph), received a patent for a combined telegraph and telephone.

18 November

1928 Walt Disney's Mickey Mouse officially debuted in the short film Steamboat Willie, one of the first sound cartoons.

19 November

1916 Samuel Goldwyn and Edgar Selwyn established Goldwyn Pictures.

20 November

1923 Patent #1,475,024 was granted to Garret Morgan for a traffic signal, the forerunner of the modern traffic light.

21 November

2013 A report from Japan's Coast Guard and earthquake experts claimed that a new islet had been created; a volcanic eruption raised the new island, which is located off the coast of Nishinoshima - a small, uninhabited island in the Ogasawara chain, far south of Tokyo.

22 November

2011 Scientists in New Britain discovered the first orchid known to flower at night, Bulbophyllum Nocturnum.

23 November

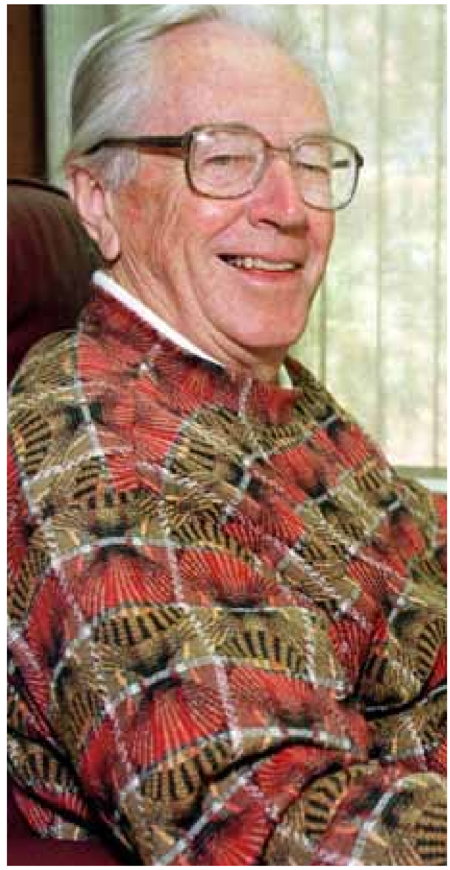
1898 Andrew Beard, an African-American inventor, was granted a patent for a railway car coupler.

24 November

1874 Patent #157,124 was granted to Joseph Glidden for barbed wire fencing.

25 November

1949 "Rudolph, the Red-Nosed Reindeer" appears on music charts.



26 November

1922 The birthday of Charles Monroe Schulz, nicknamed Sparky, the creator of the comic strip Peanuts featuring Snoopy and Charlie Brown.

27 November

1894 Mildred Lord was granted a patent for what is arguably the most essential machine in daily life: a washing machine.

28 November

1905 ARM & HAMMER's baking soda (bicarbonate of soda) was trademark registered.

29 November

2010 Pablo Picasso's electrician revealed 271 previously unknown works by the artist, claiming they were gifts.

30 November

1858 The Mason jar, a moulded glass jar used in home canning to preserve food, was patented. wn

IN MY OPINION : MIKE CROUCH

Communication vs Telecommunication

At a recent SAIEE Council meeting it was suggested that the Electronics and Software section (E&S) should be renamed to include Telecommunications. I was delighted with this suggestion as my lifetime occupation had been in the Telecoms field and I believed this to be a tremendously important field in our daily lives and for the South African economy. During discussion it was also suggested that the new section should be titled using "Communications" rather than Telecommunications. I was strongly opposed to this and I would like to discuss why this is my opinion.

BY I MIKE CROUCH I PR.ENG I FSAIEE

Communication is defined as "the passing of information or messages" and we know that in the distant past humans, animals and birds communicated using grunts, barks and twitters respectively.

(Twitters?..How very modern!) The need inevitably arose to communicate over long distances, particularly during times of war when knowing about the enemy's movements was vital. The first attempts were by the Romans and Greeks who lit signal fires and the American Indians who used smoke signals.

In Africa the use of drums was the preferred method of sending messages. In 1793 the Chappe brothers set up a series of mechanical structures that had moving arms that could be set into various configurations representing the letters of the alphabet. This system made it possible to send messages from Paris to Lille a distance of 230 km and was perhaps the first optical system. The system was very slow as each letter had to be set up and relayed from station to station. This system was the first time the word "telegraph" was used. (Tele is Greek for "afar" and graph is from Greek graphein "to write").

The first electrical communication was achieved by ST von Sommering in 1809. A cable of 26 copper wires was used with a battery and earth return. Each wire represented a letter of the alphabet and the ends of the wires were dipped in an acidic tank of water at the receiving end. When a wire was connected to the battery at the sending end, the current would flow and a stream of hydrogen bubbles would rise from that wire at the receiving end. (Electrolysis). At the beginning of transmission the hydrogen was collected in an inverted cup which moved some levers and released a metal ball that fell onto a bell, thus alerting the receive operator that a message was being sent. (Transmission speed four letters per minute!)

The first commercial telegraphs messages were sent by Samuel Morse using his code of dots and dashes. This was to be the basis of all telegraph cables on land and under the sea for many years. The discovery of electromagnetic waves by Heinrich Hertz in 1888, and patented by Guglielmo Marconi in 1896, were the forerunners of "wireless" telegraph. Meanwhile in 1876 Alexander Graham Bell had sent the first words over copper cables and this soon led to the rapid growth of the telephone. (Tele as before

means "afar" and phono means "to speak"). The first radio broadcasts took place from the BBC on 1926 and the first regular television broadcasts were introduced by the BBC in 1929. (Again Greek Tele Afar and Vision from Latin video to see).

In 1935 Dr Alex Reeves invented pulse code modulation (PCM) which was to introduce the Digital era where analogue signals were sampled and converted to digital (Binary) signals giving high speed high quality telephone and data transmission.

In 1945 Arthur C Clarke proposed the concept of synchronous (or geostationary) telecommunication satellites. His idea only became reality in 1957 when Russia launched Sputnik-1, and Early Bird (Intelsat 1) the first geostationary satellite was launched by the USA. Satellite transmission grew rapidly after this, giving Telephone, Data and Television service to the world.

In 1966 one of the most important inventions was the transmission of signals through glass fibres by Dr Charles Kao and Dr George Hockham at STC labs in Harlow England.

This invention changed the face of telecommunications by introducing optical telecoms where millions of telephone and data channels could be transmitted on the almost infinite bandwidth of optical fibre. This was particularly important for under-sea cable systems. So we have electrical and optical communications over long distances. Surely the appropriate word covering these wonders is Telecommunications.

Finally the introduction of "networks" of computer networks led to the introduction of Packet switching and the Internet with its attendant innovations of e-mail, GSM mobile, the World Wide Web and universal telecoms via smart phones etc.

In conclusion, it is clear that the most common word in the above overview is the Greek word Tele! Modern Telecommunication is one of the wonders of the world and we should take cognisance of this when we choose a name for our new section. Let us leave the word "Communications" to our friends in the advertising, interpersonal and human relations fields.

Remember that our wise forefathers in the SAIEE launched the "Telephone and Telegraph section" in 1920 and the "Light current section" in 1950. This was later changed to the Electronics and Telecommunications section which in 1996 became the Electronics and Software section. Let us not forget that the telecom world's regulator is the International Telecommunication Union (ITU) not the International Communications Union and give Telecommunications its rightful place in our range of sections. wn

Communication Failure?

"What we've got here is failure to communicate. Some men you just can't reach. So you get what we had here last week, which is the way he wants it. Well, he gets it. I don't like it any more than you men."......isa quotation from the 1967 film Cool Hand Luke.

BY | ANGELA PRICE

I like this quote, not because it conjures up memories of my misspent youth, but because of the wonderful true to life reflection it offers ....

- My hubby and I regularly experience some sort of 'failure to communicate' (he is an engineer after all).
- Times like that I often feel that there are 'some men that you just can't reach!'
- Which is when you get 'what we had here last week' .... a hum dinger of a domestic.
- 'which is the way he wants it' (debatable)
- 'well, he gets it' (yes siree he sure does... both barrels, all guns blazing)

I know it's poor form to air your dirty domestic laundry but I feel it serves a purpose here so bear with me.

I love communicating (one reason I am writing this I guess), but despite all the latest technology and inventions in the field of communication I don't believe communicating is getting any easier or better. All the new-fangled methods for communicating that have eclipsed the humble hand written note - or heaven forbid the face to face conversation - may have revolutionized our communication skills (should maybe read as technological skills?) but they have done little for the art of communication. In fact I think that rapid fire WhatsApp messages between some of my friends and I have led to some serious 'miscommunication' and hard feelings where likely none really needed to exist or could easily have been avoided with a proper conversation.

Things on the communication front are not much better in my marriage, hence the aforementioned hum dinger of a domestic. A marriage course we once attended had loads to say on the importance of communication in a marriage (I fully agree) - seems we just forgot the advice. On the domestic battleground my hubby's common complaints seem to be:

- the fact that I nag...except I don't see it that way - it would help if he just acknowledged my request/question. (FYI silence is not a response gentlemen.)
- I apparently also go 'round and round' in circles on the same topic, again I disagree....goldfish do that not fishwives.
- oh and I 'put words' into his mouth - well heck someone has to, the man doesn't communicate!

At one stage I turned to modern communication methods in an attempt to cross the communication gap with my spouse. I tried emailing my ideas/requests/ to do lists/suggestions to him at work. When asked why he did not respond/ reply/ or action them he replied that *'I was busy and eventually the email moved off the bottom of the inbox screen and got forgotten!'* 'AGGGGHHH!!'

I thought of trying WhatsApp but I know he ignores most of those unless they contain side splitting video clips or images that only other men seem to find amusing (no, not those images!) However I think I have finally fixed that problem by reverting to good old hand written notes, I invested in a small white board in the kitchen - so far so good.

You may still be wondering about that hum dinger domestic I mentioned earlier. Well after firing many rounds and emptying both barrels at each other we declared a truce. The argument had been about the plans for the day ahead and what I had thought we were going to, versus what he had planned to do. Two very different plans as it turned out. In exasperation I turned to him and wailed, 'So why didn't you tell me!' To which he innocently replied, 'Sorry love, I had it all perfectly planned in my head..........it just hadn't come out of my head!'

Ah...well finally we seem to be getting somewhere, I hesitate however to say we are actually now communicating effectively. wn

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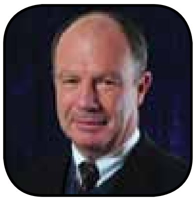

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