WATTS 2021-06

Year 91 + 06m

Monthly Newsletter of the Pretoria Amateur Radio Club
Maandelikse Nuusbrief van die Pretoria Amateur Radio Klub

PARC, PO Box 73696, Lynnwood Ridge 0040, RSA
http://www.parc.org.za zs6pta@zs6pta.org.za

Bulletins : 145.725 MHz : Sundays from 08h45 / Sondae vanaf 08h45
Relays: 1.840, 3.700, 7.066, 10.135, 14.235, 51.400, 438.825, 1297 MHz and Echolink. Activated frequencies are announced prior to bulletins
Swopshop : 2m and 7.066 MHz live on-air after bulletins
Bulletin repeats on Mondays / herhalings op Maandae : 2m 19h45

John Bardeen and Walter Brattain (back): inventors of the point-contact transistor in 1947, and William Shockley (front), inventor of the junction transistor in 1948. More on the history of semiconductors on pages 5 – 10.

In This Issue / In Hierdie Uitgawe

PARC Committee Meeting / PARK Komitee Vergadering

Club Committee Meeting :

The date of the next Meeting for the 2021 PARC Committee will be on Thursday the 24th of June from 19h00 on Zoom

Birthdays and Anniversaries / Verjaarsdae en Huweliks Herdenkings

Member's Birthdays June 2021 / Lede Verjaarsdae Junie 2021

04 Rivac Alberts RIVAC
07 Chris Oosthuyse ZS6OC
14 Attie Reynecke ZS6REY
19 Fanus Ferreira ZS6BUH
21 Marc Vanoverbeke ZS6ON
22 Dylan Foord ZS6TDK
22 Richard Peer ZS6UK
26 Pieter Stronkhorst ZR6PSR
27 Leon Fouche ZS6LEF
27 Emil Bohme ZS6EGB
30 Annelie van Niekerk ZS6AVN

Spouse's June 2021 / Junie 2021

01 Fiona, gade van Etienne Naude ZS6EFN
06 Sandy Woolatt ZS6ICE (Menno Havelaar ZS6AGC)
24 Belinda, gade van Johnny Scott ZS6JSS
27 Selma, gade van Joe Katzman ZS6TB

Anniversaries June 2021 / Herdenkings Junie 2021

24 Marita en Roy Alexander ZS6MI

Member's Birthdays July 2021 / Lede Verjaarsdae Julie 2021

06 Helen Newton ZR6HN
13 Braam Devenier ZS6AYE
13 Pieter Human ZS6PA
17 Pine Pienaar ZS6OB
19 Theo Bresler ZS6TVB
20 Roy Newton ZS6XN
26 Frank Schneider ZS6GE
29 Iain McAllister ZS5IE
30 Dawid Jansen van Rensburg ZS6VS (70)

Spouse's July 2021 / Gades Julie 2021

01 Avida, gade van Theo Bresler ZS6TVB
12 Sharmaine, gade van Louis de Wet ZS6SK
17 Judy, spouse of David Botha ZS6O
22 Ria, gade van Pete Smith-Curren ZS6PJ

Anniversaries July 2021 / Herdenkings Julie 2021

26 Antoinette ZS6D and Danny ZS6AW Liebenberg

Hope is being able to see there is light despite all the darkness
There was never a night or a problem that could defeat sunrise or hope
Let your hopes, not your hurts, shape your future
It is a mistake to ever look for hope outside one's self

PARC Membership Fees / PARK Ledegelde

For the 2020-2021 year, there will be no increases in Club Membership fees.

Club Fees therefore remain at R160 for Ordinary Members, and R60 for Pensioners and Spouse. Vir die 2020-2021 jaar sal daar geen toenames in die Klub Lidmaatskap gelde wees nie. Dus bly die gelde op R160 vir Gewone Lede, en R60 vir Pensionarisse en Gade.

PARC SUBS : PARK LEDEGELD : FROM / VANAF : 2020-10-31

Bank	First National Bank	Ordinary Members / Gewone Lede : R160 Spouses / Pensioners : R60	Your call sign must appear as statement text!
Branch Code	25 20 45		
Account No	546 000 426 73		

Please remit your subs in time to our Treasurer, or pay per transfer into the PARC account
Betaal asb. u ledegelde betyds aan ons Tesourier, of betaal per oorplasing in die PARC rekening

Please Note : If your Club fees are not paid up to date, birthday details cannot be displayed in Watts

PARC Bulletin Roster / PARK Bulletin Rooster

PARC Bulletins are presented on Sunday mornings at approximately 08h45, after the SARL Bulletins in English and Afrikaans, from 08h15. The Bulletin Presenters for the following two months are presented below. Please do contact the applicable presenter beforehand if you wish to make a contribution to the Bulletin. PARC Bulletins are broadcast on the 2-meter repeater on 145.725 MHz, and 70 cm on 438.825 and 439.025 MHz. Relays are done on 7.060 MHz by Hans Kappetijn ZS6KR and on Echolink by Johan Lehman ZS6JPL. A re-broadcast of the Bulletin is done the following Monday evening at 19h45 by Hans ZS6KR.

PARK Bulletins word op Sondag oggende aangebied om 08h45, na die SARL Bulletins in Engels en Afrikaans, vanaf 08h15. The Bulletin aanbieders vir die volgende twee maande word onder aangedui. Kontak gerus die toepaslike Bulletin leser indien u 'n bydrae tot die Bulletin wil maak. PARK Bulletins word uitgesaai op die 2-meter herhaler op 145.725 MHz, en 70cm op 438.825 en 439.025 MHz. Herleidings word gedoen op 7.060 MHz deur Hans Kappetijn ZS6KR, en op Echolink deur Johan Lehman ZS6JPL. 'n Heruitsending van die Bulletin geskied die opvolgende Maandag aand om 19h45, en word behartig deur Hans ZS6KR.

PARC Bulletin Presenters : February 2021 – June 2021			
Date	**Presenter**	**Date**	**Presenter**
13 June 2021	Alméro Du Pisani ZS6LDP	1 August 2021	Albert Schreuder ZS6SE
20 June 2021	Johan de Bruyn ZS6JHB	8 August 2021	Alméro Du Pisani ZS6LDP
27 June 2021	Louis de Wet ZS6SK	15 August 2021	Johan de Bruyn ZS6JHB
4 July 2021	Albert Schreuder ZS6SE	22 August 2021	Louis de Wet ZS6SK
11 July 2021	Alméro Du Pisani ZS6LDP	29 August 2021	Albert Schreuder ZS6SE
18 July 2021	Johan de Bruyn ZS6JHB	5 September 2021	Alméro Du Pisani ZS6LDP
25 July 2021	Louis de Wet ZS6SK	12 September 2021	Johan de Bruyn ZS6JHB

FLEA MARKET DATES / SNUFFELMARK DATUMS

PARC / PARK: 31 July ; 4 December
East Rand: 30 October
West Rand: 4 September ; 27 November

For more information contact Alméro Du Pisani: 083-938-8955

Results of the May Radio Amateur Examination

The following Candidates have passed the May RAE:

Rita Schroder ZS6SLR
Jaco-Louis Kruger ZS6JLK
Janre Buys ZS6GTW
Henk Badenhorst ZS6BA
Elias Tibane ZR6TT
Cobus Kruger ZS6TLX
Marcel van Wyk ZS6MRM

We sincerely congratulate you with your achievements and welcome you to the Pretoria Amateur Radio Club!

Our sincere thanks and appreciation to John Minter ZS6LED who under difficult circumstances conducted the RAE training.

Diary of Contests & Events / Dagboek van Kompetisies en Gebeure

Contests and Events – June 2021 / Kompetisies en Gebeure – Junie 2021 (UTC Times)	
05	World Environment Day: https://www.worldenvironmentday.global/
05	**SARL VHF/UHF QSO Party**
05 - 06	10-10 International Open Season PSK Contest: 00h01Z – 23h59Z
08	World Ocean's Day: https://worldoceanday.org/
12	Asia-Pacific Sprint, SSB: 11h00Z – 13h00Z
12 - 13	GACW WWSA CW DX Contest: 15h00Z – 15h00Z
12 - 13	REF DDFM 6m Contest: 16h00Z – 16h00Z
16	SARL Youth Sprint
17	World QRP Day
19	**SARL 40m Grid Square Sprint**
19 - 20	All Asian DX Contest, CW: 00h00Z – 24h00Z
21 - 26	**Top Band QSO Party**
26 - 27	His Majesty King of Spain Contest, SSB: 12h00Z – 12h00Z
27	ARRL Field Day: 18h00Z – 21h00Z
30	World Asteroid Day
Contests and Events – July 2021 / Kompetisies en Gebeure – Julie 2021 (UTC Times)	
01	RAC Canada Day Contest: 00h00Z – 23h59Z
03	**SARL Newbie Contest: Consult SARL website: www.sarl.org.za**
04	**ZS5 Sprint: Consult SARL website: www.sarl.org.za**
03 - 04	DL-DX RTTY Contest: 11h00Z – 10h59Z
03 - 04	Marconi Memorial HF Contest: 14h00Z – 14h00Z
10	**RaDAR Challenge: Consult SARL website: www.sarl.org.za**
10 - 11	IARU HF World Championship: 12h00Z – 12h00Z
17 - 18	CQ Worldwide VHF Contest: 18h00Z – 21h00Z
17	**Winter QRP Contest: Consult SARL website: www.sarl.org.za**
18	**ZS2 Sprint: Consult SARL website: www.sarl.org.za**
21	**SARL 80m Club Sprint: Consult SARL website: www.sarl.org.za**
24 - 25	RSGB IOTA Contest: 12h00Z – 12h00Z
28 - 29	Delta Aquarids Meteor Shower
31/7-1/8	Russian WW Multimode Contest: 12h00Z – 11h59Z

The Pretoria Amateur Radio Club does not accept responsibility for the accuracy of contest details listed above. For verification and more information, please visit the SARL website, www.sarl.org.za , as well as the WA7BNM international contest calendar at the following website: http://hornucopia.com

Pretoria Amateur Radio Klub nooi graag almal wat belangstel om aan plaaslike kompetisies deel te neem om vir Albert Schreuder ZS6SE (Komiteelid) en Gerrie Leonard ZS6GTK (Gekoopteerde Lid) te kontak om uit te vind hoe om betrokke te raak.

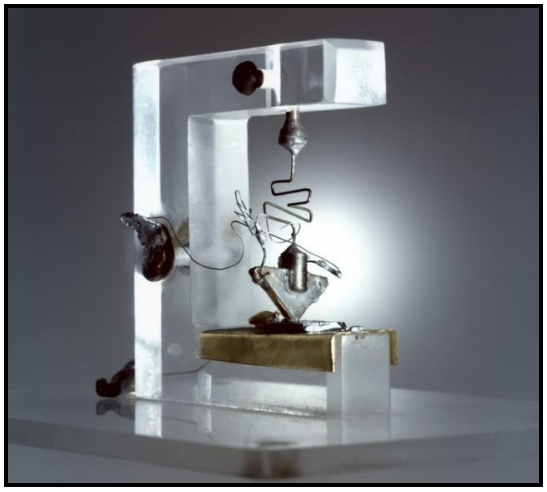
Pretoria Amateur Radio Club invites all who are interested to participate in local contests, to contact Albert Schreuder ZS6SE (Committee Member) and Gerrie Leonard ZS6GTK (Co-Opted Member) to obtain information on how to get involved.

Semiconductors and the development of the Transistor

Discussions on the history, chemistry and physics of semiconductors. By Louis de Wet ZS6SK

Semiconductors have, over the past 73 years played a major role in technological advancement, which included transistors used in the first solid-state radios receivers, integrated circuits used in the Apollo spacecraft guidance computers, cellphones and other electronic devices we know today. The history of semiconductors is long and complicated (Lukasiak & Jakubowski, 2010), and the presentation of a detailed timeline of all research and inventions involving semiconductor materials and devices would indeed be a significant task.

The transistor is arguably one of the most important invention of the past century, and is often cited of how scientific research can lead to useful commercial products (Riordan *et al.*, 1999). Developed in 1947 in the Bell Telephone Laboratories for basic research and solids physics, the transistor rapidly replaced vacuum tubes in the 1950's and subsequently stimulated the development of integrated circuits and the microprocessor (Riordan *et al.*, 1999).

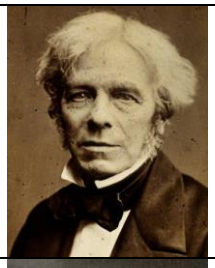


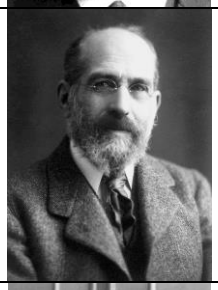
The intricate interplay of scientific, technological, social, and personal interests and developments have contributed to the invention of two distinctly different transistors: (i) the point-contact transistor (left) by Johan Bardeen and Walter Brattain in December 1947, and (ii) the junction transistor by William Shockley a month later (Riordan *et al.*, 1999). The point-contact transistor showed only limited production and never achieved commercial success. The junction transistor, however made the modern semiconductor industry possible, contributing to the rise of companies such as Texas Instruments, SONY and Fairchild Semiconductor (Riordan *et al.*, 1999).

This article will be the first of a number discussing the history of semiconductors, an overview of the chemistry of semiconductor elements such as Silicon, Germanium and Arsenic, and the interactions of these elements to create p and n semiconductors. As mentioned by Lukasiak & Jakubowski (2010), the history of semiconductors and devices invented using these elements is a long and complex one. Hence, this series will commence with a short overview indicating the persons involved, followed by a short description of their research, inventions and achievements. The information following on the next pages were compiled from the paper by Lukasiak & Jakubowski (2010). In the next issue of Watts, more information will be presented on the atomic model, the different electron configurations of semiconductor elements, and their chemical interactions.

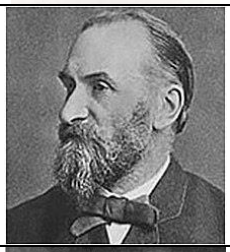
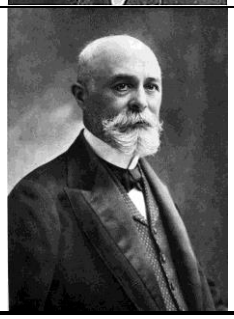
Early History

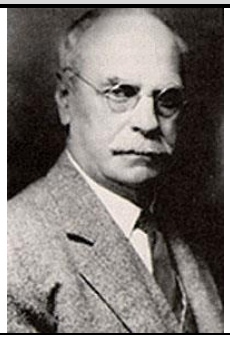
1782		The term "semiconductor" is used the first time by Allesandro Volta

1833		The first documented observation of the semiconductor effect is recorded by Michael Faraday. Faraday noticed that the resistance of silver sulphide decreased with a decrease in temperature.
1851		Johann Hitthorf conducted an extensive quantitative analysis of the temperature dependance of the electrical conductivity of Ag_2S and Cu_2S.

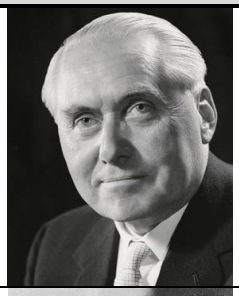
Rectification		
1874		Karl Ferdinand Braun observed conduction and rectification in metal sulphides probed with a metal point or whisker. It later played a significant role in the development of the radio and detection of microwave radiation in WWII radar systems.
1874		Arthur Schuster observed rectification in a circuit made of copper wires. Copper oxide was discovered as a new type of semiconductor.
1929		Walter Schottky experimentally confirmed the presence of a barrier in a metal-semiconductor junction.

Photoconductivity and Photovoltaics		
1839		Alexander Edmund Becquerel discovered the photovoltaic effect at a junction between a semiconductor and an electrolyte.

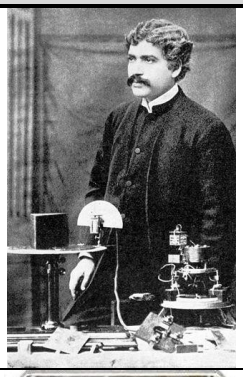
1873		Photoconductivity in solids is discovered by Willoughby Smith during his work on submarine cable testing that required reliable resistors with high resistance. Smith experimented with Selenium resistors and observed that light caused a significant decrease in their resistance.
1876		William Grills Adams and Richard Evans Day were the first to discover the photovoltaic effect in a solid material. They noticed that the presence of light could change the direction of a current flowing through Selenium connected to a battery.
1883		Charles Fritts constructed the first working solar cell. It consisted of a metal plate and a thin layer of Selenium covered by a very thin layer of Gold. The effectivity of this cell was less than 1%.

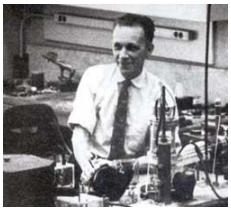
Semiconductor Theory		
1878		Edwin Herbert Hall discovered that charge carriers in solids were deflected in a magnetic field (Hall Effect).
1899	**Eduard Riecke**	Theory of electron-based conduction in metals assumed the presence of both negative and positive charge carriers with different concentrations and mobilities.
1908	**Karl Baedeker**	Observed the dependence of the conductivity of Copper(I) Iodide (CuI) (Cuprous Iodide) on the stoichiometry (Iodine content). Baedeker also measured the Hall effect in this compound, which indicated carriers with a positive charge.
1914	**Johan Koenigsberger**	Divided solid-state materials into three groups with respect to their conductivity: metals; insulators and “variable conductors”.
1928	**Ferdinand Bloch**	Developed the theory of electrons in lattices (crystals)

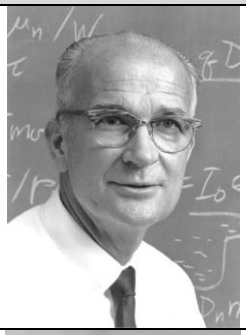
1930		Bernhard Gudden reported that the observed properties of semiconductors were due exclusively to the presence of impurities, and that a chemically pure semiconductor did not exist.
1930		Rudolph Peierls presented the concept of forbidden gaps that was applied to realistic solids by Léon Brillouin also in 1930.
1930	**Léon Brillouin**	Brillouin with his work on the propagation of electron waves in a crystal lattice, introduced the concept of Brillouin zones.
1930		Ralph Kronig and William Penny developed a simple analytical model of periodic potential.

Semiconductor Theory		
1931		Alan Wilson developed the band theory of solids based on the idea of empty and filled bands. Wilson also confirmed that the conductivity of semiconductors was due to impurities.
1931		Werner Heisenberg (Uncertainty Principle: 1927; Creation of Quantum Mechanics; Nobel Prize in Physics: 1932) – developed the concept of the "hole" in semiconductors.

1938		Walter Schottky and Neville F. Mott (Nobel Prize: 1977) independently developed models of the potential barrier and current flow through a metal-semiconductor junction. In 1939 Schottky improved his model by including the presence of the space charge.
1938	**Boris Davydov**	Presented a theory of a copper-oxide rectifier, which included the presence of a p-n junction in the oxide, excess carriers and recombination.
1942	**Hans Bethe**	Bethe (Nobel Prize: 1967) developed the theory of thermionic emission.

Devices: Point-Contact Rectifiers		
1904		Jagadish Chandra Bose obtained a patent for Lead Sulphide (PbS) contact rectifiers.
1906		Greenleaf Whittier Pickard was the first to show that silicon point-contact rectifiers were useful in the detection of radio waves (Patent in 1906).
1925	**E. Pressier**	Developed the Selenium rectifier.
1926	**L.O. Grandahl**	Developed the copper-oxide rectifier.

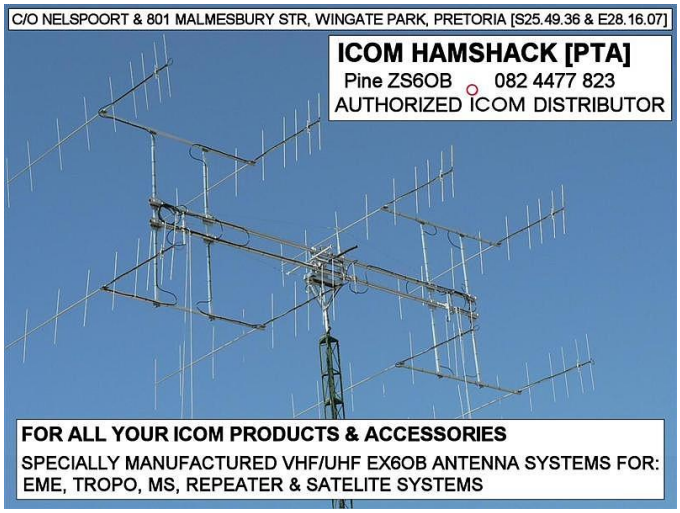
Devices: p-n Junction		
1939		Russel Ohl (Nobel Prize: 1956) discovered the PN barrier (p-n junction). Ohl with his research on the detection of radio waves realized that the problems with cat's whiskers detectors were caused by bad quality of semiconductors. He melted silicon in in quartz tubes and let it cool down. The material was still polycrystalline, but electrical tests demonstrated that the properties were much more uniform. He identified impurities that created the p-n junction that he accidentally obtained during his experimental research. Ohl held four patents on Silicon detectors and p-n junctions.

Devices: Bipolar Transistor		
1945		William Shockley introduced a concept of a semiconductor amplifier operating by means of the field-effect principle, which meant that the application of a traverse electric field would change the conductance of a semiconductor layer. Shockley's surface theory was published in 1947.
1947	 	John Bardeen (top) and Walter Brattain (bottom) constructed a germanium point-contact transistor, and demonstrated that this device exhibited a power gain. An uncertainty however existed on the mechanism responsible for the transistor action. Bardeen and Brattain were convinced that surface-related phenomena had the dominant role in the operation of the device, while Shockley favored bulk conduction of minority carriers. (US Patent No 2,524,035 : 1948).
1948	**William Shockley**	Developed a theory of a p-n junction and a junction transistor. On 26 June 1948 he filed for a patent on "Circuit element utilizing semiconductor material" which was patented on 25 September 1951. (US Patent No 2,569,347 : 1951).
1956	**Shockley, Bardeen and Brattain**	Received the Nobel Prize in Physics.
1972	**John Bardeen**	Received the Nobel Prize for his theory of super conductivity.
1948		John Shive demonstrated a correctly operating pint-contact transistor with the emitter and collector placed on the opposite sides of a very thin slice (10 µm or 0.01cm) of Germanium.

References

Lukasiak, L. & Jakubowski, A. 2010. History of Semiconductors. *Journal of Telecommunications and Information Technology*. 1/2010: 3-9.

Riordan, M., Hoddeson, L. & Herring, C. 1999. The Invention of the Transistor. Reviews of Modern Physics. 71(2): S336 – S345.



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