

Pretoria Branch S₂A₃ News
February 2001

*A newsletter of the Pretoria Branch of the Southern
Africa Association for the Advancement of Science*

Our forthcoming talk:

Date: Monday 5th March, 2001
Time: 17h15 (to 18h15)
Venue: Transvaal Museum, Paul Kruger St.
(Entrance to secure parking from
Minnaar Street, on the south side of
the Museum)
Speaker: Prof C.J.H. Schutte
Topic: Meeting our Ancestors

Refreshments after the talk.

Talk Summary:

Nature recycles dead bodies by a set of complicated decomposition processes. Consequently, we have very little *direct evidence* of how our ancestors actually looked, what they ate, what sicknesses they had, etc. Are there cases where Nature's law of decomposition did not operate? Can we get a glimpse of some of those ancestors, how they looked, how they lived and how they died? Yes, there are *very rare cases* where special conditions prevailed, thus delaying the decomposition processes. Yes, many such bodies have now been found and studied – also in South Africa.

This lecture draws attention to some of the bodies *conserved by accident* in ice, in bogs, on mountains, in deserts, in graves, etc. The examples selected illustrate particular aspects of the life and habits of mankind over roughly 14 000

years. In addition, flesh, as it were, can be “put back” on *bare skulls* by electronic technology so that they suddenly turn into *people*; they can also *lose their anonymity* and become *individuals* by means of DNA-analyses. Yes, we do “meet” some of our ancestors!

Some of the visual material used in this lecture may not be suitable for children.

Subscriptions: 2001

Thanks to all those members who have already paid their subscriptions. The Secretary sends an urgent request to those who have not yet paid, particularly those who subscribe to the SA Journal of Science, to settle their accounts as soon as possible.

Interesting News from the world of Science

A hidden ocean on Ganymede. The largest moon in the solar system, Ganymede joins two of Jupiter's other satellites, Callisto and Europa, in (most likely) possessing a subsurface ocean. In case of Europa, the liquid ocean might lie beneath an Arctic-like icepack with a thickness perhaps only a few km or less. For Ganymede the several-km-deep ocean is thought to reside at a depth of 170 km or so.

At last week's meeting of the American Geophysical Union (AGU) in San Francisco several researchers associated with the Galileo spacecraft summarized the evidence--- visual, infrared, and magnetic for the ocean. James Head of Brown University displayed sharp photographs (resolution as good as 28 m) of the much furrowed surface of Ganymede. The furrows and the many lanes of smooth, bright material running between darker areas (a banding pattern not unlike that found on Europa) suggests not volcanism but the kind of deformations that could be caused by brittle, cold, upper ice layers being fractured by contact with warmer, more ductile, lower ice in contact with liquid water. (The water would be kept liquid by the warmth of radioactivity and also by the

heat generated from the gravitational flexing of the whole moon during its travels near Jupiter.)

Infrared data, reported by Thomas McCord of the University of Hawaii, indicates the presence of the salt minerals (in this case, MgSO₄) needed for making any worldwide water stratum into an electrically conducting circuit. As Ganymede sweeps through Jupiter's potent magnetic field a current could be induced in the saltwater ocean which would modulate Ganymede's own permanent magnetic field. Margaret Kivelson of UCLA reported magnetometer measurements which could best be interpreted as exactly the kind of magnetic moderation one would expect if a deep salt ocean were present. (<http://galileo.jpl.nasa.gov>)

A green ocean in Brazil. Using a sophisticated version of weather radar imaging, scientists have now been able to track the movement of rainstorms and even to measure the amount of rainfall released, and from which altitudes.

At the AGU meeting members of the Tropical Rainfall Measuring Mission (TRIMM) reported the most precise rain maps ever achieved for the region within 38 degrees latitude north and south of the equator, a zone crucial to worldwide weather because of its vast ocean currents, rain forests, and the huge amount of solar radiation falling there. Daniel Rosenfeld of the Hebrew University of Jerusalem said that when air over the Amazon rainforest was clean, storms there unexpectedly rivaled those over the ocean in the amount of rainfall. In other words, Brazil was acting more like a "green ocean" than like a continental land mass.

Rosenfeld explained that although some particulate matter is useful for seeding raindrops, when too many fine particles are present (from wood fires, say) then water droplets are actually inhibited from forming into drops large enough to precipitate. Brazil then, at least during a period of very clear air, could approximate the conditions over the ocean. (<http://trimm.gsfc.nasa.gov/>)

Tilting at optical windmills. One of the greatest challenges facing engineers who design tiny microelectromechanical systems (MEMS) is

finding ways to power machines that often measure only microns across.

The answer, it seems, may be blowing in the optical wind. Researchers at the Hungarian Academy of Sciences have built resin-based structures that operate on principles similar to those that propel windmills. Rather than extracting energy from wind, however, the new devices are driven by beams of light. In one demonstration of the potential for light-powered machinery, an optical vane turned a series of interlinked cogwheels, each only 5 microns in diameter.

The researchers (P I Ormos, pali@everx.szbk.u-szeged.hu) manufactured various shapes for their devices, including helixes and propellers, by curing resin with focused laser light. A particularly promising structure that resembles a common lawn sprinkler (see figure at <http://www.aip.org/physnews/graphics>) spins at several revolutions per second when illuminated by a 20 milliwatt laser beam. In addition to providing torque to miniature gears, pumps, and other micro-machines, the light-powered rotors could be used to measure fluid properties on micrometer scales. Alternatively, it may be possible to study the mechanical properties of certain molecules, such as proteins or DNA, by fixing one end to a surface, attaching a rotor to the other end, and using light to apply a twisting force. (Peter Galajda; P I Ormos, Applied Physics Letters, 8 January 2001.)

Researchers to present evidence of biological cause of dyslexia. Washington, DC - Addressing a long-standing controversy concerning the causes of reading disability, a series of research studies done by a team at the Georgetown Center for the Study of Learning indicate that the areas of the brain used for reading are the same areas used for other visual tasks, and that these areas may not work properly in the brains of people with dyslexia. However, the researchers also found that an intensive, phonologically based reading intervention program could not only improve reading skills in dyslexics, but could also effect changes in brain activity that can be measured using functional magnetic resonance imaging (fMRI) technology.

"These study results are further evidence that dyslexia has biological roots," said Guinevere Eden, DPhil, co-director of the Georgetown Center for the Study of Learning. "The results are significant because they could one day lead to the creation of an early diagnostic test for dyslexia that might allow us to identify the condition in children even before reading difficulties are present, and thereby intervene early to treat the disorder." (<http://www.eurekaalert.org/releases/gumc-grt021401.html>)

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cell: 083 273 3593

Pretoria Branch S₂A₃ News
March 2001

*A newsletter of the Pretoria Branch of the Southern
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Our forthcoming talk:

Date: Monday 2nd April, 2001

Time: 17h15 (to 18h15)

Venue: Transvaal Museum, Paul Kruger St.
(Entrance to secure parking from
Minnaar Street, on the south side of
the Museum)

Speaker: Prof Johannes Odendaal
Institute of Life Sciences
Technikon Pretoria

Topic: Animal-assisted therapy –
Magic or medicine?

Refreshments after the talk.

Talk Summary:

A sound theoretical basis that is supported by scientifically measured physiological parameters is needed to gain medical support for animal-assisted therapy. Six neurochemicals associated with a decrease in blood pressure were measured in humans (n=18) and dogs (n=18) before and after positive interaction. Results indicated that in both species the neurochemicals indicated affiliation behaviour, which could be described as attention-seeking or attentionis egens behaviour. This information can be used as a rationale for animal-assisted therapy.

Editorial

For the last couple of years, Dr Glyn Jones was responsible for producing this newsletter. However, due to work related commitments, he is no longer able to continue. As from this edition, I will be taking over the editing of the S₂A₃ newsletter. I'd like to use this opportunity to thank Glyn on behalf of the members and the committee of the Pretoria branch of the S₂A₃ for the many years of outstanding service.

Walter Meyer

Newsletter by email In order to help us reduce postal costs and at the same time conserve trees, we will in future send this newsletter via email to members who have access to email facilities.

If you would like to receive future copies of this newsletter via email, please send your name and email address to elise@scientia.up.ac.za.

Interesting News from the world of Science

Schonland: Scientist and Soldier A major biography of South Africa's most distinguished scientist of the 20th century by Dr Brian Austin, University of Liverpool, UK

> 640 pages illustrated

> Hardback

> ISBN: 0 7503 05010

> Publication date: May 2001

>

> This biography of Sir Basil Schonland FRS [1896-1972] will be of great

> interest to scientists and engineers, military, political and diplomatic

> historians, and anyone interested in the development of South African

> science.

>

> <http://bookmarkphysics.iop.org>

Refrigerator On A Chip Microelectronic and optoelectronic integrated circuits (ICs) often develop hot spots when run near their maximum outputs, which may dramatically diminish the devices' lifetimes. A research collaboration led by John

Bowers of the University of California at Santa Barbara and Ali Shakouri of the University of California at Santa Cruz is working to ensure that ICs keep their cool with tiny thermoelectric (TE) refrigerators built right on top of the chips. Conventional TE coolers are already used widely to cool semiconductor lasers and other circuitry, but they are manufactured separately from the ICs and later added to the chips. The new superlattice microcoolers are grown directly on silicon surfaces, giving them more intimate thermal contact with the semiconductors and simplifying the overall fabrication process. In addition, TE coolers as small as 40 microns on a side may be precisely located at hot spots to ensure that the cooling winds up in the locations where it can do the most good. Earlier versions of the microcoolers made of silicon and germanium required buffer layers to ease the strain of matching their lattice structures to the underlying silicon substrate. By adding carbon to the mix, the researchers changed the lattice structure enough that they could do without the buffer layers, improving thermal contact and simplifying fabrication still further. Although the superlattice microcoolers have chilled semiconductor surfaces by nearly 7 degrees Celsius, they are still shy of the performance necessary for commercial applications. Theoretical calculations, however, show that a single stage microcooler should be able to provide the tens of degrees of cooling required to make them commercially viable. (Xiaofeng Fan et al, Applied Physics Letters, 12 March 2001.)

First, direct observational evidence of a change in the Earth's greenhouse effect between 1970 and 1997. Scientists from Imperial College, London, have produced the first direct observational evidence that the earth's greenhouse effect increased between 1970 and 1997.

Writing in the journal Nature, researchers in the Department of Physics show that there has been a significant change in the Earth's greenhouse effect over the last 30 years, a finding which is consistent with concerns over so-called 'radiative forcing' of the climate (2).

Previous studies in this area have depended on theoretical simulations because of the lack of data. However the Imperial team reached their conclusions after analysing data collected by two different earth-orbiting spacecraft, in 1970 and 1997.

Comparison between the two data sets has unequivocally established that significant changes in greenhouse gas emissions from the Earth have caused the change to the planet's greenhouse effect over this time period.

Professor John Harries, the lead author of the paper says: "These unique satellite spectrometer data collected 27 years apart show for the first time that real spectral differences have been observed and that they can be attributed to changes in green house gases over a long time period."

The team examined the infrared spectrum of long-wave radiation data from a region over the Pacific Ocean, and also over the whole globe. They discovered significant differences in the levels of atmospheric methane, carbon dioxide, ozone and chlorofluorocarbons 11 and 12 between the data, collected in 1970 and 1997.

"The scientists found that by taking the difference between the two sets of data for the same region, they observed the change in the outgoing longwave radiation, and therefore a change in the greenhouse trapping by the atmosphere."

Although the two experiments were flown on separate spacecraft, 27 years apart, the team showed that their comparison of outgoing infrared long-wave radiation spectra is valid. Even allowing for the different spatial and spectral resolutions of the two instruments, there are significant changes in the spectra of the greenhouse gases of the Earth, over this time period.

The team took a number of steps to ensure that their data was reliable. The effects of cloud cover were effectively removed by using a cloud-clearing algorithm. The resulting two datasets were of comparable resolution and representative of clear-sky conditions. To reduce 'noise' in the data, the team selected several regions of the globe and calculated clear-sky average spectra. To avoid

seasonal artefacts they used only selected data from the same 3-month period (April – June).

Dr Helen Brindley, second author on the paper says: "Through our modelling studies using independent knowledge of the atmospheric state we have shown that the magnitude of the changes observed can only be explained by long-term changes in the greenhouse gases such as carbon dioxide, methane, and chlorofluorocarbons."

Professor Harries described the next challenges for the team: "The next step is to assess whether these data can provide information about changes in not only the greenhouse gas forcing, but the cloud feedback, which is a response of the cloud field to that forcing."

"We must also work to test agreement with the general circulation models used in climate change experiments. These use basic knowledge of expected changes in climate forcing (for example changes in greenhouse gas amounts, solar constant) to predict the climate response."

"Since these are the models used to predict future climate, and influence policy decisions, it is imperative that they can accurately simulate measurements of what is considered to be the driving mechanism behind climate change."

"We are only at the beginning of making use of these spectral observations. Much more information is locked up in the data that we have. This provides a strong motivation for the launch of similar instruments to monitor the state of our climate." – Nature 410, 355 - 357 (2001)

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Pretoria Branch S₂A₃ News
April 2001

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Our forthcoming talk:

Date: Monday 7th May, 2001

Time: 17h15 (to 18h15)

Venue: Transvaal Museum, Paul Kruger St.
(Entrance to secure parking from
Minnaar Street, on the south side of
the Museum)

Speaker: Dr Ansie Dippenaar-Schoeman
Biosystematics Division: Arachnology
Plant Protection Research Institute
Agricultural Research Council

Topic: Spiders, a wealth of information still
to be tapped.

Refreshments after the talk.

Talk Summary:

The spider fauna of South Africa are remarkably rich when compared with some other faunas of the world. A total of 67 families of the world's 106 spider families occur in this region represented by 429 genera and about 2950 species. Although South Africa represents only 0.8% of the world's total land area it is recognized by the World Conservation Monitoring Centre (1992) as the third most biologically rich country in the world (after Brazil, Indonesia). It contains 8 % of the world's vascular plants, 6-7 % of the terrestrial mammals and 9 % of the spiders. However the taxonomic information on Southern African spiders are still rudimentary and only 144 genera have been revised (33 %). On average these revisions

recognize 41% species as new while 23% are indicated as new synonyms. Of the known genera 56% are endemic to the region while 8.6% show Gondwanian elements in their distribution.

Some topics covered in the talk are:

- Why are spiders as a group so successful?
- Where are spiders found?
- What are spiders' role in nature?



A baboon spider of the family Theraphosidae.

Interesting news from the world of science

Turning stars into gold Many common elements, such as oxygen and carbon, are known to be made in stars and distributed through the Universe when a star explodes as a supernova. This is the origin of most of the material that makes up the Earth.

It is becoming clear, however, that normal stars cannot make enough of the heavy elements, such as gold and platinum. Thus the origin of gold and platinum - on Earth and throughout the Universe - remains a mystery.

Dr Stephan Rosswog and co-workers from the Universities of Leicester, UK, and Basel, Switzerland, reported to the UK National Astronomy Meeting on Thursday 5 April about a new way to make gold, platinum and other heavy elements.

Rosswog's team has explored the idea that these heavy elements were formed in the violent collisions of super-dense neutron stars. These stars – the dead cores of old stars – weigh a million times more than the Earth but are only the size of London.

Neutron stars are sometimes found close together in pairs and Dr. Rosswog has calculated what happens when these binary stars are close enough to collide. In addition to a huge amount of energy released - enough to fuel the most powerful explosions in the Universe (known by astronomers as gamma-ray bursts) - he has found that a large quantity of gold and platinum is made and thrown out into space.

The calculations were performed on a new supercomputer at the UK Astrophysical Fluids Facility (UKAFF) based at the University of Leicester. The results indicate that the relative amounts of elements formed in his models of colliding neutron stars match those seen in our Solar System. This provides strong evidence that most of the gold and platinum on Earth was formed in the violent collisions of distant stars.

Dr. Rosswog says, "This is an incredible result. It's exciting to think that the gold in wedding rings was formed far away by colliding stars."

For more details and pictures see:
<http://www.ukaff.ac.uk/movies/nsmerger/>

A photonic transistor A photonic transistor, which uses one laser to control the amplification of signals in another laser beam, has been developed by researchers at the National Institute of Advanced Industrial Science and Technology in Tsukuba, Japan. The development represents the latest attempt to streamline optical systems. In contemporary optical devices, signals encoded in light must be converted to electrical signals to be manipulated and subsequently converted back to light for transmission. The scheme leads to complex hybrids of optical and electrical components, with high speed optical data transmission interrupted by sluggish electronics.

The novel optical transistor involves two lasers, one red and one blue, focused at the same spot on a thin film composed of metal and plastic layers. The lasers form energy-storing plasmons, local groups of collectively moving electrons, on the surface of the film. One of the lasers, usually the red one, also generates a light-scattering particle of silver in a layer of silver oxide that comprises a portion of the film. The silver particle couples energy from the plasmons into the other laser beam, enhancing a signal in the blue beam by up to sixty times. The power of the red beam determines the size of the scattering silver particle and, therefore, regulates the magnitude of the energy coupled from the plasmons and the resulting amplification.

If the new device can be sufficiently perfected, photonic transistors may become building blocks in all-optical circuits analogous to, but much faster than, modern electrical circuitry. (J. Tominaga et al, Applied Physics Letters, 23 April 2001; text at Physics News Select)

Aerobic exercise can work faster than drugs to lift depression Aerobic exercise can work faster than drugs to lift depression, finds research in the British Journal of Sports Medicine. (Benefits from aerobic exercise in patients with major depression: a pilot study 2001; 35:114-17)

Twelve people with severe depression that had lasted an average of nine months exercised daily for 10 days. Their average age was 49; seven of them were women. In 10 patients drugs had failed to substantially improve symptoms. The exercise entailed walking on a treadmill for 30 minutes every day. Three minutes of intense activity were alternated with walking at half speed for three minutes. The intensity was increased as heart rate adapted to the training programme.

Depression severity was measured at the start and end of the programme, and patients also rated their mood at the beginning, middle, and end of the 10 days, using a recognised evaluation scale.

After 10 days, six patients were substantially less depressed, including five in whom drug treatment had been largely unsuccessful. Two were slightly less depressed, while the severity of symptoms remained the same in four patients. Overall, depression scores fell by a third, and self assessed scores fell by 25 per cent. Six patients asked to continue the programme.

The authors are at pains to point out that this is a small study. Nevertheless, they say that the extent of the improvement is impressive, given that antidepressants normally take two to four weeks to work. "The observed outcomes indicate a clinical benefit not obtainable with currently available pharmacological treatments," they conclude. And the programme might be particularly suitable for those in whom drug treatment does not seem to work, they say.

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Our forthcoming talk:

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Time: 17h15 (to 18h15)

Venue: Transvaal Museum, Paul Kruger St.
(Entrance to secure parking from
Minnaar Street, on the south side of
the Museum)

Speaker: Dr Ina Plug
Former Deputy Director,
Transvaal Museum

Topic: **Throwing the Bones:
A glimpse of our past**

Refreshments after the talk.

Talk Summary

Old bones tell many stories. By studying bones from archaeological sites we can learn much about our past that cannot be studied by other means. The animal bones tell us about past climates and climate change, past environments, past animal distributions, human diet, the processes of domestication, herding practices, ritual use of animals and much, much more. Archaeozoology, or zooarchaeology as it also frequently referred to, takes over where palaeontology leaves off, namely from about 1.5 million years ago to as recent as the mid 20th century. Where palaeontology seldom has to deal with human culture, archaeozoology has to take human activities very much into account, as people were responsible for most of the bone

accumulations the archaeozoologist studies.

The expertise needed for this work covers several areas of specialization. A good faunal analyst must be well versed in the history and archaeology of the region studied, zoology, environmental conditions, and the comparative skeletal anatomy of primates to molluscs and everything in between.

This lecture, illustrated with slides, will deal with aspects of the work of an archaeozoologist in South Africa. Reference will be made to climatic changes in the past and how they influenced the life of humans, kitchen secrets of hunter-gatherers, the origins of our domestic animals, the coming of mixed farming to South Africa, ritual use of bone, and life in a small Voortrekker village.

2001 Annual General Meeting

All members are invited to attend the AGM of the Pretoria Branch of the S₂A₃, to be held at the Transvaal Museum on the 4th June 2001 at 17h00 (just before the monthly talk). As has become tradition, the meeting will be kept as short as possible and should not take longer than the scheduled 15 minutes.

Interesting news from the world of science

Schonland: Scientist and Soldier. IOP Publishing has published a major biography of South Africa's most distinguished scientist of the 20th century. The book is by Dr Brian Austin, University of Liverpool, UK, ISBN: 0 7503 05010.

This biography of Sir Basil Schonland FRS [1896-1972] will be of great interest to scientists and engineers, military, political and diplomatic historians, and anyone interested in the development of South African science. For more information see <http://bookmarkphysics.iop.org>.

Flying becomes even more dangerous. Even if you survive the in-flight food and seat-induced deep

vein thrombosis, repeated jet lag without time to recover could shrink bits of your brain. According to a paper by Dr Kwangwook Cho of the University of Bristol, published in Nature Neuroscience, five years of long-haul travel without rest time shrivels parts of the cortex and hippocampus, the thinking and learning parts of the brain.

Cho, who last year found that female cabin crew suffer poor memory and increased levels of the stress hormone cortisol after repeated long flights, imaged the brains of 20 air hostesses working for international airline companies.

The group that had less than five days to recover when they flew over more than seven time zones showed significant shrinkage compared with those given a full two weeks to recover. The more demanding schedule also cut the women's ability in spatial learning and memory tasks.

"It's tantalizing stuff," says Charalambos Kyriacou, who studies biological rhythms at the University of Leicester, UK.

According to Kyriacou, jet lag confuses the master body clock in the brain, the supra-chiasmatic nucleus, which sends out signals — such as boosted cortisol levels — to reset the rest of the body. A withering hippocampus may be the result of disrupted cell division by these signals, he speculates.

"Your brain resets quickly but your different organs reset more slowly," Kyriacou says — it's this that makes us feel lousy. To avert air-hostess brain syndrome, Cho recommends allowing plenty of time to recover after a flight.

Computing with waves. Conventional computers do their jobs by using electrons as billiard-ball like particles to move around circuits and carry out the desired tasks. At last week's CLEO/QELS lasers/optics conference in Baltimore, a University of Rochester group (Ian Walmsley, 716-275-0312, walmsley@optics.rochester.edu) presented a simple optical system that performs a database search of 50 items in a way that cannot be duplicated in any particle-powered computer. To do

the search, the researchers use wave interference, the patterns that are created when two waves, such as light waves, combine. While their demonstration is not any more efficient than traditional database searches, it is the largest search performed with wave interference. It is a follow-up to a similar demonstration in an atom (Ahn et al., Science, 21 January 2000) and expands possibilities for "wave computing" which would be intermediate in power between classical computing and quantum computing. In addition, the Rochester group uses light, which is much easier to prepare and transport than atoms.

In their demonstration, the researchers produce a single pulse of light carrying a spectrum of different colours, each containing a different bit of information. They split the pulse into two identical pulses each with half the intensity. One travels to an "Oracle," an optical element (an acousto-optic modulator), which for certain colours shifts their phase, the relative position of the peaks of the wave compared to other colours. Then they combine the Oracle pulse with the other, untreated pulse at a beam splitter, which produces two output beams, each going in different direction. Only the components of the beam which have their phases changed travel toward a spectrometer and detector, enabling the researchers to read out the information and determine the location of the desired item in the database. (Paper QWB3; http://www.osa.org/mtg_conf/CLEO/)

The limits of superluminal propagation. Last year, L.J. Wang and his colleagues at the NEC Institute reported that a composite wave pulse traveled with little distortion through a medium at a group velocity faster than c , without violating Einstein's theory of relativity, or the notion that cause precedes effect.

Sent into a chamber of specially prepared cesium atoms, the light pulse exited the chamber before the peak of the input pulse entered it. This can happen because the early part of the pulse, made of many component waves, contains all of the information in

the wave. Once inside the chamber, the pulse is rearranged such that the peak reappears at a position a little farther ahead in the chamber. This causes the composite pulse to emerge from the chamber earlier than if it had been travelling through the chamber at the speed of c . Potential applications involve the possibility of shuttling along light waves faster in applications such as telecommunications and computers.

How to define and analyse the speed of signal transfer in that set-up is a subject of a new paper by the same researchers, along with two other physicists: Peter Milonni of Los Alamos and Raymond Chiao of UC Berkeley (chiao@physics.berkeley.edu). They consider the effect that quantum noise, due in part to random spontaneous emission by the medium, has on the reliability with which a signal can be measured. The more one tries to push along the signal in the medium, the greater the number of noise-producing, signal-obscuring spontaneous emissions that occur, and any attempt to boost the signal's intensity to make it more detectable introduces delays such that the signal velocity always ends up to be less than c . Therefore, the signal velocity is defined operationally as an optical signal-to-noise ratio. In summary, the researchers extended the special relativity speed limit of c for sharp wavefronts (which act like "on-off" signals), to that of a more realistic smoothly varying signal, based on a speed limit set by quantum fluctuations. (A Kuzmich et al., Phys. Rev. Lett., 30 April 2001.)

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Pretoria Branch S₂A₃ News

July 2001

A newsletter of the Pretoria Branch of the Southern Africa Association for the Advancement of Science

Our forthcoming talk:

Date: Monday, 6th August 2001

Time: 17h15 (to 18h15)

Venue: Transvaal Museum, Paul Kruger St.
(Entrance to secure parking from Minnaar Street, on the south side of the Museum)

Speaker: Prof Dave Berger
Department of Botany
University of Pretoria

Topic: The DNA Microarrayer at the University of Pretoria:
From genes to solutions:

Refreshments will be served after the talk.

Talk Summary

The Faculty of Natural and Agricultural Sciences at University of Pretoria has installed a state-of-the-art DNA Microarrayer. The CSIR made a contribution towards the purchase of the Microarrayer system, as part of the convergence in the area of Biotechnology.

DNA microarraying is new to Africa, and is revolutionising Biotechnology research worldwide. Core microarray facilities are being set up in many Universities and Institutions overseas that are serious about establishing a Biotechnology platform.

A microarray system enables scientists to measure differences in thousands of genes in a single experiment, representing a giant leap forward in speed and precision of biological research – with

applications in Medicine, Veterinary Science and Agriculture. It is made up of two components - a

microarrayer and a scanner. The microarrayer is a robotic workstation, which is able to "print" over 10000 samples of DNA (genes) on a 1 X 1 cm area of a standard microscope slide. The slide is then "probed" with genes from two different cell types, each labelled with a different dye. The "readout" is determined by a scanner, which displays an image of the grid showing the relative amount of fluorescence at each of the 10000 spots. Thereby, 10000 genes can be studied in a single experiment.

The Human Genome Project in which the DNA sequence of a human was deciphered for the first time in February 2001 produced essentially a gene "list", stored in a super-computer. DNA microarray technology enables scientists to make sense out of this "list". Applications in the study of HIV/AIDS, cancer, influenza, and heart failure have already been reported in the literature. The instrument at the University of Pretoria will provide the flexibility for local scientists to study not only human disease, but also other important Industrial, Veterinary and Agricultural applications.

In this talk the methodology and potential of DNA Microarraying will be described, with some focus on applications in Agriculture, which is the specific interest of the speaker.

Biography of a South African scientist

Dr Hans Merensky

Born at Botshabelo (Transvaal) 6.3.1871

Died on his farm Westfalia (Transvaal) 21.10.1957

Few men in South Africa have so many living monuments to their credit as Hans Merensky. His geological discoveries of gold, the large platinum and chrome deposits and the high quality vermiculite deposits at Palaborwa; the rich diamond fields on land and in the sea on the Cape West Coast, all of which bear testimony to this remarkable man's legacy. Scattered all over South Africa thousands of people from as far a field as the Ivory Coast. Malawi, Mozambique, Zambia, Swaziland and many other countries on the African continent work and earn

their living and support their families.

Hans Merensky spent the first eleven years of his

life on the Botshabelo Mission Station. His Lutheran Missionary parents, however, returned to Germany in 1882. There he completed his schooling and attended Technical School and later qualified as a Geologist and Mining Engineer at the Berlin University.

Merensky returned to South Africa in 1904 and was held in great esteem by the mining fraternity right from the outset of his long career.

After the Anglo Boer War it was boom time in the country. Mines were developed and Merensky's services were in constant demand. The Johannesburg Stock Exchange flourished and he invested heavily, not only his own money, but also that of friends and family. Hans Merensky the poor Mission-born lad became an exceedingly rich man, as did his family and friends.

Although born in South Africa, Merensky suffered the ignominy of being interned during the First World War. With the war raging in Europe the Stock Exchange situated in Johannesburg crashed. Not only did Merensky lose his money, but also that of members of his family and friends who entrusted their money into his care.

During the lean years that followed a friend of Merensky's took care of him. Slowly but surely the tide turned to his advantage and during the 1930's and '40's he vindicated himself by his formidable discoveries. Once again Merensky became an extremely wealthy man. At last he was able to reimburse that which he owed others.

Yet once again a callous Government interned him at the onset of the Second World War. Hans Merensky, the eternal bachelor, had to remain on his farm "Westfalia" situated in the Leydenburg district.

Despite this shabby treatment, Hans Merensky invested his wealth to the benefit of the country at large. He supported universities, schools and hospitals. He established the first Agricultural school and funded libraries. He founded the Faculty for Forestry at the Stellenbosch University amongst a host of other bequests.

Hans Merensky died at the age of 81. With the money he left a Trust Fund was established to ensure the continuation of his work in the interest of the country of his birth.

Esme den Dulk.

Interesting news from the world of science

UMass Researcher Solves the Mystery of the Shower Curtain AMHERST, Mass. – There's no way to get rid of the daily annoyance of the shower curtain billowing in and sticking to an exposed body part, but there's now a way to explain the phenomenon, thanks to a researcher at the University of Massachusetts.

David Schmidt, assistant professor in the mechanical and industrial engineering department, decided to map the forces acting on a shower curtain. Schmidt's areas of expertise include computer modelling of sprays, and the shower curtain question is one he's run into several times during his career. "This is a popular question," Schmidt said. "It's nice to have the answer key."

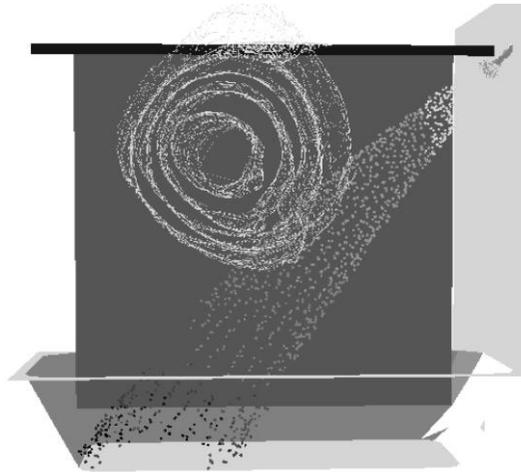
It's not as simple as it first appears. Until now, the explanation for the shower curtain's movement has been theoretical. "It's been one person's opinion versus another's," Schmidt said. With software designed by Fluent Inc., a New Hampshire-based software company, and modified by Schmidt to include spray capabilities, he decided, "I can do this. I thought it would be fun to use these tools to say more definitively what the effect was."

Using the Fluent software and two weeks' of time on his home computer, Schmidt drafted a model of a typical shower, divided the shower area into 50,000 miniscule sections, and let the software run. The software applies a technology called computational fluid dynamics to solve conservation of momentum and conservation of mass for each of the 50,000 sections over 30 seconds of actual shower time.

"What makes the shower curtain suck in is that you have low pressure on the inside and high pressure on the outside," he said. Schmidt discovered that there are two forces creating the low pressure inside the shower – Bernoulli effect and driven cavity – and it's the combination of these forces that has never been put forward.

The Bernoulli effect is the principal behind flight and an airplane's wings producing lift. The Bernoulli effect is seen near the showerhead, as air moves faster on the shower side of the curtain and pressure drops to vacuum pressure. Driven cavity involves the shower's spray. Though the drops are

being accelerated by gravity, they're actually slowing down due to aerodynamic drag, Schmidt said. "And



for every action there's an equal and opposite reaction, and the opposite reaction is the air has to start moving. That's what makes this whole flow go." The air begins moving in a stable circle, called a vortex, "just like a dust devil indoors. This one, unlike a dust devil, doesn't die out because it's continuously driven by the shower."

Anyone can try to test Schmidt's model. "The best way to see it is to turn on the shower – cold water will do fine. Use a light, thin shower curtain and a strong showerhead. Stand outside the shower, stick your head in, and blow in smoke."

<http://www.umass.edu/newsoffice/archive/2001/070901shower.html>

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Pretoria Branch S₂A₃ News

August 2001

A newsletter of the Pretoria Branch of the Southern Africa Association for the Advancement of Science

Our forthcoming talk:

Date: Monday, 3rd September 2001

Time: 17h15 (to 18h15)

Venue: Transvaal Museum, Paul Kruger St.
(Entrance to secure parking from Minnaar Street, on the south side of the Museum)

Speaker: Dr Ludwig Combrinck
Programme Leader for Space Geodesy at the Hartebeesthoek Radio Astronomy Observatory

Topic: **Benefits of Space Geodesy to the Man in the Street**

Refreshments will be served after the talk.

Talk Summary

Space Geodesy uses advanced scientific instrumentation and techniques to measure the position of geodetic stations on Earth to a very high degree of accuracy. Radio astronomy telescopes, satellite laser ranging and the Global Positioning System are three of the important scientific systems used.

The data retrieved are used to measure the rotation rate of the Earth, plate tectonics and crustal dynamics. It provides us with information about sea level heights, satellite orbits, the Earth's gravity field and provides a fixed reference frame for high precision position observations.

But what does all of this mean to the man in the street? How do we all benefit from Space Geodesy?

Interesting news from the world of science

New "Mighty Mice" research brings muscle growth closer to reality

The Johns Hopkins scientists who first created "mighty mice" by genetically engineering animals with a missing growth regulator called myostatin have now created a second group of mice whose genetic makeup shows it's possible to get the same effect by blocking the gene for myostatin, rather than entirely knocking it out.

Reporting in the July 16 issue of the Proceedings of the National Academy of Sciences, the researchers say they have identified several proteins (follistatin, mutant activin type II receptors, and myostatin propeptide) that can block the activity of myostatin. Moreover, they have engineered mice with normal myostatin, but various levels of these blockers.

"By expressing high levels of these proteins in mice, we have been able to increase muscle mass to levels comparable to those seen in mice completely lacking myostatin," says Se-Jin Lee, M.D., Ph.D., lead author of the Hopkins study. "Although more study is needed to prove that these mice are good models for humans and to find other myostatin signalling components, our work suggests that these kinds of myostatin antagonists may be effective muscle-enhancing agents for both human and agricultural applications.

The 1997 report from Lee and his colleagues focused on the muscle-building capability of knocking out, or deleting the myostatin gene, to allow the build-up of skeletal muscle in the animals.

"Until now, it's been purely theoretical that we could block the gene and obtain the same muscle-building effect as deleting the gene," Lee continues.

The researchers discovered that while mice that were engineered to produce large amounts of follistatin exhibited the most herculean muscles, the other two groups, one with excess mutant activin II receptors and one with myostatin peptide, also showed increased muscle growth.

Scientists are hopeful that the finding will provide new opportunities to treat many muscle-wasting diseases like muscular dystrophy or cachexia, the muscle loss that accompanies some cancers and

AIDS. Blocking myostatin in animals could also create livestock with more meat and relatively less fat.

"The agricultural applications are probably more straightforward, since conceivably, one could try to find ways to block myostatin activity early during development," says Lee. "For human applications, this research is just the beginning."

Among the important remaining questions is whether blocking myostatin postnatally, as would be required to treat human diseases, is effective. "These proteins all block myostatin outside the cell, so we need to see if administering these proteins, rather than altering the genome, can provide similar results," he explains.

<http://www.hopkinsmedicine.org/press/2001/JULY/010717.htm>

Synthetic antifreeze could prevent ice growth

A fish swimming in icy polar waters is helping scientists find ways to protect food from freezer burn, save fruit crops from frost, and use low temperature storage in complicated medical procedures like human organ transplants, researchers report.

A way to make large amounts of artificial antifreeze safe enough to use in living organisms has been developed by researchers looking at the "biological" antifreeze used by Arctic and Antarctic teleost fish, according to a report in the September/October issue of Bioconjugate Chemistry, a peer-reviewed journal of the American Chemical Society, the world's largest scientific society. The report will be presented August 30 at the Society's 222nd national meeting in Chicago.

A big problem with the freezing process in medical and industrial applications is that the formation of ice crystals damages living material. Certain organisms like the fish, however, have developed a successful defense — a naturally produced antifreeze called antifreeze glycoprotein, or AFGP. The biological AFGP in fish, and in some amphibians, plants and insects, prevents the growth of ice in those life forms, scientists have found.

While researchers have known about the glycoproteins for many years, they have been unable to produce large or stable enough copies for commercial applications, and the use of the natural compounds themselves is too labor and cost-

intensive to be practical.

Even though researchers do not precisely understand the mechanism by which the AFGPs function, they have been able to modify the structure of the fish AFGP enough to build a longer lasting mimic, a lot like the native AFGPs, according to Robert Ben, Ph.D., who led the research team from the State University of New York in Binghamton. Ben says the new method can easily produce large quantities of the compound that yield only to inhospitable conditions like extremely high or low temperatures.

The new synthetic proteins "are dramatically different from the natural antifreeze glycoprotein, but still display the ability to inhibit ice growth," Ben said. "This is very significant and may mean a real leap forward in the design of such compounds; we think this is incredibly promising for a number of applications."

Among potential uses for synthetic AFGP's: a frost protection spray for crops that could expand growing seasons and even allow fruits to grow in more northern climates. He also believes elimination of freezer burn is possible, along with the preservation of human organs and tissues for transplantation.

In essence, Ben reports, the new method replaces a weak chemical bond in the natural antifreeze with a far more durable one, but further study to develop greater strength in the artificial glycoprotein is ongoing. He said he anticipates that researchers will construct different variations of the modified antifreeze for different applications.

The research cited above was funded by the American Chemical Society, the U.S. National Institutes of Health and A/F Protein, a biotechnology firm in Waltham, Mass.

<http://center.acs.org/applications/news/story.cfm>

Ozero Baykal or Lake Baikal Lake Baikal is situated in the Southern part of Eastern Siberia and straddles the Republic of Buryati and the Irkutsk Province in Russia.

It is the oldest existing freshwater lake on earth, perceived to be 20-25 million years old. And the deepest continental body of water, with a depth of up to 1,620 metres. The influx of water into Lake Baikal

is primarily from the 336 rivers and streams. The most important of which are the Selenga, the Barguzin, Upper Angara or known as the Verkhnyaya, the Chikoy and Uda rivers. The outflow, however, is by means of only two rivers, the Angara and a tributary of the Yenesey.

Because of the breaks in the earth's crust which produces hot mineral water spring under water, the Baikal climate is much milder than that of the surrounding territory with an average winter temperature of minus 21 degrees and a summer temperature rising to a 10 to 12 degrees Celsius. This in stark contrast with the rest of Siberia where temperatures plummet to minus 59 degrees in places and never rise much above the zero mark in summer.

The word Baikal means Rich Lake.

There are between 1,500 to 1,800 animal species at different depths and hundreds of plant species which live on or near the surface. There are some 50 species of fish of which the Siberian Sturgeon is the largest, many measuring up to two metres. The smallest of the world's seals, the Baikal seal or Nerpa, is the only mammal and is found everywhere in the lake. It is surmised that the seals were brought from the Arctic regions to the Baikal during the thawing of one or other of the Ice Ages. During the ensuing millennia the seals have adapted to their freshwater habitat. It is a birdwatchers paradise with 320 bird species to look at.

Industries along the shore of the Baikal include Mica and Marble mining. Timber from the adjoining Taiga, the vast Siberian forests. This is processed at the sawmills and pulp and paper factories. There are shipbuilding yards and naturally a thriving fishing industry.

The lake is 636 kilo metres in length. It is estimated that it contains 1/5th of the world's fresh water. In spite of the spectacular views from the surrounding mountains rising to 2000 metres above the surface of the lake and the many hot water springs on land, creating a tourist haven, scientists and environmentalists have cause to worry about the degree of pollution and industrial waste in the region.

extract from The World Lakes Database

Esme den Dulk

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September 2001

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Our forthcoming talk:

Date: Monday, 1st October 2001
Time: 17h15 (to 18h15)
Venue: Transvaal Museum, Paul Kruger St.
(Entrance to secure parking from Minnaar Street, on the south side of the Museum)
Speaker: Dr George Makuka
National Research Foundation
Topic: *Indigenous Knowledge Systems*

Refreshments will be served after the talk.

Talk Summary

Indigenous knowledge systems refer to the complex set of knowledge and technologies existing and developed around specific conditions of populations and communities indigenous to a particular geographic area, or on account of their descent from populations which inhabited the country at the time of conquest or colonisation or the establishment of present state boundaries. These populations, irrespective of their legal status, retain some or all of their own social, economic, cultural and political institutions. In the case of this focus area, indigenous knowledge refers to knowledge developed by these populations in themselves, and knowledge developed through interaction with other populations in South Africa.

An understanding is required of indigenous knowledge and its role in community life from an integrated perspective that includes both spiritual and material aspects of a society as well as the complex

relation between them. At the same time, it is necessary to understand and to explore the potential contribution of indigenous knowledge to local development. The protection of indigenous knowledge and its utilisation for the benefit of its owners and the communities where it is practised requires research.

Indigenous knowledge should be brought into the mainstream of knowledge and its place within the larger body of knowledge be established. The socio-economic potential of indigenous knowledge should be considered, as well as the non-socio-economic values, such as the impact of indigenous knowledge on lifestyles and the ways in which societies are run. Research into indigenous knowledge systems, however, should ideally be carried out with the participation of the communities in which it originates and is held.

Interesting news from the world of science

Mark Shuttleworth to be first African in space Mark Shuttleworth, SA's first Internet billionaire, is also destined to be the first African in space. Currently training at Star City, outside Moscow, Mark hopes to be on the April 2002 Soyuz mission to the International Space Station (ISS). Mark is training as a cosmonaut, and plans to conduct scientific experiments in space.

Mark has assembled a high-powered panel of experts amongst the academic fraternity in Africa, to supervise the scientific programme. Luminaries, such as Professors Malegapuru Makgoba, Tim Noakes and Dr. Romilla Maharaj, head up the team that will assess submissions from researchers who want their experiments to be conducted on the ISS.

Mark is looking for proposals on experiments that can be performed during a flight in April 2002. This is an enormous opportunity for Africa, as the experiments will be performed in a \$95 billion laboratory that has been specifically designed by the world's most technologically advanced nations. Many countries are working to send experiments to the ISS at an enormous expense to their academic communities. South Africa will get this unique opportunity to perform world-class science in this laboratory at no cost to the taxpayer.

For more details of the available facilities see <http://markshut.temp.veriohosting.com/index.htm>.
(<http://www.scienceinafrica.co.za/2001/september/space.htm>)

Magic layer allows for the growth of GaAs on silicon. Motorola Labs scientists are the first to successfully combine the best properties of workhorse silicon technology with the speed and optical capabilities of high-performance compound semiconductors that are known as the III-V materials.

The discovery, which solves a problem that has been vexing the semiconductor industry for nearly 30 years, opens the door to significantly less expensive optical communications, high-frequency radio devices and high-speed microprocessor-based subsystems by potentially eliminating the current cost barriers holding back many advanced applications. For consumers, the technology should result in smarter electronic products that cost less, perform better and have exciting new features. The technology will change the economics and accelerate the development of new applications, such as broadband "fiber" cable to the home, streaming video to cell phones and automotive collision avoidance systems. Other potential markets include data storage, lasers for such consumer products as DVD players, medical equipment, radar, automotive electronics, lighting, and photovoltaics. Until now, there has been no way to combine light-emitting semiconductors with silicon integrated circuits on a single chip, and the need to use discrete components has compromised the cost, size, speed and efficiency of high-speed communications equipment and devices. Specifically, the discovery impacts the semiconductor industry by:

- Increasing substrate size, reducing substrate cost and processing costs for III-V manufacturing
 - Integrating the superior electrical and optical performance of III-V semiconductors with mature silicon technology to create a new industry based on Integrated Semiconductor Circuits
 - Extending the life of silicon and existing capital investments
 - Improving cost effectiveness for higher performance applications such as optical communications
 - Enabling larger scales of integration
- "This is a tremendous achievement by our

scientists and one that has the potential, when fully commercialized, to transform the industry in a way that is similar to the transition from discrete semiconductors to integrated circuits," said Dennis Roberson, senior vice president and chief technology officer, Motorola, Inc. "Motorola's announcement that they have successfully made GaAs transistors in a thin layer of GaAs grown on a silicon wafer could go down in history as a major turning point for the semiconductor industry," said Steve Cullen, director & principal analyst, Semiconductor Research, Cahners In-Stat Group.

The technology enables very thin layers of so-called III-V semiconductor materials (which include gallium arsenide, indium phosphide, gallium nitride and other high performance / light-emitting compounds) to be grown on a silicon substrate. Until now, this has been a virtually impossible task due to fundamental material mis-match issues. Specifically, the underlying crystalline structures of silicon and the various III-V compounds do not match. As a result, previous industry attempts to combine them resulted in dislocations or "cracks" in the material as the two mismatched structures struggled to bond. The key to solving the problem was introducing an intermediate layer of material between the silicon and the III-V material. The solution was found in discovering exactly the right "recipe" for a material that would easily bond with both silicon and GaAs, reducing the strain between the two target materials in the process. The idea was originally developed by Motorola Labs' scientist, Dr. Jamal Ramdani. Developing and proving the exact recipe and process grew out of work done by a broad team of scientists and engineers. Motorola Labs is now working on developing the optimum intermediate layer for indium phosphide and other materials.

Motorola Labs created the world's first 8" GaAs on silicon wafer and worked with epitaxial wafer manufacturer IQE to create the world's first 12-inch GaAs on silicon wafers and a variety of other wafer sizes. Motorola then made working power amplifiers from GaAs on silicon wafers and successfully completed numerous wireless calls using those devices in several phones over the past few months. In addition, a light-emitting device was created to demonstrate the optical characteristics. "GaAs on

silicon is just the first step and has created a baseline technology for extending our research to other materials systems," said Dr. Jim Prendergast, vice president and director, Motorola Labs, Physical Sciences Research Lab. "One of our next goals is to complete the task of growing indium phosphide on silicon. This technology should support chip clock speeds of more than 70GHz and long-wavelength lasers that are critical to fiber-optic communications."

Until now, the industry has been dependent on costly gallium arsenide and indium phosphide wafers for optical and high performance applications. Because of their brittle nature, no one has previously been able to create commercial GaAs wafers larger than 6 inches or InP wafers larger than 4 inches. Scientists have also been unable to combine light-emitting semiconductors with silicon integrated circuits on a single chip. "More than 90 percent of the existing fiber optic cable is still unused and underutilized," said Bob Merritt, vice president, Semico Research Corporation. "This technology could be the switch that eventually turns on those communications channels." Plans to Commercialize Motorola has filed more than 270 patents on inventions related to this new technology and the company intends to broadly license the technology.

Research within Motorola Labs will present at the Materials Research Society Workshop in Chattanooga, Tennessee on September 11, 2001.

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