WATTnow

Be Enlightened

Forget sport – in science let's keep co-operating

Global recession and SA's own relegation battle

Use a Wii to mow your lawn

Muslim worshipper praying in the wrong direction

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May 2009

SKA represents much more than kudos

The Square Kilometre Array (SKA) is a remarkable project that will provide either South Africa or Australia with an exceptional opportunity to host the world's most advanced and sophisticated radio telescope. The decision on which country will be awarded that privilege will only be taken in 2011.

But it is refreshing to realise that South Africa itself – whether it hosts the SKA or not – will benefit from far-reaching scientific developments that will spin from this project. As one of 19 countries involved in the SKA, South African scientists will have a direct link with some of the finest astronomers and scientists working in institutions in various parts of the world.

Moreover, with the development of MeerKAT (the Karoo Array Telescope) South Africa's scientists, engineers and technicians are proving that the local community has the necessary ability to not only host the SKA but to understand the technology required and, where possible, improve on it as well.

Many engineers may be unaware of the fact that South Africa computer programmers are regarded as among the finest in the world — and with good reason. Many young 'propeller heads' have migrated from Centurion to Silicon Valley and made themselves irreplaceable in the top computer companies and software development firms situated there.

In fact, one just has to look at Mark Shuttleworth for a shining example of what a propeller head can do when faced with a task that needs a solution – whether it is a neat algorithm or a clever program.

There is no doubt that South Africa has an abundance of talent – whether it is in the science and engineering fields or on the sports fields – and I certainly believe that our graduates, our professors and our researchers will get considerably more from the SKA than just the kudos that comes from hosting it.

And we, as a country, certainly do need to foster an interest in science and technology. In my view, *gee whiz* projects such as the SKA and the MeerKAT go a long way to encouraging youngsters to take science and engineering disciplines more seriously.

And if there is some thrill attached to science, astronomy or mathematics, then the students will apply themselves more diligently at primary and secondary schools, to ensure that they will have the necessary qualification to enter a university.

To put this in a different perspective: thousands of youngsters see people like Breyton Paulse or Herschelle Gibbs as heroes who they'd dearly love to emulate. What we need to foster is the same sort of hero-worship for engineers, mathematicians, scientists and astronomers. I have yet to hear even one youngsters hero-worship a scientist or try to emulate a famous astronomer? It may have happened, but not in my experience.

I believe that projects such as the SKA can actually foster the sort of compelling interest that is reserved for sports stars and pop musicians. Projects that unravel the mysteries of space, energy and matter and then present it in an understandable format can become completely captivating if done in the right way with the right kind of enthusiasm and gusto.

I don't know how many of you have been lucky enough to chat to astronomer David Bloch or attend any of his lectures, but he's just the sort of person to drop the boring elements of astronomy from his repertoire and replace these with something that is electric, dynamic and fascinating.

That's the approach we need to see in our schools. It starts with out school teachers who must, like a viral infection, spread an enthusiasm and fascination for science, mathematics and astronomy to the youngsters of today.

Given the standard of most teachers in this country that's an unlikely scenario if ever there was one.

Interestingly, though, if South Africa is selected to host the SKA in 2011, there is a suggestion that an outreach programme for teachers and students around the country will be introduced.

That's all well and good but personally, I believe that this initiative should not depend on the SKA at all. It should be an integral part of the MeerKAT programme and should start right now.

That way South African youngsters can be exposed to the wonders of the universe and, if done in the right way, that might just be enough to kick-start a genuine interest in science, astronomy, mathematics and even engineering.

And wouldn't that be a real victory for the whole of South Africa.

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WATT'S

WATT'S HAPPENING





4> WATT'S GOING ON?

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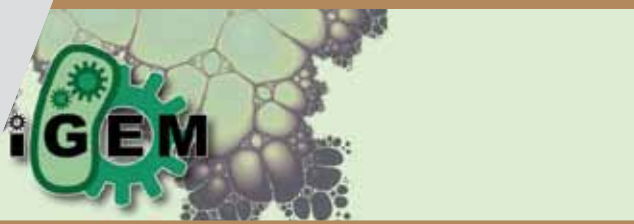

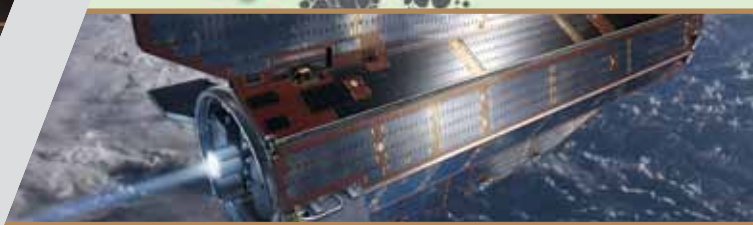

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Renewable energy tariffs praised

The generous prices contained in the Renewable Energy Feed-in Tariff (Refit) will give South Africa's renewable energy industry a boost, according to Richard Worthington of the World Wide Fund for Nature, who congratulated the National Energy Regulator of South Africa for responding to the challenges facing investors and environmental campaigners.

According to Nersa the tariffs are significantly higher than Eskom's current tariff of 22 cents per kilowatt hour and apply to wind, mini-hydro, landfill-gas and concentrated solar thermal power projects. Nersa's goal is to have about 1 100 MW of power from renewable energy projects and the more generous tariff will add between six percent and 10 percent to the average tariff charged for electricity countrywide.

Wind projects will receive R1,25 per kilowatt hour, almost double the 65 cents kW/h originally proposed under the Refit scheme. Mini-hydro plants will get 94 cents kW/h, landfill-gas projects getting 90 cents per kW/h and concentrated solar thermal power projects with a storage capacity of more than six hours getting a whopping R2,10 per kW/h. The power purchase agreements will run for a period of up to 20 years.

The tariffs paid under the Refit programme will be reviewed each year for the first five years and then every three years after that. Eskom remains as the single buyer of all electricity in the country under Nersa's recent ruling after the organisation rejected demands to create a Renewable Energy Purchasing Agency for the independent power producers.

There are several renewable energy projects on the drawing boards or underway in South Africa including the 500 MW wind farm under investigation at Jeffrey's Bay that is backed by the Mainstream Genesis Eco-energy joint venture and a landfill-gas project being investigated by Energy-G Systems, which has another three alternative energy projects underway.

According to Frost & Sullivan analyst Sipha Ndawande, renewable energy investors have not yet launched any projects because of a lack of incentives and no clarity on the tariffs. However, by providing specific tariffs for a sustained period this hurdle had been overcome.

He says that it will take up to four years for any of the wind farm projects to start generating electricity but this market is likely to be driven by an increasing number of joint ventures between project developers with local knowledge and private equity firms with access to cash along with turbine manufacturers eager to sell products.

Ndawande expects that the number of landfill-gas projects will increase significantly over the next few years as technologies improve and power generation systems become more efficient.

ECSA welcomes drive to recruit retired people

Municipalities such as Ethekwini Metro and various others around the country are recruiting retired engineers and using them to train young graduates who have emerged from universities but lack the necessary on-the-job experience to thrive. The Engineering Council of South Africa (Ecsa) has welcomed the initiative.

In fact Ecsa has called on all other South African municipalities to follow suit in order to make up for the tremendous shortage of engineers particularly in maintenance departments around the country.

According to Ecsa's acting chief executive, Hu Hanrahan, the shortage of skilled and experienced engineers is having a detrimental effect on South Africa's infrastructure and yet the retired engineers represent a huge body of skills and experience.

"These skills and the vast pool of knowledge and experience should not be wasted but should be used to mentor the younger engineers graduating from our universities today," he says.

According to a report published by the Human Sciences Research Council, the ratio of engineering professionals to citizens in South Africa was considerably lower than in other countries with only 473 engineers per one million people. Japan has 3 306 engineers per million.

There are currently about 30 000 engineering practitioners registered with the council by some of these engineers are no longer practising or have been absorbed into other sectors of the economy. Of course a number of engineers have emigrated but Ecsa has no exact figures on how many professionals have left the country.

Ecsa says that there are currently 1 025 foreign nationals registered with the council along with 414 people who are registered as technicians or technologists.

Rapid transport system will go ahead despite protest

At least 575 taxis will be affected by the implementation of Rea Vaya – Johannesburg's bus rapid transport system – and angry taxi drivers rampaged in the city, stoning passengers, smashing buses and firing shots at metro police because they believe the system will stop them from earning a living.

However, Johannesburg's mayoral committee member of transport, Rehana Moosajee, says the city is determined to go ahead with the system despite the protests from taxi drivers who claim that they were not sufficiently consulted over the plan.

Dedicated BRT lanes will be implemented on highways and major routes around the greater metropolitan area and taxis will not be permitted to use these lanes to ferry passengers to and from destinations. They will also not be allowed to have the same origination point or destination as the BRT buses.

Moosajee says that the city officials are involved in negotiations with some of the representative taxi associations in the greater metropolitan area. Moosajee concedes that when the council decided to go ahead with the BRT system it was aware that taxi drivers and owners would be affected.

The city has apparently been considering various options that will incorporate the taxi industry such as buying taxis from owners and then allocating owners shares in the operating company.

The South African taxi industry is believed to be ferrying about 10-million people a day between their homes and their places of work.

The Rea Vaya system will see the creation of special bus lanes, complete with purpose-built stations, situated roughly 750 metres apart along the main routes that allow passengers to embark or disembark from the special buses that have already been ordered from Swedish manufacturer, Scania.

According to Moosajee, a 25,5 kilometre route, with 20 bus stations, will be completed by June and will be used to ferry spectators to stadia around the city during the Confederations Cup later this year.

Johannesburg and Cape Town are the first South African cities to implement a BRT system, which has been proven in countries such as China and Australia.

Pipeline from Jozi to Mozi

A new $620-million oil pipeline that will link Johannesburg and Maputo will be completed before the end of this year by Petroline Holdings, a consortium of South African and Mozambican investors. The 450 kilometre pipeline will be able to carry about 3,5-million cubic metres of petrol annually.

Mateus Kathupa, chief executive of state-run Mozambican company PetroMoc, says the pipeline will facilitate fuel imports via Maputo, which is closer to Johannesburg than any of the South African ports. He says the pipeline will be fully operational before 2010 so that South Africa has additional capacity in terms of oil supplies.

Pipeline construction was apparently scheduled to begin in September last year and Katupha attributed the delays to problems emanating from the approval of the environmental impact assessment. These problems were, according to Katupha, likely to be resolved by May.

He conceded that other "little issues" such as paying compensation for land where the pipeline is destined to run, had still to be ironed out.

Petroline Holdings is owned by PetroMoc (40 percent), the Woesa Consortium (25 percent), Gigajoule International (20 percent) and Companhia de Desenvolvimento de Petroleos em Mocambique – a consortium of small companies – which has the balance of 15 percent.

Katupha says that the pipeline is likely to produce revenues of over $800-million a year, cut the risk of fuel shortages in central South Africa and minimise any deficiencies in transport and storage capacity of fuel on the Highveld.

Carbon dioxide emissions can be cut at a cost

Technologies that are capable of halving carbon dioxide emissions by 2050 are already available or would be in place by 2015 according to Alain Bucaille, Areva's senior vice president for research and innovation. He admits, though, that the costs of deploying such solutions – particularly for the electricity and transport environments – are extremely high.

He says that carbon capture and storage systems could be widely used in territories where the geology was capable of capturing the emissions and commercialisation of such projects would be given impetus by the fact that coal and nuclear plants for power generation were likely to remain the base-load generation option.

He says that in the transport arena there are already vehicles being made that produce less than 110 grams per kilometre of carbon dioxide compared with the current fleet of vehicles, which produce between 160 grams and 280 grams per kilometre.

Bucaille says the new engines being designed now are capable of producing as little as 30 grams per kilometre of carbon dioxide. He concedes that the world population growth will mitigate against energy savings. Because of this, he says, the world will have to double its energy production by 2050 to meet demand from consumers and industry worldwide.

Referring to nuclear power, Bucaille says that there are 440 existing plants in 31 countries and a further 30 were under construction in 11 countries. A further 41 reactors have been planned and are ready to build.

In China alone, there are 113 reactors being considered while India is planning to put up 600 nuclear reactors over the next 25 years. Bucaille believes that by 2035 at least 35 percent of the world's nuclear power will be generated in these two countries.

Meanwhile, South Africa's sole nuclear waste management site at Vaalputs, in the Northern Cape, is likely to house high-level nuclear waste materials within the next ten years, according to the Nuclear Energy Corporation of South Africa (Necsa).

Necsa's chief executive, Rob Adams, says the site is currently handling low and intermediate levels of nuclear waste from the Koeberg nuclear power station. The high level waste is being stored at special sites at Pelindaba outside Pretoria and at Koeberg.

A decision on whether to transport, to Vaalputs, the low and intermediate level waste being stored at Pelindaba is expected soon. About six percent of Vaalputs' capacity is used for low level waste and about four percent for intermediate level materials.

Mozambique to accelerate bio-ethanol production?

While much has been said about Mozambique producing bio-diesel from the jatropha beans, foreign investors have injected about $710-million into projects to produce about 440-million litres of bio-ethanol from sugar cane, millet and sorghum.

Roberto Albino, director of Mozambique's Centre for Agricultural Promotion, says that 48 000 hectares of land have already been set aside for production of sugarcane in six provinces and the full crop yield from these farms will be used to make ethanol.

ProCana, a Mozambican company has already negotiated an investment agreement with the government to build an ethanol plant while Principle Energy is planning to erect a $290-million bio-ethanol plant if it can raise $90-million to partially fund the project this year.

According to Albino, once the farms and the bio-ethanol plants are in full production between 7 000 and 10 000 new jobs will be created in the country. Most of the ethanol is likely to be sold to companies in Europe for use in vehicles there.

Albino says that if all the bio-ethanol projects are approved then an area of about 130 000 hectares could be set aside to grow sugarcane, millet and sorghum as a feedstock to make the fuel. If this is achieved, the country would be capable of producing between 850-million and 1,6-billion litres of ethanol a year.

Raymond Greaves, managing director of Principle Energy, is confident that the company will raise the necessary funds to start building the bio-ethanol plant even though foreign investors are wary of investing in African projects in the current economic climate.

With the funding in place, Principle Energy plans to erect the plant near Dombe, about 200 kilometres west of Beira and will go into production in 2011 to produce 300-million litres of bio-ethanol annually. Greaves estimates that cane yields in Mozambique are likely to be about 50 percent higher than those from cane farms in Brazil because of the high quality soils, the rainy climate and the irrigation systems that can be used.

Asked about the comparison of oil prices with bio-ethanol, Greaves says that the oil price would have to drop to below $40 a barrel for it to be cheaper than bio-ethanol.

Students pay attention when they can win R100k

A roadshow for students at universities around the country was held by Festo and SEW Eurodrive to explain the rules of the *Pneudrive Challenge 2009* competition that will eventually see the winning students receiving R100 000 worth of equipment for their university before being whisked away for a ten-day, all-expenses-paid trip to Germany.

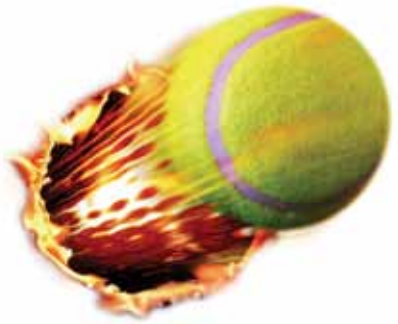
The participating universities are Witwatersrand, Pretoria, KwaZulu-Natal, North-West, Nelson Mandela, Cape Peninsula, Stellenbosch and Johannesburg.

Students are expected to design a product handling application that uses pick-and-place technology to move products between five and 15 metres. Industries that make extensive use of product handling systems include food and beverage sectors, packaging, warehousing, bulk materials handling, timber, sugar, agricultural products and tobacco.

Students must consider, in their designs, the speed, positioning, accuracy, acceleration and deceleration, repeatability and cycle time of the solution they design.

Energy efficiency is crucial and an energy efficiency calculation must be included in the submissions.

The competition closes in June this year.



FlightScope stops the umpire from being blamed

EDH, a company founded in 1989 by Henri Johnson, has as its core expertise a 3D tracking Doppler radar systems for sport and military applications. The company started by making velocity measuring radar system to track projectiles in flight and provide accurate launch velocity and short-range ballistic measurements.

But Johnson soon realised that the technology could be adapted for a number of different sports such as cricket where it is used to measure ball speed and accuracy. Today the company has products for many different sports including golf, tennis, cricket, soccer, baseball and others. Typical applications include player and equipment performance testing, television broadcast enhancements, and professional sports training.

EDH focuses on its three core technologies, microwave electronics, digital signal processing and digital image processing. The products made by the company include:

- **Golf:** FlightScope uses 3D tracking technology and determines the launch conditions of a golf ball, tracks it in flight and records the data using phased array tracking technology. FlightScope is used by retailers, club fitters, and teaching professionals as well as in golf simulation systems.
- **Tennis:** FlightScope technology is used in tennis to measure the speed of a service and is the only system certified by the International Tennis Federation (ITF). EDH's handheld scoring system has become a standard for umpires at all top Association of Tennis Professionals (ATP) and Women's Tennis Association (WTA) events. Apart from the scoring, EDH supplies data in real time to on-court scoreboards, television broadcasters, and other display media.
- **Cricket:** FlightScope is used to measure bowling speed and is widely used at international and national events in most cricket playing countries. Certified by the SABS for accuracy, FlightScope remains the workhorse for cricket bowling-speed measurement.
- **Soccer:** A soccer kicking simulator has been produced that can be used by coaches and teams for kicking practice and performance testing.

EDH is currently working on various adaptations of its technologies to come up new sporting applications.

International opportunity for young engineers

The German Federal Ministry of Education and Research is calling for the best 15 talented young researchers in environmental technology from around the world to take part in the Green Talents competition being run by the International Forum for High Potentials in Green Technologies.

The competition under the patronage of the German Research Minister, Dr. Annette Schavan, gives exceptional young scientists of tomorrow the opportunity to meet and exchange views with today's leading experts in Germany.

The competition is broken down into the following fields:

- Cleaner production
- Contaminated land management
- Resource efficiency
- Water
- Renewable energies

Students selected to participate in the programme will tour Germany for a week later this year. The young researchers and engineering scientists will visit leading universities, research institutes and companies in Germany.

Students will gather specific information about research activities on site and learn about the possibilities of co-operating with partners companies or academic institutions in Germany, one of the leading locations for research in green technology.

Individual meetings with experts and the presentation of their own research will be part of the forum that will incroporate a cultural programme and a meeting with Dr Schavan.

The selection of students will be based on scientific profiles of the applicants in the field of environmental technologies and their specific interest in co-operating with German partners. The winners will participate in a one-week international science forum to be held later this year, where they will also act as representatives of the environmental research being carried out in their respective home countries.

Participating institutions in this initiative include Rheinisch-Westfalische Technische Hochschule Aachen, Fraunhofer Water Systems Alliance and Siemens.

Further information on the competition and an application guideline are provided on the Green Talents website http://www.research-in-germany.de/greentalents

Global Recession and

by Antonio Ruffini

There are two types of people, says futurist and scenario planner Clem Sunter who was CEO of Anglo American's gold and uranium division during the 1990s. Sunter's track record includes some remarkably prescient predictions, and he says you can either be a hedgehog or a fox.

Hedgehogs have often been promoted by business literature over the decades; a hedgehog believes that if you are lucky and wish to be successful you come up with one really good idea in your lifetime. The thinking is that having come up with such an epiphany, you should pursue that idea with determination and single mindedness. This philosophy has permeated much of business thinking, and is part of the mindset behind the establishment of corporate vision and mission statements.

Sunter says it is fine to be a hedgehog when the future resembles the past, but the world is now littered with corporations that have fallen over cliffs. Assuming some integrity, these companies were led over the edge by people so obsessed by their visions that they ignored the realities in which they operated.

Sunter believes it is far better to be a fox, for foxes believe no idea is sacrosanct. Foxes believe in adaptation, survival of the fittest. That sounds Darwinistic, and is, but Sunter points out this does not mean fittest as in red in tooth and claw, which is a misinterpretation of Darwin's and subsequent thinking. It means survival of those that adapt to their surroundings and circumstances faster and better.

It is thinking like a fox that underpins the scenario planning that Sunter does. It was an approach that may well have led to a peaceful negotiated transition of power in South Africa in the early 1990s. In the mid-1980s, Sunter presented the high road vision to various influential politicians, including F W de Klerk, something that at the time most people saw as a fairytale. And just prior to 9/11 one of Sunter's books warned George Bush of the threat of nuclear terrorism on American soil, which could change the world into a gilded cage for rich nations. Though the terrorism did not use nuclear weapons in the end, the warning proved to be prescient.

Thus it is worth listening to what Sunter and his colleague Chantel Ilbury have to say about the current global scenario, what may be aptly called the great recession, and how we can expect it to pan out.

The world has been in a long boom, since 1981, and for many people that is all they have known over their whole working life. It resulted from the rise of the East, first in the form of Japan in the 1970s and 1980s, then the small Asian tigers such as Singapore, and more recently the giants of China and India. It changed the dynamic of the world and has seen global growth of 3.5% a year since 1981, and 5% a year more recently.

This prosperity rode a new technological wave as well, that of micro-electronics which led to the PC and then the Internet, and the array of wireless technologies we now have at our disposal.

But there was a warning flag, one that had been apparent for some time. What would happen should asset values, (such as homes) in the US upon which people borrowed more and more to spend more and more, start to decline. That the economic meltdown came really should be no surprise. These assets upon which US consumption was based accounted for two thirds of the US economy and the US accounts for 30% of the world's global gross domestic product (GDP), and this meant we were all going to notice when something happened.

SA's own relegation Battle

In July 2007 the index of the assets the Americans were borrowing against had turned negative and at the end of 2007 Sunter said 2008 could be a horrid year. It was, though we in South Africa felt it late. Now he says that if the world is in a V-shaped recession we are about two thirds of our way through it, with the bottom seen at the end of 2008, and a mild recovery likely to occur this year. This happens to be the view taken by the governor of the US reserve bank Ben Bernanke and US president Barack Obama.

However, having experienced several decades of prosperity it is hard for people to understand just how bad and spectacular a V-shaped recession is. The first two months of this year saw 20 million jobs shed in China. The world has changed since last year.

Easy credit no longer exists. There will be much more regulation of financial and possibly other sectors of business. Further, the time when the West, having dominated the world's affairs since the 1400s, was the centre of everything has passed; the East is now equivalent. We are also on the verge of seeing a new wave of technology dominate the affairs of the world, one which Sunter expects to be related to energy saving and sources.

But as much as things have changed and we are in the middle of a global recession, the biggest question, which is yet to be answered, is: are we in a short sharp V-shaped recession or a more dreaded lengthy U-shaped one.

It has been oft told, but is worth repeating: Someone who was 25 years old in 1929 when the world fell into recession would have been 50 when it ended in 1954. That is the better part of a working career, a significant portion of a life. A U-shaped recession is not something to be taken lightly, particularly by those of us who do not viscerally understand what it means, and that is most of us. It is telling that those who lived through that era never forgot their lifelong habits of saving and thrift.

At the end of 2008, Sunter believed there was only about a 5 percent chance of the world entering a U-shaped recession, but at the end of the first quarter of 2009 he had upped that percentage to 30 percent based on the new data available regarding the US and global economy. He sees the planned public works, the greening of America and the tax breaks to lower income earners as positive, but is worried about the propping up of distressed companies. It was this that led to Japan's lost years.

He highlights the major flags that will let us know if the dreaded U is upon us. One would be a major upsurge in protectionism that will devastate global trade. A new major war would be another signal, since contrary to some popular beliefs wars are not at all good for the global economy, and by a major war Sunter means something like the US versus an increasingly anarchistic Pakistan. A third flag would be a major bankruptcy of a major economy in a region like the European Union; not a small country like Iceland or a perennial basket case like Argentina, but a country like Poland, or Hungary. And the other big flag is a meltdown in China, where even a growth rate of 5 percent a year is seen as disastrously low and may lead to social unrest. Anything that causes China to again withdraw from the world and look inward would be very bad indeed for the global economy.

If any one or more of those events come about, the probabilities of a global U shaped recession increase dramatically, and it would be a life changer for most of us.

For once South Africa has been a good place to ride out a global economic storm, a relatively sheltered enclave. But South Africa has its own issues.

Sunter says that in 1994, a fully democratised South Africa joined the Premier League of nations, which comprises the top 55 industrialised nations in the world that an organisation such as the International Institute for Management bothers to rank. Below that is a lower division that Sunter euphemistically describes as poor but peaceful. It applies to the bulk of the developing world, and in this world money is not available for much socio-economic development.

All the various rankings show the same trend for South Africa, but that of the International Institute for Management sums it up best. For most of the past 15 years South Africa occupied a safe lower mid-table ranking, in the premier league field of 55 countries, pretty much where it belongs. No Manchester United, Liverpool, Arsenal or Chelsea; no US, Japan, Germany or China, but more like a Blackburn, Fulham or Middlesbrough.

But in 2007 it began to fall rapidly, dropping from about 37 to 50, and last year it fell further to 53 on the 55 country table, with only the Ukraine and Venezuela below it.

The relegation zone.

And as many teams that fall out of the Premier League find, it can be very hard to get back in. After relegation, the void is rapidly filled by another country that jealously guards its new-found status. Sunter says that should South Africa be relegated, its opinion on the issues of the day will no longer be sought by the international community, and corruption is likely to spread with few other opportunities available to

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those who are desperate to escape poverty.

Many South Africans will be all too familiar with the reasons for it being in the relegation zone, and these include too much violent crime, the impacts of HIV/AIDS on the country, the inadequacies of the country's infrastructure, and the fact that South Africa's industrial sector is looking uncompetitive.

As the once formidable Leeds discovered in its premier league, the fall when it comes can be hard and fast, and Sunter talks about a greater worry associated with relegation. It can be accompanied by internal disharmony and, eventually, overt conflict, which could see the country very quickly take a sharp turn left and get relegated even further to join the likes of Zimbabwe, North Korea and Somalia in the even lower division of failed states. Pakistan illustrates how quickly that can happen.

However, the probability of South Africa doing a Leeds, continuing its descent below the second tier, and turning into another failed state like Zimbabwe is low.

More likely is that it would survive total failure and languish in the second division, as many teams do after relegation, without mounting a serious challenge. It would more likely be a Coventry City, a team which spent three decades in the premier league, got relegated at the turn of the century and has not come close to returning to the top flight since.

But while the threat of relegation is real for South Africa, Sunter believes there is cause for hope that the country can do a U-turn and return to mid-table in the premier league.

For that to happen we need inclusive leadership, and with a new president, Jacob Zuma, in power it is important to see if he pursues a policy of payback or inclusiveness – the tone he sets will be important since the future of the country depends on how well we all get along.

Secondly, the country needs to fix that which is broken and inefficient, such as the education system and other institutions. There are pockets of excellence, and Sunter describes our tax revenue collection agency SARS as world class, and suggests we take lessons from that and look to replicate this success in schools, hospitals, municipalities, and elsewhere.

Thirdly South Africa needs to find ways to encourage the evolution of the second economy, to enable small entrepreneurs to access the funding so that they can grow from hand-to-mouth street traders to business people that create jobs. Germany and Japan, two of the world's top four economies, were the losers of WWII, yet they thrived after that. They thrived because in the wreckage of their WWII defeats there were no entrenched interests left and the level playing fields enabled the small businesses, which ultimately built those countries' economies, to prosper.

How South Africa will do depends, too, on whether the world avoids a U-shaped recession.

And the country does still have some good cards in its hand. Its resources sector remains globally significant and parts of it are world class. It has a strong agricultural sector with world class elements such as its wine producers, ranked best in the world on a value for money basis. It is a cheap, diverse and beautiful tourist destination, with some key events to spice it up further, the Indian Premier cricket League, the Confederations Cup, the British and Irish Lions rugby tour, the 2010 World Cup. All of those are timeous boosters to our tourism sector.

The country is also the gateway to Africa. It is the USA of Africa constituting 30 percent of the continent's GDP, and it offers technology and infrastructure to people wanting to do business on the continent. That is not trivial.

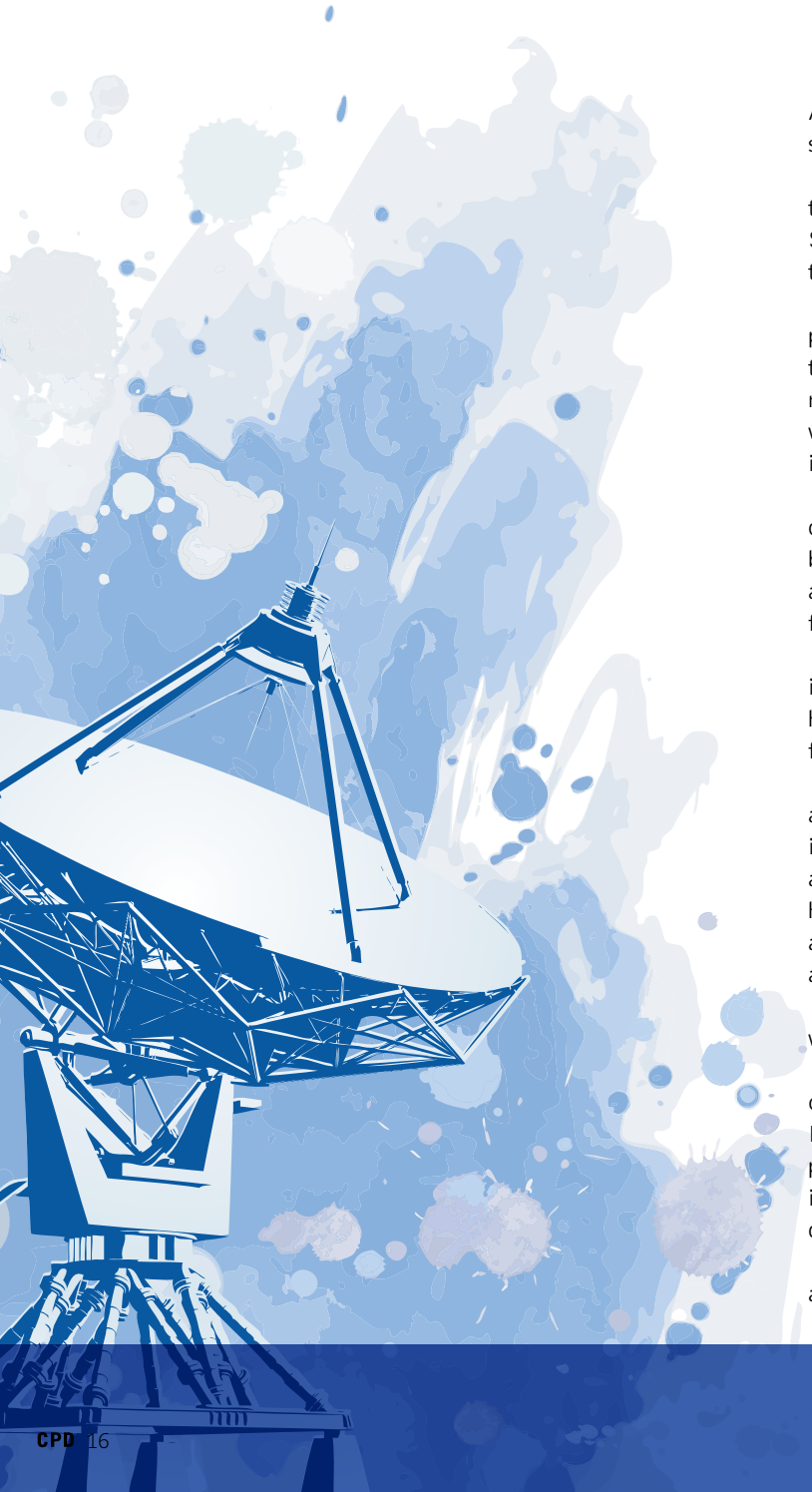
And finally, should Zimbabwe find a way to shake off the legacy of Mugabe and his cronies, without descending into a treadmill of corruption, it will provide a huge kicker to South Africa and the region.

Balancing the negatives and positives Sunter believes there is a more than even chance South Africa can return to mid-table of the premier league, and to achieve this it is important to not only focus on the negatives. Of course, we need to think like foxes.

As Sunter says, Martin Luther King did not start his famous speech with, "I had a nightmare ... "

Just as Nelson Mandela did not crawl when he took those first steps on a long walk to freedom.

Forget sport - in science let's keep co-operating



As two highly competitive countries, Australia and South Africa, have had a sustained sporting reputation that has kept both countries at the forefront of international cricket, rugby, tennis, swimming and, more recently, football. South Africa is the first country in Africa to host the World Cup having successfully hosted a cricket world cup and a rugby world cup.

So it's interesting to see the spectacle that's now unfolding between the two countries as the enter the full fray to host the world's first Square Kilometre Array, a mega radio telescope that is about 100 times more sensitive than the biggest existing radio telescope.

Both South Africa and Australia have already chosen sites for the purpose and both countries are building their own, much smaller, radio telescope almost as a proof-of-concept exercise. The South African model is the MeerKAT, a premium mid-frequency radio telescope, which will serve as a pathfinder for the cutting-edge technologies used in the SKA.

Australia is building the Murchison Radio Observatory in the deserted outback in a remote district of Western Australia and with a baseline in New Zealand some 5 500 kilometres away. It is apparently an ideal location for the observatory as it is in a radio quiet area, far from any of Australia's major cities.

The same can be said for the South African site in outside Carnarvon in the Northern Cape where two farms, the Losberg and Meysdam have already been purchased and much of the infrastructure required for the MeerKAT has already been completed.

However, both the MeerKAT and the Murchison Radio Observatory are small and insignificant when compared with the SKA. To put it in perspective, the SKA will consist of about 4 000 dish-shaped antennae and other hybrid receiving technologies. At its core, it will have several hundred antennae with outlying stations of between 30 and 40 antennae each spiralling out from the core and spread over an area of about 4 000 kilometres.

Together, the combined total collecting area of all these antennae will amount to one square kilometre or one million square metres.

The mega telescope will be sufficiently powerful and sensitive to observe radio signals emitted in the immediate aftermath of the Big Bang, billions of years ago. It will scour the universe for Earth-like planets and potential sources of life, test theories of gravity and investigate mysterious, ill-defined elements such as dark matter and dark energy.

It will work by detecting electromagnetic radiation (or radio waves) and cosmic rays emitted by extremely distant celestial objects such as

other galaxies and stars. Because electromagnetic radiation travels at a fixed speed of about 300 000 kilometres per second, very distant objects are observed as they were in the distant past.

In a sense, astronomers will be looking backwards into the past and hoping to unravel the mysteries of space or throw some light on what happened directly after the enormous explosion that resulted in the universe we know today.

Of course to achieve accuracy, the SKA needs to be built in a particularly remote area, as far was possible away from any man-made radio signals that could cause interference for the radio telescope. And there is plenty of radio interference in the congested cities of Europe and the Far East, which is why these regions have been excluded from tendering for the SKA.

Signals from cellular radio masts, radio broadcasts or air traffic navigation beacons all add to the interference levels but fortunately both South Africa and Australia have areas that are radio quiet and suitable for the deep level radio probes that will be sent to distant parts of the galaxy.

More than 50 organisations from 19 countries are working together on the SKA project that will be built at a cost of more than €1,5-billion. An international steering committee has been appointed to drive the project – and to consult on the Australian and South African pathfinder projects as well.

As a radio telescope the SKA offers increased sensitivity that allows it to penetrate dust clouds, and a the same time provides incredibly fast survey speeds that make it up to 10 000 times quicker than the largest telescope currently operating in the world today.

In fact it is radio astronomy that has been at the heart of much of the scientific knowledge gathered over many years and this field of study produced eight Nobel Prize winners in Physics in the past fifty years and more.

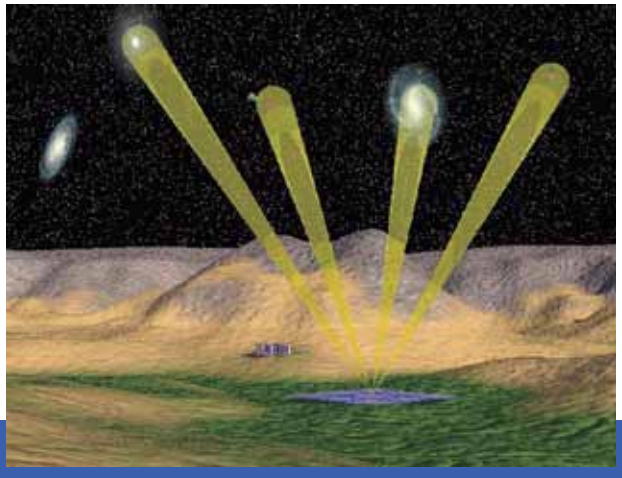
In scientific terms, the SKA is an aperture synthesis instrument and what this means is that signals from separated antennas are combined digitally to simulate a telescope with a diameter equal to the largest antenna separation – in South Africa an area of more than 4 000 kilometres.

This will provide, what is called, an extremely high angular resolution and yet it will also have a very large field-of-view. The goal is to have a field-of-view at low frequencies below one GigaHertz of 200 square degrees and a field-of-view of more than one square degree (about five full moons) at higher frequencies.

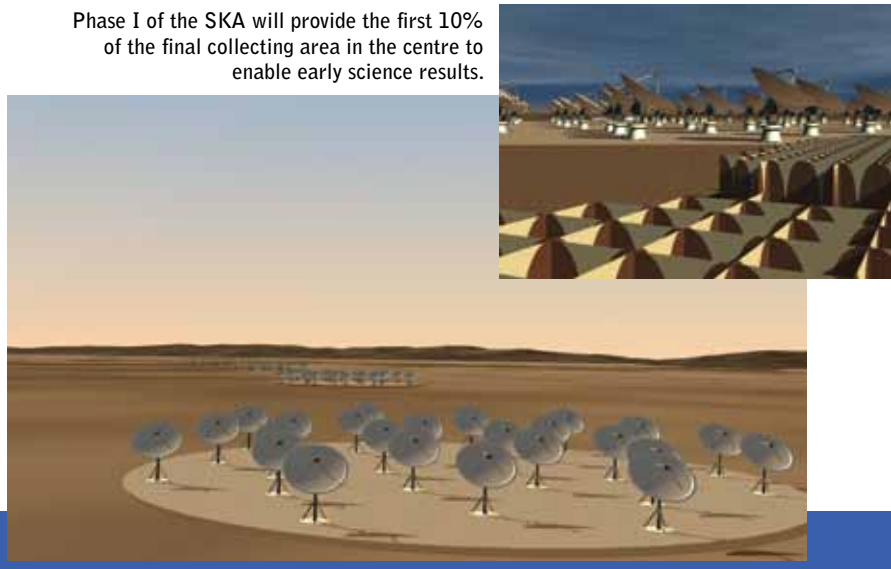
Currently scientists are working on the use of phased-array technologies to provide multiple fields-of-view that would dramatically increase the survey speed and would allow multiple users to observe different places in the sky simultaneously.

It is the combination of the very large field-of-view and the enormous sensitivity of the radio antennae that will help to revolutionise the way that scientists explore the universe. Although a decision on the site for the SKA will only be taken in 2011, scientists and astronomers are confident that by 2015, 15 percent of the final collecting area will be in place allowing them to start work on amassing data and information.

With multiple fields-of-view provided by phased array technology many astronomers can use the SKA telescope at the same time. (Credit: M. Kramer/JBO)



Phase I of the SKA will provide the first 10% of the final collecting area in the centre to enable early science results.



A MeerKAT at Carnarvon

South Africa's own radio telescope, the MeerKAT or Karoo Array Telescope will start operating from the Northern Cape, near Carnarvon next year using 20 dishes, each 15 metres in diameter to collect radio data from distant objects in the galaxies and convert this data into high-resolution images that can be assessed by the international scientific community.

Towards the end of this year the MeerKAT will perform its first light experiments. The MeerKAT is a pathfinder project (like a proof-of-concept) that is part of South Africa's bid to host the much larger Square Kilometre Array.

The South African Radio Astronomy Reserve undertook to provide the infrastructure necessary for the establishment of a radio astronomy observatory and in March last year, 14 000 hectares of land was purchased about 110 kilometres away from Carnarvon on a remote stretch of the Karoo that was largely free from any radio interference.

A detailed environmental impact assessment was completed for the two farms, Losberg and Meys Dam, that make up the Van Wyksvlei site and already the first KAT dish has been installed there. By October this year, the optical fibre cable and the optimised hybrid power transmission line will be completed and, in December, the first seven dishes will be installed.

The Northern Cape government and the South African SKA Project have spent more than R175-million on creating the necessary roads infrastructure and in developing the Klerefontein support base that will provide accommodation for astronomers and engineers and include mechanical and electronic workshops along with offices and other facilities. The Klerefontein base is just 11 kilometres outside the town of Carnarvon.

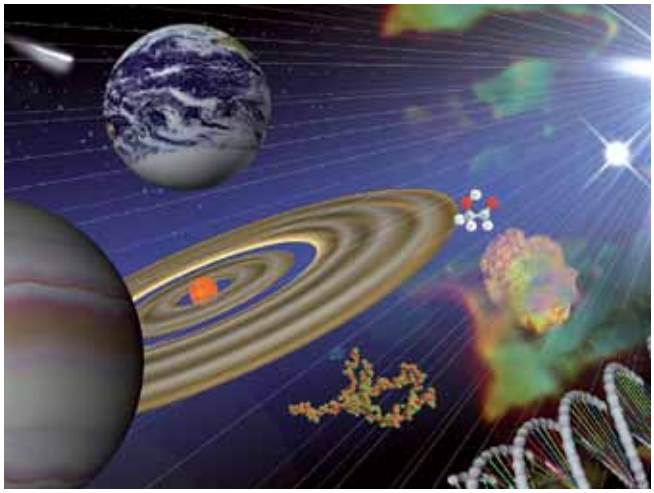
The MeerKAT radio telescope will provide excellent sensitivity and a wide frequency range from 700 MHz to 10 GHz and will have a concentrated central core for exceptional imaging of low surface-brightness features, neutral hydrogen, pulsars and transients.

About 30 percent of the dishes at longer baselines of between six and ten kilometres will provide the necessary resolution for continuum imaging.

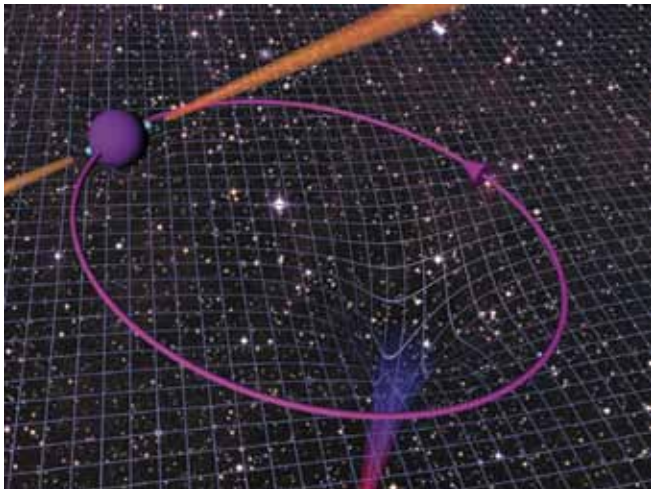
The realistic power requirement for the MeerKAT is about 4 MW at peak and a self-build programme has been approved by Eskom. A 33 kV line will run from the Karoo sub-station (Carnarvon) to the site and will be energised at 22 kV.

The cable will be buried at the array site complex but steel poles will be used for 35 kilometres from the site complex towards Carnarvon and, for earthing purposes, OPGW optic fibre cable will be strung along this section of the line. Wooden poles will be used to carry the power line the rest of the distance to Carnarvon's sub-station.

From a computing perspective the South African National Research and Education Network will provide a 10 GB/s line from the site to the operational centre in Cape Town. It will also provide a 1 GB/s link to Europe. The data will be distributed by a high-speed Ethernet switch.



The cycle of life. Interstellar gas and molecules form stars, planetary disks and finally planets, before a dying star redistributes the ingredients back into space. During this cycle complex organic molecules are formed. (Credit: B.Saxton/NRAO)



Pulsars orbiting black holes will test Einstein's description of these enigmatic objects to the extreme. (Credit: M. Kramer/JBO)

Cosmic explosions of unknown type may be detectable as radio signals with the SKA. (Credit: NASA)

The fully operational SKA will be operating at all frequencies below about 10 GHz by 2020.

The finished product will have:

- A frequency range of between 70 MHz and 10 GHz
- A sensitivity of 5 000 square metres between 70 and 300 MHz and 10 000 square metres between 0,3 and 10 GHz
- Field-of-view of 200 square degrees between 70 and 300 MHz and just more than 30 square degrees between 0,3 and 1 GHz. It will have a maximum field-of-view of one square degree between 1 GHz and 10 GHz.
- It will have 16 384 spectral channels per band, per baseline, and a calibrated polarisation purity of 10 000: 1. The imaging processors computation rate will provide 1 015 operations per second and the telescope output data rate is typically one Terabyte per minute.

Clearly the SKA is an impressive project and it certainly represents the biggest science and technology programme currently underway in South Africa. As Science and Technology Minister, Mosibudi Mangena, outlined at a recent meeting of the International SKA Forum held in Johannesburg, the SKA provides the entire scientific community with a means to better understand the universe and its creation.

Mangena and his counterpart in Australia, Kim Carr, Minister of Innovation, Industry, Science and Research, have committed both countries to building a partnership that has, as its primary goal, the advancement of the SKA programme for the good of the global scientific community.

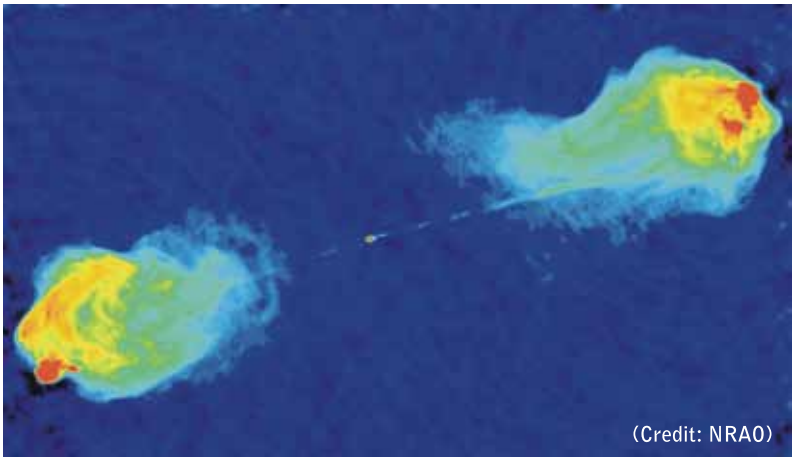
That's certainly the sort of approach that is needed when two countries are competing to host the square kilometre array anyway.

Regardless of where it is sited, the SKA will still have to be run efficiently and maintained properly and indications are that the annual operating costs will amount to about €100-million a year. Europe is expected to fund roughly 40 percent of the operational costs and the balance will come from the other countries participating in the programme, including Australia, Canada, China, France, Germany, Italy, India, Portugal, Spain, South Africa and Sweden.

Construction work is expected to start on the SKA sometime in 2012 and it will take eight years to get the radio telescope fully operational. Apparently the construction schedule for the different countries has been agreed to by both Australia and South Africa. Of course there is some special kudos attached to winning the bid and being selected to host the SKA but more importantly, the winning country will emerge as a world leader in astronomy and physics. As Mangena points out if South Africa can host the SKA, the countries scientists and researchers will immediately be exposed to the high-level technical skills needed to keep it operating. It will also mean that South Africans are working with cutting-edge technologies and even attracting some of the best scientific brains in the world to assist them with the scientific observations.

Some of the key scientific projects to be undertaken once the SKA is operational include:

- Investigating exactly what happened after the Big Bang and before the first stars and galaxies formed? In terms of current understanding, after the Big Bang, the universe expanded and cooled, turning the hot, primordial soup of particles into a sea of neutral gas. This occurred in a period referred to by scientists as the Dark Ages. The small density inhomogeneities left over from this period gradually grew under the force of gravity and eventually formed the first stars and galaxies. Radio emission in the 21-cm line of neutral hydrogen, as well as molecular lines like those from carbon monoxide provide the best observational windows through which to detect the era when gas in galaxies first turned into stars. The SKA will be the only telescope able to directly detect this epoch, providing a window into the first few hundred million years of the evolution of the universe and the formation of the first stars.
- Accreting black holes, such as those that formed in the Dark Ages may well be radio signposts for the formation of the first structures. These super-massive black holes will be studied and, some scientists say, may have a critical role to play in the environment of the different galaxies today. Almost every black hole – even those accreting in the Dark Ages – will be detectable using the SKA.
- It will be possible for the SKA to observe the mysterious substance known today as dark energy that is causing the universe to continue expanding and accelerating. The structure of the universe can be determined by observing nature's most abundant element, hydrogen. The SKA will conduct a hydrogen sky survey to detect this element in galaxies halfway across the observable universe scientists expect to survey at least one billion galaxies in the firstfew years of operation. By measuring hydrogen in those galaxies the SKA will allow scientists to understand how they formed and evolved. Using this data, scientist will then be able to measure the geometry of the universe and test whether dark energy is actually a vacuum energy or something much more exotic.


(Credit: NRAO)

Boolardy Station – home to the Aussie telescope

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) is primarily responsible for building the Australian Square Kilometre Array Pathfinder and the Murchison Radio Observatory on the candidate site for the larger Square Kilometre Array in a deserted part of the Australian Outback in an area called Boolardy Station.

To reach the area, involves travelling for 130 kilometres along the paved highway between Geraldton and Pindar and then, using a paved dirt road from Pandar, it is necessary to drive from another 220 kilometres to reach the site, chosen because it is remove and free from radio interference.

At Boolardy Station, 36 antennas, each 12 metres in diameter, will be erected to collect the radio signals that will provide the high-dynamic-range imaging, using a wide-field-of-view phased array feed.

Like its South African counterpart, MeerKAT, the Australian radio telescope will be able to capture radio images with unprecedented sensitivity over large areas of the sky. The data collection and processing is so huge that in just one week the telescope will generate more information than is currently contained in the whole of the World Wide Web and in a month, the information processed will be equivalent to all the information contained in all academic libraries of the world.

The primary role of the radio telescope is to carry out world-class, ground-breaking observations that will assist scientists, astronomers and researchers throughout the world. The information collected in Australia will be shared with scientists at over 50 institutions in 19 different countries.

Australia's radio telescope will be completed by the end of 2010 and will cost about AU$111-million.

Like South Africa, Australia is hoping to host the Square Kilometre Array and a decision on the site is due in 2011.

SALT and HartRAO

South Africa has had a sustained link with various space agencies around the world and is home to several important technological marvels including the Southern African Large Telescope situated outside Stutterheim in the Western Cape and the well-known Hartebeesthoek Radio Astronomy Observatory, (HartRAO) near Krugersdrop in western Gauteng.

This observatory is devoted to research into radio wavelength in the Milky Way and various other galaxies. The radio emissions at the 13 centimetre wavelength from the whole of the southern sky have been mapped by the HartRAO by a team of researchers from Rhodes University in Grahamstown.

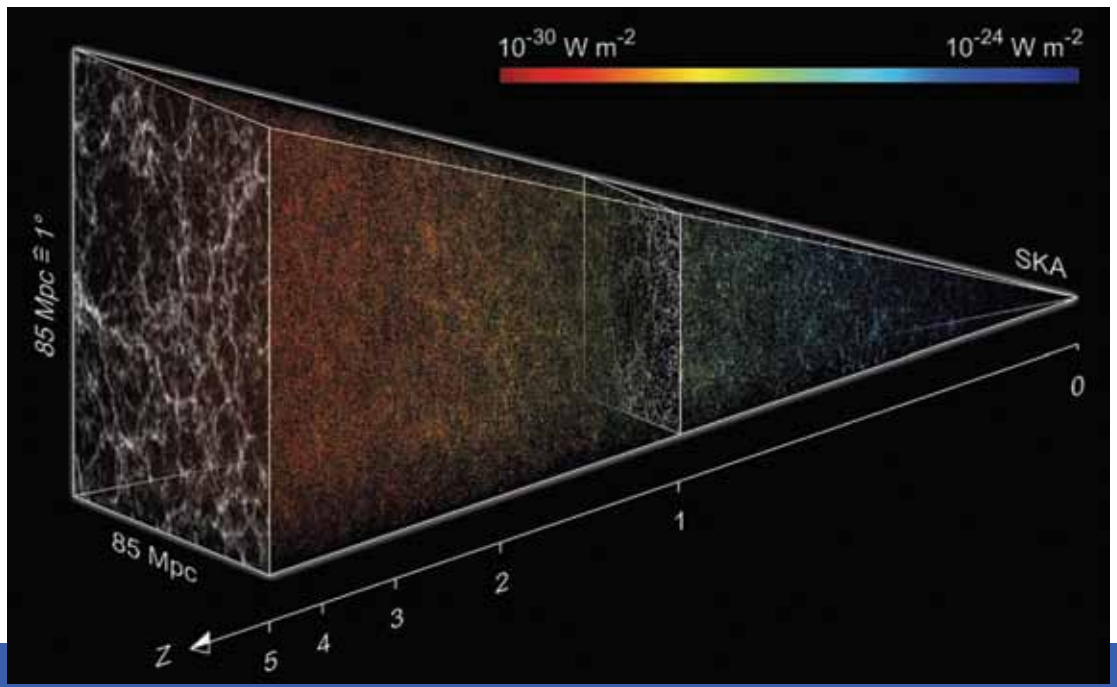
Arrayed with telescopes in other parts of the world, the HartHAO forms part of a set of 'super' telescopes that are able to detect details hundreds of times finer than those detected by the world's best optical telescopes.

SALT on the other hand is the single largest telescope in the southern hemisphere, with a 11-metre diameter mirror comprising 91 identical, spherical, hexagonal segments.

The telescope is tilted at a fixed angle of 37 degrees from the zenith so that it moves only in azimuth, rotating in position on air bearings and remaining stationary during each observation.

It can rotate through 540 degrees in azimuth. About 13 m above the mirror, is a tracker and an optical payload that look down at the mirror. The tracker moves across the mirror on a virtual spherical focus surface, allowing sky-objects to be 'followed' for a period of two hours, as the Earth rotates, without adjusting the azimuth angle.

This gives the telescope an annulus-shaped observing area in the sky, 12 degrees wide between declination angles of ranging from -75 degrees to +10 degrees.



A simulated SKA observing cone depicting the complex filamentary structure of HI on cosmic scales, which encodes the mysterious physics of the "Dark Universe". Each coloured pixel in the cone represents a galaxy emitting neutral Hydrogen (HI, rest-frame 21-cm) radiation.
(Credit: Danail Obreschkow (Oxford) and the SKADS Sky Simulation team.)

- One of the more remarkable discoveries made in the 20th Century is that stars, planets, galaxies and diffuse interstellar gas all have magnetic fields. The universe, it seems, is free from magnetic charges (monopoles) which would quickly destroy any magnetic field. These cosmic magnetic fields play an important role in controlling how stars and galaxies form, age and evolve. The naturally occurring magnetism regulates some solar activity, space weather and even helps to protect the Earth from harmful particles. In fact it is this magnetism that allows migratory birds, and other species, to navigate the world. Yet scientists do not know what it is that creates these astrophysical magnets or how it is that they maintain their strength over billions of years. The SKA will open this window because magnetic fields are illuminated by electrons spiralling around the field lines which emit radio waves called synchrotron emissions. Astronomers will use the SKA to exploit the Faraday rotation in which polarised radio light from a background object is subtly changed when it passes through a cloud of gas in which a significant magnetism is present. By measuring the Faraday rotation in the radio emission from tens of millions of faint, distant galaxies, the SKA will be able to detect magnetic fields throughout the universe. The resulting three-dimensional maps of magnetism in the Milky Way, in nearby galaxies and in intergalactic space will reveal what cosmic magnets look like, where they come from and what role they play in the evolving and changing universe.

There are many more questions that scientist hope the SKA will assist them in solving and, as each new answer is found, so new questions are bound to arise.

From a scientific perspective, the Outback in Australia or the Northern Cape region of South Africa both offer realistic sites for the SKA and the fundamental point is that the site itself needs to be a low-cost collecting area with low noise and highly integrated receivers. It needs to support the phased-array technology being developed and needs to have a wideband optical-fibre signal transport system along with fast, high-resolution analogue-to-digital converters, backed by high-performance computing engines and innovative data storage and retrieval technologies.

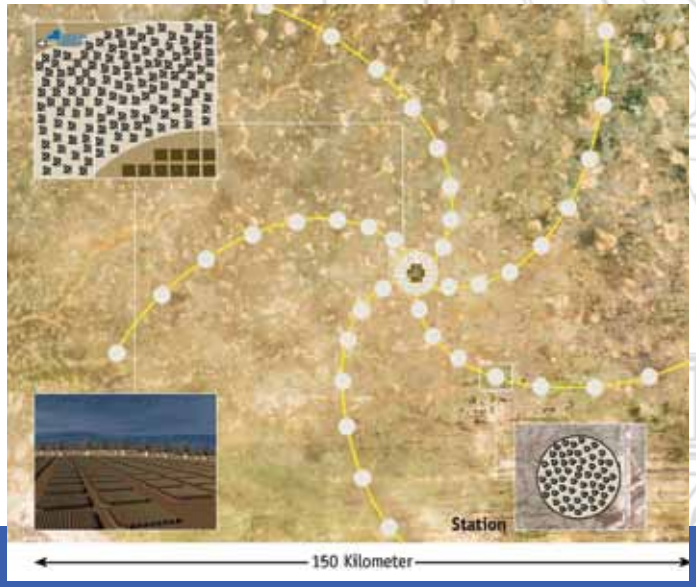
In order to achieve the high brightness and sensitivity and the high fidelity images of the sky, elements of the SKA will be distributed to an inner array and in groups of receiving elements located away from the core. The signals will be carried to a central processing engine where the data is manipulated to form images.

To move data around, the short-haul links from the inner array will transfer data at 80 Gbits per second, per antenna whereas with the long-haul links, a capacity of two Terabits per second, per station will be needed. That capacity is more than the current Internet traffic in all of Europe.

Transfers of 1 Tbyte images around the world will be needed every minute and extensive computation-based data processing will be required for calibration of the images. Simplistically put the SKA will require additional, new and as yet undeveloped algorithms to make the high-dynamic-range 106:1 images available to scientists. It will also need an effective radio interference mitigation algorithms so that radio astronomy and other services can co-exists within the relatively radio-quiet sites of Australia or South Africa.

There is no doubt that the scale of the SKA project will present challenges from whichever country is tasked with building, maintaining and operating the radio telescope. Both countries are currently involved in a co-operative partnership within the academic environment and whichever country is eventually selected to host the SKA will have been chosen because it is in the best scientific interests of the world at large. Not because it is one country 'beating' another.

**The SKA will consist of an inner core and outer stations arranged in a log-spiral pattern and extending to distances of up to 3,000 km.
A combination of receiving elements, dishes and phased array technology, will be exploited to make the SKA versatile, flexible and cost-effective.**



**High frequency dishes.
(Credit: ASTRON, C. Fluke/Swinburne U., SETI institute)**

ABB's modern, green building – a solid investment in efficiency

By Peter Middleton

This year, ABB chose to present its annual results for 2008 on a building site in Longmeadow, where its new head office, manufacturing and logistics centres will open this month. Apart from the motor factory in Alrode, all four of the company's existing sites in South Africa will relocate to the new premises – a move affecting over 1 000 ABB employees.

"It has been an excellent year for ABB in South Africa," said Carlos Pone, CEO of ABB South Africa when releasing the 2008 results. And the company's results were certainly impressive, with a 45 percent increase in revenue to R3,3 billion, and power and automation orders climbing to R4,4 billion.

But that's just part of the story because the company's trailblazing new building is sending out a really positive message about ABB's long term future and vision.

Working with developer, Improvon Properties, ABB has invested R400-million in the Longmeadow premises – a green building incorporating solar heating, grey-water recycling, efficient motors, and much more – all managed and controlled by a proprietary building management system housed in a purpose built control room.

A sustainable building, or a green building, according to Wikipedia, is an outcome of a design which focuses on increasing the efficiency of resource use – energy, water, and materials – while reducing the building's impact on human health and the environment. This can be achieved by:

- Efficiently using energy, water, and other resources.
- Protecting occupant health and improving employee productivity.
- Reducing waste, pollution and environmental degradation.

Clearly, green credentials involve much more than a few solar panels on a factory roof.

Just after the results were presented at Longmeadow, I had the good fortune to be among those taken for a tour of the new facilities. "When you build a house, the first thing you do is get together with the architect and decide what you want," says Paulo David, head of projects at ABB and our guide for the morning. ABB set up a committee to do this which included over 100 employees – so as to "optimise what we have within ABB and to make sure that we ended up with exactly what was needed."

This committee decided that the offices would be located on the northern end of the building, facing out of the Longmeadow estate – for easy access from the new London Road extension – while the factory area would be on the opposite side – with access into the industrial estate. The building is designed with a central spine, all the way down from the factory at the back to the offices at the

continued on page 25

A view of the factory looking across towards Johannesburg.

Longmeadow under construction. The additional 5 500 m² is being added to cater for expansion since the project began.

continued from page 23

front, a conduit for moving and handling materials on the ground floor and, just above it, the office space for those responsible for managing factory processes.

The factory space on the ground is split into two. On the western end of the spine is an area serviced by heavy lifting equipment – one 15 ton and two five ton cranes that can travel the full length of the building – over 200 metres. On the opposite side of the spine is a larger area that will include the warehouse and be serviced with forklifts.

The administration facilities are on three levels. The ground floor will be the confine of all client-based activities – with training rooms, meeting rooms, restaurants and executive dining rooms, everything necessary for customer care. The first and second floors will be reserved for employees.

The first and second floor administration block is designed so that the facilities are in the core – toilets, coffee rooms, photocopiers, filing rooms and so forth. This core is the only part of the building that will have permanently-installed, high efficiency down lighters.

As a key architectural design feature, people will work on the sides of the building – where the most natural light is available – in open plan areas built in an H-shape around the core. To ensure that people don't feel as if they are working in a cavernous public space, there are 60 meeting rooms and quiet rooms, breaking up the openness and providing private meeting places.

All of the offices not in the core of the building will be supplied with portable, photosensitive CFL lamps, which will automatically switch off five or so minutes after an employee has walked away. This, it seems to me, is an ideal way of personalising lighting – so as to both meet each individual's needs and develop a sense of personal responsibility.

Moving onto heat, our guide tells us that the windows are smaller, which still allows enough natural light in, but reduces the amount of heating and cooling lost through them – hence reducing both heating and air conditioning energy use. The concrete floors are insulated with 100 mm of polystyrene. "So that when the car park below us is at -5˚C in winter, we don't have to have the heating on all day to keep the offices at 22˚C."

ABB's green building does have the requisite solar heating system on its roof, "to heat all of our hot water, which we pump continually through the boiler circuits, so that you don't get cold water out of the taps before the hot water arrives," our guide explains. More innovatively though, the air conditioning system is also linked into the hot water system, to reclaim the heat generated in cooling the building down – heat that is usually vented and therefore wasted. The system gives the new building a hot water supply with the capacity to provide hot showers for all of its 400 factory workers, every day – energy saving indeed.

Water also features prominently in the new design. A water treatment plant allows all the shower and basin water to be collected, recycled and then reused in the toilet systems throughout the building. There are also two water attenuation tanks collecting rainwater off the huge factory roof, collecting 200 000 litres of water for every 100 mm of rain that falls. This water, David tells us, will be used to irrigate the water-wise indigenous gardens – and for the toilets.

Green from the efficient use of energy and resources perspective, methinks.

What about improving employee health and productivity?

Features such as 6,3 mm soundproof and shatterproof glass protect office employees from the factory noise. Smoke detectors, automatic sprinkler systems, gas smothering systems, zone isolating curtains and automatic quick-opening and closing doors are in place in case of fire. A decontamination tank has been built under the acid bath to contain and recycle any spillage.

The restaurant, David tells us, has been optimised to feed 300 people at a time, so as to make best use of the space – "because what is the point of a sit-down restaurant for 1 000 people if it is only used for one hour a day?"

Waste reduction and recycling has also not been forgotten – an area of 500 m^2 has been set aside, an area that companies such as Waste-tech and Enviroserve will be invited to manage.

ABB prides itself on its energy efficient product range. It is also justifiably proud of its new building – an inspiration to all of us who ever doubted that anything could be done to mitigate global warming. CEO Pone argues that energy efficient technologies are equivalent to an alternative fuel – but much cheaper to realise. He also views the new building as a symbol of ABB's commitments – to South Africa, to sustainable development and to the environment.

Success and investment have long been known to go hand in hand, but developing green credentials is, unfortunately, seldom associated with economic success. ABB's move is unconventional, innovative and laudible – and may well prove to make very good business sense.

An artist's impression of ABB's Longmeadow building from the Modderfontein (northern) side.

Five million people might disagree

– but the Storm's not a phone for me

There are at least five million people in the world who have bought the BlackBerry Storm. Hopefully, all five million of them are still ecstatic with their purchase. However, there are three people who I know about who have used the BlackBerry Storm and believe it's probably about as useful as a paperweight in an electronic office.

Let me tell you about it.

I excitedly arranged to collect a review version of the phone so I could test it thoroughly and write about it in glowing terms. I had heard so much about it – from the launch event in Midrand to the impressive sales figures that kept being recorded in markets around the world.

Marle Prinsloo, client service director at Idea Engineers, arranged to meet me and give me the test unit so that I could drive it for a month or so. In fact, I mentioned to her that I wanted to give it to a friend of mine, Barbara Milroy, to use because she was in the market for a new smartphone and if it was as good as people said, then that must be the phone of choice.

Having collected the phone, I decided to hang onto if for a day or two to familiarise myself with it. I had a BlackBerry Curve that I'd been using for months and I knew my way around this unit and, frankly, was very happy with it too.

So you can imagine my horror when I discovered that there is no way to 'align' the keyboard or the screen for the way that your own fingers work. For some years, I had also been 'driving' a Palm and its first step in setting up the phone was to use the stylus to configure the screen by pressing in two opposite corners and then in the middle of the touch screen itself.

There's no such configuration for the BlackBerry – and I soon found that in order to actually press the buttons or type on the keyboard, I had to press slightly above the key itself. Sure, the BlackBerry has software called 'SureType' that gives a gentle throb when you pressed the key – not necessarily the key you want but any key.

So I ended up typing: "Ive gOT the BLAckBerRy for YoU to test." It was gobbledygook.

Instead of keeping it for a couple of days, I quickly decided to give it to Barbara so that she could use it and test it for me. I'd stick with the Curve and send accurate messages too.

I showed her how the screen swivelled automatically but she wasn't particularly interested. Her first question was "Can I use my nails on the touch screen?" Like most South African women, Barbara has fashionably long, perfectly-groomed fingernails. If you have fingernails forget using the Storm. Learn, instead, to control the fat, nailess fingers to press the button correctly.

Barbara – like millions of other women – cannot use nails on this touchscreen. She refused to even try the phone and told me to take it back and give it to someone who might be able to use it.

Incidentally, the very next weekend, she went to the Vodacom shop and, having seen the phones on offer from Nokia and Sony Ericcson, Barbara bought herself a new BlackBerry Curve (the latest model) and is extremely happy with it. In fact, having charged the phone, she went back to the BlackBerry shop so that Rico, one of the experts there, could set it up for her and guess what she found?

Sitting on the seat in the centre of the BlackBerry shop was another frustrated woman, who'd been given a Storm by her husband, and who said, quite categorically, that if she could "throw the phone into the swimming pool she'd gladly do so". The poor creature had even brought her computer with her so that Rico could set up the synchronisation process. I must say, both the stranger and Barbara have been most impressed with Rico's service.

While I was somewhat frustrated by the Storm that Barbara refused to test, I had not given up. Instead, I suggested that my 24-year-old daughter, Kate, who is typically quick at grasping new technologies, should use the phone for a while. (Her review appears further on).

She was delighted and immediately rigged the phone to suit her, with ring tones, e-mail services and BlackBerry Messenger and many other things that I wouldn't have thought about using. The main problem was that it took her hours to do so.

Then, one afternoon while I was slaving behind a hot computer, I got Kate's first text message from the Storm: "I was hoPing u wErE oN uR wAy hOme so U Could coLLeCt me. But never mInd."

Clearly she was having finger trouble as well. And Kate's hands are tiny and her nails relatively short too.

Among the three of us there was, by now, a unanimous view that the BlackBerry Storm should not be taken out of its box. It should stay there and rest for all time. As a working tool, among busy people who have a lot of things to do, the Storm is, in my view, hopeless.

Kate's opinion is softer, more ladylike and certainly much kinder than mine. Barbara's review is simple and direct: she used her money to buy something she wanted and could use. A BlackBerry Curve – and she's delighted with her purchase.

When Kate submitted her review, the e-mail message to me says more, perhaps, than her review but be that as it may:

"Hi Dad, I have finally finished the review and I didn't know whether to be nice or down-right nasty so I chose the mid-point. I still firmly believe that the Storm should be thrown out of the window into on-coming traffic and smashed into a million pieces by a passing Mack truck. . ."

The Blackberry Storm: A phone I'd rather not own

By Kate Hartdegen

BlackBerry is proud to have introduced a new generation of phones – the BlackBerry Storm. It is billed as being user-friendly and not in the least bit complicated. This is true; it is not complicated if you are not an avid technology-geek. It looks fashionable, has a nice weight and an excellent screen, not to mention the superb sound and graphics.

Also, one of the great things about the phone is that there is not really a hassle using it outside. There is almost no glare on the screen unlike other touch screen phones, which means that text messages or Web pages can be read quite easily.

It has a pressure-point touch screen and can be used vertically or horizontally, adjusting itself to the change orientation. In vertical mode it has a shortened keyboard, like ordinary cell phones but when used horizontally, it has a full Qwerty keyboard, which is useful when typing Internet addresses.

It reminds me of the days when phones were phones and not computers. Like the 'old days'.

Once set-up, the phone is simple to navigate and relatively easy to understand. One must bear in mind that with all new-gen phones some adjustments are required to have the phone set up the way you like it.

It's also a pretty robust phone. If you accidentally drop it, the phone neatly loses its back and its battery, but the screen remains unharmed. I know it's not advisable to drop or throw a phone even if you get tremendously frustrated with it.

As a typical twenty-something youngster I generally do have the ability to adapt to most forms of new technology but I have found that the Storm is more of an electronic paper-weight that plays music and provides a great slideshow of the pictures you've taken.

But, trying to send a text message or make a simple phone call is really a hassle.

The SureType touch screen is based on pressure, so you must not only be light fingered, you must be incredibly accurate as well and that means pressing the buttons above the actual centre-point.

If you try to use the widely-established Short Message Service (SMS), it's an agonising trial. It can take you five minutes to send a message of just two or three lines. And it's so FRUSTRATING too.

Bear in mind that SMS or text messages mean sending a message quickly. Not so with the dear Storm. Rather than being easy and quick, it's cumbersome and erratic. Errors are common and frustration levels high.

Just to check that I was not being an imbecile, I gave it to one friend after the next and asked them to send a text message. Every one of the 23 people who tried it battled – and not one of them sent an accurate, precise message first time round.

Although Blackberry was decent enough to include a T9 dictionary to think for you it's still very trying and irritating. Worse still, if I type something in Leet-Speak (computer short-hand – 34t, l8er, id10ts) it will automatically convert the word into what IT believes the word means. Phone, phone, phone, DO NOT MAKE MY DECISIONS FOR ME.

It seem to me that the Storm and other new-generation phones are forgetting one of the most fundamental principles – even though the graphics are great and the sound is fantastic – that a phone is meant to be smart, convenient, easy and quick to use.

So if you can't type an e-mail, send an SMS or quickly call someone, then the phone itself fails. At this stage, the Storm fails. It fails dismally.

Moreover, as phones get more and more advanced, so the software has to keep pace with the technology and BlackBerry has apparently informed the Vodacom stores that new software for the Storm will be available soon. At least that's what the Vodacom store at Brooklyn told me when I popped in to find out why the screen would freeze for no apparent reason. The technical chaps blamed it on the software.

I also discovered that when the battery is low, say on two bars or less, an inexplicable message pops up to tell you that an inexplicable "application error" has occurred. That's very odd – why not provide a message that the battery is running out of power. Then I could plug it in and charge it.

If I look back at the previous Blackberry phones I've used – particularly the Curve – I've realised that any other model is infinitely better than the Storm.

For the time being anyway, I would suggest that BlackBerry forgets about touchscreen technology and goes back to the tried and tested technology it has used successfully for years.

BlackBerry actually doesn't need to copy an iPhone. It must stand on its own and be a smartphone instead.

Simply put, I cannot stand the Storm. If the manufacturers want to rescue it then they could, perhaps offer users a "stylus" that would provide the necessary accuracy and precision that makes simple tasks easy to achieve, quickly and painlessly.

Just think that, for about the same price as a Storm, I could buy myself a laptop computer, a digital camera and stick to my old BlackBerry that works exceptionally well all the time.

Perhaps I am just too old for this new touchscreen technology – although I find that really hard to believe considering that I am part of what some people refer to as Generation X.

X-rays used to treat patients and save lives during the South African War

By Paddy Hartdegen and based on a paper by historian Dirk Vermeulen

Medical technology has developed by leaps and bounds over the years and there is no doubt that the introduction of sophisticated computers have added to the enormous repertoire of diagnostic material available to doctors today.

There are now miniature cameras, inserted into a small capsule that can be swallowed by a patient and this tiny camera is linked to a recording device that captures images from the camera as it moves through the stomach and digestive tract. From there, a doctor is able to have an incredibly accurate picture of the entire digestive system from the inside.

There are many other examples: miniaturised cameras are used to travel through the arteries and deploy a stent to prevent rupturing of an artery close to the heart. In years gone by the same procedure would have required open-heart surgery.

There are literally hundreds of examples of micro-surgery being performed in hospitals and clinics around South Africa and there is no doubt that much of this technology is a direct result of miniaturisation. However, it's just as important to recognise that many of these developments would never have happened had it not been for the discovery of X-rays in the late 1800s that allowed medical scientists – and in later years all kinds of industries – to extend their knowledge rapidly.

Many historians believe that the X-ray was one of the most valuable tools ever developed for the medical profession and without X-rays, progress in the medical science would have slowed dramatically.

For most doctors, X-rays still represent the first diagnostic tool to turn to when investigating a particular injury and, based on these results, more detailed analysis such as sonar scans, computed-tomography (CT) scans or Magnetic Resonance Imaging scans might be used.

Predictably the development of the X-ray was a direct result of investigative work done by pioneering electrical engineering academics who were experimenting with new applications within the electrical field.

X-rays were discovered by Wilhelm Conrad Röntgen, who had had a rather chequered university career having been expelled from a technical college in Utrecht for taking part in what was called an unfortunate prank. He completed his diploma in mechanical engineering at the Federal Polytechnic in Zurich and went on to do a doctorate at Zurich University.

In 1888, he accepted the chair of physics at Wurzburg University and while he was there he started investigating the electrical discharges in

the Hittorf-Crookes tubes. In a paper entitled *Early X-ray Equipment, A View from the South*, historian Dirk Vermeulen points out that the vacuum levels attainable at the time, favoured the emission of cathode rays (electrons), which emerged normal to the cathode and struck the front of the tube to produce heat and visible fluorescence in the glass.

Vermeulen says that it's likely that Röntgen was looking for other forms of radiation when he covered the tube with opaque black paper to exclude any visible light produced by the discharge. Vermeulen records that a screen, coated with barium cyanoplatinite, located at a distance from the tube, displayed a bright fluorescence, indicating that some form of radiation was emanating from the discharge tube.

The radiation was capable of penetrating solid objects or materials depending on their thickness or density and he realised, early on, that these rays would be able to penetrate the human skin and muscles and reveal the bones. He called his discovery the X-ray and the name stuck after he had published his findings in the *Journal of the Wurzburg Physical and Medical Society*.

Röntgen was not involved in the commercialisation of X-ray machines but within a year several manufacturers were promoting the sale of X-ray equipment, particularly to doctors who could use them to locate a bullet or see a broken bone.

The early X-rays were primitive by today's standards and the machinery itself was difficult to operate because to get a level of sharpness in an image depended on the distance it was from the subject.

Recognising the value of Röntgen's discovery other scientists promptly began working on methods to improve the existing X-ray machines. Vermeulen writes that it was clear at the time that wavelengths and penetrating power of X-rays depended on the energy released when the cathode rays struck the anti-cathode, which in turn depended on the accelerating voltage between the cathode and the anode.

He describes the longer wavelengths (at lower voltages) as *soft* X-rays and the shorter wavelengths as *hard* radiations. According to Vermeulen, in early X-ray tubes, the anode current and the resulting quantity of X-rays depended on the gas pressure and on the voltage between the cathode and the anodes. Obtaining a particular current (radiation quantity) at a desired voltage (radiation quality) involved choosing an X-ray tube with the required gas pressure.

The Ruhmkorf induction coil was the usual high-voltage supply for early X-ray machines and consisted of a primary winding, carrying an interrupted battery supply and a secondary winding having a large number of turns. The coils were wound around a bundle of soft iron wires to provide a long magnetic core with the magnetic circuit completed through the surrounding air.

Each time the primary circuit was closed, the current rose to a level determined by the time constant. When the contact was broken the voltages across both the primary and secondary circuits reversed, reaching much higher values than those in the first part of the cycle.

A capacitor minimised contact sparking and formed a resonant circuit with the primary inductance, increasing the voltage rise time to convenient proportions and almost doubling the energy available from the secondary circuit.

The Ruhmkorf coils were widely used in the early part of the 20th Century because electric mains supplies were not readily available and batteries were the only convenient source of electrical power, which suited the Ruhmkorf coils anyway.

Surprisingly, the first X-ray machines were not particularly expensive pieces of equipment and in 1896, a Mr A Walsh of Port Elizabeth – coincidentally the President of the amateur photographic club in the city – imported some equipment from a manufacturer in Britain.

Vermeulen traced an article written by a reporter on the *Port Elizabeth Telegraph* who was invited to witness the results of X-rays in person. Walsh placed his hand on a plate and powered up the X-ray machine that was run from batteries charged at the Harbour Board store.

Walsh apparently had to expose his hand on the plate for a total of six minutes before the battery was switched off and the exposure taken into an adjacent darkroom where it was developed. The reported called the demonstration an unqualified success as he saw the bones inside Walsh's hand.

In 1899, the South African War between Britain and the independent Boer Republics of the Orange Free State and the *Zuid Afrikaanse Republiek* broke out and it was not long, before thousands of soldiers – mainly British in the early days of the war – were being wounded in battles around the country.

The Dutch people organised an emergency hospital, equipped with an X-ray machine for the Boers in Pretoria and the German Red Cross established a hospital, with a radiography unit, at Jacobsdal, south of Kimberley and, together with the Belgians, ran and emergency hospital

at the Varley Hotel in Krugersdorp as well.

The British army had ten X-ray sets shipped to South Africa and some of these were set up on board the hospital ships that operated in South African waters. Lieutenant Forbes Bruce used one of these X-ray machines in the Ladysmith Town Hall while the town was under siege and he made over 100 radiographs using the fluorescent screen.

Another X-ray machine was operated by chemist A Allerston in Pietermartizburg Military Hospital and Dr Hall-Edwards X-rayed 193 patients at the Imperial Yeomanry Hospital at Deelfontein, south of De Aar. In later years, Hall-Edwards was to become known as the father of British radiology but the accolade cost him his left forearm and the fingers of his right hand as these had to be amputated because of the radiation necrosis spreading throughout his body.

In many ways, it was the success of X-rays in the South African War that promoted widespread acceptance of the X-ray as a diagnositic tool.

Once the War ended, another enterprising person, Robert Howe-Gould, sold the Siemens X-ray machine that he had been using experimentally, to the Jagersfontein Diamond Mine where it was used to detect diamonds that workers were trying to smuggle out of the diamond diggings.

The machine was used to trap many diamond smugglers but it was not as successful as it should have been as the miners found that, by drinking large quantities of water, before and after swallowing the stolen diamonds, the diamonds did not show up in the stomach. In his paper, Vermeulen says that this may well have been true for the early X-ray machines such as the one used on the mine.

Having sold the machine, Gould gave up working on X-rays and practised as an electrical engineer until his retirement. He was a founder member of the South African Institute of Electrical Engineers and President of the organisation in 1934.

By 1913 X-ray tubes were using valves but the performance of this equipment was described as erratic and difficult to control and it was thanks, at least in part, to W D Coolidge and Irving Langmuir at General Electric that the next generation of X-ray machines were made.

Coolidge and Langmuir had devised a process for drawing tungsten into fine filaments that were suitable for incandescent lamps and, while doing this, they gained valuable experience in creating low pressures in glass envelopes using improved pumping equipment. By raising the temperature of the electrodes and glass envelopes during evacuation, they drove off occluded gases, which could spoil the vacuum during subsequent use.

The two researchers came to the conclusion that they could avoid the erratic behaviour of gassy X-ray tubes by establishing and maintaining pressures of less than one megaPascal. They replaced the original cathode rays with electrons emitted by a heated cathode consisting of a spiral filament made from a ductile tungsten strip that was produced by the Coolidge process.

With the new tubes, the quality of X-radiation could be changed by selecting the required anode voltage from a well-regulated supply. Also, the quantity of radiation could be varied independently by adjusting the filament current.

The improvements certainly boosted the quality of the X-ray images and by June of 1919, 18 000 of the new tubes had been manufactured. Just two months later, in August, this total reached 25 000. The improvements introduced by Coolidge resulted in a tube that was 880 millimetres long and was made by AEG in Germany. The anode of this tube had to dissipate 500 Watts and the length was necessary to prevent the temperature of the anode glass-metal seal from reaching unacceptable levels.

It was this development that made it possible to increase the power of the X-rays. Soon after, Siemens & Halske made a tube with a water-cooled anode capable of dissipating 100 mA at 4,5 kW for one second. The hollow copper anode stem allowed the cooling water to circulate inside the anode to remove the heat, and a tungsten disc was inlaid on the oblique face of the copper anode, to provide a refractory striking surface for the electron beam.

After that, an air-cooled tube, also made by Siemens & Halske, was developed and, in place of the original spiral, a more powerful straight filament was made. Together with its beam-forming wings, it produced a narrow, rectangular stream of electrons that spread the anode bombardment over a wider area.

The chamfer angle of 45 degrees was increased so that the apparent size of the source was greatly reduced. But as Vermeulen points out in his article, vacuum technology was applied to the manufacture of incandescent lamps, then X-ray tubes and, later, to the thermionic valve. It was these three developments that led to the many resulting benefits, one of which was the X-ray machine that is still used today.

Use a Wii to mow your lawn

What will scientists dream up next as they sit inside their laboratories puzzling over some new application for an existing technology or trying to invent a new application that will take the world by storm? Perhaps the scientists at the University of Southern Denmark have struck gold. It's the Casmobot robotic lawnmower which is operated using a Nintendo Wii remote control.

Kjeld Jensen, a robotics researcher at the university, has already demonstrated the technology by taking the Casmobot onto the university's lawns and mowing the grass using the remote control. He says the Casmobot not only makes it easy and painless to cut the grass but also does so more efficiently than many human beings.

The Casmobot uses a standard, motion-sensitive Wiimote controller to communicate via Bluetooth to a computer and a robotics module that has been built into the mower.

By tilting the Wiimote forwards, the mower drives forwards. Tilting it backwards allows the mower to reverse. Jensen says the mowing process can easily be automated if users guide the mower as it maps out the borders of the lawn. This data is stored on the computer's hard drive and then the mower follows these instructions and parameters to cut the lawn automatically.

According to Jensen, the Casmobot has already been given to professional workers at municipalities in Denmark and, as soon as they started using the machine, they were delighted with the results. He says the workers laughed, joked and smiled when they first saw the machine but now realise that it offers a really handy solution to cutting the lawns as they do so often.

Jensen says the technology is not limited to lawnmowers as it can be fitted to any kind of vehicle. He says that its possible, for instance, to take your grandmother for a walk in her wheelchair while sitting inside the comfort of your own home and using the Wiimote to control her direction.

In fact since the Wiimote was launched several years ago, thousands of people have hacked it to control other devices. Anyone interested in seeing these devices can visit the Internet site Hackawii.com where there are instructions for adapting the Wiimote to control webcams, access Google Earth and even drive a Segway.

30-million phones killed off in India

India has cut off 30-million mobile phones because it fears these devices could be used by terrorists to attack Indian targets. The connections have been terminated to about eight percent of India's 375-million mobile phone users – which are being sold at the rate of 12-million a month.

Many of India's mobile phone users are apparently buying cheap Chinese handsets that do not have the International Mobile Equipment Identity code and this means that neither ownership nor the user's position can be traced when the telephone is switched on.

Indian authorities believe that the terrorist attacks in Delhi last year were carried out by militants using Chinese mobile devices that were impossible to trace. Most mainstream mobile phones leave a personal IMEI code with each call allowing the phone to be triangulated between three mobile phone masts so the user's location can be pinpointed.

The Chinese handsets simply show a set of zeroes.

The cheap Chinese imports are bought mainly by young people in India who are looking for a phone that has the features offered by major international manufacturers such as Nokia or Motorola. The Chinese models provide the features but not the security.

One popular Chinese phone sells for about £50 and comes with Bluetooth, a camera, an MP3 player, multi-media messaging and a video player. None of the internationally branded phones are available in that price bracket.

About one million Chinese mobile phones flood into India every month where they are snapped-up by willing buyers who are often not told about the lack of security or the risk they may face of having the cellular phone disconnected by the authorities.

India's mobile phone service providers have warned all purchasers of new phones to be aware that any handset with an internationally recognised IMEI code will automatically be disconnected from the network and barred from reconnecting to it.

A$43-billion invested in Australia's broad-band backwater

Australia is to pour A$43-billion into its national broadband network in a move that Prime Minister, Kevin Rudd, described as the biggest infrastructure project ever undertaken in the country's history. He labelled Australia as a "broadband backwater", which needs to be corrected for Australia to accelerate its economic growth.

Since 2007, Australia has been working on plans to improve its broadband capacity and recently Rudd surprised the country by scrapping a tender for private firms to build a network worth between A$10- and A$12-billion. This network would provide speeds of up to 12 megabits per second.

After scrapping the tender process, Rudd says that the government will now form a company, in partnership with the private sector, and build an advanced fibre-into-the-home network offering speeds of up to 100 megabits per second.

He says that 90 percent of Australian homes and businesses will be able to receive the new, faster connection, with the rest of the country having to rely on the slower 12 megabits per second connection.

Initially the government will invest A$4,7-billion but this will climb, over the next eight years to A$43-billion. Construction is due to start next year. Rudd says that the government will sell its shareholding in the joint-venture company within the next five years when the network is running.

Telstra, a former government monopoly that was privatised some years ago, will be invited to tender for some of the work being done on the broadband project. Apparently Rudd's government is currently also considering a major shake-up of the telecommunications industry in that country.

It seems likely that Telstra will undergo a functional separation of its wholesale and retail operations. Telstra's retail operation competes with other telecommunications companies but rival companies complain that they are unable to gain access to Telstra's infrastructure because it owns a retail operation.

To me it sounds similar to Telkom – without the investment of course.

Satellite tracking antenna used to 'spot' France

A new satellite tracking dish, built at a cost of R22-million, has been installed at the Satellite Applications Centre at Hartebeesthoek, west of Pretoria. The 7,3-metre diameter X-band will receive data and imagery from Earth observation dishes in orbit in space.

The demand for data from Earth observation stations has grown dramatically in the past three years, increasing by more than 30 percent a year. It is a fully-automated dish that is programmed to received data and imagery once a week.

According to Science and Technology Minister, Mosibudi Mangena, South Africa aims to contribute to the global observation station projects and the new satellite tracking dish had been installed to streamline the acquisition of data. The data will be used to support national, regional and global priorities.

The X-band antenna was manufactured by In-SNEC, a French company, and imported to South Africa where it was installed by a French team working closely with engineers from the Council for Scientific and Industrial Research. The civil engineering and construction for the satellite buildings was carried out by local companies.

The antenna has a slew rate of three degrees a second and its installation means the SAC now has 16 antennas to track earth observation stations. A mobile antenna, operated in collaboration with the Overberg Test Range, south-east of Cape Town is also used to monitor the observation stations.

The main satellites tracked by the new antenna are France's SPOT-4 and SPOT-5, the joint Brazilian/Chinese CBERS-2B and the joint Argentinian, Brazilian, Dutch, French and Italian and American, SAC-C satellite.

Spam e-mails burn 33-billion kilowatt hours of electricity

At least 62-trillion spam e-mails are sent around the world every day, generating about 17-million tons of carbon dioxide emissions and using more than 33-billion kilowatt hours of electricity, enough to power about 2,4-million homes in Britain alone. The study was completed by climate consultants ICG International and anti-virus company McAfee.

The study found that the average business user of computers generates about 131 kilograms of carbon dioxide a year and 22 percent of this figure is directly related to spam e-mails. According to ICF if spam filtering methods are used the unwanted spam would reduce by about 75 percent, equivalent to taking about 2,3-million motor cars off the road.

However, the ICF says that while spam filtering will reduce energy waste, the more sustainable solution is to stop spam e-mails at the source. The report looks at one of the major United States-based hosting services that has ties to spammers, McColo, and says that the day after this service was closed down, global spam volumes fell by 70 percent.

The respite was only temporary as spammers found other hosting sites from which to send spam e-mails.

The Spam Report follows another survey conducted by Symantec, which highlighted the fact that spam e-mails had increased by 192 percent in the past year and bot networks had been responsible for about 90 percent of all spam e-mail sent in the past 12 months.

The *Conficker* worm allows computers to be used, invisibly, to send spam e-mails around the world and according to independent spam analyst, Richi Jennings, the vast majority of spam is sent via botnets. He says there is some speculation that the *Conficker* worm is owned and run by owners of another botnet, *Waledac*, which appears to be connected to the classic Storm botnet.

The theory is that the owners are letting *Conficker* run its course before activating *Waledac*.

Clinic on a bakkie and HIV patients benefit

A doctor working at the Bwindi Community Hospital in Uganda is caring for more than 40 000 people through his HIV Outreach Clinic, which can be loaded onto the back of a four-wheel drive vehicle and driven to remote areas where there are no roads and where impenetrable jungles limit ready access to community health services.

Dr Paul Williams moved to Bwindi three years ago and transformed a tine, basic health centre on the edge of the rainforests into an efficient community hospital. The difficulty of travelling around Uganda convinced Williams and his team to devise a way to pack his essential equipment onto the roof of his four-by-four so that he could get to people who need treatment.

He pleaded with the international donor community to make some essential equipment available to him and now has a PointCare NOW machine, a portable blood-testing device that allows a patient's blood to be analysed in under ten minutes and provide detailed information on a patient's immune system.

By counting the CD4 positive T cells it is possible to detect how advanced the HIV virus is and treat it accordingly.

The machine was developed by United States-based company, PointCare, which specialises in building diagnostic equipment for the developing world. The organisation is owned by Petra Krauledat and Peter Hansen and it was Hansen who invented the first automated CD4 test in the late 1970s.

The CD4 test used a chemical reagent that can be freeze-dried and stored at temperatures of over 40 degrees Celsius. The CD4 screening tests use antibodies or molecular tags that latch onto a chemical marker on the surface of the cells and act as flags, distinguishing the CD4 cells from other white blood cells.

Hansen says the machine originally used fluorescent markers but in the hot climate of Africa, the fluorescent chemicals degrade if they are not kept cold, making them useless in Africa for doctors working out of a temporary clinic.

So the tests were changed to use colloidal gold, extremely tiny gold particles that attached to the anti-CD4 antibodies. The gold is heat stable and can be stored at over 42 degrees C for more than a year.

The blood test used by Williams on the outskirts of Uganda's jungles takes just eight minutes to provide an accurate result. The PointCare machine runs on batteries, uses light-emitting diode detectors, a technology that will last for up to 180 000 days without breaking and using minimal electrical power. Williams points out that with correctly-monitored anti-retroviral drugs, a patient's life can be extended for up to 30 years.

UK youths use lasers to 'attack' passing helicopters

Helicopters used by the British police are being targeted by small hand-held lasers and often dazzling the pilots. In fact the police report that in 2008 there were 69 times more hand-held laser attacks on pilots than in 2003. As a result the Civil Aviation Authority has set up a task force to track down people using lasers to 'attack' helicopters.

The helicopters have been fitted with special electronic devices that record and analyse the laser 'strike' and then track the laser back to its position on the ground, allowing police officers to arrest and detain the attackers.

According to the police, most of the attackers are bored youths who have got hold of a laser pointer and amuse themselves by playing its beam over passing aircraft. To combat the laser attacks, the helicopter crew use a hand-held Laser Event Recorder that locates the point and records its wavelength so that the beam can be matched to the pointer.

Using global positioning system devices, the helicopter's thermal image camera is able to pinpoint the perpetrator and a police patrol on the ground is dispatched to the address to arrest the suspect.

The laser beams used by these youths can be bought cheaply from electronics shops situated in major cities throughout the UK and have a really powerful beam. It is sufficiently powerful to temporarily blind a pilot and, if it is close enough to the helicopter, can actually cause permanent damage or blindness.

If a suspect is arrested, police have to prove that the person recklessly or negligently endangered an aircraft. However, the Civil Aviation Authorities are now drawing up new laws, which will make it an offence to point a laser beam at an aircraft.

Most offenders regard the use of laser beams as a prank but they are mistaken as, under the current laws, they can be charged with a criminal offence and once the new laws are enacted will face prison sentences – particularly if they are repeat offenders.

GM, Segway make two-seater scooters for city commuters

Troubled American vehicle manufacturer, General Motors, has joined forces with Segway to make a new, two-seater electric vehicle that can be used by commuters to get around congested cities. The prototype is due to go on sale by 2012 – if General Motors is able to avoid bankruptcy. The company has already been advised to prepare for a bankruptcy filing with the United States authorities by June.

The new two-seater scooter, known as the Puma, has a top speed of 70 kilometres an hour and can run for about 70 kms on a single charge for its lithium-ion batteries. The name of the vehicle is an acronym for Personal Urban Mobility and Accessibility.

General Motors has already received more than $13-billion from the US government and it is urgently seeking new models to introduce to its range of expensive trucks and cars to match consumer demand for less expensive, more environmentally friendly vehicles.

Segway originally introduced its personal transporter in 2002 and has sold thousands of these vehicles in markets all over the world. The Segway costs £4 795 and has a top speed of about 18 km/h. Several of these vehicles have been sold in South Africa, and Brooklyn Mall in Pretoria, actually uses them to patrol the shopping centre perimeter.

In 2003, former President George Bush was invited to try out a Segway and he made headlines around the world by promptly falling off it even though no-one was throwing anything.

In a separate development, General Motors Corporation says bankruptcy is not "inevitable" for the organisation even though it has been given just 60 days to restructure its business and make more extensive cuts in its workforce.

The company has asked the government to supply it with an additional $16-billion in aid and according to company chief executive, Fritz Henderson, the company is trying to win further concessions from its bondholders and its unionised workers.

Last year the troubled US automotive industry, including manufacturers, suppliers and dealers, cut 400 000 jobs and further job cuts are looming. Car sales fell by a further 37 percent in March, the 17th month of steady declines in vehicle sales.

Hi Paddy,

Some years ago WATTnow ran an interesting article on global warming which broadened the understanding of the theory.

This theory of global warming seems to be universally accepted as fact.

However, there have been various articles published in recent times that seek to discredit the theory. While there may be some validity in these assertions many of the articles are written in an emotional tone that makes it difficult to accept the criticisms as serious scientific comment.

To what extent has the generally accepted theory of global warming been subject to peer review and robust scientific debate?

A follow-up article which examined the status of the theory and the extent to which it has been "proven" would be of great interest.

Regards, F.H. Kolbe

[Editor Replies: With regard to your question about whether global warming has been subject to peer review, there have been some articles published in journals such as *Nature* that seem to support the scientific side of the argument. However, in May last year, a group of 31 000 scientists signed a petition disputing the idea that global warming is a man-made phenomenon. I certainly will be doing a series of follow-up articles on this topic.

Dear Mr Hartdegen,

I am very shocked about your article stating that Virgin fired staff for chatting about working conditions among each other on Facebook. First of all, staff members always speak among each other about their working conditions and they often vent their opinions if they feel that management is not approachable.

Secondly, if there are many things wrong in a company it is very often management or even ownership, and not staff that are not conducting themselves correctly.

How can 13 members all be of the same opinion of a company if it holds no truth at all? Where there is lots of smoke there is usually fire too. How can 13 staff members be fired just because they vented their dissatisfaction by communicating with each other privately on Facebook?

Perhaps management is not reasonable or approachable?

I find it very sad that people with money can be so insensitive to the people that ultimately do all the hard work. It's the workers who make those people rich! It's also shocking that they can just be fired so easily for what ultimately seems like bad management.

Thank you for this article it is an eye opener. At least I know I will never apply to Virgin.

Regards, Dean

Dear Paddy

I am writing to you in reply to Peter Ratigan's suggestion that my report about the fire was erroneous.

Here are the facts:

There is no fire service in Betty's Bay.

If a fire breaks out, Kleinmond, which is ten kilometres from Betty's Bay, must dispatch one or both of their fire trucks – one Mercedes Benz and one Magirus Deutz – to respond to a fire.

Further assistance must be sent from Hermanus, an additional 33 kms down the line or from Gansbaai, about 80 ms away where the trainee firemen are available to assist the people of Betty's Bay.

When the fire broke out it was these trainees who were dispatched to respond to the Betty's Bay fire.

The firemen from Kleinmond and Hermanus arrived on the fire scene only to find they could not locate any of the fire hydrants, which were never serviced or marked by municipal staff. Fire hydrants were supposed to be clearly visible, painted yellow and marked on the township road maps.

This was not done.

As they were unable to locate the hydrants, the firemen congregated at the higher part of the town and observed the Fireworks Show. Just down the road from where they were, near the corner of Abalone and Oyster Streets, a house was burning.

The owner was calling and waving to two firemen dousing a burning pile of waste nearby, desperate for them to assist and try to quell the flames. The firemen retorted that the burning bush had to be contained first. It was the burning fynbos that they had to keep under control because if the fynbos stopped burning, the houses would be spared.

At a residents meeting some months after the "devastating fire", volunteers were requested to provide themselves with Bush Beaters (fashioned from a piece of wood with strips of canvas hose attached) that can be used in the event of another fire in the village.

The Betty's Bay council also advised that it would make R30,000 available (this has now been increased to R50 000) so that a shed could be built to store equipment and uniforms to fight fires.

The council also sent out a request to residents to please donate an old truck, which could be patched up by the council workshops, and this would eventually be used as a fire truck.

A quantity of pamphlets with some useful information on fighting fires has been distributed by the council and more of these are apparently due from the printers.

Betty's Bay council says it is currently formulating an emergency evacuation plan for residents of the town.

Hal C. Honey

Competition to build machines using biological spare parts

Scientists from around the world are taking part in a competition to build the best machine using parts from living organisms and more than 100 genetic laboratories will use microscopic components found in biological cells to make the machines.

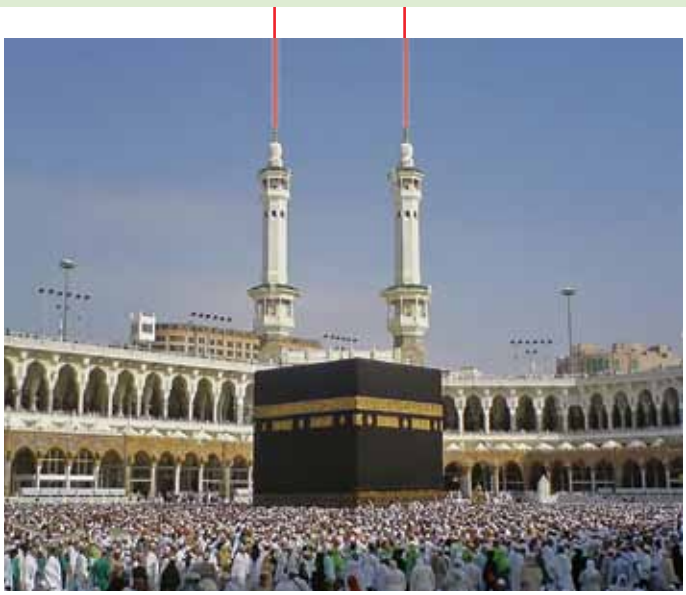
The organisers of the competition – now in its sixth year – hope that useful technologies will be created using some of the basic biological building blocks. Meagan Lizarazo, a former biologist and assistant director of the International Genetically Engineered Machine Competition at the Massachusetts Institute of Technology says that the point of the competition is to see if biological parts can be used to build and operate things.

The competition starts in June and the teams, mostly made of students from around the world, spend three months building their machines from components ordered from the MIT's registry, which contains about 3 200 biological spare parts.

The organisers are hoping that the competition will bring together some of the world's brightest and most talented young scientists and that their efforts will stimulate progress and development of synthetic biology.

One of the advocates of the competition and the biologically-based technology is scientist and entrepreneur, Craig Venter, who hopes to genetically engineer certain species of bugs to produce hydrogen for environmentally-friendly vehicles.

Critics of the programme are concerned that the young scientists could accidentally – or intentionally – produce dangerous new organisms and have suggested that if the scientific knowledge were to fall into the hands of terrorist groups they could use this knowledge to fashion more deadly viruses or develop organisms that can be used in biological warfare.



Muslim worshippers are praying in the wrong direction

More than 200 mosques in Mecca are apparently facing in the wrong direction and as a result, millions of Muslim worshippers have, for decades, been praying in the wrong direction because the mosques were not built precisely based on the qibla.

The qibla is the official alignment with the holy Kaaba shrine in the centre of Mecca's Al-Haram mosque. In terms of the Muslim practices, hundreds of millions of people around the world are supposed to face Mecca during their prayers.

The worshippers are supposed to face the ancient, black-shrouded cubic building known as Kaaba. The directional discrepancies in Mecca's mosques were noticed when researchers went to the top of various new skyscrapers being built in the city itself.

Some of the mosques are more than 50 years old and it's only now that the directional differences have been spotted. However, Saudi Arabia's Islamic Affairs Ministry has downplayed the problem with deputy secretary, Tawfix al-Sudairy, claiming that there are no "major errors".

He admits that using modern technology, some corrections have been made to the older mosques to align them more accurately with the Kaaba. He says, too, that even if some of the mosques are slightly misaligned this would not affect the daily prayers of millions of Muslims.

Many of Mecca's residents believe that directional indicators should now be installed in the mosques to show worshippers exactly how to orientate their prayer rugs so that they can be certain they are actually pointing towards the Kaaba.

Another suggestion has been to install laser beams in the tall minarets of the Al-Haram mosque so worshipers in other mosques around the city can be certain that their prayer rugs are correctly aligned and conform with the instructions contained in the qibla.

Satellite to measure gravity changes in milli-Newtons

Earth's gravity field is being measured by Europe's Goce satellite using a gradiometer to record any subtle variations in the Earth's tug as it moves around the sun. A small engine is used to maintain the Goce's orbit and prevent it from falling to Earth.

Referring to it as a super-satellite, Rune Floberghagen, mission manager at the European Space Agency says that the astronomers and scientists working on the project still have to learn how to drive the satellite to keep it in a stable orbit so that it can collect data on the gravitational forces affecting the planet.

As the Goce moves around inside the Earth's gravity field, the accelerometers will sense fantastically small disturbances – up to one part in 10-trillion of the gravity experienced on Earth itself.

The satellite was built by British firm, Qinetiq and it has a T5 ion engine to maintain its orbit as the satellite is actually so close to Earth that it brushes the top of the atmosphere.

Without the engine, the Goce would not be able to remain in place and would plunge into the ground. The engine also helps the satellite to collect crucial data about the gravity field as the buffetting of air molecules would, ordinarily, upset the gradiometer but by using the ion engine, the disturbances are counteracted.

The Goce's T5 engine has solar panels stuck onto either side of the satellite to provide a constant source of electrical power needed to make the tiny adjustments using the engine.

Floberghagen points out that levels of thrust are so small they are equivalent to the amount of force a postcard exerts when it is placed on a surface – between one and 20 milli-Newtons

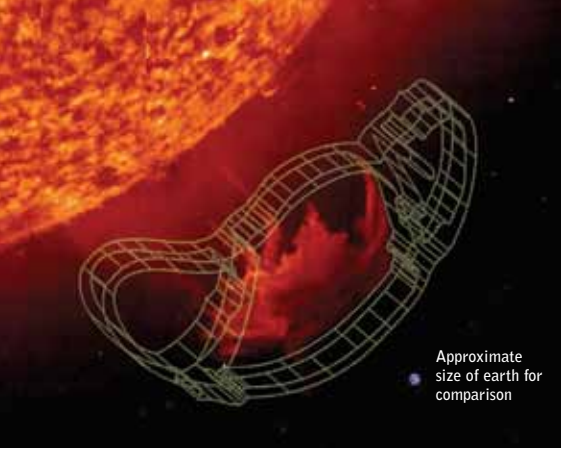
After the launch, Goce was orbiting at about 283 kilometres above the Earth but astronomers have gradually allowed it to fall closer and closer to the atmosphere until it reaches the target orbit of 263 kilometres where it will remain.

By the time this happens the Goce will have reached its own stable path as the gradiometer and the engine will work in tandem allowing it to maintain a stable path and collect essential data on the Earth's gravity field.

Scientists will use the data to help them compile high resolution maps of a geoid – and idealised globe with a surface of constant gravity. This information will be used to study the behaviour of oceans through a better understanding of how gravity affects water.

To do this the Goce senses tiny variations in the pull of gravity over the Earth. The data is used to construct an idealised surface to understand the shape of the oceans without wind or currents. By comparing the sea level and the geoid data, scientists will have a clearer understanding of the influence of gravity on the oceans.

Credits ESA - AOES Medialab



A 'croissant' that causes havoc on Earth

Massive coronal mass ejections from the Sun are shaped like a croissant according to data collected by the National Aeronautics and Space Administration's two STEREO probes that are focused on the sun. The croissant model is expected to dramatically improve forecasts of severe space weather that can disrupt electricity supplies, radio networks and telecommunications on Earth.

Angelos Vourlidas of the Naval Research Laboratory, who helped to develop the model, says that it is now possible to predict when a mass ejection will hit Earth with about three hours of uncertainty, which is a four-fold improvement on older methods.

Coronal mass ejections are billion-ton clouds of hot, magnetised gas that explode away from the sun at speeds of more than 160-million kilometres an hour. If they hit Earth, they can cause geomagnetic storms, satellite outages, auroras and power blackouts.

The ability to predict the speed and trajectory of a mass ejection is a fundamental part of space weather forecasting. According to STEREO programme scientist, Lika Guhathakurta, the mass ejections are complicated, but of the 40-odd ejections studied so far, all had a common shape, akin to a croissant.

Thousands of coronal mass ejections have been observed by NASA and the European Space Agency spacecraft over the years but it is only now that scientists have discovered they have a common shape because, in the past, the observations were made from a single point of view.

Scientists suspect that the reason for the croissant shape of the coronal mass ejections is a result of the twisted magnetic fields on the sun. Vourlidas says the magnetic fields are a bit like a rope that is held at either end but twisted in opposite directions until the middle of the rope becomes a fat, knotted, tangled mess.

He says that coronal mass ejections start out as twisted ropes of solar magnetism and when the energy in the twist reaches some threshold there is an explosion that expels the ejection away from the sun. Vourlidas says it looks like a croissant because the twisted 'ropes' of magnetism are fat in the middle and thin around the edges.

Guhathakurta concedes that there are many other questions that still need to be answered such as how much plasma it contains and the orientation and strength of the internal magnetic fields.

The STEREO probes are on a mission to accurately record both sides of the sun so that they can provide a 360 degree view of the star and scientists expect that these probes will actually run into coronal mass ejections giving them data that can be studied in situ.

Scarce minerals may fuel bloody African conflicts

High-technology industries around the world are scrambling to get their hands on scarce stocks of rare metals for use in appliances that range from television sets to mobile phones and researchers believe that the shortage of materials could fuel bloody conflicts in Africa and other developing countries at some time in the future.

The materials include indium, germanium, scandium, and gallium and demand for these metals is set to explode over the next 20 years according to a research report from Germany's IZT and Fraunhofer Institutes for the economy ministry.

It says that gallium is used in light emitting diode displays and for flat-screen television displays and demand for this metal is expected to rise six fold from current production levels by 2030.

Demand for neodymium, used in magnetic technology, will be about four times more than the current production levels. China already uses about 97 percent of the world's neodymium and researchers say that China's determined push into Africa is directly related to securing supplies of rare minerals for its manufacturing industries.

In terms of mobile technology, demand for coltan, sometimes called grey gold is considered to be a major factor in the continuing bloody conflicts in the Democratic Republic of Congo – the world's largest producer of coltan.

According to Rolf Kreibich, IZT's scientific director, many of the valuable rare minerals are concentrated in few countries and he believes that further conflicts will occur as industries scramble to secure reliable sources of the rare metals.

Bolivia currently has the world's largest reserves of lithium – critical for the manufacture of batteries – and various different countries are scrambling to reach agreement with the Bolivian authorities to ensure that they have a secure supply of this metal.

Kreibich expects that the growing demand for scarce minerals, many of which are by-products of other mining activities, will result in a price explosion in the years ahead. He says it is extremely difficult to recycle the rare metals as they are often used in combination with other metals.

Kriebich believes that because of the scarcity and importance of some of these minerals the G20 nations should agree on a regulatory framework for the use of these minerals. If not, Kreibich says, a European, regulatory agency should be formed to ensure that manufacturers are able to secure reliable sources of rare minerals.

A 'People's Car for Africa' – from agricultural machinery

A group of Ugandan students have built a pick-up truck, known as the *Poor Man's Car* from sheet metal, bits of wood and a diesel engine that was once used to power a corn mill. The design is, at best, utilitarian and would need to be extensively refined before it could go into production.

The dirt-cheap car was assembled from farm equipment, but Moses Sebulime and his classmates at Makerere University believe that the runabout could bring mobility to the masses in Uganda and the rest of Africa.

He says the engine is easy to remove so that it can be used for other agricultural machinery when it's not needed to run the vehicle. Sebulime has been working on an African vehicle for the masses ever since he finished an internship with Tata of India, responsible for building the world's cheapest car, the Nano.

The car cost the students $4 500 to build but Makerere University's mechanical engineering professor, Dr Yasin Naku Ziraba, says that costs would come down significantly should it go into mass production. The university has appealed to the Ugandan government to provide the funding for a prototype.

Many different companies have claimed that they are building a "car for Africa" but so far few have ever gone into production.

All the vehicles in Africa are imported from manufacturers around the world but several vehicles have had a remarkable lifespan on the continent with the mostly plastic Citroen CV, various Peugeot models and the legendary Renault R4 dominating much of the African continent for years.

In later years, and still today, the Toyota vehicles – including the tremendous four-by-four Landcruiser – have become ubiquitous in Africa.

Photos: Dr. Yasin Naku Ziraba.

Image of the Hand of God recorded by NASA

Images of a spinning neutron star, with a pulsar buried deep inside it, look remarkably like an outstretched human hand with fingers pointing upwards. The images were captured by the Chandra observatory circling about 500 kilometres above the Earth and transmitted to scientists at the National Aeronautics and Space Administration.

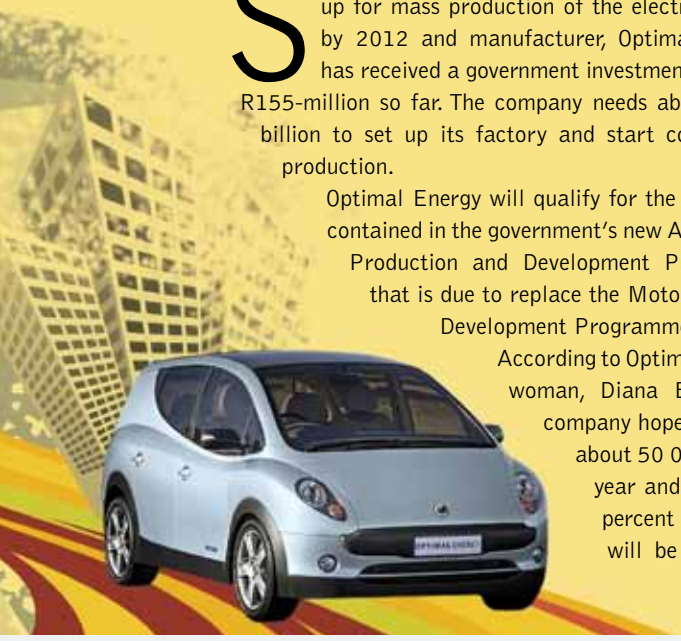
The Chandra observatory is capable of capturing X-ray images of high-energy locations across the universe such as the remnants of an exploding star. The pulsar recorded by Chandra is just 18 kilometres in diameter although the cloud or nebula that it produces stretches across 150 light years of space.

It has been dubbed the Hand of God and follows the discovery of the Eye of God – an image that was released by European astronomers in February this year showing a nebula that was produced by pulsar B1509, about 17 000 light years away.

Neutron stars are created when standard stars run out of fuel and start to collapse. The Hand of God is rotating at about seven times a second and golden-red lights in the image are actually a part of the neighbouring gas cloud that has been energised by the wind of electrons and ions ejected from the pulsar itself.

The colours of the image indicate the different energy intensities with blue light representing the highest energy X-rays, followed by the green and then the red light.

SA's *wunderkar* needs R1,5-billion



South Africa's wunderkar, the Joule is gearing up for mass production of the electric vehicle by 2012 and manufacturer, Optimal Energy, has received a government investment of about R155-million so far. The company needs about R1,5-billion to set up its factory and start commercial production.

Optimal Energy will qualify for the incentives contained in the government's new Automotive Production and Development Programme that is due to replace the Motor Industry Development Programme in 2012.

According to Optimal spokeswoman, Diana Blake, the company hopes to make about 50 000 units a year and about 80 percent of these will be exported.

She says that there is considerable interest in the Joule and as a result, she believes it will be a relatively simple matter to raise the required capital.

Optimal Energy has appointed Step Strategic Venturing to assist it with raising funds.

A pilot fleet of Joule vehicles is expected to be on South African roads sometime next year. The second prototype of the Joule is virtually complete and will undergo a further range of tests. The vehicle is equipped with an on-board charger and can draw electricity from an ordinary 220 V socket.

The battery has a range of about 200 kms and if a second battery is added, this range doubles to 400 kms. At this stage the batteries are being imported but, in due course, manufacture of the batteries will switch to an unnamed local company.

The six-seater vehicle is likely to retail for around R200 000.

According to Optimal's chief executive, Kobus Meiring, the company is currently employing 80 people, but once it goes into production an additional one thousand jobs will be created while at least 5 000 people will be employed in related and supportive industries.

Africa must spend billions on electricity production

Africa needs to spend $563-billion over the next 20 years to meet its power needs, according to Frost & Sullivan analyst, Jeannot Boussougouth, who says that annual demand will increase by more than 4,4 percent.

He says the sub-Saharan region needs to urgently attract private sector investors and several countries will have to urgently reform legislation to provide attractive tariff structures and will have to move towards an energy diversification policy. Moreover, all African countries will have to consider using renewable energy resources to generate power.

He concedes that it is increasingly difficult for independent power producers (IPPs) to raise the necessary funds to erect new power stations. Boussougouth says the economics of IPP developments will hinge on the demand and the incentives that are offered to them by individual governments or agencies.

He says that the investment returns for IPPs could exceed 20 percent in Africa compared with the 15 percent in South America and just 2,5 percent in eastern Europe.

In West Africa there are already 20 possible power projects being investigated that would add 3 472 MW of capacity to that region.

These plants exclude any new generation capacity being planned by Nigeria where a 2 000 MW hydro-electric project known as Mambila is on the verge of being built.

Several new projects are also on the drawing boards in the Democratic Republic of Congo, the biggest of which is the Grand Inga project that will cost an estimated $80-billion and, once completed, will be capable of producing 320 terawatt hours of electricity a year.

In South Africa, Eskom is planning to spend R363-billion to increase its power generation capacity.

There are currently an estimated 500-million Africans without access to electricity in the sub-Saharan Africa region.

Boussougouth says that the African region has huge reserves of coal and gas, providing an excellent base to develop new electricity generation plants and when these resources are combined with renewable energy such as hydro-electric power, geothermal plants and wind farms, it is clear that Africa will be able to provide enough energy for its people provided that it can find the money to build the plants.

Boussougouth concedes that in the current economic climate – coupled with some investor suspicion regarding Africa – the major problem remains that of finding investors who are prepared to risk money in sub-Saharan Africa's energy sector.

40 new coal mines needed in SA

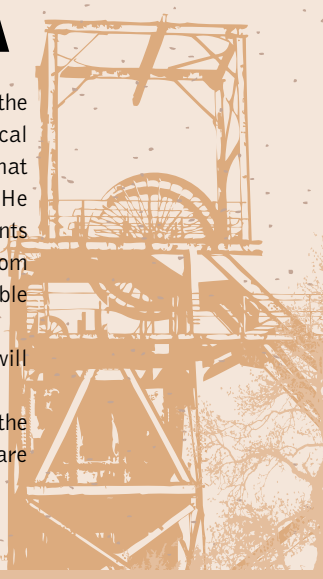
South Africa needs to open about 40 new coal mines over the next ten years at a cost of about R110-billion according to Eskom's coal expert Johan Dempers. The country will have to produce about 374-million tons of coal by 2018 just to meet the growing demand mainly from new electricity generation plants.

He says that forecast figures show that by that time, South African mines will be producing about 385-million tons, giving it a buffer of just three percent. He says that coal demand is likely to rise by about 40 percent over the next ten years because of an increase in exports needed to meet global demand along with the coal required by Sasol for its coal-to-liquid-fuel plants.

Dempers says that to further complicate matters, the coal transportation infrastructure – for exports and local consumption – needs to be re-developed with a goal that will see just two percent of coal being moved by road. He warns, though, that this would require huge investments to ensure that coal could be moved via conveyor belt from the mine to the power station or via a robust and reliable railway network.

According to Dempers at least 600 skilled engineers will be needed at the new mines.

So far seven new mining rights have been awarded by the Department of Minerals and Energy and another eight are expected to be granted by the end of this year.



Billions pledged to improve road and rail links

International lending agencies and Western nations will provide about $1,4-billion to rebuild much of Africa's damaged and deteriorating road and rail infrastructure in an effort to improve trade links and boost economic growth. Already, Britain has agreed to provide £100-million to help fund the North-South Corridor running from the Democratic Republic of Congo and Tanzania in the north to South Africa.

Once complete, the new North-South Corridor will link Tanzania, Democratic Republic of Congo, Zambia, Malawi, Botswana, Zimbabwe, Mozambique and South Africa.

This new road will have subsidiary trunk roads that link directly to various ports along the east coast. More than 8 000 kilometres of roads have to be rebuilt or improved. African leaders are to meet in Lusaka, Zambia to discuss plans to attract international funding to boost road, rail and port infrastructure throughout the southern and central African region.

In terms of the plan, upgrading and maintenance of roads is expected to cost about $7,4-billion over the next 20 years. Zambia's President, Rupiah Banda says the transport, energy, civil aviation and other infrastructure development has lagged behind the rest of the world and Africa must now adopt an approach that will encourage investments in these sectors.

So far the World Bank, the African Development Bank, the European Union and Britain have all pledged funds towards redevelopment of Africa's infrastructure. More than 600 kilometres of railways will have to be rebuilt to link eastern and southern African countries.

African governments have themselves to blame for the shocking state of roads and rail networks, having refused to invest in maintenance programmes over the years. Ugandan President, Yoweri Museveni says that the lack of infrastructure is directly preventing African countries from trading with overseas markets.

Major developments such as the Chinese-built Tazara railway (also referred to as the Uhuru Railway or the Tanzam Railway) from Zambia to Dar es Salaam is not running because it does not have sufficient rolling stock or locomotives.

This railway line was completed in 1976 at a cost of $500-million (paid for by the Chinese and, at the time, the largest foreign aid project undertaken by that country) and covers a distance of 1 860 kilometres.

And yet it cannot transport freight from any of the countries it runs through – when it does run.

A trip from the DRC to South Africa currently takes several weeks because of the poor roads infrastructure in the DRC itself, Zambia and Zimbabwe. Worse still, many of the trucks using the roads are heavily overloaded, causing further damage to the existing roads infrastructure.

In fact one such truck eventually broke down at the N4-N1 interchange outside Pretoria while carrying a load of 108 tons. It was barely able to move under its own weight.

The fact that it had managed to get from the DRC to Pretoria was a tribute to the manufacturers – and a sad indictment of the idiotic, but exhausted driver who'd managed to get it that far.

Flying by the heat of the sun

An aeroplane powered by the sun's rays is set to fly across Europe in an effort to prove that solar energy can be used as a viable aviation alternative. The Sunseeker II plane will be flown by pilot and designer, Eric Raymond in the first trans-European flight undertaken so far.

The environmentally-friendly aircraft has been developed by Solar Flight and built by a Swiss team of engineers and technicians led by Eric Lentz-Gauthier who says the Sunseeker 11 weighs just 130 kilograms, is about seven metres long and has a wingspan of about five metres.

Four lithium polymer batteries are fitted inside the wings to store power that is provided to a five kilowatt engine used for takeoff and climbing. Once the plane hits its cruising altitude of about a thousand metres, it switches to solar power so that it can maintain altitude.

The plane is capable of cruising at 60 km/h under solar power and about twice that speed using batteries. So far, Sunseeker II has done more than 60 flights of an hour or more since it was built in 2002 and it has also been flown at an altitude of more than 5 000 metres by Raymond.

According to Raymond, Sunseeker II has a more efficient tail design, carries a full complement of navigation instruments while the larger wings provide a greater surface area for the solar cells, which are embedded in the wings rather than stuck on top of them as was the case in the first solar plane, Sunseeker I.

Raymond says that he likes to fly the plane at an altitude of about 3 000 metres (10 000 feet) as he can benefit from bright sunlight for solar power and yet ensure that the electronics and the motor remain cool because of the altitude.

$300-billion earmarked for Africa at G20 summit

At least $300-billion of the more than $1,1-trillion stimulus package agreed to by the G20 leaders at a meeting in London should be earmarked for developments in Africa claims the United Nations Secretary-General Ban Ki-moon.

He's called on the G20 nations to turn their pledges into concrete action saying that part of the stimulus package should be used for official development assistance in developing countries and those classified as the most vulnerable countries.

Many of the developing and vulnerable countries are situated in Africa.

The call for concrete action comes after Italy, as one of the G8 countries, admitted that it had not met its aid obligations, prompting calls from Anti-poverty campaigner, Bob Geldoff, to have Italy stripped of its G8 presidency.

A communiqué from the G20 summit indicates that $240-billion will be earmarked for developing countries from the G20 nations and will be handed out in the form of loans. A further $100-billion will be provided through the World Bank and other Multilateral Development Banks and this figure is expected to rise to $300-billion over the next three years.

Ironically, research undertaken by Oxfam International, International Action Network on Small Arms and Saferworld, shows that the cost of conflicts on African development amounted to $300-billion between 1990 and 2005.

A study entitled Africa's Missing Billions published in 2007 shows that the continent loses an average of about R18-billion a year through armed conflicts, wars, civil wars and insurgencies and the direct result is that individual African economies shrink by at least 15 percent because of the violence and unrest. More than a trillion dollars has been donated to Africa over the past 50 years by wealthy western nations.

In a separate development, South Africa's Standard Bank has been given a $400-million credit line from the International Finance Corporation (IFC) to support trade financing deals in sub-Saharan Africa.

This loan is part of a co-ordinated global initiative announced at the G20 Summit. The banks will use the credit line for expanding funding for trade of consumer goods, intermediate goods, small machinery and commodities.

According to Standard Bank, its extensive African footprint makes it the ideal choice for facilitating trade flows into and out of Africa.

Terrafugia builds a flying car that works

An American company, Terrafugia, has built a remarkable aircraft that combines the ease of driving with the thrill and convenience of flying. In fact the flying car has made a successful 30 second test flight and has also been used on the roads around Boston, Massachusetts.

According to Terrafugia's chief executive, Carl Dietrich, the Transition is a light sports plane that has been designed to be driven home on the roads after a day of flying in the skies. It can be parked in an ordinary garage, has been designed for pilots and performs just like an aeroplane, he claims.

The flying car has created so much interest in the United States that already the company has received 49 orders for the $194 000 vehicle. It uses advanced avionics, a lightweight engine and composite materials.

What has helped Dietrich turn the flying car into a reality is that the Federal Aviation Administration created a new classification for aircraft – known as the light sport aircraft – that allows small private plans and ultralight experimental planes to take to the skies. The licence requirements are less stringent.

This led to Dietrich pushing ahead with the design of a plane that could flit around the skies and, after touchdown, be driven home in peace and parked in a garage until the next flying trip. The Transition, while being the first plane of its kind in the world, is not the only one as Cessna is developing its SkyCater and the Icon A5, which will compete with the Terrafugia's plane.

The plane itself is about the size of a large bakkie (equivalent to, say, a Ford F250), has huge windows and looks a bit like an old BMW Isetta with wings. When flying, it's about the size of a microlight plane.

Eskom will keep polluting SA's skies

Eskom currently generates about 224-million tons of carbon dioxide emissions a year and it claims that it will be able to reduce these over the next 15 years but has warned that its carbon emissions will increase as new power stations come on stream.

Eskom's chief executive, Jacob Maroga, says that it will reduce its "relative carbon dioxide footprint" but what this means, exactly, remains unclear. Eskom still relies heavily on coal as the feedstock to generate electricity, hence the enormously high pollution levels from the power stations.

Maroga says that Eskom has an internal target of reducing "total emissions" by 2050 even though, by then, the generation capacity will have almost doubled from the current level of 40 000 MW. Asked about possible new nuclear generating capacity Maroga says that the cost of building a new nuclear facility is about four times that of a coal power station resulting in a capital cost of between R250-billion and R300-billion for a new nuclear power station.

This figure has been disputed by Areva – a major component manufacturer for nuclear power stations – who claims that the actual cost differential is only 1,7 times more expensive. Eskom is working on various renewable energy programmes including large-scale solar and wind power projects and hopes to generate 1 600 MW of power from renewable sources by 2025.

However, this is minute compared with the almost 80 000 MW that it will hope to provide to the southern African power grid by 2050.

Last year Eskom burned 125-million tons of coal to provide electrical power for South Africa and its neighbouring states and this is likely to rise dramatically once the new power stations are fully operational and the return-to-service projects are running at full capacity.

In a separate announcement Maroga says that Eskom may need additional support from the government in order to finance the R343-billion capital investment programme over the next five years. So far the government has provided a guarantee of R60-bilion and a subordinated loan of R176-billion to the utility.

So far, Eskom has spent R46-billion on capital expansion projects in the past financial year and is planning to spend a further R87-billion in the current financial year. Expenditure is expected to peak at R104-billion in the 2010-2011 financial year.

SAIEE 2009 AGM

The AGM for the centenary year was held on 26 March at the Museum of Military History. The President Victor Wilson was not available due to ill-health so Ian McKechnie chaired the meeting. Various reports were read covering the past year 2008 after which the award for best research paper for the SAIEE Africa Research Journal was announced. The award was shared between the University of Johannesburg and the University of Stellenbosch.

The University of Johannesburg's team comprised K Ouahada, HC Ferriera, AJH Vinck, AJ Snyders and TG Swart and their paper was entitled *Combined Spectral Shaping Codes and OFDM Modulation for Narrowband Interference Channels*.

The Stellenbosch team consisted of E Laubscher and RH Geschke with their paper was entitled *A Novel Uniplanar Electromagnetic Bandgap Unit Cell Design with Reduced Spurious Radiation*.

A premium and certificate were awarded to all members of the teams.

Mr Grobler addressed SAIEE members at the AGM on what the SAIEE has achieved over the past 100 years and examined some of the challenges that lie ahead of the Institute in the next 100 years.

The evening closed with refreshments and a light supper.

Top right: The Incoming President duToit Grobler being inducted by Ian McKechnie.

Right: The new triumvirate of vice presidents with Du Toit Grobler: Angus Hay, deputy president, (Left); Andries Tshabalala, senior vice president, (Right) and Mike Cary, junior vice president (Far Right).

Bottom left: Du Toit Grobler thanks the outgoing chairman of the Electronics and Software Committee, Ian Gebbie, for the role he has played in this committee over the past year.

Bottom middle: SAIEE President, Du Toit Grobler thanks Isaac Kruger for the role he has played as Chairman of the Power Committee over the past year.

Bottom right: Du Toit Grobler – the new President of the South African Institute of Electrical Engineers.

Visit of Senior Sasol Electrical engineers

On 24 March 2009, 34 senior electrical engineers from Sasolburg and Secunda visited the observatory. The objective of the visit was to encourage the non-members to join the Institute and reap the benefits of membership.

The first item on the agenda was a lecture by Dirk Vermeulen ,vice chair of the Historical Section. Dirk presented slides from his book about the Observatory and related the story about its start when the site contained a meteorological centre which eventually became an observatory.

The Historical Section of the SAIEE then showed the visitors the library and museum, after which they toured the new interactive science centre run by SAASTA. After lunch the visitors listened to a lecture on transformers and then returned to Secunda and Sasolburg.

The senior person, Mr Theuns Erasmus, thanked the SAIEE for a most interesting and instructive day.

Mike Cary – impressive CV to match the role of Vice President

Well known professional engineer and stalwart of the SAIEE, Mike Cary, has been elected as the vice president of the South African Institute of Electrical Engineers. Mike has been a professional engineer since 1970 having graduated with a Bachelor of Science degree from the University of the Witwatersrand.

He started work – like many other newly qualified electrical engineers – with Eskom in 1968 and remained there until 1972, before resigning to join the Electrical Protection Company, where he was appointed as a design engineer.

It seems that there is something reasonably consistent about Mike's need to keep finding new challenges because, four years later, in March 1976 he left the Electrical Protection Company to join Chemilite as the assistant managing director.

Predictably perhaps, he was appointed managing director four years later, for Disbar and SA Flameproof, having resigned from Chemilite in 1980. His stay with Disbar was short-lived and Mike joined Fuchs Electrical Industries as the chief design engineer and about a year later was appointed the chief engineer of that company.

He quickly migrated up the corporate ladder and in 1985 was appointed as a director of that company. Mike moved to Fuchs Transformer Company (part of General Electric) as a director and general manager in 1986, and remained there until 1988, when he moved to GEC Transformers, as the director and general manager.

In 1990 mike became general manager of ABB Powertech's power transformers divisio, and later, the general manager of the distribution transformers part of the company. In September 1994 he moved to AEG and was involved in consulting work and sales in the switchgear and protection side of the company.

Then in 1995, Mike moved to Rotek Engineering, where he started out as the general manager power distribution, before becoming the managing director of the company in May 1999. He is now a corporate consultant to Rotek Industries.

His involvement with business associations has been extensive and he has served two terms as the Vice Chairman and one as chairman of the Electrical Engineering and Allied Industries Association (SEIFSA). He is currently a member of the executive committee of CIGRE (SA) and a member of SIEFSA and a council member (and vice president) of the SAIEE.

Mike is the treasurer of Applitech (in association with the AMEU and Eskom) and treasurer of the AMEU Affiliates. He is a member of the Eskom Pricing Steering Committee and a member of the Eskom Enterprises Operations Committee.

Apart from an impressive working career, Mike has a number of business achievements that he can be proud of, including his qualification with a Bachelor of Commerce degree from the University of South Africa which he completed in 1973 and then his successful completion of the Advanced Executive Programme, which he completed at the Unisa School of Business Leadership in1980.

He is a member of the South African Institute of Certificated Mechanical and Electrical Engineers, has a Government Certificate of Competency (Factories) and is a Fellow of the SAIEE.

Mike is married, has three sons and two grand-children. Apart from working and studying, Mike has an interest in hiking and in all sports.

Bergville High-School Science Educator Tutoring – a Piece of Cake?

Thavi explains the photo-electric effect to science teachers at Bergville.

Igor explains the refraction of light to the teachers and its importance for students.

Fascinated students watch as Brad demonstrates interference by means of a ripple tank

The beginning of April saw the start of this year's Science teacher tutoring in Bergville. This session covered the areas of Waves, Sounds and Light and Matter and Materials from a Physics focus point of view.

Now one would imagine that a post-graduate engineering student teaching high school science to science educators would find it relatively straight-forward, even easy.

Well it is not that easy at all! In fact, all of the post-graduates have consistently found that their understanding of basic fundamentals can be sorely tested by 'simple' questions posed by the educators. For example, in a Doppler effect problem where the source and receiver are both moving relative to each other, why can one not simplify the calculation by just taking the differential velocity between the source and receiver?

Add to this that the present curriculum is very new and that certain sections, such as lasers, are only being taught for the first time this year. Add further that the material supplied to educators by the DoE, such as the answers to the example exam paper are incorrect in several places! Now one can better understand how what seems simple up front can be quite challenging in the implementation!

In order to teach effectively, it is necessary for an educator to have a fairly deep understanding of the subject to correctly answer out-of-the-ordinary questions from learners. With this deeper knowledge, one can often surmise the origin of a learner's question, answer it and then expand on why a particular line of thinking may be faulty or not.

Not only did the tutors cover the basic principles of the various subject areas but also discussed how to introduce the new sections to the learners so that the teaching process is most effective.

Thanks go to the tutors Brad Duncan, Nick West, Thavi Govender, and Igor Djurdjevic from Wits University for their enthusiasm, time and effort in this endeavour.

Brad Duncan, Nick West, Thavi Govender and Igor Djurdjevic enjoying a spot of lunch as the Bergville