

SOUTH AFRICA

## Looking to the Heavens To Develop the Continent

by Marsha Freeman

South Africa is a country of dramatic contrasts. It is host to the most advanced radio telescope in the Southern Hemisphere, but is struggling to overcome 400 years of subjugation of the great majority of its people by two European empires, and nearly 35 years of the forced segregation of the races, under apartheid. It is the only nation in Africa to operate a nuclear power plant, but at the same time, 55% of its rural population, and more than 12.5 million people in total, have *no* access to electricity. It is the leading nation in the world in producing radioactive isotopes, critical for advanced medical diagnosis and treatment, while millions of non-white South Africans live in hovels made of scrap metal, in “informal settlements,” with no electricity or running water.

National unemployment is about a quarter of the 50 million population, with black youth unemployment double that figure. The Afrikaner government’s apartheid policy of the second half of the 20th Century left the nation with a 5:1 differential in spending for whites versus blacks in education. Although the government spends about 18% of its total budget on education, it will likely take a generation or more to eliminate that inequality.

In 1994, the first democratically-elected government faced almost insurmountable challenges, while thousands of the well-educated whites, who could have contributed critical help in rebuilding the country, left. Nelson Mandela’s policy that there be reconciliation,

not retaliation, as the apartheid government left office, likely saved South Africa from a civil war.

The government of South Africa is committed to up-lifting the 80% of the population that had been held in virtual slavery since colonial rule. It has pledged to increase literacy from the current level of 82%; to continue to bulldoze the “informal settlements” as they are replaced with decent housing and basic infrastructure; to create 5 million new jobs, by 2020.

But even with its great riches in minerals and raw materials, South Africa cannot escape the international financial blowout which is now bringing world trade, along with South Africa’s exports, to a halt. Last year, South Africa lost 53,000 manufacturing jobs, and the projected economic growth rate for this year is down to about 3%. In order to create the jobs required, it is estimated that at least a 7% annual real growth rate is needed.

And South Africa, with all of its own challenges, lives in a neighborhood where people suffering from drought, famine, and civil war are flocking to the “greener pastures” of that nation, thanks to its open-door policy. As quickly as the government is building housing for the poorest of its population, new arrivals to the “informal settlements” make it more difficult to attain the rate of progress it has planned.

But democratic South Africa also inherited a scientific and technological legacy which has been deployed to up-lift that nation, and Africa more broadly.

## Scientific Orientation

While it is focused on investment in housing, education, transportation, energy, healthcare, and other basic economic infrastructure, the government of South Africa intends to use all of the available resources it has to accelerate progress. In this, its emphasis on, and deployment of resources into scientific advancement, education, and development is extraordinary.

Prior to 1994, leading-edge space and rocket technology and nuclear programs were under development, as military projects. The African National Congress-led government abandoned these programs after 1994. More recently, and with an impetus from the scientific community, universities, and industry, the government has placed a new emphasis on leveraging its human capital and base of high technology skills to initiate national science and technology programs as a driver and enabler for leapfrogging into the future.

The progress that South Africa has made in this regard, won it the bid, on behalf of all of Africa, to host the prestigious annual Congress of the International Astronautical Federation, in Cape Town Oct. 3-7, which was attended by this author.

In 1999, South Africa became the first country to send a microsatellite, weighing 64 kilograms (about 140 pounds), into Earth orbit. SunSat was designed, assembled, and operated by faculty and students in the electrical engineering department at the University of Stellenbosch, and was launched by the United States.

Using data from foreign satellites, South Africa developed the capacity to interpret and make use of Earth observation imagery. In one example, five years ago, the Satellite Applications Centre, now SANSА (South African National Space Agency) Earth Observation, began using satellite data to create a multi-year data base to document the state of “informal settlements,” for the Department of Human Settlements in the North West Province. By comparing new housing delivery rates with settlement growth, the government is able to more accurately identify and track the housing gap.

Building on the country’s experience and skill, and



*Cape Town, the venue for this year’s International Astronautical Congress, is tucked inside Table Bay, shielded somewhat from the Atlantic Ocean. This detailed image was taken in February 2010 by South Africa’s Sumbandila satellite, as seen in an artist’s drawing in the inset.*

recognizing the value of an African-designed and -owned Earth remote sensing satellite, the government commissioned SunSpace—a company spun off from the University—to build a larger, prototype Earth observing satellite, Sumbandila, which means “lead the way.” The R26 million (\$3.7 million) Sumbandila satellite was launched in 2009, and has collected images of the Earth for two years.

The next step, as outlined in late September by Dr. Sandile Malinga, the head of the new South African National Space Agency (SANSА), is Sumbandila-2, an operational Earth observing satellite, projected to cost approximately R400 million (\$52 million). This operational satellite is being planned, not as a stand-alone capability, but as part of the African Resource Management Constellation (ARMC) whose goal is to vastly upgrade satellite coverage of the entire African continent.

The goal of the satellite projects of South Africa and other African nations is to end their dependence upon other nations for satellite images and technology, and instead, develop indigenous capabilities. As was stated during the Congress, buying just a few images of your country costs in the tens of thousands of dollars. And those dollars comprise a growing high-technology trade



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*During the first space Congress to be held on the continent of Africa, leaders of five African space agencies described the space programs and the aspirations of their nations. Left to right: Seidu Oneilo Mohammed, Nigeria; Sandile Malinga, South Africa; Harry Kaane, Kenya; and Tahor Iftene, Algeria. At the the microphone, is Mustapha Masmoudi, from Tunisia.*

deficit, between Africa and the space-faring nations.

The government of South Africa is also considering resurrecting the rocket test-and-launch facilities at the Overberg Test Range, which had been developed in the 1980s, to launch an Earth-observing/reconnaissance satellite for the military. That program also created satellite integration and test facilities, and some industrial capabilities, which are now deployed for the civilian space program. A rocket launch facility at the Overberg site would be the first one on the African continent.

### **Imagination and Wonder**

There is apparently an old joke, which goes: “God put all of the astronomers in the Northern Hemisphere and all the interesting objects in the Southern.” Not *all* the astronomers!

Centuries ago, it was of practical importance to be observant of the southern sky, as explorers rounded the Cape of Good Hope, hoping to find a sea route to the East. Before 1600, measurements of the Earth’s magnetic field were made, to aid navigation. This region was also of particular interest, due to the South Atlantic anomaly, a region of weakening of the Earth’s magnetic field.

Participation in the International Polar Year of 1932-33 led to the establishment of a magnetic observatory at the University of Cape Town. The Cape Town observatory was later moved to Hermanus, where it operates

today. It is certified as part of an international network of geomagnetic facilities which monitor the interaction between the Sun and the Earth, and recently inaugurated the Space Weather Operations Centre, to develop the tools to issue warnings of magnetic storms.

Early on, it was well appreciated that an astronomical observatory in the Southern Hemisphere would reveal parts of the cosmos that the great majority of the world’s astronomers had, in fact, never seen. In the 1820s, the Royal Observatory at the Cape of Good Hope was established by the British, and for over more than a century, it was visited by internationally prominent astronomers.

In 1972, the telescopes at the main observatory site in the dry Karoo region of South Africa were merged with observatories in Johannesburg and Pretoria, to form the South African Astronomical Observatory. The SAAO is South Africa’s national center for optical and infrared astronomy.

The single largest optical telescope in the hemisphere today is the Southern African Large Telescope (SALT), completed in 2005. South Africa is the major shareholder in the international consortium that built the telescope, and about 70% of SALT was built there.

In 2003, the government, encouraged by its success in building SALT, decided to take a giant leap, and registered an interest in hosting the Square Kilometer Array (SKA), which, when it is completed in 2024, will be the largest, most precise radio telescope array in the world. The only other bids are from Australia and New Zealand; the winner will be chosen next Spring.

Scientists and engineers working in South Africa have been searching for radio-wave signals from space since the dawn of the space age. In 1961, NASA built a radio-wave antenna at Hartebeesthoek, about 50 km west of Johannesburg, to receive signals from its earliest lunar and planetary probes. After it was closed as a NASA station in 1974, the facility was converted to the Hartebeesthoek Radio Astronomy Observatory (HartRAO). There, precise satellite location techniques using laser ranging, and tracking Earth’s continental drift, complement studies in radio astronomy.

In order to develop the leading-edge technologies that will be required to build, operate, and coordinate the Square Kilometer Array's 3,000 radio antennas (with a total surface area of the dishes of 1 km<sup>2</sup>) which will be spread over 1,000-km distances, the government embarked on a precursor radio astronomy program, which is now coming to fruition.

The Karoo Array Telescope, or MeerKAT, will consist of about 64 radio astronomy dishes when it is completed over the next few years. By 2016, it will be ready to do science, but already more than 500 hours have been allocated to top scientists in South Africa and around the world. The first prototype dish was built and tested at HartRAO in 2007, and the first seven operational dishes (KAT-7) are undergoing testing, and will be commissioned by the end of this year in Karoo. Whether or not South Africa, and the eight other African nations that are partners in the project, win the bid to build the SKA, MeerKAT will be doing world-class radio astronomy for decades.

## **Imagination and Wonder**

One of the most important reasons that the government of South Africa has placed such a prominent emphasis on promoting advancements and contributions to space science was expressed by Dr. Sandile Malinga at the Cape Town international space conference (see interview, below). The practical applications of space technology in agriculture, communications, long-distance learning, weather forecasting, health, disaster management, infrastructure planning, and all the rest, will allow South Africa to compress its timeline of economic development. But it is science, which Dr. Malinga described as "imagination and wonder," which justifies his government's expenditures on projects such as the Square Kilometer Array.

In her interview (see below), Minister of Science and Technology Niladi Pandor expressed the need to move forward, and overcome "Afro-pessimism." That is the *intention* of the South African government. But the accelerating global financial crisis and collapse of, most profoundly, the European and American economies, will make that impossible.

When America returns to being "the country that inspires us," as Pandor recalled, South Africa will be positioned to contribute to, and benefit greatly from, a new alliance among nations based upon great global economic projects. South Africa also will play a critical role in the development of all of sub-Saharan Africa.