

WHEN AFRICA LOOKS TO THE STARS

"The Earth is the cradle of humanity, but one does not spend one's entire life in a cradle. "

Constantin Tsiolkovski

In order to overcome prejudice, to revive in us that feeling of optimism and wonder that exists in every child, in every discoverer, in every leader who dares - a feeling that our societies have the unfortunate habit of killing off in the adults that we are - I want to make known a little-known aspect of Africa: its taste for the future, and more precisely for space.

March 2019. The French president has just toured Ethiopia and Kenya. He has seen the enormous economic advances, but also the requirements in terms of technological leaps. The French CNES (Centre National d'Études Spatiales) issued a press release on France's commitment to strengthen space cooperation with East Africa.

I have few illusions in general about the aims of Western leaders. But I am optimistic: I know that the world is on the threshold of a new era. As the 'less advanced' countries make their way onto the international stage - through initiatives such as the New BRICS Development Bank or the New Silk Roads - the old industrialised countries are increasingly forced to respond, even in their own cynical way, to this new call for multilateralism, cooperation and knowledge sharing.

Whether it likes it or not, if it wants to save its credibility, France will have to abandon its Kouchner-style rice bags and its development aid policy and replace them with satellites and engineering schools.

However, much better than the European countries (which have turned away from an industrial model that made them successful), the African countries understand that space has become a real lever for development... on earth.

ESSS or the « Mad People's Club »

Founded by 47 astronomy, astrophysics and space science enthusiasts, the Ethiopian Science and Space Society (ESSS), nicknamed the "Crazy People's Club", was established in 2004. Its objective? To contribute to the development of astronomy, space science and related sciences within ten years", in order to "make Ethiopia an effective and experienced player in space science and technology".

A passion, an idea, a slightly 'crazy' project, but a successful gamble: nine years later, in 2013, the ESSS has already installed an astronomical observatory on the top of Mount Entoto, overlooking Addis Ababa, at an altitude of 3 200 m. Although the facility began operating in 2015, two 1 000 mm telescopes are currently in use. Given the country's proximity to the equator and high altitude, the conditions are ideal. "Being involved in astronomical research and technological advances here in my country was a childhood dream. This is the first time I have used a telescope this big!" said Ghion Ashenafi, an engineer at the observatory, when it was commissioned.

Abinet Ezra of the ESSS exclaims: "They think we are crazy because they think we are just looking at space and stargazing, but they don't see the big picture!" In an interview with the British newspaper The Guardian, near the Addis Ababa Institute of Technology, the Ethiopian scientist explains how space research is in fact a very 'down-to-earth' field: it improves agriculture, fights climate change, creates many jobs and so on. Science and technology are essential to a country's development," she says.

Our priority is to encourage the younger generation to take up science. "It was our priority to convince the government: now they are convinced!" explains Dr Solomon Belay Tessema, former director of

the ESSS. For him, it is clear that astronomy will serve "not only science, but the 94 million Ethiopians"!

Supporters of the Ethiopian programme also argue that space science is essential to lowering the cost of telecommunications, as long as we can make ourselves capable of launching our own satellites (which are still too often leased to other countries for exorbitant amounts).

The ESSS is now conducting a feasibility study for the construction of a second observatory, even larger than the first, in Lalibela. This site, at an altitude of 4,200 m and with a dry climate, is perfect. This second project would have the support of the International Astronomical Union, of which the ESSS has been a member since 2012. The International Astronomical Union, an international non-governmental association, coordinates the astronomical work of all researchers around the world. It was founded in 1919 by a French astronomer, Benjamin Baillaud, and now includes over 70 countries. In Africa there are: Egypt (1925), Morocco (1988), Nigeria (2003) and of course South Africa (1938), the leader in space science on the continent, as we will see later in this chapter.

Finally, in December 2019, Ethiopia launched its first satellite, thanks to a Chinese rocket. While the 70 kg spacecraft will serve as a training aid for the country's engineers, it will be used for monitoring in the areas of water, agriculture, climate, environment and mining. In short, it doesn't get more local than space!

During his visit to Ethiopia, Emmanuel Macron visited the Lalibela site... but for other reasons. Classified as one of the country's most sacred sites (and a Unesco World Heritage Site), Lalibela is home to rock churches dating from the 13th century, which are a feat of engineering and have long fascinated visitors (some even say they were built by angels!). As the rock from which they are carved is eroding, the French president has pledged as part of his "cultural diplomacy" to "finance and accompany the work with the Ethiopians to restore these churches. "

Thus, on this site of Lalibela, situated 680 km north of Addis Ababa, the most beautiful works of the past and the most beautiful works of the future could rub shoulders, combining... inner contemplation and contemplation of the infinitely great!

Satellites for all of Africa: a panoramic view

But what a long way we have come since the creation of the ESSS in 2004! Those first steps 'into space' that we have just mentioned are in fact becoming great leaps for Africans...

In early 2017, the Ministers of Science and Education representing the 55 nations of the African Union (AU) decided to adopt a continent-wide space policy for the first time. This major new initiative is seen as 'critical to the economic development of the continent' and will focus on 'promoting science, technology and innovation'. In January 2019, the AU endorsed the creation of a genuine African Space Agency, choosing Egypt to host its future headquarters.

And the stakes in terms of development are clear. On 8 May 2017 in Pretoria (where the 37th Symposium on Remote Sensing of the Environment was being held), the new director of the South African Space Agency, Val Munro, pointed out that Africa covers 22% of the Earth's surface and is the hottest continent in the world, with a third of its territory deserted and more than 90% of its soil unsuitable for agriculture. Under these conditions, space technology can contribute to 35 of the 40 goals set by the African Union for the continent's economic and social development, he said.

More and more African countries are already using satellite data to bring a scientific dimension to their policy-making. This includes the construction of transport infrastructure, agricultural monitoring, water resource assessment, natural disaster management, disease monitoring, etc. However, only

Algeria, Morocco, Angola, Ghana, Egypt, Kenya, South Africa, Nigeria and now Ethiopia have their own Earth observation satellites. And of these, only a minority (mainly the latter two) produce them themselves.

Rwanda

"Africa is just tired of being in the dark. It's time to take decisive action (...) Light and power Africa (...), accelerate the pace of economic transformation, unleash business potential, spur much-needed industrialisation to create jobs [and] connect the elite schools to bridge the digital divide that still affects half the world's population": this is the stated motivation of OneWeb, the US-based global communications company that is now helping a number of African countries, including Sierra Leone and Rwanda, to get new satellites.

It is thanks to this company that the Rwandan sky recently welcomed a brand newcomer, Icyerekezo. The satellite, so named by students from Nkombo Island, was launched on 26 February 2019 from French Guiana, in partnership with the Rwandan government. Its mission: to provide these students, isolated on Lake Kivu, with an internet connection. Like all the rural schools in the country, their establishment suffers from a total lack of internet access.

For the Rwandan Minister of Education, Eugene Mutimura, the project is in line with Rwanda's "master plan for ICT in education", which aims to "connect schools and give Rwandan children great opportunities (...)" More and more emerging countries aspire to boost their technological capacities, because they know that they are a vector for rapid development. So while Rwanda could have used standard fibre optics, it preferred to use a satellite, which is less expensive and more promising. For ICT and Innovation Minister Paula Ingabire, the choice of Nkombo students represents "their own aspirations to embrace the STEM [Science, Technology, Engineering and Mathematics] fields and develop the workforce of the future. This partnership responds to [Rwanda's] intention to become a regional hub of technological innovation (...) creating new opportunities for [its] innovators. "This choice to use new technologies to solve problems is not new to Rwanda, which for example was the first country in the world to use drones to transport blood to remote clinics.

Kenya

Kenya is one of the newcomers in the space field. The country built its first satellite (CubSat) on its own territory at the University of Nairobi, before launching it in Tokyo, Japan, in May 2018. It is a nano-satellite measuring 10x10 cm and weighing 1.2 kg! Its purpose: to collect information for weather forecasting, food security mapping, livestock and wildlife monitoring, border surveillance and disaster management.

According to the International Fund for Animal Welfare, an elephant is killed for its ivory every 26 minutes in Africa. The fund has therefore set up a programme called TenBoma to combat elephant poaching - from the Swahili Nyumba Kumi, a Kenyan philosophy of communal living that means 'ten houses'. TenBoma works by keeping bomas, or villages, safe, provided they look after each other in groups of ten. The programme will use data sent by the satellite.

"This breakthrough will inspire our scientists and young people to continue to be innovative, competitive, and use their knowledge for the good of humanity. We will now move on to the next phase and build bigger and better satellites," said university professor Isaac Mbeche at the launch of Cubsat.

South Africa

It has been said that South Africa is the most advanced country in the continent in this field. In 1999, it was the first African country to launch a 64 kg micro-satellite into orbit. Designed, assembled and operated by professors and students from the Department of Electrical Engineering at Stellenbosch University, SunSat was launched by the US. But there is more: today, it is the largest optical telescope in the Southern Hemisphere (completed in 2005), located in South Africa. It is the Southern African Large Telescope (SALT).

In 2003, the South African government, encouraged by its success in building the SALT, decided to go one step further, offering to host part of the ambitious Square Kilometer Array (SKA) project. With 200 parabolic telescopes and 130 000 fixed radio antennas spread across Africa and Australia, the SKA will cover a total collection area of 1 km². When completed in 2024, it will be the largest and most precise radio telescope array in the world. Better still, it will be at least five times more sensitive and 60 times faster at processing data than the best radio telescope in existence today!

For Ms Naledi Pandor, South Africa's Minister of Science and Technology until 2012 (and former Minister of Higher Education and Vocational Training), it is essential to overcome 'Afro-pessimism': 'One of the things we wanted to do was to change the way the world sees Africa. We tend to see the continent as a place of terrible problems, famine, disease, war, and not as a place of knowledge (...) We are trying to change this image so that we are associated with a centre that attracts top researchers. "He added: "We have worked very hard to launch a partnership between the South African programmes and the African continent. We have 23 universities in South Africa. At the moment, 820,000 young people are enrolled there, so much so that we are almost overwhelmed. And the amazing thing is that of that number, about 50,000 are from other African countries. "

Nigeria

At the 2018 Lake Chad International Conference (see p.106), the author of this book had the opportunity to interview one of the members of the National Space, Research and Development Agency of Nigeria (NASRDA). Established in 2001, the agency, which is part of the Federal Ministry of Science and Technology, aims to ensure the ambitious development of the space industry in Nigeria. Nigeria already has its own satellites, including NigeriaSat-1, launched in 2003, which uses satellite imagery to monitor oil activity in the Niger Delta. Satellites like this one are already making it possible to analyse climate data and improve agricultural practices.

Surveillance from the sky should also make it possible to locate Boko Haram hostages as part of the war on terror. Finally, Nigeria hopes to send its first astronaut into space by 2030!

Extract from the interview:

- Sébastien Périmony: "It's funny, since for most Europeans, when we think of Africa, we don't think of a space industry, we think of conflicts, famine, wars. "

- Elvis Nsofor, engineer at NASRDA: "Yes, when I was in Italy and Germany last year, and every time I had to make a presentation to some of my colleagues, they were all very surprised! 'Really, do you have a space agency in Africa? Do you really have a space agency, but why do you have a space agency?'" "

When France gets involved

As we outlined at the beginning of this chapter, despite the economic and industrial harakiri that has been taking place in Europe for several decades, the prospect of future opportunities that this scientific

awakening of Africa will provide has not escaped some people.

Thus, on 8 July 2018 in Paris, Jean-Yves Le Gall, President of the CNES, met Khaled Abdel Ghaffar, Egyptian Minister of Higher Education and Research. The subject of their exchange? The prospect of "space cooperation (...) in the context of the extension of bilateral relations with France [and] the rise of the Egyptian space sector (...)". It should be noted that France has a common past with the country of the pyramids, particularly in Earth observation and telecommunications.

It is in this continuity that on 14 January 2019, the first France-Egypt space seminar took place in Cairo. The two countries signed a cooperation agreement covering a whole range of fields, including, once again: Earth observation, but also climate observation, various civil applications of space technology, the development of nano-satellites, and finally, training. At this event, "Egypt reaffirmed its position as a new space player with strong regional ambitions in Africa and the Arab world "1.

Jean-Yves Le Gall, once again present at the seminar, took the opportunity to invite his counterparts from the Egyptian Space Agency (EgSA) to visit the Toulouse Space Centre, in order to continue the discussions and 'start working together'. The President of CNES was accompanied by a large delegation, made up of his colleagues as well as representatives of the European Space Agency and the French university ISAE-SUPAERO.

TIBA-1, the Egyptian government's telecommunications satellite, was manufactured in Toulouse and launched on 26 November 2019 in French Guiana by the Ariane 5 launcher. Thales Alenia Space recently won the international tender to build Egypt's Nilesat 301 telecommunications satellite, which is scheduled to leave Earth in the first half of 2022. As the Thales Alenia Space website states: "Nilesat-301 will also contribute to the extension of telecommunications and direct digital broadcasting services in the same frequencies for two new major African regions. It will also enable the provision of high-speed Ka-band connectivity services throughout Egypt.

Conclusion

Today, in the midst of a health crisis (coronavirus, locust invasions, etc.), African countries are facing serious threats of famine, making the applications of space technology all the more relevant. The most recent case in this field is the ability to predict malaria epidemics: we know that there is a correlation between mosquito larvae, which spread malaria, and humidity concentrations, which can be tracked by satellite. So governments can anticipate. This technology has already been put into practice in South America with NASA's Land Data Assimilation System (LDAS) project, which allows satellites to track environmental factors (such as rainfall) or human activities (such as logging) over the Amazon rainforest that may attract mosquitoes.

We cannot stress enough that scientific progress, and with it access to knowledge, is the number one ally of the sovereignty and development of the countries of the South - and, let us not forget, one of the first demands of the non-aligned countries. Cooperation with Africa in the space sector will therefore be one of the challenges of the 21st century. "For every €1 spent on space, €100 is redistributed to a country's economy," says Sékou Ouédraogo, head of aeronautics projects at Safran Aircraft Engines. For him, it is clear: "The continent's development depends on space"².

¹ According to the Egypt Independent, an English-language publication of the daily Al-Masry Al-Youm.³⁸

² Sékou Ouédraogo is the author of *L'Agence spatiale africaine, vecteur de développement*, L'Harmattan, 2015.