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NEXT EINSTEIN FORUM

Deep Impact

How Africa's space rocks are driving planetary science Pg18

Scientific African Magazine

Scientific African Magazine documents science and technology developments in Africa and from Africans for the general public. We review innovations that matter. We ask the hard questions. We highlight best practices. The Magazine is published by the Next Einstein Forum (NEF).
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Celebrating diversity

Did you know that nearly half of all research performed in sub-Saharan Africa (SSA) is in fields related to health?

At least it was as recently as 2014, when the World Bank published its report 'A decade of development in sub-Saharan African science, technology, engineering and mathematics research'. That report noted a rapid growth in SSA's contribution to global research output from 0.44% to 0.72% in 2003-2012. But those advances were largely attributable to a 4% annual growth in health research. Indeed, the report said, by the end of the decade studied 45% of all the research done in SSA was health-related.

The share of STEM research in SSA had declined annually by 0.2% over the same decade.

It's not difficult to see why. Research in Africa has historically been dominated by two disciplines: health and agriculture. Both disciplines were vital to the colonists that laid the foundations for many of the continent's research institutions. This focus survives to this day, as many of the continent's challenges—which science is being asked to solve—revolve around food insecurity and ill-health.

But science in Africa is about more than agriculture and health. To thrive, the continent needs not just medics and farmers—it needs engineers, mathematicians, ecologists and astronomers. It's this diversity of intellectual endeavour that we want to celebrate here at *Scientific African Magazine.*

In this issue—our third in print—there is health. There is agriculture. But there is so much more. For example, our cover story is about asteroids. Over one-fifth of all space rocks found on the planet have been discovered in Africa. Some of those rocks have traveled from planets like Mars and Mercury, and provide us with invaluable insights into these nearby worlds. Until recently, the equipment and expertise required to study these rocks did not exist in Africa. But this is changing.

There are also inspirational tales of scientists working in unexpected fields. The issue introduces us to Adewale Awoyemi, the 'birdman of Ibadan', whose successful ornithology club is helping to raise awareness about Nigeria's ornithological treasures. We meet Esther Kioko, who has spent decades studying creepy crawlies in Kenya and along the way helped rural communities create income-generating 'butterfly farms'.

> **Africa doesn't only need medics and farmers—it needs engineers, mathematicians, ecologists and astronomers**

And then there's the practical insights that could change the way you live your life. If your grandmother told you to wash your itchy eyes with seawater, we're sorry, but she was wrong. Want to know the best way to eat cassava to avoid cyanide poisoning? Read our story to find out.

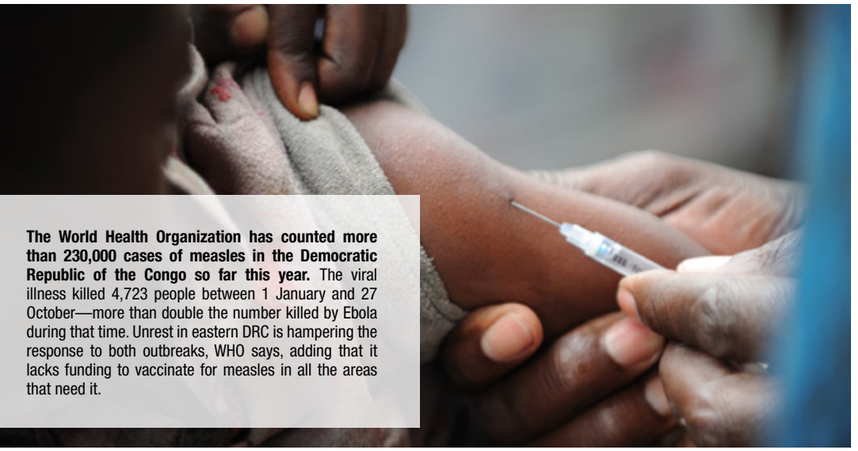
We hope the stories contained in these pages will inspire and inform. We hope the will challenge the notion of African science being all about health and agriculture. But we also hope it holds up a mirror to the continent, saying: This is what we are. After all, the stories we tell about ourselves influence how we see ourselves—and by consequence, our actions in the world.

If you think we should be covering an important, science and innovation driven, Africa relevant story, write to us at: *magazinen@ef.org*

Nathalie Munyampenda & Linda Nordling

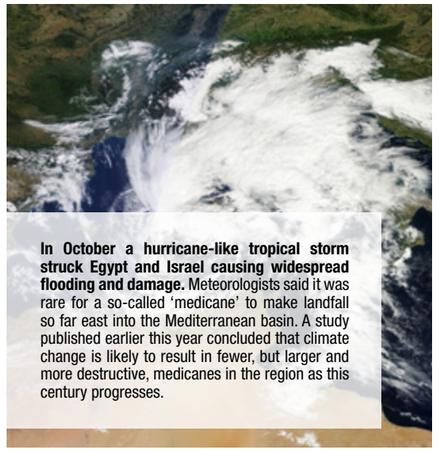
In Brief

Top science news from around the world

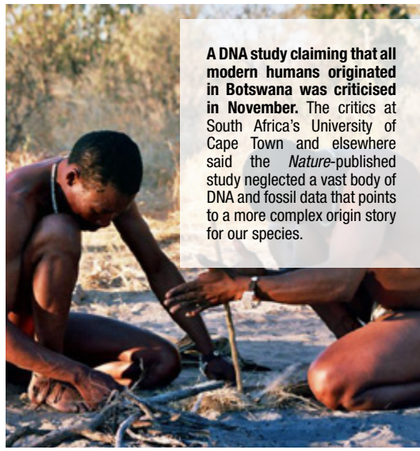


The World Health Organization has counted more than 230,000 cases of measles in the Democratic Republic of the Congo so far this year. The viral illness killed 4,723 people between 1 January and 27 October—more than double the number killed by Ebola during that time. Unrest in eastern DRC is hampering the response to both outbreaks, WHO says, adding that it lacks funding to vaccinate for measles in all the areas that need it.

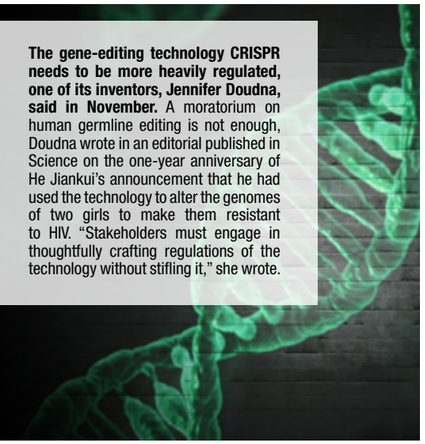
A November study reported that a third of Africa's tropical plants could be threatened by extinction. Four hotspots—West Africa, Ethiopia's highlands, central Tanzania, and southern Democratic Republic of the Congo—stand to lose more than 40% of their current biodiversity. Reasons for this include activities such as logging and mining, as well as climate change, the authors write in Science Advances.



In October a hurricane-like tropical storm struck Egypt and Israel causing widespread flooding and damage. Meteorologists said it was rare for a so-called 'medicane' to make landfall so far east into the Mediterranean basin. A study published earlier this year concluded that climate change is likely to result in fewer, but larger and more destructive, medicanes in the region as this century progresses.

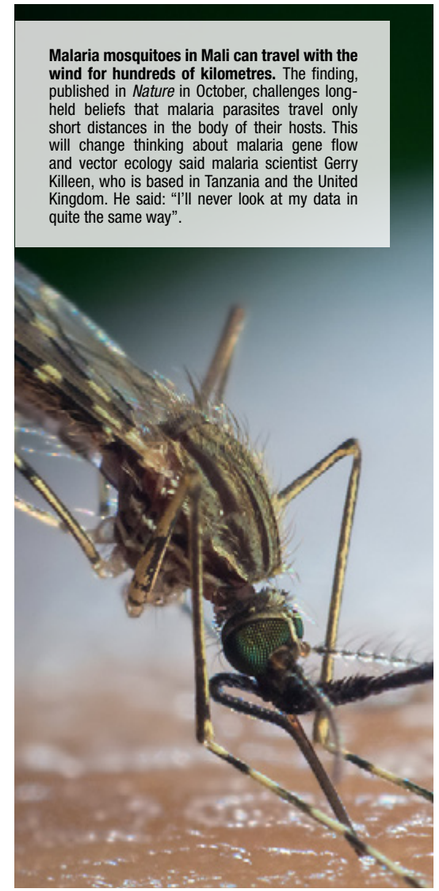


A DNA study claiming that all modern humans originated in Botswana was criticised in November. The critics at South Africa's University of Cape Town and elsewhere said the *Nature*-published study neglected a vast body of DNA and fossil data that points to a more complex origin story for our species.

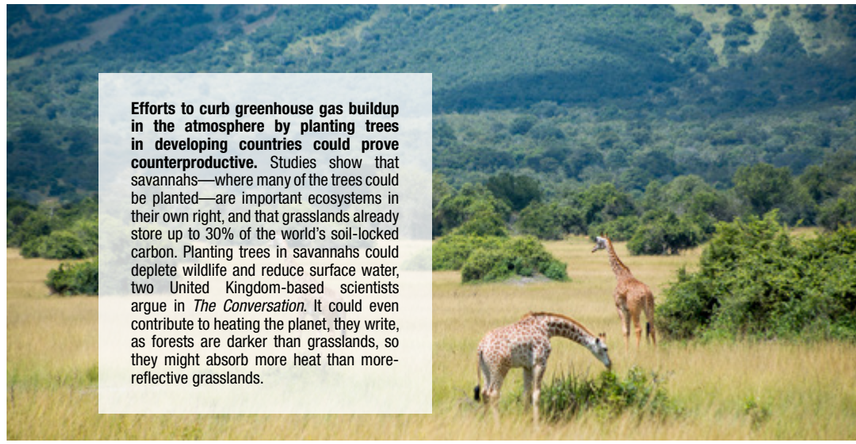


The gene-editing technology CRISPR needs to be more heavily regulated, one of its inventors, Jennifer Doudna, said in November. A moratorium on human germline editing is not enough, Doudna wrote in an editorial published in Science on the one-year anniversary of He Jiankui's announcement that he had used the technology to alter the genomes of two girls to make them resistant to HIV. "Stakeholders must engage in thoughtfully crafting regulations of the technology without stifling it," she wrote.

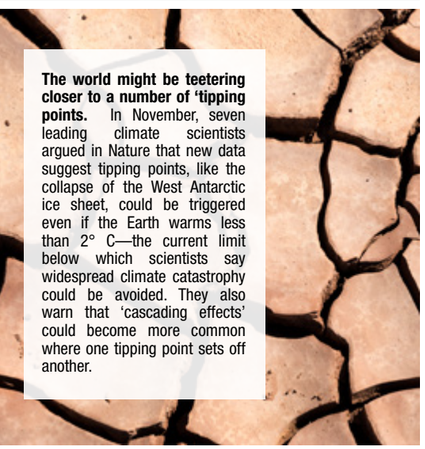
A laboratory in the United Kingdom has been accused of commercialising a piece of technology developed using DNA from Africans without their consent. *Science* reported in November that whistleblowers say the Wellcome Sanger Institute outside Cambridge developed and bought 75,000 gene chips without legal agreements with partner institutions—including universities in South Africa. The technology drew on the DNA of hundreds of African people who knew they were participating in research, but who had not agreed to being part of commercialisation. Sanger says it never commercialised the chips, or profited from them.



Malaria mosquitoes in Mali can travel with the wind for hundreds of kilometres. The finding, published in *Nature* in October, challenges long-held beliefs that malaria parasites travel only short distances in the body of their hosts. This will change thinking about malaria gene flow and vector ecology said malaria scientist Gerry Killeen, who is based in Tanzania and the United Kingdom. He said: "I'll never look at my data in quite the same way".

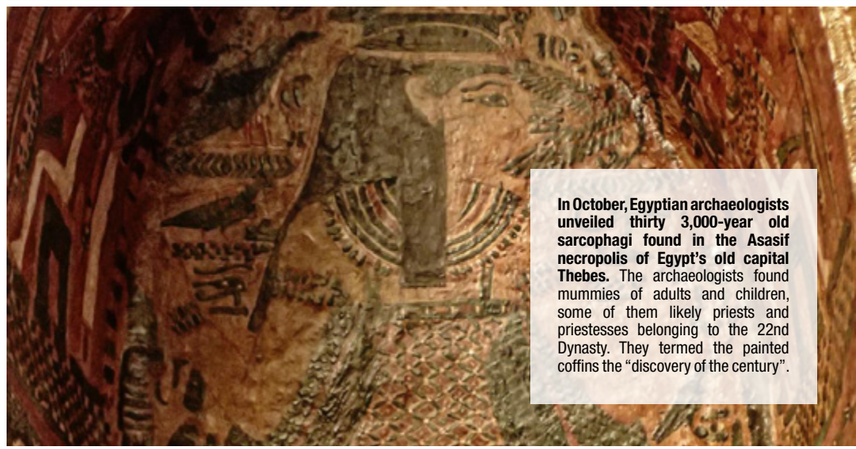


Efforts to curb greenhouse gas buildup in the atmosphere by planting trees in developing countries could prove counterproductive. Studies show that savannahs—where many of the trees could be planted—are important ecosystems in their own right, and that grasslands already store up to 30% of the world's soil-locked carbon. Planting trees in savannahs could deplete wildlife and reduce surface water, two United Kingdom-based scientists argue in *The Conversation.* It could even contribute to heating the planet, they write, as forests are darker than grasslands, so they might absorb more heat than more-reflective grasslands.



The world might be teetering closer to a number of 'tipping points. In November, seven leading climate scientists argued in Nature that new data suggest tipping points, like the collapse of the West Antarctic ice sheet, could be triggered even if the Earth warms less than 2° C—the current limit below which scientists say widespread climate catastrophy could be avoided. They also warn that 'cascading effects' could become more common where one tipping point sets off another.

The first all-women spacewalk took place at the International Space Station on 18 October. A spacewalk is when an astronaut exits their spacecraft, wearing a space suit that keeps them alive. Christina Koch and Jessica Meir from US space agency NASA spent seven hours repairing a faulty battery unit. "This is really just us doing our jobs," Meir said during the walk.



In October, Egyptian archaeologists unveiled thirty 3,000-year old sarcophagi found in the Asasif necropolis of Egypt's old capital Thebes. The archaeologists found mummies of adults and children, some of them likely priests and priestesses belonging to the 22nd Dynasty. They termed the painted coffins the "discovery of the century".

Photo Credit: ILRI/Flickr

ARV drugs in Ugandan pork is a growing health concern

By Esther Nakkazi
A freelance journalist based in Uganda

Mounting evidence that farmers in northern Uganda try to fatten up their pigs with antiretroviral drugs destined for humans with HIV has raised serious health concerns in the East African country.

The practice could be putting many Ugandans at risk. Ugandans are the biggest pork-eaters in Africa, with each person on average consuming 3.5 kilograms every year, according to the International Livestock Research Institute.

The practice has been reported in the media for a few years, as it has allegedly been causing drug stock-outs at HIV clinics. And in 2017 Ugandan police arrested a hospital guard in the Lira district for selling stolen drugs to farmers.

However, to date there have been no studies to confirm whether there are ARV drug residues in pork sold to consumers. Now, Ugandan scientists are preparing to weigh in on the matter.

Ritah Nakato, a PhD student based at the Makerere University College of Health Science, has been collecting pig blood from abattoirs in Kampala and Lira to check it for traces of the four types of ARVs that police claim are being abused.

In June this year, she presented interim results at a research conference in Kampala, and they suggested there was cause for concern. She told *Scientific African Magazine* that there is not yet enough evidence to say anything for certain, "but my research will find out if these allegations in the media were true".

Nakato is conducting interviews with farmers, abattoir owners, and agricultural officers to tease out how the drugs might be reaching the farms. While some might be stolen from hospitals, others could be bought directly from HIV-positive people who are tempted by the money.

Farmers allegedly pound the drugs into a powder and add it to their pig feed to boost the animals' appetites, making the pigs fatten quickly. Some also believe the drugs can help keep dread diseases like African Swine Fever at bay.

People who eat the contaminated meat could expose themselves to harmful drug residues, says Vetjaera Haakuria, a veterinary pharmacy specialist at the University of Namibia. It could also accelerate the development of HIV strains resistant to ARVs, he says—something that a recent WHO report found to be on the rise in 12 African countries.

Even more worrying, Haakuria said, is that HIV-positive patients might cease to take their medicines in the mistaken belief that eating pork from pigs fed with ARVs is an alternative to taking the drugs. "It threatens to roll back the gains made in both public health and HIV treatment," he said.

Ugandan veterinary doctor and pig farmer Emma Luyiga, who lives in Entebbe, confirms that she has heard about the practice. She denounces it as "morally and ethically wrong" and emphasises that there are no benefits to feeding pigs ARVs. She says there are plenty of legal feed supplements that can be fed pigs if farmers want to accelerate their growth.

Through her research, Nakato aims to give policymakers the hard evidence they need to eradicate the practice in the country. She also hopes it will set the scene for better surveillance both of the quality of pork sold in Ugandan markets and of the ways that the healthcare system distributes HIV drugs to patients.

For Haakuria, the episode is an opportunity to improve the coordination between human and veterinary health in the country. "This highlights the need for interdisciplinary cross-talk between animal and human health professionals to tackle the problem," he said.

South Africa's MeerKAT telescope: We ain't seen nothing yet

By Sarah Wild
A freelance journalist based in South Africa

In September, South Africa's MeerKAT telescope discovered giant bubbles at the centre of our galaxy. This is the telescope's second major finding—the first was one of the most magnetic objects in the Universe, a magnetar. But both of these discoveries were accidents, and scientists are excited for what the telescope will find when it is actually looking.

MeerKAT scientists tracked the magnetar while the telescope was still being commissioned and not all of its 64 dishes were operational. The team then stumbled upon the giant bubbles at the centre of the Milky Way, thought to be the result of radiation exploding out of a black hole. The scientists had actually been looking for a "nice picture" to show off the telescope at its inauguration last year, rather than planning to do any actual science.

"It is a really cool discovery," South African Radio Astronomy Observatory chief scientist Fernando Camilo says of the radiation bubbles. But, he adds: "It wasn't predicted and not what MeerKAT was designed to do."

So what will MeerKAT discover when it is really looking? The telescope was designed with specific scientific mysteries in mind. Many of these mysteries involve hydrogen—the lightest element on the periodic table and most abundant in the Universe. Hydrogen is the fuel of stars and astronomers can follow the traces of ancient hydrogen to get an idea of what the early Universe looked like.

"A lot of our science is the study of hydrogen throughout the history of the universe," Camilo explains. Through the hydrogen-emission line, which is the signal astronomers look for to detect the element, scientists will be able to investigate how galaxies are formed and how they evolve, he says.

The science team had fun naming MeerKAT's observing projects, and many reflect the telescope's African heritage. One project that will trace ancient hydrogen is called Looking at the Distant Universe with the MeerKAT Array or 'Laduma'.

Laduma is an isiZulu world meaning "it thunders", and is colloquially used in South Africa when a football player scores a goal. The Laduma survey's shape (through time and space) also resembles a vuvuzela horn, which is a common sight and sound at South African football matches. The ancient hydrogen spotted by Laduma will help piece together the puzzle of what the Universe was like just after the Big Bang, and understand how it is expanding.

Some of MeerKAT's projects will act as pilots for the giant Square Kilometre Array (SKA), which, when built, will form the largest radio telescope in the world with dishes and antennas scattered across Africa and Australia. One of these is the evocatively named Mightee (or the MeerKAT International GHz Tiered Extragalactic Exploration) project, which will look deep into space beyond the Milky Way to explore the evolution of galaxies. Mightee will act as a pilot for the cosmology experiments that the substantially more powerful SKA will undertake. Many questions remain about how galaxies form and evolve, and those answers could point to what happened when the first galaxies came into existence.

"Generally the MeerKAT science is strongly in line with the general SKA science drivers," explains Patrick Woudt, head of astronomy at the University of Cape Town. Woudt heads up the ThunderKAT large survey project, whose name stands for 'The HUNt for Dynamic and Explosive Radio transients with meerKAT'.

Astronomers and astrophysicists have become increasingly interested in transients, which are phenomena that can be very short-lived and thus easy to miss and follow up on, such as supernovae, gamma-ray bursts and fast radio bursts. Transients are some of the most mysterious and exciting phenomena in the Universe; this area of astronomy is growing quickly as astronomers try to figure out how to capture these events before they pass and then understand them.

ThunderKAT will use all the data gathered from many projects on MeerKAT, and will be able to make images of the radio sky on different time scales – from minutes to years, he explains. "This is a new way to maximising the potential discovery of new and unusual transient phenomena," says Woudt.

MeerKAT will help astronomers make huge advances compared to previous telescopes observing the same frequencies through its increased sensitivity, its wide field of view (so they can sample more of the sky at faster time scales), its clearer images, and finally because of its data policy which will allow astronomers to search all the data for new and unusual phenomena, Woudt says.

Still, while astronomers are eager to investigate the enigmas they know about, it's also likely that the telescope will keep throwing up surprises for the scientists who operate it. Camilo, who came to South Africa specifically to work with MeerKAT, wonders what in 10 years the telescope will have helped discover. "Usually the most amazing things that are discovered are things we hadn't considered," he says.

Photo Credit: Google Stock

Morsure de serpent: les antivenins de mauvaise qualité inondent le marché africain

Par Kossi Elom Balao
Un journaliste basé au Togo

Une étude de Médecins sans Frontières (MSF) montre que les antivenins qui ont largement inondé ces dernières années le marché africain sont de mauvaise qualité et à peine efficaces. L'organisation plaide pour un essai clinique de ces produits avant leur mise sur le marché.

Kabinin Yaou, Togolais et père de famille, est l'un des rares à avoir survécu à la morsure de la petite vipère l'échide ocellée—la plus dangereuse dans la région de la savane ouest-africaine.

« Avant mon arrivée à l'hôpital, je saignais abondamment. Le médecin m'a administré un sérum et m'a fait quelques piqûres, » raconte-t-il. Avec beaucoup de chance, Yaou est sorti guéri, au bout de sept jours. « Très peu survivent après ces mêmes types de traitements ».

L'échide ocellée a tué de mars à juin 2019 six personnes dans son village, Kamina, situé à l'est du Togo, à 281 km de la capitale. Contrairement aux autres victimes, Yaou s'est rendu dans le centre hospitalier de son village. Le centre n'ayant pas d'électricité pour conserver au frais le sérum adapté à ce type de traitement, l'évacue directement vers l'hôpital de l'Ordre de Malte à Elavagnon, environ à 60 km de Kamina.

Ces types de défis contribuent au nombre élevé de victimes de morsures de serpents en Afrique. En Afrique subsaharienne seulement, les morsures de serpents causeraient entre 435 000 et 580 000 d'envenimations et 20 000 à 32 000 de décès par an.

Chose pire encore, sur ce continent, les antivenins en circulation sont des produits de mauvaise qualité et très peu efficaces au même titre que les sérums stockés par les cliniques. C'est le constat de Médecins sans Frontières, qui a publié une étude détaillant l'examen des données cliniques relatives à chaque produit antivenin actuellement disponible sur le marché africain.

La négligence de cette pathologie a compromis la disponibilité et l'évaluation du traitement antivenin en Afrique, où le marché des antivenins est très mal régulé, indique MSF. L'étude, rendue publique le 24 juin, dans la revue scientifique PLOS NTD, a identifié 16 sérums antivenimeux différents.

Certains mauvais produits entrent sur le marché africain parce que « les agences de médicament dans les pays africains n'ont toujours pas les capacités d'évaluer en profondeur les dossiers que leur soumettent les producteurs en vue d'obtenir une autorisation de mise sur le marché, » explique au *Scientific African Magazine* Julien Potet, conseiller en maladies négligées pour la Campagne d'Accès aux Médicaments Essentiels de MSF et l'un des auteurs de cette étude.

Le coût du traitement antivenin pose aussi problème, dit-il. En Afrique, « on se retrouve avec la mise sur le marché de certains produits qui, pourtant, ont montré de mauvais résultats quand ils ont été évalués par des laboratoires indépendants ». Ces antivenins sont moins chers que les antivenins plus efficaces. Donc il faudrait utiliser une très grande quantité de flacons pour espérer avoir une réponse thérapeutique satisfaisante. « Si le patient doit payer le prix total, qui s'élève souvent à plus de 50 euros par flacon, l'accès au traitement reste limité », dit Potet.

Jean-Phillipe Chippaux, directeur de recherche à l'Institut de Recherche pour le Développement basé en France, et spécialiste des envenimations en Afrique, explique de son côté que les antivenins coûtent cher parce que « leur production demande un long processus de fabrication même si des efforts sont faits pour la standardiser ».

Julien Potet souligne qu'il « est important que les pays endémiques et leurs bailleurs de fonds achètent des stocks d'antivenins efficaces et de qualité et qu'ils les mettent gratuitement à la disposition des hôpitaux en zone rurale qui accueillent les victimes de morsures ».

Au Togo, il y a quelques mois, la Fondation 4-5-6 La Suite, une organisation à but non lucratif, a offert au pays, 8 000 flacons d'antivenins Inoserp Pan Africa, fabriqués par le laboratoire Espagnol Inosan Biopharma.

« Ce sérum est efficace si le patient est emmené en consultation dans les 72 heures après la morsure, » renseigne Dogbe Kossi Valentin, docteur et assistant médical dans une clinique privée à Anié, ville située au centre du Togo. Sa structure a soigné trois victimes de morsures de serpents cette année. « Avant ce don, il y a eu des sérums parallèles, mais qui n'étaient pas efficaces », précise-t-il.

Mais même si un traitement efficace devenait plus accessible, certaines personnes n'y auraient pas recours. À Kamina, et beaucoup d'autres villages Togolais, il y a des superstitions et des mythes qui entourent les morsures de serpents, qui empêchent les victimes de chercher de l'aide médicale.

Photo Credit: Designed by jcomp / Freepik

A new use for coffee-processing waste, but is it sustainable?

By Christabel Ligami
A freelance journalist based in Kenya

Waste from coffee processing could be used to clean polluting runoff from other industries, a group of Kenyan scientists has shown. But with the country's coffee harvests dwindling, others wonder if it is worthwhile pursuing a technology based on a waning resource.

Coffee is Kenya's fourth greatest generator of foreign income after tourism, tea, and horticulture. Waste coffee husks—produced when dried coffee fruits are milled to get at the bean inside—are usually discarded at milling sites, creating an unsightly and toxic mess given that it contains high levels of caffeine and tannins.

To explore a new use for the waste husks, a group of scientists from the universities of Nairobi and Kabianga set out to test whether they could be used to clean polluted industrial wastewater. They targeted crystal violet dyes, which are routinely used in the textiles, leather, plastics, and printing industries.

There are other ways to remove these dyes from wastewater but they are expensive, the scientists write in their paper, which was published in the September issue of *Scientific African*. They add that the dyes still end up in the environment where they can cause cancer in animals and humans. The dyes also pose a threat to aquatic ecosystems as they stop sunlight from penetrating into rivers and ponds.

The scientists crushed coffee husks into a fine powder which they washed and dried. They then tested its ability to extract dye from a solution. Using this method, they were able to remove 98% of the dyes from a solution. Thus, waste coffee husks are "suitable and sufficient" for removing crystal violet dye from wastewater, the scientists write. They add that the technique could be a "low-cost and eco-friendly" way to remove these dyes from wastewater.

However, Kenya's dwindling coffee harvests could risk strangling the supply of waste coffee husks over the long term, says Moses Wang'ombe, an agricultural engineer at Egerton University in Njoro, Kenya. He says that while the team's results are promising, the method might not be sustainable on a large scale.

As coffee prices have fallen worldwide, Kenya's coffee farmers have struggled to stay afloat. Many have abandoned the crop for more lucrative ones. Kenya's coffee production has decreased from 130,000 tonnes in 1988 to 45,000 tonnes in 2016/17, according to the International Coffee Organisation. This year, the country's coffee production is expected to fall to its lowest level in 50 years.

Wang'ombe says industries looking to clean their wastewater are unlikely to adopt a technology with a supply problem. He adds that other materials have been suggested for dye removal, including sawdust, coconut husks, and peanut husks.

There are also competing uses for the coffee husks. Benjamin Muya, a coffee farmer in Nyeri in the central highlands of Kenya, says the husks collected from his seeds are turned into biofuel briquettes. "This has not only helped to sort out the menace of litter with the coffee husks that was there before but also created another source of fuel," he says.

However, the University of Kabianga's Wycliffe Wanyonyi, an author on the coffee husk paper, says profits from waste husks could provide a lifeline for ailing coffee farmers. "[Selling husks] will bring additional income to the farmers and in the long run, coffee farming will become profitable," he says. "If this happens more, farmers will be happy to restart coffee farming, and there may be no shortage of husks."

Reference: Adsorption of toxic crystal violet dye using coffee husks: Equilibrium, kinetics and thermodynamics study
https://www.sciencedirect.com/science/article/pii/S2468227619306775

Photo Credit: ILRI/Flickr

Your grandma was wrong: seawater doesn't cure eye infections

By Jessica Ahedor
A journalist based in Ghana

The use of seawater as a home remedy for conjunctivitis—an eye infection that causes redness and itching—has been passed down in Ghana for generations. But now scientists and doctors in the country are warning people against the practice, calling it ineffective and potentially dangerous.

Conjunctivitis is a common complaint in Ghana, especially during the country's dry season. The infection, which can be bacterial, viral or environmental in origin, affects the inner lining of the eye. It is known locally as 'Apollo'—a name it earned when a severe epidemic in the capital Accra coincided with the first moon landing.

When Apollo strikes, relatives or friends tell sufferers to swim in the sea if they can. If they don't know how to swim, they are told to wash their eyes out with seawater. The practice is not limited to the coast, and extends surprisingly far inland. People living far from the ocean will send for containers of seawater and store them at home. Other home remedies for the condition include flushing the eye with breast milk, or even urine.

Sterile salt water is commonly used in healthcare to clean out wounds, and can be safely used to wash out eyes. Seawater, however, contains bacteria which could lead to worse infections and even blindness, three Ghanaian researchers write in a paper published in *Scientific African* this month. And rising pollution levels in the Gulf of Guinea could be making the tradition increasingly dangerous, they write.

This information might have prevented Kwesi Twum, a 45-year-old trader who lives in a fishing community in western Ghana, from nearly losing his sight three months ago. "I got Apollo, and my neighbour asked me to use seawater mixed with ash to wash my eyes. After I had done that I realised there was blood coming out of my eyes. Had it not been [for the] medical interventions, I would have been blind by now," he says.

The scientists—two of whom hail from the University of Cape Coast (UCC) in Ghana while the third is an eye doctor from Offinso about 200 kilometres away from the coast—collected seawater samples from Cape Coast beaches and tested if it could kill conjunctivitis-causing bacteria, which they isolated from Ghanaians with the condition. They compared these results with sterile salt water and boiled seawater, as well as with a range of pharmaceutical eye-washes.

"The reason for our research was to establish whether or not the age-old practice should continue, since most Ghanaians believe anything from a natural source has no side effects," says Samuel Kyei, one of the authors from UCC.

They found that while most of the preparations—even boiled seawater—showed some antibacterial effects, plain seawater in fact introduced additional bacteria into their cultures. For seawater to be safely used to treat eye infections, they write, the water first needs to be boiled, and the practice should not be used as a replacement for antibiotics.

The public needs to be educated about the risks of following age-old health traditions that do more harm than good, says Dorothy Fiadoyor, an ophthalmic nurse at the Korle-bu Teaching Hospital in Accra. She says that around half of the patients who come to see her during the dry season have complications from washing their eyes with seawater, and she says it remains one of the leading causes of blindness in Ghana.

"I am happy this paper is focusing on Ghanaian scientists who are working to help rid society of practices that are affecting lives," she says.

Reference: Samuel Bert Boadi-Kusi, Samuel Kyei, Emmanuel Duodu, 'The use of sea water as a homemade remedy for infectious conjunctivitis—any cause for alarm?' Scientific African, Volume 4 (2019)

Photo Credit: Adam Jones

Study reveals chinks in the armour of Zambian superbugs

Photo Credit: USAID in Africa/flickr

By Sibusiso Biyela
A science writer based in South Africa

Drug-resistant bacteria that flourish in hospitals cause thousands of deaths worldwide each year. But a study of superbugs found in a Zambian hospital offers hope that the country may have more weapons left to fight the scourge than better-resourced ones in Europe or North America.

Hospital staff often unwittingly transmit the bacteria between patients. So researchers from the University of Zambia, the Ministry of Health and the Lusaka Apex Medical University collected nasal and hand swabs from 140 healthcare workers at the University Teaching Hospital in Lusaka between May to July 2017, and scoured the samples for bacteria.

Of the doctors, nurses and laboratory staff that participated in the study, 17.1% tested positive for Staphylococcus aureus, one of the most common bacterial causes of hospital-acquired infections. Worse, 5.7% of their sample were carrying S. aurus strains that are resistant to many common antibiotics, known as methicillin-resistant staphylococcus aureus, or MRSA. Bacteria of this kind are estimated to have killed 20,000 patients in 2017 in the United States alone.

But while the MRSA identified in the study was resistant to commonly used antibiotics like penicillin and tetracycline, they remained sensitive to antibiotics that aren't commonly used in the hospital like amikacin and teicoplanin. This mirrors the patterns of resistance found in other low-resource parts of the world like Nepal, the researchers write in their paper published in *Scientific African's* September issue.

"This low resistance rate is most likely due to low usage of these drugs at the healthcare institution," they write. "This indicates that these antibiotics can be used as treatment options for MRSA infections."

The proportion of staff at the Zambian hospital carrying MSRA was in line with international rates. A 2014 systematic review published in BMC Infectious Diseases found that 4.0% of healthcare workers carried MRSA in Europe, and 6.6% in the United States of America. The data on carriage rates in developing countries are patchy, but Zambia's number is higher than the zero rate reported by a similar study in Kenya and 2.5% in India.

However, Godwin Chakolwa, who led the Zambian team, worries his data may underestimate the rates at the hospital. He told *Scientific African Magazine* that many health staff refused to take part in the study, leading to a small sample size that might not be representative. He said this reluctance to take part is par for the course in his country, where many people distrust scientists. "They thought that there was some deception in what we were doing. They did not believe that we would not use their information for [something] else," he said.

Chakolwa said there are many ways that the hospital, which is Zambia's largest referral hospital, could reduce the infection risk. One of the best ways of preventing MRSA from spreading in a hospital setting is through stringent infection control, from simple things like handwashing to high-tech cleaning of hospital wards and medical tools. "The healthcare workers need to have seminars where they would be educated on infection prevention as a means to protect patients," he said.

Studies like this are valuable as they contribute to a better understanding of antibiotic resistance in southern Africa, says Adrian Brink, Head of the Division of Medical Microbiology at the University of Cape Town, who did not have any links to the research. "Although this was not investigated in the current study, carriage has been identified as an important risk factor for infection for example in patients undergoing surgery," he said.

Brink said the study should be a lightning rod to encourage practices such as improved hand hygiene and infection control in low resource environments on the continent. But Chokolwa said the low-resource setting goes beyond the hospital itself to the conditions of research in Zambia. It took him and the team almost a year to complete the study, instead of the six months it would have taken, had all the funds and equipment they needed been available.

Reference: Godwin Chakolwa et al, Carriage rate and antimicrobial resistance profiles of Staphylococcus aureus among healthcare workers at a large tertiary referral hospital in Lusaka, Zambia. Scientific African, Volume 5 (2019)

Not all manure dumps are equal for the black soldier fly

By Sarah Wild

Breeding maggots could be a lucrative side business for pig farmers in Ghana. A team of scientists in the country investigated the best manure dumps for rearing maggots of the Black Soldier Fly (Hermetia illucens) by looking at where wild populations chose to lay their eggs. The maggots of the ubiquitous fly have enormous potential for waste management, the authors write. The flies can break down organic waste to reduce the pressure on landfills and are also a source of protein for livestock. But not all manure is made equal–and the scientists found that black soldier flies have a definite preference. They found maggots reared in pig excrement were heavier and longer than those reared in compost heaps. Nearby chicken and sheep waste dumps, on the other hand, did not tempt any flies to lay eggs in their midst. The paper makes recommendations for students, researchers, and entrepreneurs who plan to breed black soldier fly larvae for research or to sell, says Ebenezer Ewusie, lead author and a senior research scientist at the Biotechnology and Nuclear Agriculture Research Institute in Ghana. The most important recommendation, he says, is to cover cages or containers with a fine-meshed muslin to prevent attack by the parasite Dirhinus giffardii, which deposits its egg into the larvae of the host. The covering will also ensure sufficient ventilation for the larvae while ensuring that the parasitoid wasp cannot get in. "Implementing these recommendations will enhance quality control and efficient rearing of black soldier flies," he says.

E.A. Ewusie et al, The black soldier fly, Hermetia illucens (Diptera: Stratiomyidae): Trapping and culturing of wild colonies in Ghana, Scientific African 5, September 2019

Photo Credit: https://www.flickr.com/photos/ifta-media-library/41659517985/in/photostream/

Fufu, Gari or Chips? A choice with health impacts

By Sarah Wild

More than 800-million people around the world eat cassava. And no visit to a West African country would be complete without sampling fufu, a dish made from the root vegetable. But raw cassava contains high levels of cyanide, and if not prepared correctly it can be poisonous. A group of scientists has investigated how best to prepare the tasty starch in order to minimise its toxicity. The Cameroon-based researchers collected ten local and ten improved varieties of cassava from around Mbankomo in the central region of the country. They processed them into traditional foods, namely "Chips", "Gari" and "Fufu". Fufu preparation, hands down, removed the most cyanide at 91%. The researchers prepared fufu by washing, peeling, and immersing the cassava in water for five days, followed by crushing it into a paste before sun-drying it for another five days. Chips, for which they peeled the cassava, cut it into small fingers, and sun-dried it for five days, extracted the least cyanide, at 47%. Gari—made by grating the cassava into a firm paste, fermenting in a bag for four days, sun-drying it for four hours and then roasting it on a low heat—removed about 80% of the cyanide. The researchers suggest that cassava eaters scape the skin off the inner part of the root vegetable, as this skin contains cyanogenic compounds. Their findings could have implications for regions that eat a lot of cassava, in order to stave off conditions caused by cyanide poisoning such as goiters and tropical ataxic neuropathy, a nerve-damaging disorder.

Y. Njankouo Ndam et al, Influence of cultivars and processing methods on the cyanide contents of cassava (Manihot esculenta Crantz) and its traditional food products, Scientific African 5, September 2019

Photo Credit: https://www.flickr.com/photos/129099219@N03/33411976086

Microalgae: a cheap way to get your omega-3 fatty acids

By Sarah Wild

Photo Credit: Pixabay Stock

Omega-3 fatty acids are an important component of our brains and our eyes, but our bodies cannot produce them internally, so we need to eat them. They are famously found in fish oil, but fish can sometimes contain heavy metals, antibiotics, or other contaminants, and is also expensive. Scientists in Tanzania and South Africa claim that microalgae—which are small single-celled organisms found in water, and are a primary food source in aquatic ecosystems—as a good natural source of preformed omega-3 DHA (a type of fatty acid), and that it even outperforms fish oil. Yet, Eastern Africa has not exploited the potential of microalgae to improve nutrition and health in the region, they write in their paper, published in the November issue of Scientific African. So far, they write, there is no scientific information regarding the nutritional and phytochemical profiles of local microalgae. They call for more research into microalgae, as well as possible business models that would allow people to access this sustainable source of omega-3 fatty acids.

C.N. Charles, T. Msagati, H.Swai, and M. Chacha, Microalgae: An alternative natural source of bioavailable omega-3 DHA for promotion of mental health in East Africa, Scientific African 6, November 2019

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Deep impact

Photo Credit: Envato Stock

One-fifth of all the meteorites found on Earth have been discovered in Africa, and the role of locals in studying them is growing, reports Sandrine Ceurstemont.

In early June last year, Roger Gibson was watching the news when a meteorite sighting was reported not far from Johannesburg in South Africa where he lives. A security camera on a farm had filmed the fireball disappearing below the horizon. Gibson, a geologist at the University of the Witwatersrand, was part of the team that recovered the space rock, which had landed in the middle of a game reserve in Botswana.

This meteorite was special because a team of astronomers surveying the sky in Arizona in the United States had tracked it eight hours before it hit the Earth—a feat that had only been managed twice before. "With 99.9% of falls that are observed, there's no warning," says Gibson. "Suddenly there's a bright light in the sky, something explodes and maybe the pieces are found."

Gibson usually studies the craters left behind by such impacts, not the rocks themselves. But this time he was part of the rescue mission, braving rugged terrain, lions and elephants. "Imagine walking through the bush, with someone with a gun next to you just in case there's a wild animal," he says. "And you're supposed to focus on the ground."

"IMAGINE WALKING THROUGH THE BUSH, WITH SOMEONE WITH A GUN NEXT TO YOU JUST IN CASE THERE'S A WILD ANIMAL."

Roger and the tracking team show where they found one of the pieces of the meteorite that fell in Botswana

Photo Credit: http://www.nasa.gov/images/content/716969main_black_beauty_full.jpg

The recent meteorite in Botswana is one of many noteworthy falls in Africa. The continent is the largest source of meteorites in the world, accounting for 20% of finds worldwide. They include three rocks from Mars, which are rare, and several lunar meteorites. One rock is thought to be from Mercury—the only one found on Earth so far.

Analysing meteorites can provide clues about the history of our solar system, so it is no surprise that scientists are interested in recovering them. However, while Africa might be an important source of space rocks, most of them are sent away to be analysed in developed countries. "Even the biggest research labs in Africa don't have enough instruments to analyse meteorites, so we always need to collaborate with labs in America and Europe," says Fouad Khiri, a geologist at Ibn Zohr University in Agadir, Morocco, who studies the rocks.

Khiri has been investigating why there are so many finds in Africa. The landscape is often key: it's easier to spot meteorites in deserts, which cover a large part of Africa's surface area. Their dark colour stands out against the light-coloured sand. They are also better preserved in dry conditions. Having an evenly spread-out population also helps, he adds. "We found that in countries with a uniform population distribution, there are lots of observed falls."

Several rare meteorites have been recovered in Morocco, whose eastern Sahara region is one of the most prolific places for finds worldwide. The most famous is Tissint, a Martian meteorite that crashed out of the night sky in July 2011. Its fragments were recovered during the following months near a desert town of the same name. "It's a very important meteorite because it's the fifth from Mars that was seen falling to Earth," says Abderrahmane Ibhi, another geologist at Ibn Zohr University who found a piece of it. "It contains information about the Red Planet."

An international effort

While Ibhi and other Moroccan researchers contributed to research on Tissint, foreign teams led the detailed analyses of its make-up. This arrangement makes sense to Khiri. He says that while his university recently acquired a scanning electron microscope that can reveal the chemicals and minerals inside a meteorite, they don't have the full range of instruments found abroad. "We are missing instruments that would allow us to finalise our observations and confirm the origin of the meteorites we receive," he says.

The information obtained from such close scrutiny can be groundbreaking. Studying Tissint, Philippe Gillet from the Swiss Federal Institute of Technology in Lausanne and his colleagues found traces of organic carbon—a key component of all known life on Earth—in the meteorite. They suspect that the carbon was deposited in the rock while it was still on Mars by a liquid rich in organic matter, which may suggest that there was once life on Mars.

Another Martian meteorite was found in the Moroccan desert in the same year as Tissint. It is noteworthy since it's one of the oldest and contains more water than any other specimen. Nicknamed Black Beauty, it's thought to be over two billion years old. There is evidence that it was weathered by water, suggesting that the surface of the planet may have been wetter during that time period than we had previously thought.

African meteorites are also giving insight into conditions on the moon. Masahiro Kayama from the University of Tokyo in Japan and his colleagues recently analysed a lunar specimen found in the Sahara desert in 2005. Kayama was surprised to find that it contained moganite, a mineral that requires a lot of water to form. It's the first time moganite has been found in a space rock. "It was believed to be absent from extra-terrestrial materials because it only originates from recent abundant water activity under high pressure," he says.

NASA's Deep Impact spacecraft and India's Chandrayaan-1 probe have detected water in the top few meters of the moon's surface during flybys. However the moganite discovery suggests that water exists further below the surface, where the meteorite is likely to have formed. "It provides a possibility that water or ice survives in the subsurface until now," says Kayama. This is of interest for future moon missions, which could use the water for drinking, extracting oxygen for breathing, or for hydrogen fuel, he says.

Building African capacity

The origin of the meteorite that fell in Botswana still hasn't been revealed. Like the Moroccan meteorites, it is currently being classified by an international team. However, in a first for Gibson, his lab is describing the composition of the minerals it contains. "We have some interesting results that we now need to cross check against the [meteorite] database to see whether we are going to add extra information about this particular subclass," says Gibson.

He was joined on the expedition by local students. Together, they were able to do what none of them had done before—locate pieces of a meteorite. It took them a week to find the first fragment, and they recovered more pieces on subsequent expeditions. "It's an example of bringing in the resources you have and being able to utilise that in the search," he says.

There are few African experts in meteorites and related branches of planetary and space science. Gibson was brought on board because he was relatively close to the impact site and had relevant field experience. But there are initiatives to train more local experts. The African Initiative for Planetary and Space Science (AFIPS), for example, was founded about two years ago. As part of its activities, it provides training for African students and scientists.

Meanwhile, in Morocco, Khiri and his colleagues have been teaching locals about meteorites. Through presentations and site visits organised across the country, they have been showing people how to distinguish them from terrestrial rocks. Taking the GPS coordinates of a find is also important for its provenance to be recognised by the Meteoritical Society, an international organisation that approves all new meteorites. To date, this information is missing from most Moroccan meteorites, which were usually picked up by local people who did not know to note down the exact coordinates, or by meteor hunters set on selling the rocks for profit. As a result, these meteorites are classified more generally as coming from northwest Africa. "It negatively affects Morocco's meteorite heritage," says Khiri.

Khiri thinks the outreach efforts are having an impact. Locals frequently contact his team for advice when a fall happens in the region. And whereas many of the rocks brought to him used to be from Earth—not space—genuine finds are becoming more common.

For his part, Gibson continues to encourage his students to see the value in studying meteorites. New knowledge of the solar system isn't just about capturing the imagination: it can have practical applications on Earth and on the continent. "There is no real difference between knowing how to interpret river systems and surface landforms on Mars and on Earth," he says. "That knowledge can later be used to understand rivers in [a student's] home country and help with agriculture and water resource management," he says. On a continent made up of developing nations with immediate issues to tackle, meteorites may have a home after all.

Sandrine Ceurstemont is a freelance journalist based in Morocco

Moroccan geologist Abderrahmane Ibhi from Ibn Zohr University found a piece of the famous Martian meteorite Tissint.

Photo Credit:

Seeds of change

Nigeria plans to roll out genetically modified cotton next year. Its scientists say the country won't repeat the mistakes that led to Burkina Faso reversing a similar decision after the quality of the product dropped. But some farmers and anti-GM activists aren't convinced, reports Joseph Opoku Gakpo.

This growing season, farmers on more than 1,000 cotton farms across Nigeria are growing genetically-modified (GM) cotton under the watchful eyes of scientists. Come harvest, the scientists will compare the modified cotton with the traditional strains also grown on these farms, carefully evaluating the new strains in terms of their resistance to pest attacks, fibre quality and adaptability to the Nigerian climate.

It's a dry run for the end of 2020, when the modified variety is expected to go on sale nationwide in a first for the West African country. The modified varieties must show better traits than the traditional ones, otherwise they will not be released, says Amos Mohammed Sagir, a plant breeder with the Institute for Agricultural Research at Ahmadu Bello University, who leads the project. "When you are testing foreign materials, you use local materials to see which ones perform better. If the local variety performs better, then you don't take the new variety," he says.

It is a bold move, not least because Burkina Faso—the last and only West African country to do the same in 2008—abandoned it in 2015 after buyers complained that the cotton was low-quality with fibres too short to attract premium prices.

Scientists like Sagir believe the lessons from Burkina Faso have been learnt, and that Nigeria's experience will be different. "What happened in Burkina is a thing that will not happen with us here in Nigeria," Sagir says.

Photo Credit: Issouf Sanogo/AFP

But others—including Nigeria's still-substantial anti-GM lobby and environmentalists—say it's a fool's errand. "No nation, especially in Africa, should gamble with GM cotton," says Nnimmo Bassey, director of ecological think tank, Health of Mother Earth Foundation. The foundation has called for a ban on genetically modified organisms (GMOs) in Nigeria and a review of laws to "close loopholes that allow for the unchecked infiltration of GMOs".

A familiar standoff

If the standoff between scientists and environmentalists seems familiar, it's because the type of cotton being planted has been around for decades—and the controversy surrounding its introduction in Africa nearly as long.

> **It's important to judge a GM crop variety on its actual performance, rather than on the predicted benefits.**

The modified strain is known as Bt cotton. It has been engineered to include genes from naturally occurring soil bacteria, Bacillus thuringiensis, which makes it poisonous to insects who feed on it. This built-in pesticide is effective against bollworm, a pest that can decimate up to 90% of cotton fields if left unchecked. In Burkina Faso, before the introduction of Bt cotton, bollworm was destroying between 20% and 65% of cotton fields, even when farmers used pesticides to control it. Managing the pest costs farmers up to US$60 million annually.

The United States has been growing Bt cotton since 1996, and China since 1997. But Nigeria—and most of Africa—has been cautious of the technology. Rumours that GMOs cause diseases like cancer and kidney failure, or kill animals that feed on them, have put governments and consumers off. Nevertheless, in 2011, Nigeria passed the National Biosafety Management Act, which sets out the regulations scientists and corporations need to follow to put GM crops on the market.

Last year, the National Biosafety Agency greenlighted a request by the Nigerian arm of Indian firm Mahyco and scientists at Nigeria's Institute for Agricultural Research to sell Indian-made Bt cotton seeds to Nigerian farmers.

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The seeds had already undergone confined field trials in Nigeria, but last year's approval paved the way for the mass trial currently underway in the country. Now, expectations are high, as is skepticism. Many see it as a watershed moment for the technology in West Africa: boom or bust.

Sagir, for one, is optimistic. He expects that farmers will be pleased that Bt cotton has the potential to reduce their pesticide use by 50%—saving them money, improving their health, and preserving the environment. Another supporter is Rose Gidado, deputy director of Nigeria's National Biotechnology Development Agency, who says that with Bt cotton, farmers could quadruple their yields from the current maximum of 0.9 tonnes per hectare to 4.4 tonnes per hectare.

But Burkina Faso's experience shows it's important to judge a GM crop variety on its actual performance, rather than on the predicted benefits. The country commercialised Bt cotton in 2008 as part of a national biotechnology drive. Within six years, more than 70% of all cotton grown in that country was GM. One survey found that this led to a 22% increase in yield and a 51% profit gain for farming households.

However, all was not well. Buyers complained that the Bt cotton was yielding low-quality, short fibres that limited their attractiveness on the international market. In 2015, the cotton industry announced it would return to traditional cotton seeds. Traders claimed the debacle had cost them US$85 million over the five seasons GM cotton was grown.

Nigeria's different strategy

Gidado says the risk that the same thing will happen in Nigeria is small. "Nigeria's strategy is different," she says. Where Burkinabe scientists took a chance and crossed an American Bt cotton variety with local varieties to produce a variant suitable for growing conditions in Burkina Faso—a process known as 'backcrossing'—the Nigerian seed was developed in India, where it was produced to thrive in similar climatic conditions.

Sagir says that it was the backcrossing process that created an incompatibility in the Burkina Faso Bt cotton, which in turn impacted its quality. "That was why they went back to their own materials," he says. Matthew Schnurr, an international development professor at Dalhousie University in Canada, who has studied Burkina Faso's experience with Bt cotton, confirms that the backcrossing negatively impacted both the length and quality of the cotton, "which in turn lowered its price on the international market".

Nigeria's Bt cotton will involve no backcrossing. This, and the fact that the Indian variety is being tested thoroughly under real-farm conditions, is what gives Sagir confidence.

However, GMO opponents are not convinced by the assurances from Nigeria's scientific community. Bassey from the Health of Mother Earth Foundation says the pests the Indian Bt cotton is meant to resist have already developed resistance to it in India. This, he says, is a warning Nigeria should take seriously. "Today, Burkina Faso is better off not growing GM cotton, whereas Nigeria is slipping into the hole they managed to escape from. It doesn't show good sense for any country to slide down that failed path."

As for Nigeria's cotton farmers, Muyiwa Olatidoye, an agricultural consultant in Osun state who has studied farmers' willingness to adopt new cotton varieties, is cautiously optimistic that they will accept GM seeds.

"However, much needs to be done in the area of awareness and more importantly, on careful implementation," he says.

Patience Koku who owns Replenish Farms in Kaduna State—a noted GM proponent who manages a 500 acre corn field—says she will go into cotton production once the Bt variety hits the market. "Before now, the devastation by the bollworm made me not to even consider it. But with Bt cotton now, I can make the investment on commercial scale. Because I now know it's a viable business," she says.

But Gloria Okon of the Fadama Cooperative Farmers' Society in Katsina State, who previously has voiced concern about GMOs, is suspicious of the scientists and multinational firms promoting the GM cotton varieties. She says it's "an indirect way of seeking to control our food systems" and she "will not be ready to grow them."

Joseph Opoku Gakpo is a journalist based in Accra, Ghana, who covers environment, agriculture and rural development stories for Joy FM and Joy News TV. He is also a trained biotechnology expert with a degree in agricultural biotechnology. In 2016 he received a 12-week travel grant to visit the United States for leadership training by the Cornell Alliance for Science, a capacity building initiative that aims to "promote access to scientific innovation as a means of enhancing food security, improving environmental sustainability and raising the quality of life globally" whose main funder is the Bill & Melinda Gates Foundation.

South Africa's divided past is reflected in its innovation landscape

South Africa is ranked as Sub-Saharan Africa's most innovative country. But its innovation landscape is marred by deep inequalities that look likely to persist, reports Sarah Wild.

South Africa leads innovation in sub-Saharan Africa, according to the 2019 Global Innovation Index. But this ability to transform research into marketable products is dominated by a few universities—something which is unlikely to change. The legacy of Apartheid and inequalities in funding mean that some institutions are better resourced than others, both in their ability to produce research and to commercialise it.

Universities are hubs of new knowledge, but many of these ideas remain trapped in the silo of academia. Academics present their work at conferences and publish journal articles, and commercialisable knowledge—which is often supported by government funds—remains on paper instead of finding its way into the real world.

This is why, in 2008, the country introduced a law to compel researchers to disclose the intellectual property (IP) generated through the use of government funds. That law established the National Intellectual Property Management Office (Nipmo), which is mandated to ensure that technologies and ideas developed using public funds are identified, protected and commercialised. Nipmo does this in tandem with 36 technology transfer offices located at universities and research councils around the country.

Most of South Africa's technology transfer offices were established after the introduction of the law. But the country's oldest and best-resourced research institutions—such as universities formerly reserved for whites—were protecting their IP prior to the law coming into force. As a result, they have had more experience in protecting and profiting from their IP than the others. It's an inequality that, a decade on, has proved persistent.

> **If we can't do good research, we can't get the ideas.**
>
> **~ Fredda Makoto, technology transfer manager at the University of Limpopo**

Limpopo: 'IP knowledge is scarce'

Fredda Makoto, technology transfer manager at the University of Limpopo, heads up one of the newer offices. She established the office three years ago, and now has a staff of three. "We receive disclosures of innovative ideas to do a patent search and see if they meet the patentability requirements, we check trademark and copyright [ideas] for their originality," she explains. The office also assists researchers to raise funds to develop their innovations, facilitate industry-university partnerships, and work with business incubators to help people get their companies off the ground.

One of the main challenges of her job is creating awareness about the services her team offers, she says. "The knowledge [about IP] here is too scarce," she explains. "So we're marketing the office, arranging workshops for managers to train on a basic level of IP and technology transfer so [that] the researchers do not publish without protecting their IP." She says that this challenge reflects a lack of understanding in society as a whole. "The IP and technology transfer knowledge is too scarce around the country, not just [at this] institution."

Another problem is the lack of facilities, such as state-of-the-art equipment and laboratories, she adds. "If we can't do good research, we can't get the ideas." The University of Limpopo is an historically disadvantaged institution, established in 2005 through the merger of the University of the North and the Medical University of South Africa. Under Apartheid, the University of the North was designated a "black" university, and did not receive as much funding and support as "white" universities. This means that the institution lags in infrastructure and capacity compared to previously advantaged universities.

One way to overcome this is through collaborations with other research institutions or with industry, Makoto says. This is one of the activities that she helps researchers with. She also encourages researchers to work with one of more than a dozen technology stations that the country's Technology Innovation Agency has created throughout the country. These technology stations, funded by government, offer services, such as rapid prototyping; testing and analytical services; and consultation, technology audits and feasibility studies. Different technology stations have a different focus; one, for example, specialises in 3D printing technology.

Technology stations tend to focus on areas that are relevant for the university or research council it is linked to. Limpopo's technology station focuses on food, Makoto says, since food science is an important research area at her institution. The station assesses the bacteria in food, as well as its toxicity, she says. It also checks if food products comply with safety regulations. The station has the equipment to test for these parameters, which universities may not be able to afford.

'We punch above our weight'

Technology transfer offices at South Africa's previously advantaged universities look a lot different. Stellenbosch University nestled in the Cape Winelands has a long tradition of technology transfer and industry collaboration. Its office—which is actually a university-owned company, known as Innovus—chooses to place more emphasis on getting companies off the ground than just identifying and protecting IP arising from research. "We are punching a little bit above our weight," says Anita Nel, CEO of Innovus, who oversees a staff of more than 20.

Innovus also has a start-up incubator, which hosts new university companies for up to a year providing administrative support and training. "Although labour intensive and more risky for universities than just licensing the technology, we find so many benefits in [setting up companies]," Nel says. Last year, Innovus started five companies. This year, it has only started one so far, but there are more in the pipeline, she says.

> **We are punching a little bit above our weight.**
>
> **~ Anita Nel, CEO of Innovus, Stellenbosch University's technology transfer company**

The companies spun out with the help of Innovus are already worth a significant amount to the university, says Nel. They employ close to 300 people, and in 2018 had a combined turnover of R268 million (US$17.5 million). This also means they are paying tax, so their social impact is far better than if the university simply licensed the technology, Nel adds.

Since it was established Nipmo, and the technology transfer offices it oversees, have been responsible for a number of patents. According to the South African National Survey of Intellectual Property and Technology Transfer at Publicly Funded Research Institutions, on average 100 new technologies were added annually between 2011 and 2014, with the actual number of licenses executed per year quadrupling from 2008 to 2014. In addition, 45 start-up companies were formed in this period, with almost three-quarters of them based on publicly funded IP, according to the survey.

But more than 88% of the revenue produced by publicly funded intellectual property between 2008 and 2014 accrued to only four unnamed institutions, which had existing technology transfer expertise. Kerry Faul, who heads up Nipmo, says that these institutions were previously advantaged under the Apartheid regime, with greater government support, and that they had an historic culture of commercialisation.

Resources alone not enough

However, Nimpo's Faul says that while access to resources can help a university become stronger at innovating, it's not enough. A culture of innovation is just as important, she explains: "You can have a large research base, [but] none of it is applied or output focused." She cites the University of KwaZulu-Natal, a composite university created by the merger of the formerly "white" University of Natal and the formerly "black" University of Durban-Westville in 2004. "UKZN has a high research output, but has a low innovation output. [Technology transfer] is not part of their culture," she says.

Also, she says, for many previously disadvantaged institutions like Limpopo, a major issue is that they are located in remote areas far from the big city centres—a function of Apartheid's geospatial planning. "Their struggle is pulling the private sector in," she explains. "The big private sector companies tend to want to work with universities next to the big cities."

Back in Limpopo, Makoto says her efforts are beginning to bear fruit. Several Limpopo researchers have patent applications pending for innovations including how to produce marula wine and a method for creating fish-food pellets. One team was recently awarded an international patent for a method to improve the propagation of strelitzia, an indigenous South African flower that resembles the bird of paradise.

In Stellenbosch, Nel faces challenges, too. Even though Innovus is well-known in the academic community, the staff and student turnover at the university means that raising awareness about it remains a big part of her team's job, just like it does at the University of Limpopo.

For Nel, who has been at Innovus since 2006, the biggest challenge is finding staff. "When I left university, technology transfer was not an option as a career in South Africa. When we have to go out recruiting, you struggle to get experienced people," she says, adding that the technology transfer industry in the country "recycles" people as they move from one technology transfer office to another.

Faul, whose job is to oversee all of the country's technology transfer offices, recognises that there are inequalities. But she does not see the gap closing anytime soon. She says many of the country's universities may not ever have the intention to become innovation-focused. "They're still educational institutions."

Sarah Wild is a freelance journalist based in Johannesburg, South Africa.

FEATURE

How Kenya's devolution hobbled healthcare

Moving the responsibility for healthcare from national to local government was meant to improve service delivery. It has done the opposite, writes Verah Vashti Okeyo.

Photo Credit: © Natalia Jidovanu

Earlier this year, two girls died of dog-transmitted rabies in western Kenya. The deaths incensed veterinarians who had been struggling to obtain rabies vaccines from the local government for years. By all accounts, the veterinarians should have been able to source the vaccines. In 2014, Kenya's national government had embarked on a drive to eliminate rabies by 2030, starting with vaccinating 70% of the country's dogs. Local governments were tasked with procuring the vaccines, which cost a dollar a dose.

A rapid increase in the area's dog population had made vaccination scale-up a priority, the veterinarians argued. But local health officials disagreed. "The local governor did not see rabies as a serious problem," says one of the veterinarians, all of whom spoke to *Scientific African Magazine* on condition of anonymity. Moreover, local health officials told him the area where the girls lived had not voted for the governor anyway. That throwaway comment fuelled a concern the veterinarians had been harbouring for years: that local politics was influencing the distribution of health resources, entrenching health inequalities, and possibly causing avoidable deaths.

The veterinarians' worry is not new. For decades, political commentators and political science researchers in Kenya have noted that regions that harbour supporters of the political opposition remain poor and sidelined. In 2009, World Bank economist Raymond Muhula wrote that many Kenyans say they are being treated unfairly in areas that don't align politically with the central government. And, he wrote, this sentiment was reflected in the "availability of social services, such as water".

But in recent years critics' focus has changed from national to local politics. Scientists and healthcare experts say that a process known as 'devolution'—which has moved political control of a number of policy areas, including healthcare, to Kenya's 47 self-governing counties—is making things worse.

That is the opposite of what the architects of devolution intended when the process began in 2013—the year when Kenya transitioned from a centralised to a devolved system of governance. This new system transferred the provision of services like health, transport, and public works to the newly formed semi-autonomous counties. Devolution, the architects said, would tackle disparities between regions, improve service delivery, and engage citizens by bringing local decision-making closer to affected communities. In many instances, it has worked: Some counties have new health centres, roads, and street lights that wouldn't be there without devolution.

But for certain areas of healthcare, it has been a disaster. Decentralising disease control was not a good idea, says Kariuki Njenga, an infectious disease expert at the Kenya Medical Research Institute (KEMRI) in Nairobi. Njenga, who has worked on national disease outbreaks for decades, says he has personally witnessed healthcare workers and scientists being delayed in their response because governors or other senior county officials would expect to be paid courtesy calls, asked to officiate openings, or be included in press statements—all of which would take time. He has also experienced officials insisting that they be left to handle the disease without the national government's help, even when they lacked the necessary resources and skills.

It's not just disease control that has suffered, according to Kenneth Wameyo, a veterinarian who until his death in early November was based in Nairobi and part of the Kenya Veterinary Association. He said that, since devolution, the management of health interventions across the country has lost its uniformity.

For example, there are counties such as Nyandarua in the centre of the country, which organises vaccinations for livestock to prevent Rift Valley Fever—an acute viral disease that affects domesticated animals but can also cause illness in humans when they come into contact with a carcass or infected animal. Other counties in the north do not have the same plans. In counties that vaccinate, only about 70% of livestock receive the vaccine. This has been enough to keep the disease out of central Kenya. However, in February this year an outbreak of Rift Valley Fever occurred in Nyandarua, infecting hundreds of cattle and sheep and at least two people. Local veterinarians and healthcare staff believe the outbreak was a result of unvaccinated livestock from the north moving into Nyandarua. Had vaccination been governed at national level, this might have been avoided, they say.

Wameyo said county governments lack the technical skills needed to plan and implement health interventions. And, as illustrated by the example of rabies in western Kenya, what drives action is not always what is best for patients. "Every governor wants to outshine the other, or make this or that section of their county happy," said Wameyo.

Scientific African Magazine asked the central Ministry of Health to respond to the issues raised in this article, including the concern that devolution has empowered local policymakers without putting in place safeguards to assure the quality and fairness of healthcare distribution. The ministry did not respond.

Not just a rural issue

The problems are not limited to rural areas. During a cholera outbreak that centred on a popular Nairobi hotel in June 2017, Ben Muia, then county executive in charge of health, would not allow the national government to intervene and help Nairobi County contain the disease. At the time, Jackson Kioko, then national director of Kenya's medical services, said that the central government's hands were tied because, constitutionally, Nairobi County had jurisdiction over health services.

A contributing factor is the way in which devolution has changed the allocation and spending of health budgets. Before devolution, clinics and other health providers' budget requests—whether for routine work or emergencies—would go to the provincial director of medical services. There were then eight provinces: Nairobi, Central, Rift Valley, Eastern, Coast, Western, Nyanza, and North Eastern. As long as the requests were in line with national policies, health providers say the money would usually materialise, since the provincial managers had no discretion to decide how money should be spent.

However, under the current system, the county manages the funds for public health facilities, and county officials have full autonomy over how to spend it. Thus, critics say, county-level officials are able to reject requests for funding, even when those requests are in line with national healthcare guidelines. This is what the veterinarians in western Kenya believe happened when they asked their local health officials for rabies vaccines.

Some of the challenges blamed on devolution have their roots in nepotism and bad governance, says Edwine Barasa, director of the KEMRI-Wellcome Trust Nairobi programme in Kenya, who also heads its Health Economics Research Unit. He says the people appointed to look after health at county level are often selected for reasons other than being suitable for the job—their appointment might be a personal reward from the governor, or they might belong to a community that voted for him. This erodes accountability, he says, and leads to poor resource allocation. "To be seen as doing their work, politicians would build hospitals and not know which healthcare workers would see patients there, or what medical equipment or supplies [the hospital would need]," he says. Under these circumstances, disease control and preventive medicine suffer, he adds.

Barasa's own research bears this out. In a 2018 paper, he and colleagues from the United Kingdom investigated the effects of power on priority-setting for healthcare resources in post-devolution Kenya. From interviews with more than 300 policymakers and community representatives from 10 counties, they concluded that devolution increased local politicians' power to make healthcare decisions without addressing underlying social structures and discriminatory practices that had historically skewed healthcare resource allocation. This, they wrote, has "led to the continued exclusion of the most vulnerable from priority-setting processes".

The solution, for Barasa, is two-fold: Put in place mechanisms that ensure counties use their money prudently, and teach communities about their rights to healthcare so they in turn can agitate for better disease management. But Ouma Oluga, a medical doctor and the secretary-general of the Kenya Medical Practitioners Pharmacists and Dentists' Union, says things will only change when the central government realises the damage that devolving healthcare has done—a process that he believes could take many years, and cost many more lives. Oluga, who says he has endured strikes and disease outbreaks since devolution, has reached a point of fatalism: "Let the government smell its mistakes.".

Verah Vashti Okeyo is a global health reporter and development communications researcher in Kenya.

Kenya's butterfly queen

Esther Kioko has gone from village girl to top insect scientist. Here she tells Geoffrey Kamadi about her journey so far.

Like many of the children in the village where she grew up, Esther Kioko's favourite pastime was chasing grasshoppers, praying mantises, and other bugs. The children would disembowel the hapless critters using acacia thorns, "just to have the pleasure of counting the eggs inside them", she says.

Since then, Kioko has turned her passion for insects into a career and is now the head of the zoology department of the National Museums of Kenya, home to more than 3.2 million invertebrate specimens. She leads a project to assess the diversity of pollinating moths and butterflies in East Africa and another on vegetable insect pollinators in Kenya's drylands.

In August this year, she was awarded the Marsh Award for Ecologists in Africa, a £2,000 travel grant given out annually by the British Ecological Society to allow African scientists to travel to the United Kingdom and connect with scientists there.

A happy childhood

Life was simple and joyful for Kioko growing up in Ithaeni village in Machakos District, a few dozen kilometres east of Nairobi. This sun-scorched, rain-starved spot, where little grows except for the hardy acacia, lies in a famine-prone region of the country. "Yet life was happy, regardless of the hardship," Kioko says, a nostalgic smile playing on her face. "It was nothing out of the ordinary for us. This was the only life we knew."

The support Kioko received from her parents went a long way towards shielding her and her siblings against the harsh realities of hunger and want. Her father was a mechanic in Nairobi. Her mother looked after the homestead and tended the village's modest coffee farm. After sundown, Kioko and her siblings would huddle around the paraffin lamp to do their homework. "Our eyes would smart, of course, because of the smoke," she says. Her mother kept the light burning, making countless treks to the market and back to buy paraffin in a 300ml Fanta bottle.

Kioko attended primary school in her village. Later, she enrolled at Kenya High School in Nairobi—a former European girls' school. Her family took out a cash loan from the coffee farmers' cooperative to pay her school fees. A new world opened. She tasted, for the first time, custard and egg curry as well as bread and butter pudding—types of food that were very different from the traditional muthokoi staple in her village, a mixture of boiled beans and maize. But as much as she appreciated the new environment and the goodies it offered, she never forgot her primary reason for being there: her academic mission.

One early role model for Kioko was Wangari Maathai, who later won the 2004 Nobel Peace Prize for her contributions to sustainable development, democracy, and peace. Maathai once came to speak at Kioko's high school. "Seeing her oozing with confidence the way she did, not just as an environmental activist but as a woman, was something really to behold," says Kioko.

Studying biology, chemistry, and geography at high school, Kioko says she was "fascinated by the way something as small and inanimate as a seed would develop and grow into a fully-fledged plant". She went on to study biology and zoology at Kenyatta University, where she stayed for her master's and doctoral degrees. After joining the National Museums of Kenya after her first degree, she went to the University of Wales in the United Kingdom to undertake a postgraduate diploma in applied insect taxonomy.

Community impact

Since completing her PhD in 1999, Kioko has spearheaded many significant research projects. She led the taxonomic identification and differentiation of two stem borer pests that were decimating maize and sorghum crops in Kenya. This work made it possible to control the pests through imported egg parasites rather than chemical pesticides. "It is very important to correctly identify the enemy before starting the fight!" she says.

Kioko also played an instrumental role in developing new technologies for smallholder farmers involved in sericulture—farming silkworms for silk production—and apiculture—keeping bees for their honey. Additionally, she pioneered research on the wild silk moth in Kenya, which opened new opportunities for sericulture.

Her contributions to the identification of butterflies and moths and their habitats in the coastal forests of Kenya helped establish butterfly farms in the region. These farms export butterflies and moth pupae to insect parks around the world. Initiated in 1993, the Kipepeo Project (Kipepeo means butterfly in Swahili) is a community-based enterprise that supports the livelihoods of people living in and around Arabuko Sokoke Forest Reserve on the Kenyan coast. "It began as a countermeasure against forest destruction, by offering an alternative source of income to the community," says Kioko.

She believes growing up in a village has helped her connect with rural communities. Today, the Kipepeo Project generates 1.2 million Kenyan shillings (US$12,000) from tourism in addition to the 18-20 million KSh the project itself raises as revenue yearly. It employs 2,550 people directly (800 in butterfly farming and 1,750 in beekeeping), while sustaining another 40,000 locals indirectly through spin-offs such as curio selling and hospitality.

Photo Credit: Google Stock

"This has enhanced the appreciation and conservation of the Arabuko Sokoke Forest, ensuring that our natural heritage lives on," says Kioko, who sits on the project's steering committee. Other communities at the Kenyan coast are following suit. For instance, the nearby Kaya Kauma community is putting up a butterfly farming enterprise of its own.

Looking to the future, Kioko is interested in how insects could help address food insecurity—for livestock, as feed, but also for humans. She is focusing on insects as food as well as pollinators. The award from the British Ecological Society has inspired her, she says "to keep going despite and in spite of extraordinary challenges that many times come my way" and also to motivate others, especially young scientists and smallholder farmers.

Inside this bug-focused naturalist beats the heart of a humanist, too. When asked what it is about insects she finds so captivating, her reply could apply equally to other Kenyans who grow up under difficult circumstances yet find pleasure in helping others: "Their ability to continue offering so much service to us and our environment despite the fact that we rarely recognise and take care of them."

Geoffrey Kamadi is a journalist based in Kenya.

How I set out to mend a broken world with the help of science & Madame Curie

Marie Sklodowska-Curie (1867 – 1934) was a Polish-French physicist and chemist and is the only scientist in the world who has won two Nobel Prizes in different categories.

Photo Credit: https://commons.wikimedia.org/wiki/File:Marie_Curie_(Nobel-Chem).jpg

By Amal Amin

The world turned upside down the day after I returned to Egypt. I had just completed the lab work for my chemistry PhD in Germany, and on 10 September 2001 I travelled home with my small daughter, leaving my husband behind to continue his studies. Our luggage went missing in Munich, and I arrived late and tired at my parents house.

The following day, when I woke up I discovered terrorists had attacked the United States. Muslims were being blamed worldwide, and there was fear of war and recession, hatred, and revenge. Despite being back in the country of my birth, surrounded by family and friends, I felt unsafe and alone. Everything seemed illogical—everything except science, my only constant in a changing world.

In the middle of that ugly chaos, I knew I wanted to use science to make the world a more logical and peaceful place, where we accommodate each other, where we all live together, where nobody lives alone.

I got my chance when, in 2009, I met fellow dreamers at a conference for young scientists in China. Together, we founded the Global Young Academy—a forum for young researchers from different continents and cultures who share a passion for using research to solve global challenges. Afterward, I personally founded the GYA group for women in science to promote gender equality.

In the middle of that ugly chaos, I knew I wanted to use science to make the world a more logical and peaceful place.

It may seem curious that a muslim woman from a traditional family founded such a group. But I have never been one to unquestioningly follow tradition. As a child, I was impressed by the story of Marie Curie, my first role model. She became one of the world's foremost scientists, a winner of two Nobel prizes, despite suffering a lot during her life and having to face many challenges as a woman. Curie inspired me to study science, and chemistry in particular.

I decided to get my PhD outside my country, even though I knew that doing so pitted me against cultural stereotypes at home of what women were expected to do. My family encouraged me to be the best student I could be, but they did not want me to travel alone for long periods without starting a family. Luckily, I married a colleague who shared my dreams.

Immediately after our first daughter was born I was accepted for a German PhD scholarship. My husband took care of our daughter while I learned German, and then joined me in Germany.

Germany was tricky. My culture, looks, and preferences set me apart from my peers. I was the only married person in my group, and the only one with a child. My husband and I woke up at 5 a.m. during the week and I often worked weekends. I wanted to finish my degree quickly, and I did—completing my practical work in 18 months instead of the usual three to four years. I wrote up my PhD back in Egypt. By then my personality had changed. I had become stronger; I would not let any hurdles stop me from accomplishing my dreams.

Back in Egypt I wanted to introduce some of the techniques I had learnt in Germany to my research at the National Research Center in Egypt. For my PhD, I used catalysis and controlled polymerisation—a technology that can be used to create nano-structures. I met with several obstacles. I realised that our problems in developing countries are not always due to a lack of funding, but sometimes because research predominantly faces away from innovation. There was no teamwork, and scientists were working as separate islands, pursuing promotions and furthering their scientific careers—not working to deliver impactful change to society.

Traveling widely, to more than 35 countries, I also found that no matter where I went, people viewed scientists as distant from their daily lives. So, in Egypt, I co-founded the Egyptian society for nanotechnology and the Egyptian Young Academy of Sciences. I traveled with other members of EYAS to rural areas to raise science awareness and boost the impact of science in society.

The world is changing fast, driven in part by technology. I think it's time for all of us to slow down a little. Science must be more moral and human, otherwise it will be turned against us. And we as scientists must drive that change.

I believe science can be a great force for unity. From my work as a woman scientist and at the GYA, I saw that all the barriers that separate scientists—gender, religion, culture—are artificial. On the level of people, we are all similar. Science is a universal language. I want future generations to share a more progressive perspective. Also, I believe in the value of networking and science diplomacy to strengthen the impact of science worldwide

I recently founded 'women in science without borders', a movement that targets men and women alike. It aims to bridge the gender gap, but also to connect people with scientific knowledge and create a network to enable

Life is not easy for any of us, but what of that? We must have perseverance & above all confidence in ourselves. We must believe that we are gifted for something and that this thing must be attained.

Photo Credit: Freepik

people to serve society more effectively. It encompasses all sectors of society including NGOs, industry, entrepreneurs, youth, and policymakers. The movement has reached more than 40 countries. Its first three meetings were held in different countries in Africa; the fourth one will be held in Brazil in March 2020.

During my life, I have had ups and downs. I've had failures as well as successes. I've worked hard without recognition; I have been called hard and unfeminine. However, I did not give up, and I hope my story will inspire others. We need role models who help us dare to hope that there will be light at the end of the tunnel of hard work. For me, the following words—by Marie Curie, who else?—have always offered comfort.

Amal Amin is an associate professor for nanotechnology specialising in polymers at the National Research Center in Cairo, Egypt. She has a special interest in science communication, increasing public awareness of science, science advice, innovation, and science policy.

The Birdman of Ibadan: Small actions can yield big results

By Adewale Awoyemi

Ibadan is one of sub-Saharan Africa's largest cities by surface area. Anthropogenic activities in the city, notably urbanisation and farming, are negatively affecting bird diversity. However, awareness campaigns, especially by the Ibadan Bird Club which I coordinate, are changing people's perception. The Ibadan Bird Club has 500 registered members, and around 40 people turn up at each of our monthly meetings. Our meetings are open to all—young and old, experts and novices. In my estimation, it is unarguably the best bird club in Nigeria and arguably the best in West Africa.

Most Nigerians I have met understand the importance of biodiversity. Some will tell you stories of streams that were protected by sacred groves, while others will tell you how their grandparents sustainably harvested non-timber forest products. I think the main challenges to biodiversity conservation in Nigeria are, firstly, the inability to practically implement local know-how of biodiversity conservation in the face of economic hardship, and, secondly, greed on the part of some rich people. For biodiversity conservation to be sustainable in Nigeria, all stakeholders must be involved and their needs—especially those that will ensure healthy livelihoods—must be met.

My own first birding outing was as a postgraduate student in September 2014 in the Amurum Forest Reserve. The reserve is near Jos, north-central Nigeria, where the A.P. Leventis Ornithological Research Institute is located. The institute awarded me a scholarship for a masters in conservation biology, and birding was part of the coursework. It was a lovely first-hand experience for me, and my interest grew from there. The most amazing birding experience I've had to date took place at 11 a.m. on 14 April 2017 in Agbado Ekiti, in Ekiti State about 200 km west of Ibadan. I sighted the endangered Ibadan malimbe (Malimbus ibadanensis) out of its natural range. These striking red and black birds were only discovered in 1951 and are endemic to south-west Nigeria. We monitored the birds for about two months and our research was published in the journal Malimbus.

All birders have birds they dream about spotting in real life. I dream about seeing the Secretarybird (Sagittarius serpentarius), an elegant raptor and the first bird species mentioned to me by my lecturer during my undergraduate course at Ekiti State University. It is found throughout Southern and East Africa, and to a lesser extent in the drier regions of West Africa. Other dream sightings include the Abyssinian ground hornbill (Bucorvus abyssinicus) that stalks the savannah in search of prey, and the Red-headed picathartes (Picathartes oreas), which is one of Africa's most elusive rainforest bird species. It builds cup-shaped mud nests on overhangs, in crevices or caves. Another bird I'd love to see—although I'd most likely see more than one!—is the Sociable weaver (Philetairus socius) found in Southern Africa. Sociable weavers construct permanent nests on trees and other tall objects. These nests are truly spectacular and the largest built by any bird. They are large enough to accommodate over a hundred pairs of birds, housing several generations at a time.

When I talk about birds with my non-birding Nigerian friends I get many different responses. Those of the Yoruba ethnic group call me "Baba Eye" which means father of birds or "Baba Eleye" meaning someone who sells or possesses birds. They will then ask how they can buy caged birds for ornamental and acoustic purposes. Of course, that's where the opportunity presents itself for me to preach bird conservation, and I will invite them to join the Ibadan Bird Club where they can observe birds freely in the wild.

Our bird conservation challenges in Nigeria are significant, but I have learnt that small actions can yield big results. Just 35 people attended the re-launch of the Ibadan Bird Club in February 2016. That number has increased to over 500 in just three years. Sociologically, that's an impact. Scientifically, we have also made significant impacts through citizen science. These efforts were outlined in an article about the club published in a peer-reviewed journal earlier this year.

My passion for birds extends to my own life. I am now married to an ornithologist, so I am a complete Birdman! I suspect that our kids will have flair for birds too. As they say, birds of a feather will flock together.

Adewale Awoyemi is a Nigerian ornithologist who coordinates the Ibadan Bird Club and manages the city's International Institute of Tropical Agriculture Forest Center. His passion for conservation has earned him the nickname 'father of birds'.

Photo Credit: Dr. David Dekoeyer

Ibadan Bird Club at a glance

- The Ibadan Bird Club was established in March 2014 by the Nigerian Conservation Foundation in partnership with the Department of Wildlife & Ecotourism Management, the University of Ibadan, & the Forest Project at the International Institute of Tropical Agriculture. The aim was to build local capacity and enhance the conservation of birds in the Ibadan area.
- In February 2016, the club was relaunched so that it could be coordinated by the IITA Forest Center as an activity of the A. G. Leventis-funded Ornithological Monitoring Project. It meets at 4 p.m. on the last Saturday of every month. Membership is free and open to all.

Photo Credit: Dr. David Dekoeyer

Mon chemin vers l'indépendance

Par Marcel Tongo Passo

Comme tout bon projet, ma thèse de doctorat a été parsemée de beaucoup de difficultés. Même si à chaque fois j'ai trouvé le courage de continuer, j'avais, à un moment, pris la décision de ne pas m'engager dans une carrière de chercheur à temps plein, préférant l'enseignement. De plus, un de mes superviseurs m'avait fortement déconseillé d'éviter de m'engager dans le domaine du VIH/SIDA si je voulais poursuivre une carrière de chercheur.

Le tournant dans ma carrière s'est produit lorsque j'ai pris conscience d'un fait étonnant : bien que le VIH soit originaire du bassin du Congo, il y avait peu ou pas de scientifiques de cette région pour raconter son histoire naturelle depuis son introduction chez l'homme jusqu'à sa dissémination à travers le monde. En outre, lors des nombreuses réunions scientifiques internationales auxquelles j'avais participé, peu d'Africains avaient présenté leurs travaux. Je me suis interrogé sur les causes de cette situation et j'ai compris que je pourrais être l'un de ceux qui la feraient changer.

Après ma formation de post doctorant en Afrique du Sud, j'ai eu le privilège de recevoir un financement de 100 000 dollars pour retourner dans mon pays, le Cameroun, et initier mon propre programme de recherche. Ce financement provient du programme SANTHE (acronyme anglais pour Réseau d'Afrique sub-saharienne pour l'excellence sur la tuberculose et le HIV) et est destiné aux chercheurs sur la voie de l'autonomie. L'étude financée permettra d'expliquer l'histoire de la propagation de l'épidémie du virus VIH-1 groupe M (VIH-1M) au Cameroun, dans tout le Bassin du Congo, et même au-delà.

Par exemple, elle pourrait fournir une indication sur la raison pour laquelle certains variants rares circulant dans le Bassin du Congo ne se sont pas propagés à l'échelle mondiale. En effet bien que la prévalence du VIH-1M soit relativement faible dans les pays du Bassin du Congo, ceux-ci abritent pourtant une quantité extraordinaire de variants viraux d'inégale distribution. Des études sont donc nécessaires pour déterminer s'il existe des différences biologiques entre les souches virales qui circulent dans le bassin, susceptibles d'expliquer leur répartition inégale dans la région. Les données générées par cette étude peuvent se révéler importantes pour le développement d'un vaccin anti-VIH pour la région.

Ma vie avant la recherche

Je suis né et j'ai grandi dans une région côtière du Cameroun, au sein d'une famille moyenne de quatre enfants. Très éveillé, je cherchais toujours à tout comprendre. J'étais aussi celui qui entretenait le jardin : j'allais chercher des fleurs pour les replanter à la maison, ou dans des pots. Ma passion pour la connaissance du vivant et de la nature a commencé de bonne heure. Adolescent, à l'âge où la plupart de mes congénères étaient suspendus aux dessins animés ou aux films d'action, je m'intéressais plutôt aux documentaires consacrés à la nature, tout particulièrement aux animaux, comment ils parviennent à survivre dans des environnements souvent très hostiles. Je me souviens encore de mon émission favorite qui s'intitulait Splendeurs sauvages.

J'ai atteint un point culminant de cette passion pour la science quand, alors que je jouais dans la cour de notre maison, j'ai découvert des oisillons tombés de leur nid. Deux ou trois avaient été mangés par un chien et par un lézard. J'ai rapidement récupéré les trois qui restaient. Je leur ai construit un nid de fortune dans une boite que j'ai cachée, en sécurité dans un endroit isolé. Tous les jours à mon retour de classe (j'étais déjà au secondaire), je les nourrissais consciencieusement. Un jour, j'ai retrouvé le nid vide. J'ai pensé un instant qu'un prédateur les avait dévorés. Mais non : la boite contenant le nid aurait dans ce cas été renversée. Ils s'étaient simplement envolés. Quelle joie!

Cette expérience m'a instillé l'amour de la science et un désir de comprendre comment la vie fonctionne, et comment elle s'adapte à différents environnements. Aussi, à l'université, alors que mes notes me permettaient de m'inscrire en filière physique-chimie, j'ai choisi les sciences naturelles. À cette époque, j'ai été une exception.

Je me suis donc inscrit à l'université de Yaoundé 1, en sciences naturelles, puis en biochimie. Cela a été un choc au début : c'était l'unique université du pays, avec un nombre impressionnant d'étudiants. Pour les cours en amphithéâtre, il fallait arriver entre 4 et 5 heures du matin pour avoir une place assise.

Je ne résidais pas loin de l'université, mais n'ai pas pu supporter ce rythme. J'ai alors préféré préparer le concours d'entrée à la faculté de médecine. Malheureusement, je n'ai pas été admis. J'ai ensuite essayé de convaincre mes parents de la nécessité d'aller poursuivre mes études à l'étranger. Peine perdue!

Alors, j'ai supplié mes amis étudiants de me laisser photocopier leurs cours, que je n'avais pas pris en note puisque j'avais préparé le concours de médecine. Au premier examen partiel, j'ai eu la note de 04/20. C'était scandaleux pour quelqu'un qui venait de réaliser une moyenne de 15/20 à l'examen de fin de cycle du secondaire. Mais je ne me suis pas découragé, et grâce aux deux autres examens de l'année, j'ai remonté la pente et j'ai été admis en deuxième année.

En quête d'opportunités

Mon objectif à ce moment était d'aller le plus loin possible, bien que des proches me conseillaient de repasser le concours de la faculté de médecine. J'ai obtenu ma licence, puis ma maîtrise et mon diplôme d'études approfondies. Ensuite, ma carrière universitaire a connu un passage à vide, car je ne trouvais personne pour m'accueillir pour une thèse de doctorat. Je faisais donc, sans fin, des stages dans des laboratoires de recherche, au Cameroun et à l'étranger. C'est justement lors d'un de ces stages à l'étranger, à Nairobi, au Kenya, en 2006 que j'ai rencontré celle qui est devenue mon superviseur de doctorat. Dix ans après mon diplôme d'études approfondies, en 2011, elle m'a accueilli dans son département de virologie à l'université du Cap (UCT), en Afrique du Sud.

Tout de suite le problème du financement s'est posé. Les études coûtent très cher dans cette université qui est la plus réputée en Afrique. Heureusement, tout s'est arrangé, et en 2014 j'ai obtenu mon précieux diplôme de docteur (PhD). Les conditions et le cadre d'étude étaient impeccables ; rien à voir avec ce que j'avais connu dans mon pays. Il faut néanmoins rappeler que l'UCT est une université à majorité blanche, et il m'arrivait parfois de remarquer des regards pas très accueillants. Ma thèse a essayé de décrire l'influence que la diversité génétique du VIH-1M pouvait avoir sur les réponses immunitaires à médiation cellulaire.

En 2015, après mon doctorat, j'ai commencé ma formation post-doctorale dans la même université, d'abord au département d'immunologie, puis au département de bio-informatique. La thématique de cette formation était de comprendre les étapes entre l'entrée du VIH chez l'homme et sa propagation comme épidémie mondiale.

En 2017, j'ai quitté Le Cap pour rejoindre l'université du Kwazulu-Natal, à Durban, toujours en Afrique du Sud. J'avais en effet postulé à un appel à candidature du programme SANTHE. Je n'étais pas enchanté d'aller dans cette ville, mais l'offre financière était alléchante et je ne pouvais résister, d'autant que je n'avais plus de financement pour continuer à travailler à l'UCT.

Mon nouveau superviseur m'a encouragé à poursuivre sur la thématique commencée au Cap. Pendant cette période, je me suis rapproché du directeur du programme SANTHE, en poste dans la même université, et je lui ai proposé d'être mon mentor. C'était en effet un chercheur non seulement africain mais, aussi mondialement reconnu. Il m'aiderait à trouver une bonne niche de recherche sur l'étude biologique de la vaste gamme des virus du VIH-1M que l'on retrouve dans le Bassin du Congo. Il a été ensuite d'un grand secours dans la rédaction de mon premier projet de recherche financé par le programme SANTHE pour revenir chez moi, au Cameroun, en juin 2018, et commencer une nouvelle carrière.

Au départ, je ne m'étais intéressé qu'au volet financier du programme SANTHE, qui me permettait de poursuivre en post-doctorat. Mais une fois à Durban, j'ai constaté que c'était un vaste réseau de scientifiques d'Afrique australe, d'Afrique de l'est, et de certains pays occidentaux. Plus intéressant, j'ai réalisé que SANTHE finance non seulement les étudiants de niveau maîtrise, doctorat et post doctorat, mais aussi des collaborations entre chercheurs du réseau. L'un des principaux objectifs de ce programme est de transférer les connaissances scientifiques et de renforcer les capacités. Il est né d'une collaboration ancienne entre les pays concernés.

Retour au Cameroun

L'une des faiblesses cependant du réseau est qu'il ne contenait jusqu'à lors qu'un seul pays francophone (le Rwanda) et pas de pays situés en Afrique centrale et de l'ouest, qui sont aussi touchés par les épidémies de VIH et de tuberculose. L'inclusion d'un deuxième pays francophone d'Afrique centrale offre désormais de nombreuses possibilités aux scientifiques des pays de cette région de collaborer avec leurs homologues des pays déjà impliqués dans le réseau.

En tant que chercheur en voie d'autonomie, il est extrêmement difficile de compétir avec des chercheurs senior déjà bien établis pour des subventions de recherche importantes. C'est précisément à ce niveau que le prix SANTHE Path-to-Independence a sa place. Ce financement constituera une excellente ressource pour un débutant comme moi. Il me permettra de générer des données préliminaires et contribuera à étendre le programme SANTHE aux pays francophones de l'Afrique du centre et de l'ouest.

Revenir dans mon pays après ma formation a toujours été un rêve pour moi. Il m'a fallu plus de dix ans entre mon diplôme d'études approfondies et mon doctorat. Je suis parfaitement conscient que beaucoup de jeunes de mon pays sont dans la même situation. Ces jeunes, parfois très intelligents, n'arrivent pas à exprimer tout leur potentiel à cause du manque de chercheurs expérimentés et bien connectés à l'étranger, susceptibles de les encadrer. Pourtant les maladies infectieuses d'origine virale sont à l'origine de défis importants, que ne pourront relever que des personnes bien formées. Voilà le rôle que je me suis fixé en retournant dans mon pays. L'effort commence déjà à payer. Je viens en effet de recevoir deux financements extérieurs, par l'ANRS **(Agence Nationale de Recherche sur le Sida et les Hépatites Virales)** et par la Fondation de recherche allemande (DFG).

Educating children displaced by Boko Haram is vital for Nigeria's future

'People dumps' that house children displaced by Boko Haram could become breeding grounds for extremism unless the educational provision in them improves drastically, writes David Mba.

Perhaps Nobel-prize winning author Wole Soyinka put it best when he wrote: "One's own self-worth is tied to the worth of the community to which one belongs."

It's a useful quote to keep in mind when visiting the poverty-stricken Internally Displaced People camps of northern Nigeria.

In December last year I visited two such camps with colleagues from the Nigerian Young Academy. The visits came about because one of the four sustainable development goals the NYA has decided to focus on is SDG 16: Peace, Justice and Strong Institutions. NYA wants to bring awareness to the education of internally displaced persons in Nigeria.

As our team found on our visit to two such camps, Nigerians displaced by the Boko Haram insurgency live there in appalling conditions, with a lack of food, poor housing, poor health services, poor sanitation facilities and a chronic shortage of education.

Will these ramshackle camps affect the self-worth of a generation of displaced Nigerian children? We think they will. That's why we believe these 'people dumps' are not just bad news for the 1.9 million Nigerians who live inside them. We believe they are bad news for Nigeria as a whole.

Seeing is believing

A forward-thinking country educates all its children. It's the efficient thing to do. But set that aside for a moment. Only last year, in a 'Perpectives on Terrorism' report on Boko Haram, its three authors—Adesoji O. Adelaja, the late Abdullahi Labo, and Eva Penar—noted that a "lack of economic opportunities has been found as a root cause of terrorism".

Already traumatised by displacement, and without even basic education, children in these camps will have very little opportunity to improve their socio-economic condition. That will leave them vulnerable to extremist propaganda; the very thing that displaced them in the first place. Seemingly abandoned by the rest of Nigeria, there is a real danger of these camps actually becoming a source of terrorism.

The argument that extremism is simply being relocated from the north of Nigeria to the various IDP camps across the country gains credence when you visit the camps and witness that they are without money, without education and without hope.

At Karonmajigi camp, which houses around 2,400 people displaced from Borno State, we were told most of the 200 children who live in the camp do not go to school. This is because there are no schools in the camp.

At the New Kuchingoro IDP camp we heard a similar story. This camp houses around 1,600 people, displaced from Borno state. Around 350 are children. This camp has a school, but it is short of both teachers and textbooks. We saw many children who ought to be in school playing around the camp. The closest government school is at least five kilometres away, and while camp children could in theory attend this school the death in 2017 of a pupil crossing the road on the way to the school has discouraged others from making the long trek.

Photo Credit: Chris Parkes/Street Child, UK

So what can be done?

Unlike refugees, who cross borders, people who have been internally displaced have no protections or formally agreed-upon rules. There are no international resources or funding. The care for them therefore falls to local and national government.

Last year, Nigerian president Muhammadu Buhari announced the Federal Government's intention to adopt a national policy on internal displacement. He said a policy of "realising the Sustainable Development Goals for all, including migrants, refugees and internally-displaced persons" would help regulate the internal displacement crisis and complement the fight against insurgency.

But we saw little evidence in the camps we visited of any commitment by local or national government to take on terrorism by helping the victims with their education. By contrast, our visits have shown the clear abandonment of any attempt to educate children within the IDP camps.

The authorities may argue that more pressing matters take precedence, such as battling the terrorism that caused the initial displacement. I would argue that helping our countrymen and women displaced by Boko Haram is very much part of the battle against terrorism. There is a path to terrorism from poverty and hopelessness that must be blocked by the government.

Our visits showed the clear abandonment of any attempt to educate children within the camps.

As an academy of researchers, the NYA is interested in making evidence-based decisions as well as encouraging other researchers to find ways of coming to the aid of those currently displaced from their homes. Creation of knowledge is good, but transmitting that knowledge beyond the university walls to society is even better. So, it is important that we do not ignore the plight of those residing in these camps, but use our knowledge to improve their situation.

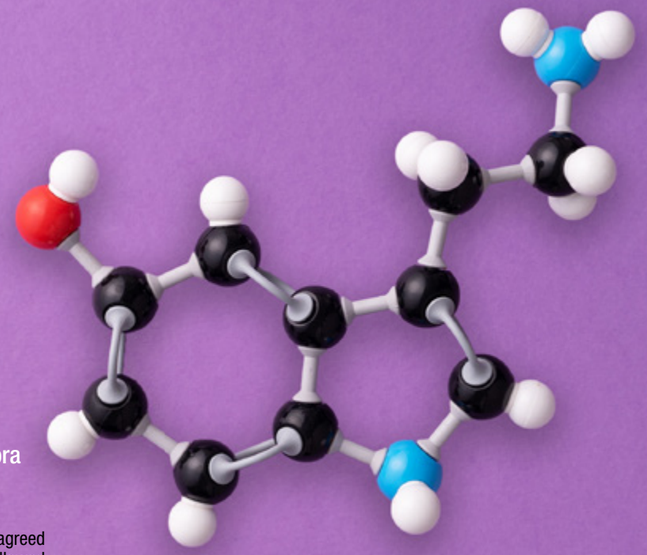
It is now imperative that specific intervention programmes are initiated to address the neglect of these most vulnerable of Nigerian children. They must be given hope through education. It is vital for them. It is vital for their families. And if that does not move you, remember this: it may also be vital for future peace in Nigeria.

David Mba is a Nigeria-born mechanical engineering professor based at De Montfort University, UK, where he is also Pro Vice-Chancellor and Dean of Computing and Engineering. Mba visited the IDP camps with Nigerian Young Academy representatives Dr Tope Olomola (NYA President), Dr Abiodun Egbetokun, Dr Matthew Omoruyi and Dr Aminu Mohammed.

Reference: Public Opinion on the Root Causes of Terrorism and Objectives of Terrorists: A Boko Haram Case Study' by Adesoji O. Adelaja, Abdullahi Labo (Late) and Eva Penar, Perspectives on Terrorism, Vol 12 Issue 3

Photo Credit: David Snyder for USAID

How young Tunisian scientists revitalised science in their homeland



By Mohamed Jemaà

Tunisia has increased its investment in education and science, but many professionals leave the country, representing a loss on that investment. Now, a global network of young Tunisian scientists is feeding diaspora expertise back into the country.

Since gaining independence from France in 1956, Tunisia has made a lot of investments in education and science. In 2018 only two continental grantmakers—South Africa's National Research Foundation and Tunisia's Ministry of Higher Education and Scientific Research—appeared in the Top 10 of research funders in Africa. Also, last year Tunisia ranked 14th globally in terms of scientific output as a proportion of GDP.

A great deal of the investment has been in the life sciences, which include biology, medicine and biochemistry. A July 2019 search for 'Tunisia' in the online journal PubMed returned more than 21,000 articles, compared with only 13,500 for Morocco and 7,000 for Algeria.

However, many Tunisian academics live abroad. In 2015, the Tunisian diaspora represented approximately 13% of the Tunisian population. More than 100,000 researchers, doctors, and pharmacists are estimated to have crossed the sea and established themselves in Europe, North America, or the Arabic peninsula region, making brain drain a real concern.

For a young scientist growing up in Tunisia, this can be discouraging. But a young group of life scientists—of which I'm one of the founders—is working to change that.

It all started in December 2014 at a biology conference in Tunisia. A small group of us—some working in Europe, some in Tunisia—began to talk about how boring life science conferences were in our homeland. There would be the same old names as speakers, same old studies. There was no chance for young scientists to take up space and shake things up.

In our group, we had all graduated from Tunisian universities and spent at least one postdoctoral post outside Tunisia. We recognised the considerable role that the Tunisian science diaspora could play in the development of Tunisia in general, and science and education in particular. And so we set ourselves a crazy task: To organise a scientific event in Tunisia for young scientists within the next 12 months which we would call the International Symposium of Young Researchers in Biology in Tunisia.

English would be the main language of our symposium—a first for Tunisia, where French is the language of science. This was not a popular decision at first, but we ignored the naysayers.

To make sure our symposium was different to the others, we agreed on some fixed rules. Only (excellent) young researchers would be allowed as speakers. We invited both Tunisians and non-Tunisians. Those working abroad had to be principal investigators, but because it was not possible at that time to be a young PI in Tunisia, local speakers did not have to lead research teams in order to speak. We also agreed that English would be the main language of our symposium. This was a first for Tunisia, where French is the language of science and where meetings are generally held in French. However, we felt that this tradition limited international participation.

I have to confess that it was not a popular decision at first. People thought it would be an obstacle to local participation, hinder audience-speaker interaction, and limit our success with sponsors. But others were enthusiastic, and in the end we just ignored the naysayers. We found that most young researchers were happy to speak English, which was comforting.

In the end, the speaker list included scientists from France, Italy, Singapore, Brazil, and Tunisia. Among the 180 participants were representatives from Algeria, Morocco, France, Germany, the United Kingdom, Sweden, Denmark, the United Arab Emirates, New Zealand, Japan, Singapore, and the United States of America. It was the first and biggest scientific event in the country to be 100% dedicated to young scientists. The symposium was a success, and we resolved to keep building on it. The Young Tunisian Researchers in Biology—or YTRB—network was born. It aims to connect young Tunisian scientists to peers all over the world, in order to share knowledge, experience, & technology. The network arranges the international symposium every second year in Tunisia. More than 100 participants took part in the second symposium, held in May 2018 in Hammamet. The next symposium will be in Sfax in March 2020.

The network also organises workshops to introduce new research techniques and skills to students in Tunisia and neighbouring countries. The workshops have covered protein modelling and docking (2016 and 2018), flow cytometry (2018), how to plan and get a postdoc (2018), and 'from genomics to proteomics' (2019). We will hold a workshop on using the fruit fly as a model for biomedicine in October this year in partnership with the DrosAfrica network and Sfax University.

In addition, we arrange videoconferences, inviting young scientists to give talks over Skype followed by a round of questions. The audience is located in a university auditorium with a local YTRB collaborator chairing it. We have organised video conferences at universities in Bizerte, Monastir and Sfax with speakers from Canada, Denmark, Germany, Switzerland, the Netherlands, and the USA. We also arrange smaller meetings, which are similar to the large symposium but focus on one subject—a technique, usually, or a scientific novelty. We have had one on laboratory animal science, which focused on introducing new and low-cost animal models to Tunisian laboratories.

We also train young Tunisian biologists to communicate their science to the wider public. In 2018, we launched communications awards for young scientists, with local journalists and members of literature associations forming a non-scientific judging panel. The awards will be given out annually.

In parallel with these scientific activities, YTRB has started a science diplomacy lobby group to promote Tunisian research outputs to the rest of the world. We have also started to offer our help to Tunisian public institutions as external experts. For example, when more than 15 babies died from infection at a hospital in Tunis, provoking public outrage, our network launched a project to study the infectious agents that caused the deaths using novel techniques, and to communicate the results to the public.

However, there have been obstacles in our path, the greatest being our limited resources. When we started our activities, fellow co-founder Chameseddine Kifagi and I contributed about €10,000 to get the project off the ground. To fund our conference, we have counted on several cultural exchange organisations in Tunis run by France, Italy, Germany, and Spain. We also obtained financial help from the Tunisian Ministry of Higher Education and Scientific Research.

The network is growing rapidly—we have hundreds of members all over the world. We still work on our visibility, and encourage young scientists to join us. But we have also faced silent—and sometimes not so silent—disapproval from some older heads of laboratories. It's because of what we represent: young and diaspora scientists.

We believe that YTRB is bringing in a new age for Tunisian science. This is evidenced by the increase in meetings, symposia, workshops, and even research positions in universities with the tag "young scientist" attached to them. This definitely encourages us to continue our work and investment in the future of Tunisian science with the motto: Be Young, be Brilliant, be YTRB!

Visit our website (https://ytrbiology.weebly.com/) or Facebook page (Young Tunisian Researchers in Biology) and support the network. You can also contact us via biology.tun@gmail.com

Mohamed Jemaà is an expert in the field of genomic instability. Since 2017, he has been based at Lund University in Sweden. He dedicates this article to the memory of YTRB co-founder Myriam Fezai, who passed away earlier this year.

Five ways to help young researchers succeed in Africa

A practical guide to how research directors can improve institutional ecosystems for the benefit of the next generation of scientists.

By Fredros Okumu

Herry Mapesi is a young physician researcher based in Ifakara, some 450km from the Tanzanian economic capital of Dar es Salaam. He has the loudest laughter in town, and apart from being occasionally perceived as snobbish, he has a beautiful mind and an extraordinarily likeable character.

Herry and his colleagues run an 11,000 patient HIV clinic serving nearly 50 villages in the vast Kilombero Valley. About half of their patients are on regular follow up, receiving the best possible treatment for HIV and related illnesses, such as tuberculosis, meningitis, diabetes and chronic kidney diseases. When I last visited, 94% of their patients no longer had any detectable HIV virus in their blood, meaning they can no longer transmit the virus to their partners. Herry and team have created a clinic providing comprehensive treatment and nutritional services for families affected by HIV. Today, HIV-infected mothers who attend the clinic no longer transmit HIV to their children even if they breastfeed regularly.

Herry and his colleagues achieve these impressive outcomes despite working in remote areas with limited funds and resources. The team also works closely with Tanzanian health agencies to support the development and evaluation of improved care and treatment regimens for chronic Illnesses.

Herry and colleagues are research scientists at Ifakara Health Institute, where I'm the director of science. Like all young scientists they write papers, attend research conferences, study for PhDs and apply for grants. Yet their primary mission remains unchallenged: Improving people's health and wellbeing. Theirs is a research program with a difference. Their work—both clinical and research—profoundly impacts people's lives every day.

As a science director at a major African research organisation, I have a vested interest in understanding how we can best support young researchers like Herry.

Over the past three years, I have examined management practices commonly used by organisations and businesses around the world to improve staff performance and creativity. This included carrying out multiple surveys and in-depth interviews with innovators and researchers in and outside Africa. In this article I share some of the lessons I learnt about challenges facing the continent's early-career researchers, and practices institutions can prioritise to help them succeed.

Wanted: Training, funding and fellowships

The challenges are many, and several aren't new. There are still only a handful of opportunities for high-quality research training on the continent, and unacceptably low levels of supervision and mentorship for young people aspiring to a life in research. Limited financial investment from governments has also hamstrung the growth of critical scientific mass, and hampered progress in exploratory but potentially high-impact research.

There are also few role models, and science is still widely perceived as a club of bearded introverts and bookworms strongly averse to fun and fiercely unwelcoming to women—a situation keeping many talented youngsters away.

Another age-old challenge is the glorification of individual success over that of teams. This is driven in part by archaic ways of evaluating scientists based on publication counts, citations and research grants. Unchecked, young researchers easily adopt the ethos that they are "competing against" rather than "with" others. At Ifakara Health Institute, Herry and colleagues have curtailed these toxic egos by embracing the African humanness philosophy of Ubuntu: I am because you are. Perhaps this is easier for young people than it is for their more established, Nobel-chasing godfathers.

In addition, many African universities still run geographically segregated departments, despite proof that interdisciplinary work has greater impact. Engineering schools can be tens of kilometers from biological sciences or medical schools, effectively limiting opportunities to co-create solutions. Architectural and organisational innovations such as shared coffee lounges, subsidised cafeterias, open plan offices, or glass walls may help in certain circumstances, but are not enough to bridge these gaps.

There are other challenges like excessive administrative and teaching loads for young faculty, and poor management practices. Language gaps, too, can prevent non-native speakers from taking full advantage of the English-dominated global research ecosystem. This is not a uniquely African concern but must be especially considered in African countries where French, Swahili, Portuguese or Spanish are the main languages of instruction.

- 1. Provide effective supervision & mentorship
- 2. Maximise community interaction
- 3. Promote interdisciplinarity
- 4. Focus on sustainability
- 5. Tackle barriers for women & minorities

Five actions for change

So, how can we start to tackle these challenges? In my view, the most important action we can take as research leaders is providing effective supervision and mentorship. This may include long-term commitments to guide early-career researchers on matters both related to work and not, such as engagement with communities or regulatory agencies, and family resettlement. Institutions should create environments where supervision or mentorship arrangements are mutually agreed, rather than being institutionally enforced. Training programs should mix hard and easy tasks, so young people experience incrementally more difficult challenges for optimal learning. Alex Ezeh, former chief executive of the trail-blazing African Population and Health Research Centre based in Nairobi, once told me: "You must occasionally throw your young researchers into the deep waters, but always be ready to dive in, if they are drowning."

The second action I propose is to maximise interactions between researchers and their target populations, communities or patients. This will help them identify priority questions first-hand and make them more likely to create or adapt solutions to fit local contexts. At Ifakara Health Institute, community members are our most important stakeholders, and we take great pains to protect our partnerships with them. This is also the reason that colleagues like Herry and his team have remained impactful despite being so far from the tarmac, and so limited by financing.

Communities can also be great sources of new knowledge for researchers, making these partnerships perfect for "mutual learning". For example, after expert mosquito biologists had tried fruitlessly for more than 30 years, it was the young village boys who showed us the exact locations where malaria mosquitoes congregate each evening for their ritualistic sex games, a discovery which could allow scientists to target these mosquitoes for community-wide control.

The third action is to deliberately and actively create interdisciplinary programs. At Ifakara, young researchers now regularly combine math, chemistry and biology to create new diagnostics for infectious diseases like malaria, something only possible because of the active desegregation of disciplines. Others are using portable ultrasound devices to limit potentially toxic treatments for people falsely diagnosed with Tuberculosis.

On funding, and fourthly, we need to focus on building sustainable research ecosystems and careers. With increasing financial constraints and economic vigilance, research and academic institutions can be tempted to operate on a traditional profit and loss basis, as if they were typical businesses. However, investments in science are mostly long-term, and returns take several years to materialise. Equally important are semi-autonomous and flexible leadership structures. These should embrace efficient administrative and financial systems, which meet international standards without ignoring research priorities. Sadly, bottlenecks like delayed contracts or slow procurement procedures are still common in many universities, enormously demotivating for scientists.

Fifthly, and finally, institutions should identify barriers to women and under-represented groups joining their ranks, and advancing in the workplace, then endeavor to overcome these barriers. There is strong evidence that gender and cultural diversities are both associated with higher performance in workplaces, and diversity requires a commitment from the top.

Beware the spitting cobra

Those are five ways in which we, as leaders of research institutions in Africa, can help our young colleagues thrive. But how do we do it? And what incentives should we use to encourage change? Should we use direct incentives, for example paying scientists for each research paper?

Well, it turns out nothing works better than Dale Carnegie's principle of honestly and sincerely appreciating people. Financial or material incentives beyond regular institutional pay grades are unsustainable and can backfire with serious cobra effects. For those who don't know this idiom, the cobra effect harks back to an anecdote from colonial-rule India. Wanting to reduce the number of venomous cobra snakes in Delhi, the British offered a bounty on dead cobras. Soon, people began breeding cobras to collect the bounty, and when British scrapped the reward programme the breeders set their snakes free—pushing the wild cobra population beyond what it was before the programme was introduced.

In the same way, financial incentives for publishing in high impact journals may lead to unscrupulous practices, such as fabricating data, which can be devastating to an institution's reputation. While it can be tempting for managers to provide material incentives in the short term, staff may come to feel entitled to these rewards, creating a vicious cycle of institutions always having to give more. Cultivating intrinsic motivation and recognising hard work are far more effective for maintaining long-term success.

My five actions are only a few examples of what institutions in Africa can do to catalyse effective ecosystems for their early-career researchers. A careful mix of these practices and others not covered here, will allow young stars like Herry and friends to shine brighter, while staying true to their mission: Improving people's health and wellbeing.

Fredros Okumu is Director of Science at Ifakara Health Institute in Tanzania, and an Associate Professor at the University of the Witwatersrand in South Africa. He is a mosquito biologist and public health expert working on new ways to improve control and prevention of vector-borne diseases. https://twitter.com/Fredros_Inc

Let's teach our children science in their own languages

African governments and scientists should agree to a two-generation plan to move away from European-language science teaching on the continent.

By Rafiou Agoro

I remember the day I learnt about cell biology at my school in Kougnohou, the tiny Togolese village where I grew up. I was 15 years old, and it was my first experience of the subject which would later become my passion. Seeing me smile when I came home, my mother said: "Hey son, welcome! The food is ready, but before eating, tell me what you have learned in school today."

My mother did not attend high school, but she is the smartest person I have ever met. She is able to make complex price calculations in her head to sell loincloths at the market. She and I both speak three Togolese languages fluently. Yet I found it really difficult, almost impossible, to explain cell biology to her. I realised that the problem was not that my mom did not have a college degree. Rather, it was my fault for not being able to find simple words to explain cell biology in a language she understood.

I was taught in French, the language of instruction in Togo. I am not sure my teacher could have done differently, as there is no scientific vocabulary in the local languages. Besides, many Africans associate communication in European languages with a high level of knowledge, and some teachers are loath to use the common tongues. It's a challenge that repeats across Africa. Togo alone has 40 languages, and the continent boasts close to 2,000. Few of them have scientific vocabulary, and so even popular languages like Ewe, which is spoken not only in Togo but also in Benin and Ghana, are not up to the task of science teaching.

I think now, as I did then, that this is something that needs to change. I agree that it will be more difficult than continuing to communicate science in European languages, but I don't think our recent colonial history should continue to define us.

A break with history

It will be tough in the beginning, no doubt, to find existing words that can convey new meanings, or create new words fit for the purpose. But our varied local languages are rich, and we are inventive. Did my ancestors ever exchange scientific knowledge in African languages? It is highly probable that they did, and certainly not in European languages. Knowledge has been transmitted from generation to generation in Africa. This is also science, defined by www.dictionary.com as "a systematically organised body of knowledge on a particular subject".

Let's be clear here, Africa's history is heavy and we carry many scars from the past. Sacrifice and vision should be our leitmotiv and locomotive to drive us so we can shine in the coming generations. Prosperity comes with innovation and the innovation arrives when science and technology are stimulated by good science communication—between scientists, but also with the public whose support is crucial.

Thinking back to my own experience, I should have pushed my teacher to explain the science in an African language. If he couldn't do it, I should have gone to the school principal and voiced my desire to be able to receive my science education in an African language. I also should have discussed it with language teachers and explored options with them.

I think maybe what is missing is a strong will to cut the umbilical cord with colonisation and shape our own scientific journey in collaboration with partners from Asia, Europe, and the Americas. If we as Africans think communicating science in local languages is impossible, then it will be. Conversely, believing that it is possible represents the first step towards tackling this myth that it is impossible to communicate science in African languages.

So, where to start? My suggestion is that we—Africans scientists, linguists, policymakers, and governments—should agree on a two-generation plan to help science communication transition from European to African languages. It may be difficult to tackle all the languages at once, but perhaps we can start with the most popular ones in each country.

In parallel with the long-term planning, we should all be curious as students, scientists, and teachers to communicate in African languages with our peers and relatives about science and knowledge. I know, it sounds difficult. But is it impossible? Not at all.

Why I wrote this in English?

My goal with this piece is not to call for an immediate switch from European to African languages. After all, this piece is written in English, not Ewe, Kotokoli, or Kabiye. Nowadays, science is globalised, and being able to communicate your science in English represents a huge advantage for scientists wanting to share their discoveries with the rest of the world. And by writing this in English, I am able to communicate this idea with a wide range of readers from all around the world.

But, before we earn global success, why not earn local success in a worthy fashion? Starting to teach science in African languages would be a huge step forward. It would not need to be 100% in African languages—we can still borrow some technical terms and expressions as part of this transition process. We can also create a new vocabulary through the combination of existing words.

I have hope that we can make this change happen in the next two generations. Communicating science in African languages should be a right and should be protected by our constitution—which in Togo, by the way, is not written in an African language.

Rafiou Agoro is a Togolese molecular and cellular biologist working at Indiana University School of Medicine (USA) and co-founder of the African Diaspora Scientists Federation (https://adsf.club), a networking platform for African scientists living in the diaspora who want to share their scientific expertise with people in their home countries.

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A PEEK INTO THIS YEAR'S AFRICA SCIENCE WEEK

Africa SCIENCE WEEK
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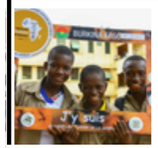
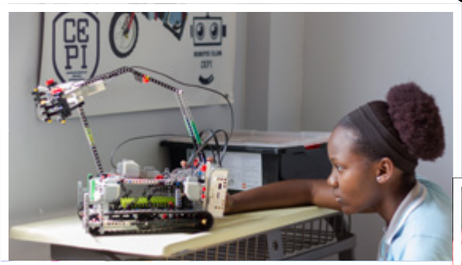


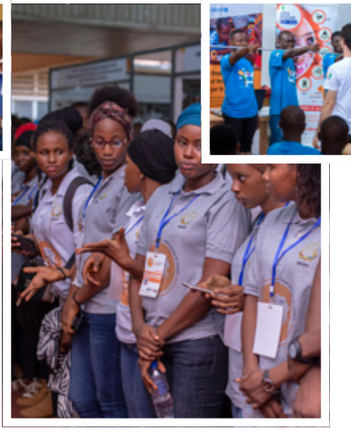
Guinea

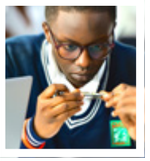
Kenya

Mali

Cape Verde

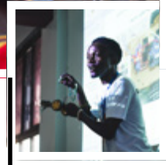






Morocco

Rwanda



Tanzania

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