Astroscience Exploration Network (ASEN) and ASEN2022—preparing the ground

At the core of the inaugural conference of ASEN was the question "How do we best move forward facing the specific circumstances of various countries in Africa or the wider Global South while aligning with needs and requirements?", coupled with "How do we achieve both impact and reach within a community?"

Prof Golden Gadzirayi Nyambuya from NUST (Zimbabwe) confirmed that a local programme for astrophysics is currently in the implementation phase. Discussions during the conference revealed some specific points that require attention, including:

1. Africa is vast and diverse. It cannot be defined by the needs of one country alone in no uncertain terms. (Mukesh Bhatt, born and raised in Kenya, now based in the UK);
2. There is a lack of funding for science in general and astroscience in particular (Buzani Khumalo, South Africa;
3. There are many opportunities for smaller grants, which should be highlighted and targeted. Scientists from the Global North could provide training on how to write proposals to secure funding (Daniel Helman, Micronesia). In this respect NoRCEL seeks help from the international community in raising funds from Global North;
4. No astroscience courses (e.g., astrobiology) are available and there is a general lack of continuity throughout education system (Timothy Chukwudiegwu Egbuim, Nigeria and Buzani Khumalo, South Africa);
5. There are inadequate astroscience employment opportunities available on the continent itself (Jeff Siyambango, Zambia);
6. Although gender bias is prevalent around the world, it is particularly a problem in Africa (Othusiste Lekoko, Botswana);
7. Outreach can begin at a local level and a focal person (point of contact) should be assigned so as to follow up the team and regularly report on the relevant activity (Alexander Takele Muleta, Ethiopia);
8. On-line events have become widely popular, but connection issues continue to be a deal breaker for participants from African countries, not only because of unstable or slow networks, but also because of unreliable electricity supply (Martin Dominik, UK, President of NoRCEL); and
9. Resources and information can be shared on a dedicated webpage of the NoRCEL website. The Chair of the forum, Sohan Jheeta, advised that this could be implemented.

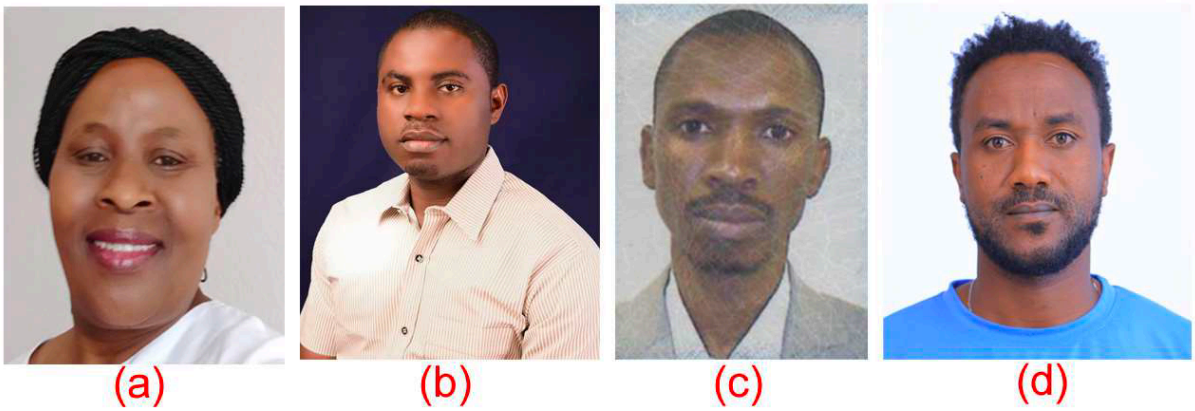

Figure 1: some of the African participants who gave input during the open discussion on the morning of the second day—(a) Buzani Khumalo, South Africa. (b) Timothy Chukwudiegwu Egbuim, Nigeria. (c) Othusiste Lekoko. (d) Alexander Takele Muleta, Ethiopia.

Accounting for diversity of societal, cultural, and scientific environments across Africa is a key challenge, and ASEN needs to foster development at the specific level that matches these. While we will not succeed by copying recipes that were designed for the

environments of highly-developed countries, we must also not fall into the trap of making ASEN solely follow concepts that reflect the most advanced economies in Africa (e.g., South Africa, Ethiopia and Botswana). ASEN needs to be an innovative initiative that is driven from within Africa, not from the outside and rather than being restricted to Africans, we envisage it evolving into a global endeavor, where the spirit of Africa can inspire much beyond, and the Global North can learn.

We will also need to have the employment situation in mind. Development of scientific capacity and related skills need to go hand in hand with opportunities to make good use of it. While Africa is one of the places most in need of home-grown talent, those who could make a positive difference for their country frequently fail to see an adequate future there and consequently seek employment outside the African continent, with such a "brain drain" ultimately robbing its future. Therefore, we need to be proactive in building career paths, or otherwise we end up caught in between "Does an astrophysics qualification help to 'put food' on the table?" and "Why should I stay here if the only bright future that I see is elsewhere?" It should also be noted that there is a risk of an inter-African "brain drain" towards the more developed economies. This unprecedented brain drain to high value economies should be discouraged at all costs for at least two reasons. First, we need to help stem the flow of Africans towards already developed economies because in general, if given half a chance of a high value, comparative quality education, young African students would be less inclined to look for pastures anew elsewhere. These have been our findings since 2015 and it is high-time to redress such an imbalance. Of course, curbing of the exodus of Africans will not happen in an instant, but what we learnt from the inaugural ASEN2022 conference is that there is a change of air and NoRCEL is at the heart of it, instigating and initiating the necessary change—a good balanced education is the way forward. Second, the African continent is a unique land mass in that it has great many astrobiological features (e.g., The Great Danakil Depression in Ethiopia, Figure 2a), as well as vast desert areas (e.g., Sahara), where meteorites could be easily located; clear dark night skies for astronomical observations (Figure 2c); the continent has unpolluted air which allows for networks of radio-telescopes/spectrometers to be installed which could peer deep into the night sky, as exemplified by the marvel of the Square Kilometre Array located in South Africa; finally, not forgetting the now, all the rage, "astronomical tourism" venturing into these dark spaces wanting to observe the sky in all its majestic glory. The possibilities are limitless and now imagine young Africans becoming the curators of all these bountiful treasure troves on their own doorsteps.

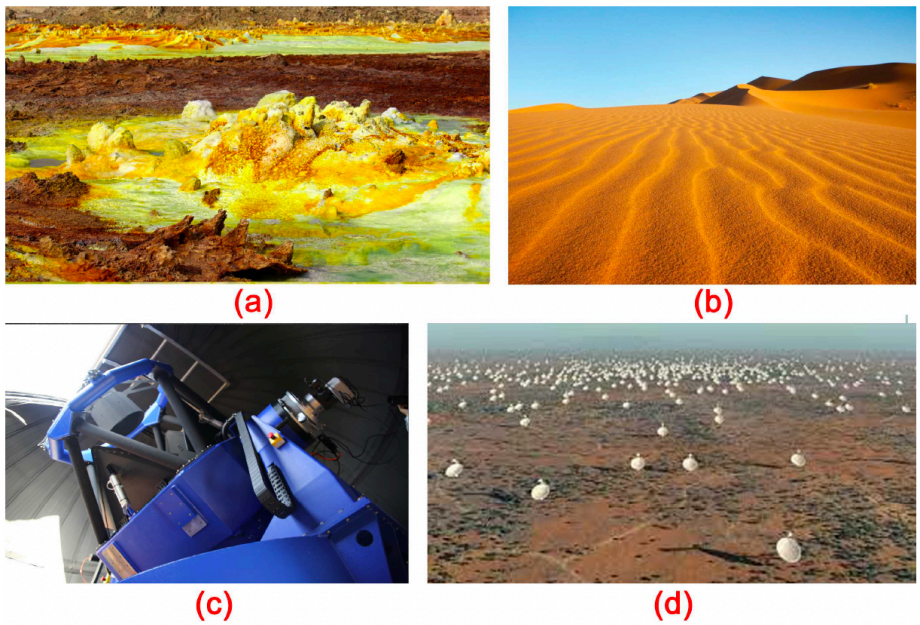

Figure 2: (a) an astrobiological site at Danakil Depression valley in Ethiopia (Credit Felipe Gomez/Europlanet. (b) Desert Sahara. (c) 2 x 1m Newtonian telescopes at Entoto Observatory and Research Center, Addis Ababa, Ethiopia, credit Sohan Jheeta. (d) Square Kilometre Array (SKA)—artist's impression of SKA in South Africa - upon installation will be the world's largest telescope

The way forward with the NoRCEL/ASEN initiatives

ASEN should be developed gradually and we will need to attract students and raise them up while building further capacity (e.g., in the field of radio-astronomy studies) that enables them to further grow into future proactive and creative thinkers and leaders with international visibility. We can help build on previously scientific collaboration in astroscience by offering tailored hands-on training. As a result, skilled young people would provide the grounds for new industries, ultimately driving further economic diversification and specialised higher-level degree programmes, requiring accomplished practitioners of African origin, thereby opening up further employment opportunities.

Attendance—ASEN2022

Although the focus of attention was on Africa, there was significant interest from the rest of the world, even with all the time-zone issues that this entails. We had attendees located in 40 countries around the world as illustrated in Table 1. The Global South dominates with 65% of the represented countries. About half of those (14) are in Africa, thereby covering about 1/3 of the continent

GLOBAL NORTH	GLOBAL SOUTH				
	LATIN AMERICA	MIDDLE EAST	AFRICA	ASIA	OCEANIA
AUSTRALIA CANADA FINLAND FRANCE GERMANY GREECE ITALY JAPAN NETHERLANDS RUSSIA SERBIA SPAIN UK USA	BRAZIL CHILE MEXICO	IRAN IRAQ JORDAN OMAN	BOTSWANA EGYPT ETHIOPIA MALAWI MOROCCO NIGERIA RWANDA SOUTH AFRICA SUDAN TANZANIA TUNISIA UGANDA ZAMBIA ZIMBABWE	INDIA MALAYSIA PHILIPPINES TAIWAN	MICRONESIA
14	3	4	14	4	1
	26				

Table 1: countries are broadly classed as either Global North or Global South.

Oral presentations

The meeting itself included fourteen scheduled oral presentations, five of which by speakers located within the African continent, two from Middle Eastern countries (Oman and Iran), one from Mexico, and five from Global North countries (UK and Japan):

Mukesh Chiman Bhatt (Birkbeck College, University of London, UK)
"African Futurism"

Noting that Africa itself originally provided the world with its population, our first keynote speaker Mukesh delivered some views on more recent African history and, maybe, on its future. In particular, Earth observation and space exploration could be very helpful for the continent. Bearing in mind that African ways of thinking are more diverse than Western European ones, Mukesh noted that, given the right circumstances, such diversity can indeed represent a unique source of strength, which remains untapped to date.

Masauko Utila (University of Malawi)

"The Influence of Passivation Layers on Light and Elevated Temperature-Induced Degradation (LeTID) Behaviours of Silicon Solar Cells"

Masauko covered a subject of great significance as the world tries to wean itself off fossil fuels, as well as being a useful technique for energy harvesting in space. Although obviously a work in progress, his studies are indeed helpful as part of an intensive search for effective renewable energy.

Muhammad Yahya Alradi Eldaw (National Centre for Research, Sudan)
"Asteroids Exploration Capacity Building and Activities in Sudan"

Muhammad engages his community by leading student groups to comb through data from the International Astronomical Search Collaboration (ISAC), a programme that provides high quality astronomical data to citizen scientists around the world. The aim is to distinguish genuine asteroids from other potential sources of the observed data. As he makes clear, this encourages critical thinking at the student level, a crucial skill whose benefits potentially extend far across the nation. This project is a gold-plated example of both national and, indeed, international positive outcomes of a local outreach programme.

Thobekile Sandra Ngwane (National University of Science and Technology, Zimbabwe)
"An investigation into the Sun's Equilibrium State"

Thobekile gave an engaging presentation on tracking down the cause of an unexplained 160-minute global pulse cycle on the face of the Sun. By working on the idea of a constant-density homogenous convective envelop, Thobekile described a variation on the Standard Solar Model which agrees with the current known parameters of the Sun.

Figure 3: (a) keynote speaker, Mukesh Bhatt. (b) Masauko Utila. (c) Muhammad Yahya Alradi Eldaw. (d) Thobekile Sandra Ngwane

Golden G. Nyambuya (National University of Science and Technology, Zimbabwe)
"Astrophysical Influences on Earth's Climate"

Golden, our second keynote speaker, described one potential answer to the so-called "Faint Young Sun Paradox", i.e., that the observation of traces of life implies the existence of liquid water on the early earth, in spite of the calculated low energy output of the young Sun and the propensity for occasional "snowball earth" deep freezes. While acknowledging that it is not the only potential explanation, Professor Nyambuya analysed the idea that the early Earth may have had a greater solar energy capture radius, finding that the measured (ITRF) expansion rate of the solid Earth (about 0.45 mm/year) is not inconsistent with the collapse of an extended atmosphere over geological time.

Jackson Achankunju (A'Sharqiya University, Oman)
"Potential of Microalgae from Xeric Habitats for Astrobiology"

Focusing on extremophile cyanobacteria, Jackson considered their use in supplying "valuable products" in both terrestrial and space station environments. The potential for their survival on Mars was briefly discussed, as well as the greater tolerance of prokaryotes over eukaryotes under these conditions.

Ahya Razaei (University of Tabriz, Iran)
"Application of Remote Sensing in Agriculture"

Principally, Ahya's work on remote sensing applies to both Earth and, potentially, to exoplanets. This oral presentation focused on its use in observing plant life for agricultural purposes and briefly covered climate change and extrasolar applications.

Miryam Palacios-Perez (Universidad Nacional Autónoma de México)
"What was between the OoL and LUCA? … in terms of proteins"

In this keynote speech, Miryam described the on-going work within her Theoretical Biology Group. After a brief discussion of potential prebiotic chemistry, Miryam concentrated on aspects of the so-called RNA world and what has been described as the primeval genetic code, with its ability to connect up to eight different amino acids into a wide variety of peptides. The species generated in this way seem to be capable of binding relatively simple but important entities such as ions and small molecules, including nucleotide-containing substances. This is an area of great interest.

Gbenga Festus Akomolafe (Federal University of Lafia, Nasarawa State, Nigeria)
"Does Trichoderma harzarium enhance the early growth of Amaranthus spinosus under normal gravity and microgravity conditions?"

Unfortunately, this presentation could not be delivered due to power outages—a common occurrence in some countries in Africa as noted earlier, but a recording will be available to access online. Gbenga investigated the use of a bio-fertilizer for the early growth of spinach on land and space environment using a simulated microgravity device. Results showed that the two varieties of spinach responded better in terms of the percentage germination, radical length, and plumule length under the normal gravity than microgravity environment. However, the seeds of the microgravity germinated earlier than those of the normal gravity. The treatment with the fertilizer did not produce any significant effect on the germination and growth of the spinach varieties under both environments, but could have been more positively seen at the later stage of the growth of the plant. Any questions should be directed to Gbenga Festus Akomolafe or his colleague Joseph Omojola at: gbenga.akomolafe@science.fulafia.edu.ng or omojola.josef@gmail.com respectively.

Figure 4: (a) keynote speaker Golden G. Nyambuya. (b) Jackson Achankunju. (c) Ahya Rezaei. (d) keynote speaker, Miryam Palacios-Pérez. (e) Gbenga Festus Akomolafe.

In addition, we had four informative presentations from parts of the world where research environments are already well-developed, related to topics that invite collaborations with otherparts of the world:

Tony Z Jia (Earth-Life Science Institute, Japan) discussed membrane-less protocells as a potential component facilitating early life;

Anastasia Kokori (Centre for Space Exochemistry Data, UCL, UK) described their ExoClock Project to monitor the ephemerides of transiting exoplanets for the guidance of the forthcoming Ariel space mission;

Shinji Karasawa (Sendai National College of Technology, Japan) presented a video on the climate consequences of the precession of the Earth; and, finally,

Eva Stüeeken (University of St Andrews, UK) gave an interesting talk on the geology of a major meteorite strike from the Miocene epoch in what is now known as southern Germany, with a view to its assessment as creating an environment suitable for the origin of life (a talk enlivened by a can of imaginary Campbell's Primordial Soup!)

What next?

In conclusion, while largely overcoming the connection difficulties mentioned above, this short meeting has demonstrated the value of imaginative scientific studies to local communities, as well as the wider world. Moreover, it is particularly worth recognising that there is high-quality research that runs on little funding, as well as well-funded research of poor quality, i.e., good research requires some support, but money itself does not buy research quality. NoRCEL's engagement in the Sub-Saharan African region since 2015 revealed that there is definite call for more astroscience by those young Africans who have heard of astrophysics, astrochemistry and astrobiology. Our AstroScience Exploration Network (ASEN) will directly respond to this call and enable them to take their aspirations forward to the benefit of their country, the continent, and the wider world.

The next ASEN conference will held be in June 2023 in Lusaka, Zambia