

4 Imaginaries of outer space from Africa

Astronomy infrastructure in South Africa and Madagascar

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The Square Kilometre Array (SKA) is an internationally funded effort to build the world's largest radio telescope infrastructure and advance research in radio astronomy, a branch of astronomy interested in studying celestial objects by detecting and analysing their radio frequency emissions. While dispersed across the globe through a myriad of research collaborations in astrophysics,¹ the majority of the telescope infrastructure is currently being built in South Africa. In this chapter, we draw on the ethnographic research conducted in South Africa and Madagascar to explore the imaginaries that are elicited in outer space research by looking at how SKA continental initiatives reverberate locally. We trace the roots of historical aspirations for outer space research and juxtapose them with aspirations for modernity based on the political discourse of the African Renaissance. We aim to query how aspirations materialise in real infrastructural projects, shaping physical landscapes and becoming entangled in local politics, as well as what happens when their materialisation remains potential.

Over the past decade, Africa has made its move into space, and the SKA is part of this broader trend. Public and private investments in space science and the space industry have surged dramatically (Pović et al. 2018). Earth-based space infrastructure, such as telescopes, have garnered particular traction. With its dark skies, areas of relative radio quietness, and a privileged view over the less explored Southern Hemisphere sky, the African continent offers sought-after locations for the placement of telescopes from the perspective of scientific research. Mediating our knowledge of outer space, the ever improving telescopes continue to excite the astrophysical community and elicit hopes for new data that will help understand ever more of the universe's dynamics. More broadly, telescopes prompt "the enthusiasm of imagination" (Mrázek 2002, 166), configuring outer space as a trope that symbolises modernity, internationalism, and a technologically driven "better" future.

However, as infrastructures, telescopes are not erected in a vacuum. In the words of Susan Leigh Star and Karen Ruhleder, grasping infrastructure requires dealing with their relationality, since they never emerge as things “stripped of use” (1996, 113). Telescopes are material structures that emerge across time and space in relation to institutions, legal policies, and land use regimes (Anand, Gupta, and Appel 2018; Edwards 2003; Mitchell 2002). The infrastructures themselves, and their anticipation, give shape and are shaped by everyday human experiences of hope, inclusion, and abandonment – they filter people’s ties to a place through their visions for immediate futures. Entrenched in historical power relations and terrestrial conflicts around resource management, telescopes bring outer space imaginaries in touch with geopolitically informed conditions.

But how to study such a big infrastructural project ethnographically? How to acknowledge the aspiration that infrastructures elicit without resorting to a language of modernity that lends itself to justify land appropriation and inequality? How to engage with a topic that brings multiple scales, spaces (even outer space), and temporal frameworks into relation with each other? As this chapter will show, astrophysics in Madagascar cannot be detached from South Africa and historically situated notions of “Africa” that engulf Madagascar into South Africa’s visions for radio astronomical infrastructure and the African continent as a whole. With this chapter, we point to the potentials of collaborative scholarly work between the fields of anthropology and history across time and space. Collectively, we demonstrate how astrophysical infrastructures on earth are concurrently shaped by situated local practices and imaginations, and by larger-scale geopolitical conditions and imaginaries of outer space.

To do this, we draw on our two ethnographic encounters with the SKA radio telescope in South Africa and Madagascar to explore the stratified layers of history and politics that inform aspirations and hopes that come with Africa’s move to space. The SKA infrastructure is what ties our two fieldwork projects together. While in South Africa the precursor infrastructure (the MeerKAT telescope) to the international project is a pre-existing structure, in Madagascar the SKA is still at a planning stage. As noted by Brian Larkin, “what distinguishes infrastructures from technologies is that they are objects that create the grounds on which other objects operate, and when they do so they operate as systems” (Larkin 2013, 329). We show how the SKA as a pan-continental system also becomes the grounds for anticipatory prospects of astrophysical infrastructures in Madagascar, which are tied to ideological discourses and funding in South Africa. Engaging with studies in the anthropology of infrastructure (Star 1999; Larkin 2013; Anand, Gupta, and Appel 2018), we argue that approaching outer space through the lens of these situated terrestrial infrastructure projects allows us to show how national aspirations and commercial

interests travel and transform between infrastructurally linked places. We do so in three steps.

First, we describe how space infrastructures gain traction through a political narrative centred on the role of progress in science and technology to fulfil the expectations of modernity raised by the post-colonial and post-apartheid transition in South Africa (Beinart and Dubow 2021). We begin our discussion by tracing the origin of a stream of political thought, the African Renaissance, which was key for gearing up the political momentum and investments in astronomy in South Africa in the aftermath of apartheid and for turning South Africa into a global exemplar in radio astronomy.

Second, we discuss how the scientific imaginary of outer space attached to the African Renaissance legitimated the repurposing of a vast area in the semi-arid Northern Cape of South Africa to build the telescope infrastructure, and how this clashed with other uses of this terrestrial space. We address this by attending to the expectations of modernity that accompany the development of outer space science in these locales, as well as the inherent tensions that emerge from the actual grounding of such imaginaries (Ferguson 1999; Archambault 2012; see also Anand 2012; Barry 2001; Mitchell 2002, 2011; Von Schnitzler 2008).

Third, we turn to Madagascar. Astrophysics' infrastructures bear aspirational values, desire, fantasy, pride. Larkin calls this "poetics" and notes that "infrastructures also exist as forms separate from their purely technical functioning [...] They emerge out of and store within them forms of desire and fantasy and can take on fetish-like aspects that sometimes can be wholly autonomous from their technical function" (Larkin 2013, 329). The international SKA project is envisioned to unfold across two consecutive phases, the first of which is currently implemented in South Africa. The second phase, the planning and implementation of which remains uncertain to this day, forecasts the expansion of the South African infrastructure to other sites across eight countries in southern, eastern, and western Africa, including Madagascar. Taking the perspective of young astronomy-enthusiasts in Madagascar, this final section examines the already emerging poetics of outer space infrastructure prior to its materialisation. It shows how desire, aspiration, and pride of outer space research shape imaginaries of terrestrial spaces, international collaborations, and personal senses of not being disconnected. It furthermore traces how, with the prospect of astronomy infrastructures emanating from South Africa, "Africa" becomes an epistemic object of hope. Such poetics of outer space infrastructure in Madagascar nurture personal relations to objects that may or may not materialise in the future and, in doing so, allow people to articulate their aspiration for a better future.²

The hypervisibility of space infrastructure and the African Renaissance

The SKA is led by the SKA Observatory, an inter-governmental organisation established by an international treaty signed in 2019.³ The project encompasses a network of research collaborations across the globe – backed by national governments’ commitments to a long-term budget.

While ideas to design the SKA date back to the 1990s, it was during the 2000s and early 2010s that institutional and research collaborations geared up towards implementation. In 2008, a project office, which later became the project’s global headquarters, was established in the UK, and in 2011 the SKA was registered as a UK non-profit organisation. After a competitive bid, the decision was made in 2012 to split the planned physical infrastructure and create two telescopes, one in South Africa and the other in Australia. The decision ended a protracted competition for securing the international project between these two countries, one which had received extensive local and international media coverage. South Africa’s competitiveness came as a surprise for many international observers, considering the much longer history of radio astronomy in Australia.

In South Africa, the decision was celebrated not only as an accomplishment for the domestic scientific community but also as a success for the country and the entire African continent. South Africa’s inclusion of eight “African partner countries” helped to make the bid more convincing by framing the telescope as *African*, delineating “Africa” as a particular epistemic object that has political currency. As Naledi Pandor, the South African Minister of Science and Technology, commented:

What am I feeling? I am excited, I am happy for our scientists, I am happy for our country, I am happy for Africa. We have done it! Who would have thought, so I am thrilled. [...] As a country and as the African partners we remain committed to the SKA project. We have always said we are ready to host the SKA and the world has listened to us.⁴

The SKA was deemed to be a tangible expression of “Africa rising,” the continent’s increasing participation in the global knowledge economy, and the fourth industrial revolution. Commenting on the SKA, former President of South Africa Jakob Zuma stated: “South Africa is confident that the country will deliver on the expectations of the continent and world.”⁵ In the post-apartheid moment, outer space research epitomised the expectations of modernity (Ferguson 1999; Redfield 2000), formulated along with science’s claim to universality (see Nieber 2024). In conjunction with the SKA bid, a wider interest in radio astronomy emerged in South Africa, which today is coordinated under the South African Radio

Astronomy Observatory (SARAO) facility of the National Research Foundation.

The pursuit of optical astronomy in South Africa has a much longer history, dating back to the colonial period with the founding of the Royal Observatory in 1820 by the British. As noted by historian Saul Dubow (2019) in his historical review of astronomy's development in South Africa, during this period astronomy played an important practical and symbolic role in fulfilling the colonial civilisational mission (see also Osbourne, Chapter 5, this volume). From a practical perspective, astronomy contributed to advancements in navigation, cartography, and timekeeping, which were important for exploration and colonial endeavours. Astronomy, along with other sciences, was thus utilised by European powers to bolster their claims of superiority and justify the colonial project. The transition to apartheid marked an attempt by the white minority government to institutionalise astronomy as a national endeavour, especially during the 1980s, a period in which South Africa was isolated internationally (Dubow 2019).

With the end of apartheid in 1994, the African National Congress (ANC) government embraced and largely rebranded astronomy from a colonial and apartheid endeavour into a new force of transformation as part of the new political elite's continental and global ambitions. Under the presidency of Thabo Mbeki from 1999 to 2008, astrophysics and other key natural sciences assumed a new role in relation to discussions around the "African Renaissance." This line of political thought, inspired by pan-Africanism and humanism in the heydays of decolonisation (see Grilli and Gerits 2020), saw the progressive force of science as the catalyst by which African countries could finally break away from the legacy of colonialism (see Mavimbela 1998).

Against the backdrop of these ideas, it is at the beginning of the 2000s that efforts were made to build South Africa into a global exemplar in radio astronomy. South Africa initially joined the SKA with the status of observer in mid-2001. In 2005, the National Research Foundation (NRF) submitted a proposal to host the SKA infrastructure in the semi-arid and sparsely populated Northern Cape province together with selected sites in "African partner countries." The South African government committed significant financial and human capital investments to design and build two SKA precursors – KAT-7 and then MeerKAT. In 2009, the Department of Science and Technology inaugurated the site in the Northern Cape that was identified as the most suitable for radio astronomy (more below). In 2010, their open call for international projects made MeerKAT known among the global scientific community. South Africa's winning bid in 2012 to host a majority of the international infrastructural project marked the culmination of years of political discourse in which developments in

astronomy and its infrastructures became the material proof of South Africa's advances, "bringing about a science Renaissance across the continent."⁶

Contrary to Star's (1999) contention that infrastructures are taken for granted and invisible "by definition," only to become visible when they break down, the SKA is an example of a hypervisible infrastructure rich with symbolism of the past and future of South Africa. The SKA infrastructure marks a shift in the narrative of astronomy as a colonial science – one that legitimates the colonial civilisational mission – to a science of transformation in the post-apartheid period. Similar to the other large infrastructural projects of that period, such as the Volta Dam in Ghana (Miescher and Tsikata 2009) or the Grand Renaissance dam in Ethiopia (Belay et al. 2020), the SKA carried symbolic value for nation-building aspirations through its hypervisibility that made the infrastructure possible and meaningful (cf. Barker 2005).

When in 2016 the first images produced by MeerKAT were released to the press after yielding scientific results far exceeding any initial expectations (Patel 2016), Pandor declared:

The MeerKAT telescope, which is predominantly a locally designed and built instrument, shows the world that South Africa can compete in international research, engineering, technology and science. We are proud of our scientists and engineers for pioneering a radio telescope that will lead to ground-breaking research.⁷

The SKA's role was not only to be an infrastructure for astrophysical science, but also to extend and promote important social and economic benefits of science and technological development. Through scientific outer space imaginaries, terrestrial spaces and their socio-economic conditions were to be re-configured and the "African Renaissance" – including its conceptual work on "Africa" as a discursive construct – could flourish.

Expectations of modernity: contested terrestrial spaces

The core of the SKA telescope infrastructure is located in the semi-arid and sparsely populated central Karoo region of South Africa, 700 km north-east of Cape Town (see also Walker, Chinigò, and Dubow 2019). Since the end of the colonial period, the region's economy has centred around large-scale commercial sheep farming. Carnarvon, one of the nearest towns to the core site of the telescope, some 80 km away, has been designated as the "home of the SKA project." Counting approximately 5,000 residents, Carnarvon has high rates of unemployment and school dropout. It is an Afrikaans-speaking area, where over 90 per cent identify

as “coloured” and 10 per cent as “white.” Despite being a minority, the latter dominate Carnarvon’s commercial sheep farming industry and the few other businesses based in town – an enduring legacy of apartheid (see also Chinigò 2019).

The physical presence of the SKA in the area around Carnarvon dates back to 2008, when the National Research Foundation acquired two farms to serve as construction sites for the KAT-7 radio telescope. Radio astronomy requires, on the one hand, low radio frequency interference and, on the other, good access to transport and logistical infrastructure, and this sparsely populated area was identified as well suited to these needs. Initially, and for about a year, the two farms retained grazing rights in the vicinity of the SKA and were allowed to continue their farming activities whilst the telescope’s construction was still underway. This was an important moment, because it signalled the possibility for coexistence of farming and astronomy – flocks of sheep would hide from the sun in the shade under the KAT-7 dish (Figure 4.1). For the farmers living around the SKA, such possibility for coexistence symbolised the seamless



Figure 4.1 Sheep under the dishes.

Source: Carnarvon resident.

materialisation of the transition to a type of modernity that did not require any particular breakaway with the past. Rather, it was a type of modernity that sprouts out of local conditions and existing land uses. Sheep seemed to be thriving under the shade of the telescope. Residents perceived the prospect of the SKA as a valuable opportunity to rejuvenate a declining agricultural economy in one of the most marginalised regions of South Africa. In many ways, at this stage the SKA symbolised the materialisation of the expectations of modernity opened by the African Renaissance's call for a progressive role of modern science to pave the way to a new prosperous era.

As the KAT-7 project evolved into MeerKAT, however, the radio astronomy requirements to limit radio frequency interference around the infrastructure increased. In the following years, no farming was allowed on the premises of the telescope dishes. As the need for radio silence around the telescope increased, farming activities – for instance, the use of petrol-powered cars, cell phones, and other radio-emitting devices employed in modern farming – proved to be incompatible with the project's pursuit. The separation between sheep and dishes happened at the same time as fractures between Carnarvon residents and SKA management started to emerge. The narrative of the SKA as the driver of the African Renaissance changed and, with increasing restrictions in the area around the SKA site, critical voices gained volume. The compulsory Land Acquisition Programme (LAP) put in force between 2016 and 2017 to constitute a buffer zone against radio interferences around the core site was the initiative that attracted the most controversy. The LAP builds on a set of legislative initiatives that, starting with the 2007 Astronomy Geographic Advantage Act, have led to the declaration of the Karoo Central Astronomy Advantage Areas. These consist of three concentric areas of regulation spanning most of the Northern Cape Province and grow increasingly restrictive towards the core (see Figure 4.2). These legislations are meant to limit radio frequency interferences around the telescope infrastructure, and hence aim to prioritise astronomy over other human activities.

As well as the two mentioned above, 32 additional farms were subsequently purchased. While legally farmers were left with no option but to sell the land, anecdotal evidence highlights that compensations were quite generous and above the average market price. Two main grievances were voiced by the white commercial farmers' community. First, farmers complained that the land acquisition was imposed from above, and that when the SKA first approached Carnarvon, there was no mention about land acquisition beyond the two farms purchased by the project initially. Second, farmers argued that the economic impact of subtracting a huge tract of land from their local economy, primarily based on agriculture,

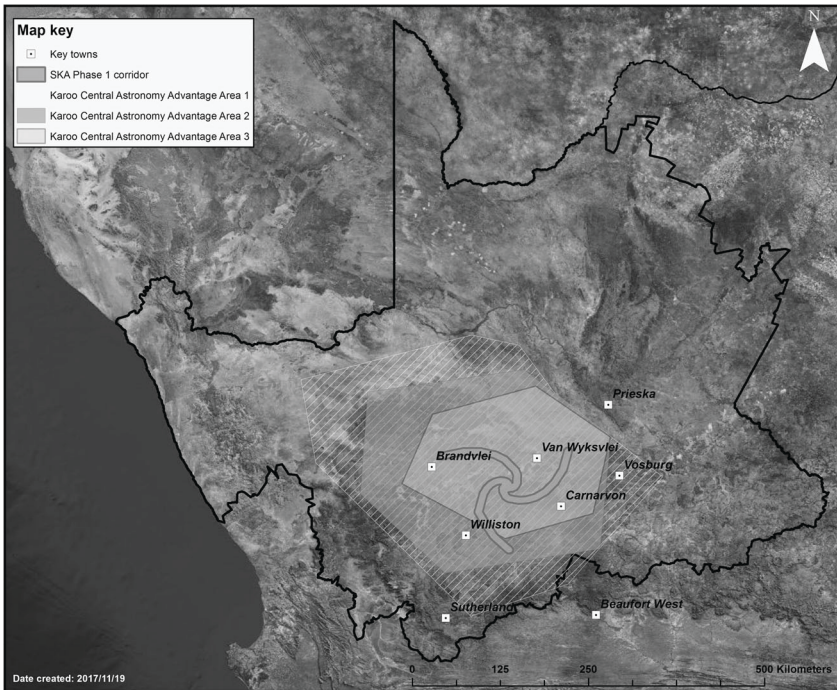


Figure 4.2 Map prepared by South African Research Chair in the Sociology of Land, Environment and Sustainable Development, Stellenbosch University.

was being underestimated by the legislators. A broader feeling of mistrust for local authorities underlined the white farmers' criticism of the land reform, given the role of land expropriation as a political tool used by the ANC national government to address the legacy of apartheid.

White farmers usually voiced these concerns in local media and in local engagement meetings organised by project management. As explained by one farmer, their main task was to challenge "the dominant narrative presented by the SKA and the government to the outside world that the SKA is constructed in a desert without people."⁸ The presumption of an "empty" hinterland erased the farmers and needed to be vocally contested. Another white farmer confirmed that despite the initial promises, "it is now clear that the SKA is not acting in the interest of the local communities and what makes farmers angry is that the Karoo is presented as an empty land. Our estimations show that the project will have an impact on 46,000 people."⁹ While probably the most cohesive and organised group,

white farmers were only one among many voices in the local community questioning the SKA's adverse economic and environmental impact.¹⁰

In February 2017, SKA SA (now SARAO) signed an agreement with the farmers' organisation. The agreement was meant to explore "ways [in which] affected agricultural land is optimised to accommodate ongoing farming activities where possible, as long as the functioning of the radio observatory is not compromised" (SARAO 2017). Subsequently, the management of the 132,000ha of land that constituted the core of the SKA site in the Karoo was handed over to the South African National Parks (SANparks). Under its management, this core area became a "special nature reserve" and was renamed Meerkat National Park (ROSA 2020). Effectively, this is now a conservation area characterised by a special status that restricts access for all persons not involved in scientific research. No longer a farming area, occasional guided tours to the telescope site organised by SARAO local staff are the only possibility for local residents to visit the area.

The African Renaissance pursuit of astronomy in the name of scientific progress was marked by profound contradictions and historically loaded discussions around land use and land reform. The initial imperial vision behind the undertaking of astronomy under British colonialism was re-adapted twice. During apartheid, it was first elaborated in terms of a nationalist agenda (see Dubow 2019). Then, with the advent of democracy in 1994, the pursuit of astronomy was reconfigured as an important part of the African Renaissance. In this context, white farmers, the group who benefited from apartheid inequalities, have currently been displaced in the name of the pursuit of modern science. This allows us to draw important insights to the anthropology of infrastructure. First, the modernist vision of the African Renaissance justified the construction of the SKA as a symbol of the new democratic South Africa. This is an example of an infrastructure that elicits enthusiasm for a technologically mediated better future, a future that is also "just" because it is aimed at redressing past inequalities. Hypervisibility is therefore a characteristic of infrastructures for the exploration of outer space such as the SKA. While hypervisibility emphasises the future possibilities that infrastructures unlock, it tends to obscure the complex and contradictory histories within which infrastructures are enmeshed. Second, the restriction of other land uses required by radio astronomy, and the displacement generated by the SKA telescope in the Karoo, produced a significant experience of abjection at both individual and societal levels. Such experience is particularly prevalent when hypervisible infrastructures seemingly fail to fulfil the expectations of modernity that made them possible initially (Archambault 2012; Ferguson 1999). In Carnarvon, the grand narrative of "Africa rising" shows its price and these tensions are growing with time.

In Madagascar, where the construction of radio astronomy infrastructures has not yet commenced, the hopes for scientific progress still trump all worries about possible adversary effects.

The poetics of astronomy infrastructure: Malagasy potentialities

Our professor said that Madagascar takes part in the SKA project. We don't know how it is going or what has happened. And it's already three years or more since he told us. [...] And this [vague talk about the SKA in Madagascar] is also the reason why many young people choose astronomy, because they are very interested in the SKA project and we would love to have a bit of a follow-up. According to the information we received, the telescope in Arivonimamo will be transformed into a radio telescope. It's a good future for Madagascar if we manage to complete this major project, because it's a very big project.¹¹

This is a quote from an interview with Ilo, an astronomy student from Madagascar. He finished his physics "licence" (bachelor's degree) with distinction and is now in his first year of the astrophysics Master's programme. Ilo speaks excitedly about Madagascar's involvement in the Square Kilometre Array (SKA) project, for which he understands the conversion of a dish in Arivonimamo to be pending. He laments that the students are not well informed, but his hopes, building on what they were told more than three years ago, are high. It will bring a good future for Madagascar, Ilo strongly believes, because "it's a very big [infrastructural] project." Some more context on this "very big project" and Madagascar's potential involvement that already spurs emotions and local actions is necessary here.

The international headquarters of the SKA are located in the United Kingdom, and European countries contribute the vast majority of the project's funding (see Figure 4.3). South Africa is the only full member country of the SKA international consortium; the other eight African partner countries do not contribute to the budget directly. This uneven landscape emphasises South Africa's leadership role in the continent's science and technology initiatives that reproduce the unequal relations between metropolitan interests and the presumed "empty" hinterland on the continental scale. Thus, South Africa's hegemonic position in Africa, usually referred to in terms of its "exceptionalism" (Lazarus 2004), is a continuation of its global ambitions.

To understand the relationship between South Africa and its SKA African partner countries, we must take a step back to the early 2000s, when preparations were made in South Africa to harness Africa's potential for astrophysics. Radio telescopes that would be located in Africa – with its

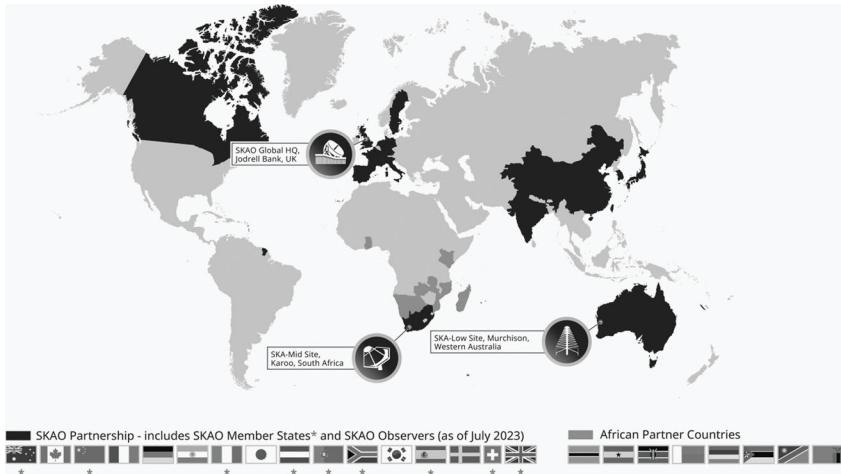


Figure 4.3 Map of participating countries in the SKA Organization. Credit: Square Kilometre Array Organisation.

considerable landmasses in the Southern Hemisphere – promised to yield scientific perspectives into outer space that are complementary to existing data and could thus complexify astrophysical observations. With a vision to profit from the astrophysical demand for African telescopes and to design a truly “African” bid for the SKA, designating the SKA as evolving into a pan-continental infrastructural system, South Africans sought existing large telecommunication facilities that could be transformed into telescope dishes. Subsequently, a South African delegation visited the countries where suitable candidates for renovation were identified. As a whole, South Africa assembled eight “African Partner Countries” that form the “African VLBI network” (AVN). The AVN is designed with the goal to expand the SKA across southern, western, and eastern African countries, effectively turning the African continent into a giant telescope to probe into the universe. South Africa’s vision for the SKA was portrayed as an African vision; it proposed to meet the upscaling of astrophysical investigations by upscaling scientific infrastructures to continental levels. Although the actual implementation of the SKA’s Phase 2, which would include converted satellite dishes in African partner countries, is indeterminate as of now, their anticipation alone has already sparked a number of local effects and impacted terrestrial imaginaries, which we exemplify with the case of Madagascar. Put differently, the poetics of astrophysical infrastructures precede their installation in Madagascar.



Figure 4.4 The disused telecommunication dish in Arivonimamo, Madagascar. Photograph taken by Hanna Nieber.

Like many current students, Ilo had heard about the SKA before he started his astrophysics studies. Indeed, the prospect of Madagascar hosting part of such a big infrastructure excited him to such an extent that it determined his choice of study. He and many other astrophysics students continue to express their desire for astrophysical infrastructure to be built in Madagascar and eagerly await news about the dish in Arivonimamo (Figure 4.4).

In Arivonimamo, approximately an hour's drive from Antananarivo, Madagascar's capital, the formerly state-owned telecommunications company built a telecommunication dish in 1972. When the first plans to include African partner countries took shape in South Africa, this disused dish became an attractive possible asset for the SKA. Its potential to be converted into a radio telescope put Madagascar on the map for South Africa's partner countries. Delegations from South Africa that visited the facility found the dish suitable, and advised Malagasy science professors to initiate the introduction of a programme for astrophysics at the state university. The astrophysics master's programme at

the University of Antananarivo was inaugurated in 2014, from which Ilo later profited. Working towards inclusion in the SKA, the Malagasy Ministry of Higher Education and Scientific Research and the now private telecommunications company that owns the dish agreed on a 20-year lease in 2017 to enable conversion of the dish into a telescope. However, political shifts have resulted in unstable support for this project in Madagascar. Furthermore, the SKA itself withdrew support for the conversion, after a very similar project in Ghana proved more expensive than initially anticipated and did not yield the same scientific value as a newly built dish would have done. Nevertheless, holding on to Madagascar as one of its African partner countries, the SKA now plans to erect a new telescope in a more favourable location in Madagascar instead. This new dish has yet to materialise. In the meantime, Malagasy astronomy enthusiasts still harbour hopes to find funding for the Arivonimamo dish conversion. As an object that had attracted an interest from South Africa and that, for now, remains the only tangible materialisation of what could one day become an infrastructure for radio astrophysical research, the planned dish in Arivonimamo continues to nurture Malagasy astrophysicists' hopes and aspirations for a functional radio telescope on Malagasy grounds.

An island in the Indian Ocean, Madagascar often portrays itself as a "continent" in its own right (De Wit 2003; Randrianja and Ellis 2009). Overall sentiments towards the African mainland among the Malagasy are not particularly favourable, sometimes even condescending. Mamy, another astrophysics student and passionate about doing something good for her country, articulated this attitude: "When people would speak about Africa, I used to think that Africa is later than other continents [lagging behind]." ¹² Mamy had spoken previously about her investment in social change and her volunteering work with children from impoverished backgrounds. She has a vibrant "let's-do-this" attitude to life, and, coming from her, the notion of Africa's inertness, its being late and lagging behind, is not a compliment.

But Mamy did not utter this sentence as a conclusive statement. Rather, she intended to provide context for the perception change that came about for her after getting involved in astronomy: "When I discovered astronomy, the first project I discovered was the SKA Project. And I was really amazed that Africa can host some big project like this!" While her surprise attests to the persistence of the derogatory stereotypes of Africa in Madagascar, it also marks the moment Mamy started to think about Africa in more positive terms. Here, astrophysical infrastructure serves as an indicator of development in Africa, one that is deemed desirable and becomes a potential locus of pride. The prospect of being infrastructurally

linked to Africa allows Mamy to participate in this pride and in this large infrastructure's poetics. Another student and astronomy enthusiast, Ary, took this a step further. She said:

I believe that the continent is developing significantly. [...] there are projects [...] that bring participant countries of the same continent together and for us, that's Africa [speaking about the SKA's AVN]. It's important that the countries of the continent maintain a certain [reliable] connection to make this concept work. So, Madagascar can develop more by getting closer to the countries of the African continent.¹³

Ary thinks that submitting to a predefined logic of belonging and improving Madagascar's relationship with Africa would be a strategic accomplishment. Taking the astronomical project as an example, she posits that individual projects may profit from continental cohesion, and indeed this is the discourse that the SKA promotes for the African partner countries. In the official SKA discourse, the engineering logic of assembling telescopes is directly linked to an ideational configuration of developing the African continent. In a recent podcast interview, the SKA Observatory Council Chairperson, Dr Catherine Cesarsky, said:

SKA will continue what indeed MeerKAT has been doing extremely well. Which is, on the one hand, [to] attract young people in the country [South Africa] towards astronomy, perhaps, but I would say science and technology in general, and this is useful not just obviously for astronomy or for SKA, but it's useful for the country. Training young people to later work in many, many different avenues using very particular skills that can be learned through astronomy.

It's also astronomy for development. SKA is doing it at a very, very high level. [...] they are giving scholarships, a large number of scholarships, many of them to Africans and not just from South Africa, at least 30 per cent have to be from other African countries.¹⁴

Astrophysics, here, is an attractive natural science, with transferable skills to other fields of science and technology. Like many other people, Cesarsky easily takes the discursive step from advancements in science and technology to development. In Madagascar, the discursive tropes that Cesarsky taps into are well-known and oft-repeated. However, while the SKA infrastructure is celebrated in the South African political discourse as enabling a grand idea of "Africa" to materialise, Ary maintains a more critical distance. For her, the SKA infrastructure brings development; "Africa" figures merely as a means for such development to also take

place in Madagascar, taking advantage of the particularity of outer space's vastness:

We study something that is very vast, that has a big scale, so many regions can become involved in the same project. In certain sciences, one can be interested in something very small and local, so one can think that local research suffices, but for astronomy that does not work.

Astronomical infrastructure, Ary makes clear, requires collaboration across local contexts because astrophysicists study "something that is very vast." She acknowledges that the infrastructural needs to study the vastness of outer space entail particularities to which Madagascar's terrestrial placement caters. Though marginal to and perhaps even distinguishable from "Africa," it sufficiently meets the geopolitical conditions of belonging to "Africa" to become encapsulated as an "African partner country" for the SKA. Ary thereby exemplifies how astronomy not only elicits excitement and motivates people to engage with science, technology, and big data, but also influences people's imaginaries of geopolitical transformations on earth. With the SKA, "Africa" becomes a meaningful point of reference that mediates students' relationship with outer space. With the anticipation of the infrastructure to arrive, this "Africa" elicits hope, desires, and potentials for pride in Madagascar – the changing disposition to "Africa" is an infrastructural effect that precedes the local materialisation of radio telescopes. Put differently, the desire to make Madagascar relevant to the study of the universe, spurred by the poetics surrounding the anticipation of astronomical infrastructure (Larkin 2013; see also Anand, Gupta, and Appel 2018), has turned "Africa" into a strategic epistemic object that facilitates hopes of inclusion, development, geopolitical transformations, and scientific access to outer space.

Conclusion

Space anthropology invites the methodological and epistemological challenge of attending concurrently to the vastness of outer space, the immanent histories of a small town in a remote province of South Africa, and the aspirational futures of astronomy students in Madagascar. These realms do not easily connect with each other. Existing and emerging infrastructures for outer space create tensions with local inhabitants in Carnarvon that Malagasy students of astrophysics do not consider; future infrastructures for outer space and their already existing poetics create hope and desires for astrophysics students in Madagascar that are not shared by the Carnarvon residents. Yet both are connected through an emerging infrastructure for research on outer space, the SKA, and it is

through space anthropology's work across scales that an analysis of the SKA's relation to "Africa" as an epistemic object comes to the fore.

Discursively framed and politically supported as instantiation of the "African Renaissance," South Africa's investments in astrophysical infrastructures become subsumed in a logic of national modernity that leverages imaginaries of the continent's future – but radically deemphasises the repercussions of such investments for local residents in Carnarvon. Here, "Africa" becomes a notion that supports South Africa in reconfiguring its territories and thinking beyond its national boundaries. It is this notion of "Africa" that local concerns need to be defended against. The local concerns at the site of a future telescope in Madagascar, on the other hand, are yet to emerge. Perhaps potentially difficult situations in Madagascar could be averted by taking the South African case into consideration, but perhaps each site comes with its own dynamics. While such a speculative story of a potential future could be told, in this chapter we are more interested in how the promise for astrophysical infrastructure in Madagascar is entangled with a re-evaluation of "Africa" and as such already has an impact in the present. The prevalent unease with which many Malagasy people regard their country's belonging to the African continent shifts for astronomy enthusiasts. Not least because it is "African," Madagascar was selected as a SKA "African partner country" which has already led to the inauguration of an astrophysics Master's programme at the University of Antananarivo. Promised investment in infrastructure and ongoing human capacity building, many young Malagasy believe, are ingredients for Madagascar's development – and this development comes through an "African" project for research on the universe. The SKA's framing of "Africa" may connect the case studies in Carnarvon and Madagascar; however, these cases in juxtaposition show how differently people relate to outer space research and its multi-scalar historical and contemporary repercussions, including notions of "Africa."

On a methodological level, we have worked through ethnographic and historical methods. We have used our ethnographic encounter with the SKA as an entry point to interrogate the stratified layers of politics and history behind Africa's move to space. The analysis of large-scale infrastructures for outer space research necessitates this, and in this chapter we have provided an example of how it can be achieved. This collaboration has allowed us to trace the emerging pan-continental astrophysical infrastructure operating as a "system" (Larkin 2013) and to take seriously how infrastructural connections forge engagement – albeit differently – with a connective epistemological object: Africa. In working collaboratively, we have pointed to the complexities that discursive delineations of outer space infrastructures elicit for intra- and inter-state relations as well as relations to larger – continental – structures.

Finally, we have engaged with the anthropology of infrastructure to interrogate how scalar relations between regions, from local to cosmic, are produced. Our fieldwork highlights two important aspects of the anthropology of space infrastructures. First, the hypervisibility of space infrastructure produces expectations of modernity. Second, the promise of astronomy infrastructure produces infrastructural effects, desires, fantasies, and hopes that precede the building and technical functioning of the telescopes. Taken together, these two aspects of astronomy infrastructure constitute the hinges by which outer space is connected to “Africa” in the grand narratives of the future and practical hopes for development.

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Notes

- 1 The term “astronomy” delineates the study of celestial objects and matter. “Astrophysics” is a branch of astronomy, theorising the structures of the universe by applying physical and chemical laws. In this chapter, we use them with flexibility to account for the language that is used by our interlocutors and in official documents.
- 2 This is similar to what Dimitris Dalakoglou (2010, 2012) termed infrastructural fetishism.
- 3 For more information visit www.skao.int/en [accessed on 21 November 2023]. The SKA is expected to pave the way to important scientific discoveries about the universe and to generate innovation spillovers to many sectors through a multiplier effect.
- 4 SABC news, 25 May 2012. See www.sabc.co.za/news/a/4b4dbc804b602a6c9be09f5b1193da06/Engineers,-scientists-to-benefit-from-SKA-project-20122505 [Accessed 25 August 2017].
- 5 See www.theregister.com/Print/2012/05/25/ska_shared/ [Accessed 24 July 2023].
- 6 See www.gov.za/president-jacob-zuma-visits-ska-project-karoo-celebrate-african-science-success-story.
- 7 See www.ska.ac.za/media-releases/meerkat-joins-the-ranks-of-the-worlds-great-scientific-instruments-through-its-first-light-image/.
- 8 Interview with a white farmer, Carnarvon, 14 March 2016.
- 9 Interview with a white farmer, Carnarvon, 25 March 2016.
- 10 Chinigò and Walker (2020), Walker and Chinigò (2018).
- 11 Interview with Ilo (pseudonym), 18 March 2022, translated by author HN.
- 12 Interview with Mamy (pseudonym), 23 February 2022.
- 13 Interview with Ary (pseudonym), 1 March 2022, translated by author HN.
- 14 Extract from the podcast *The Cosmic Savannah* [thecosmicsavannah.com], episode 59, 5 December 2022.

References

- Anand, Nikhil. 2012. "Municipal Disconnect: on Abject Water and its Urban Infrastructures." *Ethnography* 13(4):487–509.
- Anand, Nikhil, Akhil Gupta, and Hannah Appel. 2018. "Temporality, Politics, and the Promise of Infrastructure." In *The Promise of Infrastructure*, edited by Nikhil Anand, Akhil Gupta, Hannah Appel, 1–38. Durham: Duke University Press.
- Archambault, Julie Soleil. 2012. "'Travelling while Sitting Down': Mobile Phones, Mobility and the Communication Landscape in Inhambane, Mozambique." *Africa* 82(3):393–412.
- Barker, Joshua. 2005. "Engineers and Political Dreams: Indonesia in the Satellite Age." *Current Anthropology* 46(5): 703–27.
- Barry, Andrew. 2001. *Political Machines*. London: Athlone.
- Beinart, William, and Saul Dubow. 2021. *The Scientific Imagination in South Africa: 1700 to the Present*. Cambridge: Cambridge University Press.
- Belay, Yeshiwas Degu, Emanuele Fantini, and Iginio Gagliardone. 2020. "The Grand Ethiopian Renaissance Dam: Media Narratives and State Building." *Afriche e Orienti* 2: 27–48.
- Chinigò, Davide. 2019. "From the 'Merino Revolution' to the 'Astronomy Revolution': Land Alienation and Identity in Carnarvon, South Africa." *Journal of Southern African Studies* 45(4): 749–766.
- Chinigò, Davide and Cherryll Walker. 2020. "Science, Astronomy, and Sacrifice Zones: Development Trade-offs, and the Square Kilometre Array (SKA) Radio Telescope Project in South Africa." *Social Dynamics* 46: 391–413.
- Dalakoglou, Dimitris. 2010. "The Road: An Ethnography of the Albanian–Greek Cross-Border Motorway." *American Ethnologist* 37(1):132–149.
- Dalakoglou, Dimitris. 2012. "'The Road from Capitalism to Capitalism': Infrastructures of (Post)Socialism in Albania." *Mobilities* 7(4): 571–86.
- De Wit, Maarten J. 2003. "Madagascar: Heads It's a Continent, Tails It's an Island." *Annual Review of Earth and Planetary Sciences* 31: 213–48.
- Dubow, Saul. 2019. "200 Years of Astronomy in South Africa: From the Royal Observatory to the 'Big Bang' of the Square Kilometre Array." *Journal of Southern African Studies* 45(4): 663–87.
- Edwards, Paul N. 2003. "Infrastructure and Modernity: Force, Time, and Social Organization in the History of Sociotechnical Systems." In *Modernity and Technology*, edited by Thomas J. Misa, Philip Brey, and Andrew Feenberg, 185–225. Cambridge, MA: MIT Press.
- Ferguson, James. 1999. *Expectations of Modernity: Myths and Meanings of Urban Life on the Zambian Copperbelt*. Berkeley: University of California Press.
- Grilli, Matteo, and Frank Gerits (eds). 2020. *Visions of African Unity: New Perspectives on the History of Pan-Africanism and African Unification Projects*. Cham: Palgrave Macmillan.
- Larkin, Brian. 2013. "The Politics and Poetics of Infrastructure." *Annual Review of Anthropology* 42: 327–343.
- Lazarus, Neil. 2004. "The South African Ideology: The Myth of Exceptionalism, the Idea of Renaissance." *The South Atlantic Quarterly* 103(4): 607–628.
- Mavimbela, Vusi. 1998. "The African Renaissance: A Workable Dream." In *South Africa and Africa: Reflections on the African Renaissance*, edited by G. Pere, A.

- Nieuwkerk, and K. Lambrechts, 29–34. South Africa: Foundation for Global Dialogue, FGD Occasional Paper No. 17.
- Miescher, Stephan F., and Dzodzi Tsikata. 2009. "Hydro-Power and the Promise of Modernity and Development in Ghana: Comparing the Akosombo and Bui Dam Projects." *Ghana Studies* 12(1), 15–53.
- Mitchell, Timothy. 2002. *Rule of Experts: Egypt, Techno-Politics, Modernity*. Berkeley, CA: University of California Press.
- Mitchell, Timothy. 2011. *Carbon Democracy: Political Power in the Age of Oil*. London: Verso.
- Mrázek, Rudolf. 2002. *Engineers of Happy Land: Technology and Nationalism in a Colony*. Princeton, NJ: Princeton University Press.
- Nieber, Hanna. 2024. "Universality as Horizon: Aspirations and Geometries of Astrophysics in Africa." *Zeitschrift für Ethnologie | Journal of Social and Cultural Anthropology* 149 (1): 53–70.
- Patel, Prina. 2016. "Africa's MeerKAT 'First Light' Images Have Blown All Expectations." *The Conversation*, 28 September. <https://theconversation.com/africas-meerkat-first-light-images-have-blown-all-expectations-65246>
- Pović, Mirjana, Michael Backes, Paul Baki, David Baratoux, Solomon Belay Tessema, Zouhair Benkhaldoun, Michael Bode et al. 2018. "Development in Astronomy and Space Science in Africa: Comment." *Nature Astronomy* 2: 507–10.
- Randrianja, Solofo, and Stephen Ellis. 2009. *Madagascar: A Short History*. Chicago, IL: University of Chicago Press.
- Redfield, Peter. 2000. *Space in the Tropics. From Convicts to Rockets in French Guiana*. Berkeley, Los Angeles, London: University of California Press.
- Republic of South Africa (ROSA). 2020. "Declaration of Certain Properties Situated in the Northern Cape Province the MeerKAT National Park." Proclamation No. 15 of 2020 under the National Environmental Management: Protected Areas Act, 2003. Government Gazette, no. 43145. 27 March. Cape Town.
- SARAO. 2017. *SKA and Agri SA Partners for the Benefit of Local Communities*. Last modified 2 February 2017. www.ska.ac.za/media-releases/ska-and-agri-sa-partners-for-the-benefit-of-local-communities/
- Star, Susan L. 1999. "The Ethnography of Infrastructure." *American Behavioral Scientist* 43(3):377–91.
- Star, Susan L., and K. Ruhleder. 1996. "Steps Toward an Ecology of Infrastructure: Design and Access for Large Information Spaces." *Information Systems Research* 7(1): 111–134.
- Von Schnitzler, Antina. 2008. "Citizenship Prepaid: Water, Calculability, and Techno-Politics in South Africa." *Journal of Southern African Studies* 34(4): 899–917.
- Walker, Cheryl, and Davide Chinigò. 2018. "Disassembling the Square Kilometre Array (SKA): Astronomy and Development in South Africa." *Third World Quarterly* 39(1): 1979–1997.
- Walker, Cheryl, Davide Chinigò, and Saul Dubow. 2019. "Introduction. Karoo Futures: Astronomy in Place and Space." *Journal of Southern African Studies* 45(4): 627–639.