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INTRODUCTION. RETHINKING TECHNOSCIENTIFIC GLOBALISATION WITH THE GLOBAL SOUTH

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IN LATE 2023, THE HOUTHI MOVEMENT TOOK THE WORLD BY SURPRISE when it launched a series of drone attacks against ships navigating through the Bab-el-Mandeb strait, in support of the Palestinian cause. This Islamist group, despite leading a violent uprising against Yemen's government since 2004 and controlling a large part of the country, was barely known beyond the Middle East before this event. The Supporters of God (Ansar Allah), as they call themselves, organised in the mountains of northern Yemen during the 1990s, under the leadership of a local religious figure. The airborne attacks they carried out demonstrated their capacity to alter the march of the world: while they were threatening the strait, four of the world's largest shipping companies stopped using it, diminishing global trade flows by 12% according to some analysts. These attacks challenged the prevailing notion that global dynamics are solely

influenced by major technological players – the richest nations and multinational corporations. Targeting the lifelines of modern economic globalisation – supertankers, megaships – they prompted global superpowers like the United States, India, and France to collaborate in deploying planes, warships, and drones to protect shared economic interests.

The rapidity and intensity of this international response accompanied a reassessment of the image of Houthis, from perceived uneducated, technology-averse militants to sophisticated military actors on the global stage. However, within certain online communities outside the Western world, the movement's technological prowess and military endeavours were already recognised and sometimes celebrated. On the Chinese-owned video application TikTok, thousands followed Rashid Al Hadad, a 19-year-old Yemenite who posted videos of himself on the *Galaxy Leader*, a massive Japanese ship captured on the Red Sea. Furthermore, the Houthis kept on displaying their acute awareness of the strategic importance of technological infrastructure. In February 2024, on the encrypted telecommunication platform Telegram, the group released a map detailing submarine cable routes in the Red Sea, through which approximately 17% of global internet traffic transits. Their threat to destroy this infrastructure appeared as the possibility of a serious blow to Europe-Asia technological communication.

Although at that time the Houthis did not own submarines able to dive deep enough and locate the cables in the Red Sea, the risk they represented could not be dismissed. In fact, they had displayed a great ability to harness the technological inventiveness of Global South countries and populations, despite their exclusion from mainstream international relationships.[1] The HESA Shahed 136 drones, which had been used by the Houthis to attack boats in the Red Sea, originated from the Iranian military-industrial complex: they had been designed by two companies which incorporated a gasoline jet engine, an uncommon feature for drones, usually powered by Lithium-ion batteries. According to specialists, they were the cheapest drones in the world, priced at around 20,000 dollars, a bagatelle in comparison to the American and European missiles, which can cost 2 million dollars per piece (Sabbagh 2024). On the 9th of January, Britain's HMS *Diamond* intercepted 7 of the 18 drones

launched by the Houthis, notably utilising Sea Viper and Aster missiles, which cost between 1 and 2 million dollars each. The low cost of the Iranian drones largely owed to the incorporation of technologies made in BRICS countries, such as Chinese voltage converters and Russian navigation systems, which were in use on the Russian-Ukrainian battleground at the same period. Indeed, the Russian government had collaborated with the Iranian authorities to develop and manufacture its own version of the Shahed 136 drone, the Geran-2, which Ukrainian soldiers sarcastically called the 'mopeds' or 'lawnmowers' because of the loud sound emitted by their engines.

The Houthis' drones, designed and produced in the Global South, signal the emergence of new geopolitical alignments that challenge the idea of global order and the military hegemony of countries hosting the highest capital-intensive technologies. But they also illustrate the capacity of Global South countries and populations to develop original innovations despite limited financial capacity and, in this extreme scenario, exclusion from dominant production networks. This situation also underscores the necessity of broadening our perspective to include oft-ignored social groups in the analysis of the production, consumption, and global circulation of technologies. It shows that the forces simultaneously shaping the future of global technoscience and international trade can emerge from the most unexpected places, challenging conventional wisdom and prompting a reassessment of global power processes. The Global South countries host some of the key dynamics that shape global technological capitalism, and this realisation is pivotal for understanding the complex, multifaceted nature of technoscientific globalisation. Looking at technoscientific globalisation 'from below' – that is, from non-hegemonic countries and subalternised groups – provides a critical lens through which to reexamine the interplay between technology, power, and society at the global scale. Our edited volume builds on such an effort.

GLOBAL SOUTH CONTRIBUTIONS TO TECHNOSCIENTIFIC GLOBALISATION

Be it through technological uses, production, or innovation processes, Global South populations, firms, and governments play a key role in shaping the relations

between sciences, technologies, and markets at an international scale. This phenomenon is even more striking as Global South countries have long been considered as cut off from globalising dynamics, as exclusive extractive sites, or as remote recipients for technical innovations – last in line and benefitting from them only a long time after the richest countries. Although historians of science and science studies scholars have demonstrated the geographical variety of knowledge streams fashioning global science and technology, as stated in Joseph Needham's metaphor[2] (Needham 1964), dominant discourse has kept 'othering' the South, implicitly considering it foreign to rationality, science, and innovation (Prasad 2022; Said 1997). But attention to the actual developments of global capitalism makes such a preconception even more erroneous. Across most technical domains, the globalisation of technological innovations increasingly affects and shapes Global South countries, not only as sites of extraction, but also as sites of production, innovation, and consumption. In return, Global South populations increasingly participate in the fabrication of technologies, through innovation and production practices, as users adjusting and diverting technological goods from their initially intended uses, or as locations for the dismantling and relegation of unused technical objects, from massive container ships to TV screens. As a result, we can observe the contribution of the Global South to technological globalisation in multiple domains.

Innovation – First, while dominant discourse tends to frame the Global South as the cradle of copy industries, unable to come up with radical innovation, recent dynamics suggest that this vision might be skewed. Although the fact is concealed by the power structures of the academic field, Sub-Saharan African universities, for instance, play an increasing role in global knowledge production (Gebremariam et al. 2023). In the IT sector, through developing platform technologies or geospatial tools adapted to local needs, many African states, from Rwanda to South Africa, have notably elaborated forms of government at the national or city scale that are 'smart' – digitally tooled – in their own ways (Odendaal 2023) and despite the persistence of multiple forms of digital marginalisation (Chacko 2022). In the medical field, the Global South countries have been developing treatments sometimes more efficient than the products of capital-intensive R&D firms from the North, as illustrated by the dramatic

contribution of Nepalese and Indian ophthalmologists to eye surgical science and to the low-cost and rapid treatment of cataract problems (Williams 2019). In the agricultural sector, attention to long-term solutions has led to the questioning of supposed universal technological fixes and the elaboration of new scientific paradigms, as illustrated by alternative treatments for Panama disease in Filipino banana plantations (Paredes 2023). This ability to locally develop systems of innovation and infrastructures, not only depending on imported technologies but benefitting from local engineering knowledge and skills, is nothing new – and scholarship shows that even during the colonial period, local engineers and inventors contributed to the establishment of massive infrastructural projects, as in the case of India's electricity supply system in West Bengal (Sarkar 2021). However, this ability of Global South countries to innovate is now becoming more important in defining what technical innovation is and should be, at an international scale, and in some fields this innovative capacity and the variety of paths it opens is particularly visible: nowhere in the world are there more innovative processes around energy supply than in subtropical regions, where alternative energy procurement systems are frequently harnessed through off-grid systems (Boamah 2020). In that regard, Global South countries undeniably play a growing part in the expansion of global markets for technologies through multiple forms of creation and innovation.

Production – Additionally, the Global South hosts critical sites for the industrial production of technological devices, as illustrated by the fact that most ICT devices are exported from Asia, with local companies producing their own smartphone models (Chinese Oppo, Huawei, Xiaomi, Indian Micromax), along with the models from US brands such as Apple's smartphones, produced by Taiwanese firm Foxconn across Asian countries. Global South countries tend to differ from the richest ones in often taking up the production process of technologies, since Northern countries keep on outsourcing growing shares of industrial production to Southern firms. India's pharmaceutical industry stands out in supplying medicines to the world. For example, most antiretroviral medicines used against HIV in the developing world come from India (Rajan 2017). Brazil, after the USA, is the second largest producer of genetically modified (GM) crops (Aga 2021; Peschard

2022), and emerging countries do not depend only on crops that are selected in the Global North, sometimes developing their own seed banks through alternative means (Chacko 2022).

Extraction – Furthermore, even though many Global South countries are still too often considered as massive extraction sites by governments and companies alike (Gudynas 2020; Tsing 2005), they no longer extract resources only for others' benefit. The 'resource curse' that has long plagued developing countries, rendering them unable to draw development benefits from mineral-rich ground, is being challenged and reconfigured. Mobile phone batteries across the world still widely rely on the labour of Congolese miners and traders (Smith 2021), and the nuclear plants of the Global North are filled with Nigerien uranium (Hecht 2014). But at the same time, Southern governments and populations are increasingly aware of the power they hold over the world's technological futures, as illustrated by the intensity of environmental struggles in Peruvian Amazonia (Buu-Sao 2019). This is also true for biological extraction: in the context of the global fight against influenza, Southern countries have been particular places of extraction with no assurance of benefit sharing or accountability, but this is beginning to be contested. When the World Health Organisation's labs transferred Indonesian H5N1 samples to a pharmaceutical company without consulting Indonesia, the country withdrew from the WHO virus-sharing mechanism (Stephenson 2011). Moreover, what is extracted in the South can also be consumed locally. In Ghana, nuclear engineers hope that they will soon be able to put African uranium to good use within their own nuclear plants to generate energy (Osseo-Asare 2019).

Consumption – The Global South countries also represent growing markets for the consumption of multiple industrial and technological products and services. Cement has been adopted across Africa to the extent that local populations have developed an effective relationship with this material, which is used to materialise dreams of comfortable living spaces (Choplin 2023). The Sahel countries have become major users of surveillance technologies to control migration flows (Donko 2022). Financial technologies across Asian and African countries have been adopted swiftly, and populations have harnessed the possibilities provided by digital finance to facilitate payments, exchange money,

and acquire loans (Donovan and Park 2022; Kusimba 2021). New technologies designed for cultural industries have met with great success in the developing world, the global expansion of platform economy infrastructures being a case in point (Boczkowski 2021; Bouquillion et al. 2023; Lobato 2019).

Relegation and revaluation – Global South countries' contribution to the globalisation of technologies is not restricted to innovation, production, extraction, and consumption. An important aspect of their participation in global capitalism consists in the handling and revaluation of relegated goods, waste, and residues. This can be illustrated through the case of second-hand and wrecked vehicles sent from rich countries to poorer ones. Indeed, African countries absorb 40% of the global flow of second-hand vehicles. This is not a new trend, but it is taking on a new dimension because of the more stringent regulations that Global North countries are imposing on their vehicle fleets. Growing awareness of the health effects of particulate matter (PM) is leading to a technological, environmental, and health imbalance to the detriment of countries with fewer control resources, to which fleets of relegated vehicles are directed. In this way, by reinforcing environmental regulation, the Global North countries are accelerating the obsolescence of their car fleets and fuelling the flow of exports to the countries of the Global South. Second-hand vehicle markets in Ghana, for instance, largely trade in obsolete vehicles coming from North America. The conditions of existence and transformation of these vehicles are embedded in the practices of various stakeholders, traders, and technicians, such as the so-called fitters (Powell 1995). This is the term for informal sector mechanics who repair vehicles in Ghana. Fitters are illegitimate in the eyes of the authorities, despite the fact they are involved in a process of value creation and innovation through maintenance and repair (Edgerton 2011). This situation also shows how materials can move from one category to another following different value sets and different contexts – for example, from waste to consumption goods, from matter extracted from animals to medicines (Appadurai 1996).

APPROACHING TECHNOSCIENTIFIC MARKETS 'FROM BELOW'

If Global South countries are fully participating in the expansion of global technoscience markets – whether as innovators, manufacturers, consumers, raw material providers, or scrap recyclers – then this participation needs to be thoroughly characterised. This book focuses primarily on how such activities manifest within Global South countries themselves, rather than on how these activities transform science and technology globally. But is there a distinct way in which technoscientific globalisation manifests in the Global South, and is it meaningful to consider the 'Global South' as a relevant entity? We argue that in both cases the answer is 'yes'. However, addressing these questions requires careful consideration and critical use of analytical tools, such as the concept of 'from below', which has guided the authors' work. The following section elaborates on this perspective and explains our approach in studying technoscientific globalisation 'from below'.

On one hand, the globalisation of technoscientific markets is not a uniform process; it unfolds in contrasting ways depending on where it takes place. On the other hand, regularities characterise shared features depending on geographical, historical, social, and economic variables. In that perspective, we contend that it makes sense to account for the experience of technoscientific globalisation shared by countries usually gathered under the loose category of 'Global South' – alternatively 'developing countries', formerly 'Third World,' and in some cases 'least developed countries' – all of them composing the 'Majority World' (Alam 2008). One major reason to highlight these shared experiences is to expose some of the structural economic inequalities and power asymmetries between countries that determine how technoscientific globalisation is experienced. Indeed, we think there is something obscene in the 'flat world' narrative where atomised entities would coexist through horizontal relations, and in the acritical celebration of both economic globalisation and technological solutionism. The observation of daily life and socio-anthropological fieldwork in (financially) resource-poor contexts often confronts the observer with radically different life experiences to their own, in which the exercise of human rights

to life, to liberty, to security is much more constrained than in richer settings. The social sciences have a duty to account for such a difference. However, we condition the use of that broad category to empirical investigation, which allows us 1) not to reduce the experience of social actors in the Global South to one of exclusive subordination, and 2) to keep a constant focus on the singularity of these social actors that the 'Global South' category tends to obliterate. Furthermore, recent works have shown that such a category as 'Global South' needs to be diversified, understood as a 'polyphonic' category (Waisbich et al. 2021). 'South' and 'North' have become plural categories that now encourage multiple forms of analysis, from studies of the South in the North to ones of the North as seen from the South, and the East/West countries do not always fit unquestionably in either North or South. The category 'Global South', then, mostly follows the use of the 'South' as a category when it is advocated by 'the nations and groups of the South to assert their difference by means of scientific criticism' (Dumoulin Kervran et al. 2018).

From this position, the 'North-to-South' narrative of technological transfer, knowledge dissemination, or market fabrication is being challenged by the emergence of research and development capabilities across the globe and more specifically in countries of the Global South. No innovation process is fully local nor global; such processes are the product of an assemblage of knowledge and know-how from multiple origins (Bhaduri 2016). These dynamics of polycentric innovation, coupled with market strategies, often take original and discrete paths, as they are embedded in sets of rules that challenge the dominant forms of organisation of global capitalism (Arnold 2019; Quet 2022) and global science determined by the richest countries. As a result, emancipation and constraint become rearticulated in unexpected ways in the Global South considered as a site of innovation, production, and consumption. While new markets and promises are appearing (Donovan and Park 2022), emerging players such as India and China are disrupting the traditional geopolitical balance and hierarchies of innovation (Kaplinsky et al. 2009), reframing, for instance, the dominant conceptions of digital and pharmaceutical capitalism (Lei 2023; Lindtner 2020).

Global studies offers opportunities to analyse this phenomenon through the coinage 'globalisation from below'. In recent years, the social sciences

have increasingly stressed the need to better integrate actors and objects 'from below' – often located in the Global South – into the analysis of economic globalisation (Choplin and Pliez 2018; Mathews et al. 2012; Tarrius 2002). A growing body of research has documented the role of subaltern groups in the dynamics of global change and market fabrication. This research has shown that the notion of 'globalisation from below' (Mathews et al. 2012) serves as a useful entry point to highlight issues often neglected by dominant analyses of economic globalisation. Non-hegemonic actors such as informal female workers (Gago 2017), migrants, marginalised groups and communities (Tsing 2015), and small intermediaries (Tastevin 2012) play a key role in the contemporary circulation of goods, people, and ideas, alongside more powerful and better-known actors. Engineers and scientists from the Global South have been fully part of this connective process even when their role has been erased or marginalised (Laveaga 2018).

The category of 'from below' has also been adopted by some STS scholars. In that sense, Sandra Harding (2008) argues that proposals to investigate modernity and its sciences ought to look at positions 'from below', which involves taking into consideration the standpoints of women and the world's other least-advantaged citizens. Likewise, recent STS studies have turned their attention to innovation 'from below' to consider the position of those with low socioeconomic and geopolitical status in global science. The qualifier 'from below' refers to people who are 'marginalised in some relationship of power', including in science and technology production (Williams 2019), though the choice of a perspective 'from below' does not preclude drawing on related concepts.

The notion of 'from below' remains fuzzy, however, as it encompasses a wide range of heterogeneous operations and actors who can be more or less dominated. The study of things and processes 'from below' – be they globalisation, markets, capitalism, history – is not new and has already fostered multiple debates. For instance, historians have provocatively asked 'who is below?'. 'Below' may vary according to the boundaries defining the category: for instance, the working class or the poor, if adopting socioeconomic criteria; the developing nations' populations, according to the critique of international trade; the women in patriarchal societies; the marginal, persecuted, or nonconformist groups and

individuals, following social studies of deviance; or simply those not belonging to the elites (Cerutti 2015; Hailwood and Waddell 2013). In that regard, choosing to investigate 'from below' requires a serious effort at defining what kind of 'below' is at stake. Following a more general understanding, tracing history from below means restituting the 'roads that have not been travelled and that have lost the battle for legitimacy' (Cerutti 2015).

Recognising and building on the abovementioned literature that adopts a perspective 'from below', we propose in this book to make cautious use of that expression. We acknowledge its relevance, as it has oriented many of our discussions since we started working as a collective, but we also refuse to take the meanings of 'from above' and 'from below' for granted. This has two implications for the way in which we analyse technoscience and market expansion 'from below' throughout the book. Firstly, we insist on the power asymmetries and hierarchical differences implied by such expressions as 'from above' and 'from below' (Choplin and Pliez 2015). In that sense, to analyse 'from below' requires both approaching and defining 'the actors from above' as a contrasting entity. Secondly, we understand 'from below' as a broad category and acknowledge that the uses we make of the expression differ at times, depending on the phenomena we describe in the chapters. Though obviously encompassing the wide spectrum of vulnerable, invisible, and usually forgotten actors, it may also include others who are not 'subjugated' and less obviously identified as 'from below', such as elite scientists, experts and managers in the Global South, or emerging nations such as South Africa, India, and Brazil that share a 'betwixt-and-between status' (Pollock 2019). These are 'non-hegemonic' countries and actors in the sense of being dominated in the international division of scientific labour, though still building up room for manoeuvre to develop national policy (Losego and Arvanitis 2008) and pursue nation-building projects. Moreover, they might also establish new power inequalities and hierarchies vis-à-vis other countries and populations within the South. However, they all share 'vantage points from a peripheral space of global science' that becomes a 'location of insight' (Pollock 2019). As a result, our perspective on technoscience and market expansion in the Global South is as much 'from below' as we can make it, but every time this is required, we will clarify which 'below' we are dealing with.

ENQUIRING INTO GLOBAL SOUTH TECHNOSCIENTIFIC GLOBALISATION: AN ANALYTICAL FRAMEWORK

Over the last quarter of a century, STS has increasingly focused on non-Western countries. Pioneering works published in the 1990s laid the foundation for increasing scholarship in the 2000s (Abraham 1998; De Laet and Mol 2000; Harding 2008; Waast 1995). Special issues (Postcolonial Studies 2009; Science as Culture 2005; Science, Technology and Human Values 2014, 2016; Social Studies of Science 2002), handbook chapters (Anderson and Adams 2008), and dedicated handbooks (Harding 2011; Medina et al. 2014) gradually established 'postcolonial studies of technoscience' as a dynamic subset of STS. Research has shed light on the worldwide expansion of technoscience by examining it from the perspective of Global South countries. 'Going South' (Dumoulin Kervran et al. 2018) has enabled us to unpack the specific forms of dispossession or capital accumulation at play (Peterson 2014), the coexistence of contradictory disease ontologies and care practices (Langwick 2011), the adjustment of innovative practices to resource-scarce settings (Chee 2021), and the beliefs embedded in development or technological narratives (Invernizzi et al. 2008; Rottenburg 2009) – to mention but a few examples. This body of exciting scholarship has helped the STS community recognise the significant insights gained from studying technoscience beyond the wealthiest, most powerful, and academically prestigious sites (Pollock 2019). It has also firmly established that the technoscientific development of global societies is deeply intertwined with the countries of the Global South. In a way, extending Achille Mbembe's discussion, the world's technoscientific becoming is African, Asian, Latin American – it goes South (Mbembe 2020).

Falling within this scholarship, our book's main contribution lies in the effort to define and discuss some of the primary characteristics of the science/technology/market nexus as it manifests in Global South countries. The preceding sections have explained why and how we study technoscience and market expansion in the Global South. Through innovation, production, extraction, consumption, and revaluation practices, the Global South countries, institutions, and populations contribute to global technological capitalism. Simultaneously,

technological expansion profoundly affects social, political, and biological life in the Global South. Furthermore, considering the entanglement of technologisation and capital expansion in the Global South sheds light on dynamics often overlooked when studying technoscientific capitalism solely from the perspective of the North. This section posits our analytical stance by outlining the major features that characterise technological globalisation in the Global South and differentiating it from developments in the Global North. Existing literature and our own research indicate several dynamics that characterise technoscientific globalisation in the Global South compared to high-income countries. The following paragraphs introduce eight main features, which are discussed in the subsequent chapters.

Firstly, technological globalisation in Global South countries is often characterised by the heterogeneity of equipment and infrastructures coexisting in the same space. Whether for water procurement (Anand 2011; Zérah 2014), electricity (Guillou and Girard 2023), or transport (Gopakumar 2020), a wide array of equipment coexists within the same territories, from brand new and cost-intensive materials to very old and low-tech ones. The same applies for technological devices. For instance, on Indian roads, one can encounter a great variety of means of transport, from expensive cars to cycle rickshaws, bullcarts, and camels. This heterogeneity and the hybridisation processes it fosters are partly addressed by the concept of 'creole technologies' proposed by historian David Edgerton (2007). Edgerton frames as creole technologies those that have been translocated, appropriated, and locally manufactured. One example Edgerton provides is that of long-tailed boats with car engines attached to wooden structures, turning them into speedboats, which first appeared in Bangkok and then spread to other Thai cities and Southeast Asian countries. However, this heterogeneity also results from the uneven distribution of resources among users and citizens, as explained by Ashley Carse while following Panamanian roads. While the canal hosts prosperous trade, for some people, 'infrastructure [be it roads or electricity] arrives slowly, if at all' and villages or whole areas can remain bluntly excluded from infrastructure installation (Carse 2014). Heterogeneity thus manifests through forms of prioritisation and feelings of exclusion. It relates to factors such as socioeconomic inequalities and

weaker regulatory intervention by the state. It can also accompany decentralising dynamics, as in the case of energy procurement.

Secondly, the study of technological capitalism in the Global South highlights alternative value-making strategies and specific market constructions that cater to demands absent in the richest countries. One example is 'Bottom of the Pyramid' market strategies (Prahalad 2005), which create forms of capital accumulation by involving the poorest segments of the world population in markets. In the financial sector this phenomenon is illustrated by financial inclusion, microfinance or microinsurance, along with the development of solar batteries, mini-grids, and low-cost electricity devices in the energy sector. (Guillou and Girard 2023; Sarkar 2021). The nutritional and medical sectors also see the emergence of specific goods, such as humanitarian fixes or nutraceuticals targeting the rural poor (Redfield 2016; Street 2015). Moreover, these market strategies align with various corporate formations and practices of capitalism that a focus solely on the richest countries would overlook. The role of some of the wealthiest businesspeople and corporations based in emerging countries must be thoroughly analysed in a world superficially dominated by Google, Apple, Facebook, Amazon, and Microsoft (the GAFAM). Reliance Industries in India, one of the largest petrochemical industries globally, is also a leading actor in biotechnologies and telecommunications. The Brazilian firm Vale S.A, one of the world's largest mining companies, plays a crucial role in renewing extractive practices and defining energy policies from Canada to New Caledonia. In Kenya, Safaricom has been pivotal in designing and implementing digital payment systems. The Vodacom Group, including Safaricom, and the Nedbank Group created M-PESA, aiming to provide a quick, safe, and easy way of transferring money via mobile phone technology, which was soon adopted by a large portion of the Kenyan population. These alternative markets and styles of corporate capitalism are supported by regulatory strategies that can differ from those promoted by the highest-intensive technological capitalist firms. Such differences are illustrated at times by disagreements and protests in arenas like the World Trade Organisation that reveal differing conceptions of regulation framed within Global South nations, particularly around intellectual property rights.

Thirdly, technoscientific globalisation progression in Global South countries accompanies the emergence of original and influential forms of governance. Due to their strategic positions as nodes and gatekeepers in international relations and economic exchanges (Cooper 2005), public administrations have evolved into hubs of industrial development and innovation (Mavhunga 2018). For this reason, governance in the South has been exposed to a greater extent, and much earlier than in the North, to computer science, statistics, and digital technologies (Zimmermann 1984; Breckenridge 2014). Recently, the digital industry has contributed to develop forms of governance made for the South, deeply affecting in return the development of governance and identification practices in both North and South. For example, multiple African countries were already equipped with biometric identity card systems, years before European countries developed biometric identity cards to identify their citizens. The digital industry has played a major role in the construction of such circulations from Southern to Northern governance. The Indian Aadhaar system is a particularly famous illustration of this model. Beyond Aadhaar, systems like Pakistan's National Database and Registration Authority, and others developed in Kenya, Ghana – and throughout Africa, especially West Africa, due to migration and Islamist attacks – demonstrate the widespread impact of such initiatives. Rooted in remote governance, these systems enable the provision and distribution of public services, but they are materialising very diverse politics, from financial inclusion to police surveillance or citizenship participation (Jacobsen 2012). These artifacts (the IT systems) fundamentally alter the relationship between governments and citizens, shifting towards 'coded citizenship', where individual characteristics are converted into data for administrative manageability (Kitchin 2016; Rao and Nair 2019; Taylor and Broeders 2015), thus digitalising the 'biopolitical technology of rule' (Masiero and Shakhti 2020; Rose 1999). While digital identity schemes may enhance food security governance, they can also introduce errors that exclude populations from essential services, thereby reducing access to citizenship (Eyenga et al. 2022; Nayak 2020), perpetuating North-South inequalities (Debos and Desgranges 2023), and displacing historical controversies over politics and public participation with technical debates centred on infrastructures and IT experts (Passanti and Pommerolle 2022).

Fourthly, technoscientific globalisation in Global South countries is marked by the heavy constraints imposed by international inequalities, as well as efforts to contest and circumvent these limitations. Individuals and institutions often depend on external funding, face restrictions on international mobility, and encounter asymmetries in decision-making power, largely due to significant differences in state funding and investment capacities. This dynamic is evident in global health research processes, where US and European institutions seek 'partnerships' in Global South countries but frequently make unilateral decisions on research topics, collaborators, and publication venues (Crane 2013; Feld and Kreimer 2019). Conversely, Global South actors must navigate constrained strategies to secure partnerships and opportunities (Kingori and Gerrets 2016). In response, these actors increasingly participate in new geopolitical assemblages and trade routes, distancing themselves from the economic and cultural dominance of the wealthiest countries. The COVID-19 pandemic provided striking examples of this reconfiguration of global trade relations and geopolitical formations. While European countries and the US monopolised most of the vaccine doses produced by their companies, Chinese and Russian COVID-19 vaccine developers established a significant presence in the developing world, employing business strategies that emphasised registration, collaborations, and manufacturing agreements, including full production processes in the South. Chinese COVID-19 vaccines accounted for nearly half the total volume produced globally in 2021[3]; nearly 900 million doses of Sinovac's CoronaVac were administered through vaccine cooperation agreements with 20 countries outside China, with the largest proportions going to Indonesia, Brazil, Turkey, and Chile. Most Sinovac agreements to expand manufacturing capacity were with upper-middle-income countries, with Egypt, Indonesia, and Brazil being the largest manufacturers by volume. Beyond COVID-19 vaccines, China is increasingly seen as a valuable partner by other Global South countries like Brazil, due to less stringent intellectual property requirements in trade and investment agreements compared to the US, EU, and Japan. This shift could facilitate new forms of agreements, leveraging negotiations with other global players (Ido 2023).

Fifthly, the detrimental social and environmental externalities of globalisation are largely borne by the Global South countries and populations. Air

pollution and global warming effects are most severe in Global South countries (Khandekar et al. 2023; Landrigan et al. 2017), toxic materials such as dangerous pesticides or waste are more present due to the 'unequal distribution of exposure' (Bureau-Point 2021; Geissler and Prince 2020), and occupational health risks are higher in developing countries compared to the richest ones. Outsourced industrial activities often lead to outsourced pollutants. For instance, while many countries consume Indian medicines, this comes at the cost of significant environmental pollution due to chemical waste (Boudia et al. 2021). Among various case studies, the informal sector's role in collecting and salvaging waste, and reintegrating recovered materials into the formal economy, is noteworthy. Waste from Global North countries is seen as a resource in the Global South, where its collection is a vital economic activity and the recovery of resulting resources is key to the global economy. In many ways, some developing countries have become dumping grounds for technological waste from around the world, no longer limited to high-income countries (Lepawsky 2018). Among these numerous dumping grounds, Agbogbloshie's e-waste site in Ghana is one of the most infamous (Akese and Little 2018). Since Chinese authorities enforced stricter regulations, many used or obsolete items are increasingly sent to other parts of Asia or African countries for repair or dismantling, forcing vulnerable communities to live alongside highly polluting activities that constitute 'toxic colonialism' (Liboiron 2021; Pratt 2010). The academic field of waste studies has highlighted how domestic waste becomes an informal income source for many vulnerable people (mostly from lower socioeconomic classes) in the Global South countries, who are relied upon by institutional collection systems but struggle for political recognition (Bercegol and Gowda 2018; Dinler 2018; O' Hare 2019). This is illustrated by Indian waste pickers who reintegrate technological waste into value chains (Bercegol 2020). When Northern countries discard batteries and solar panels, complex and efficient valuation networks are established in countries like Kenya to repair and maintain existing solar grid technologies (Cross and Murray 2018).

Sixthly, technological development in the Global South, because devices and equipment still often come from the North, heavily involves technological adjustment and adaptation: modifying tools to meet local needs, adapting

metrics to local standards, and tailoring food products to local tastes and nutritional requirements. Companies adjust their offer to local demands. For instance, Hindustan Lever Limited developed an affordable washing powder requiring less water (Subrahmanyan and Gomez-Arias 2008). However, customers themselves often initiate these processes by imaginatively repurposing technologies. This was evident with the Chinese domestic electrical manufacturer Haier, which redesigned washing machines to accommodate washing potatoes after realising that rural Chinese consumers were using their machines for this purpose in addition to doing laundry. Haier's engineers modified the machines by providing wider pipes to prevent clogging by mud (Anderson and Billou 2007). Technological innovations thus emerge not only through top-down, global-local, and unidirectional exchanges but as a back-and-forth process involving continuous adjustments. These situations, however, remain embedded in postcolonial legacies that often perpetuate power relations. Consequently, adjustment or adaptation can also take on conflictual forms, requiring stakeholders from the Global South to find arrangements – sometimes with global firms and sometimes against them – to overcome technological dependency. One of the most significant examples described in the literature is the process of reverse engineering or learning by copying, which involves extracting knowledge and know-how from a manufactured object. This has been studied in the context of generic antiretroviral (ARV) production in Brazil (Cassier and Correa 2009). ARV reverse engineering in Brazil has demonstrated the appropriation and adaptation of technology by a Global South country despite tight intellectual property rules and the global HIV epidemic.

Seventhly, this also makes us more aware of market features that, although they might exist worldwide, take on particular importance in resource-scarce settings in developing countries. This is the case of uncodified practices frequently unregulated by the state. The significance of informal maintenance and innovation practices is particularly high in countries where people have limited access to expensive standardised products. The Indian concept of 'jugaad' – which refers to a quick, improvised fix often seen in the informal sector, driven by urgent needs and limited resources (Kumar and Bhaduri 2014) – perfectly illustrates this (Bhaduri 2016; Parthasarathy 2022; Philip et

al. 2012) as it shows specific practices of maintenance in developing contexts as compared to the richest countries (Denis and Pontille 2022). Another aspect of informality involves the complexity of informal sourcing processes within formal industrial operations, as highlighted by technological institutions and firms (Gameiro and Quet 2023). Informal sourcing is not exclusive to Global South countries, as it can also be found in the richest countries (Tsing 2015). However, it is a more systematic feature in developing contexts, where informal labour is often highly developed and where informal labourers are much more exposed to health and safety risks. This indicates that technological capitalism is intertwined with traditional hierarchies and forms of exclusion, such as the Indian caste system, which tend to be overlooked when focusing solely on the formal sections of value chains. Indian Dalit and tribal communities significantly contribute to global technological value chains, although much of their participation is invisibilised and poorly rewarded financially. In its more brutal form, technological capitalism feeds this informalisation through the mechanism of a 'depletion economy' (Precarity Lab 2020).

Lastly, the focus on technological developments in the Global South also calls for more attention to 'cosmotechnics', which refers to the ways in which technological developments resonate with situated conceptions and imaginaries of technological development (Hui 2021). Over centuries, a universalist framework was imposed by European nations through colonisation, sustained intellectually by the establishment of a 'colonial library' (Mudimbe 1988) and sometimes forcefully through various developmental or environmental interventions (Blanc 2024; Mavhunga 2018). This framework, however, tends to obscure the complex representations of the relationships between science, technology, and the universe, as well as their global diversity. Cosmotechnics, as a descriptive concept, highlights the existence of various understandings of the relations between science and society across continents, calling for a better appreciation of their role in national technoscientific projects, closely related to the notion of 'technoscientific imaginaries' (Jasanoff and Kim 2009). An increasing number of studies have focused on specific Southern countries as case studies. For instance, Anne Pollock immersed herself in a laboratory in Johannesburg, demonstrating how contemporary research

and development practices in biotechnologies are anchored in a collective desire to see South Africa regain its status as an innovative power (Pollock 2019). Other studies have shown that 'traditional' medicine can be considered mainstream and modern in certain regions of Asia and Africa (Kloos 2020; Osseo-Asare 2014) and can become a field of major innovations in the pharmaceutical sector through processes of reformulation (Pordié and Gaudillière 2014). This last line of research invites focus on the effects of ethics, norms, values, and ideologies on the technoscientific evolutions of the Global South.

PRESENTATION OF CHAPTERS

Building on this analytical stance, the case studies gathered in this book shed light on the diverse ways in which social groups from the Global South engage in the expansion of technological markets by navigating complex power structures and regulatory frameworks, thereby contributing to shaping the trajectory of technoscientific capitalism. Methodologically, most of the work presented here is grounded in ethnographic approaches, and relies upon semi-structured interviews, direct and participatory observations, archival work, and engagement with grey literature. Geographically, the fieldwork has been anchored mainly in nine countries (Brazil, Chad, China, Ecuador, Ghana, India, Kenya, Mauritius, Senegal) on three continents – Africa, Asia, and Latin America – through ten chapters, which could be deemed either too few or too many: our focus is on attempting to define regularities in Global South experiences of technoscientific globalisation, and this book aims at being a first step in a longer research process. The geographical diversity of our studies is not primarily a strategic choice, and it essentially reflects our own individual fieldworks and area specialisations. The contingency of this selection accounts for the relative abundance of chapters studying India (3) while regions such as Southeast Asia or Oceania have been left aside. In this regard, our endeavour should be interpreted overall as a call for more dialogue and discussion between studies in multiple non-Western locations, aiming at the description of connections and similarities between Global South experiences of technoscientific globalisation. Such discussion

could also put more emphasis than we have done – through lack of means – on the particular role of Chinese actors in these interconnections. Most of us were met during our fieldwork with the presence of Chinese actors but were not able to follow their leads since we were locally focused, saving this work for later. We think, however, that by discussing a variety of technologies and locations, our case studies help foster understanding of how technoscientific globalisation works from below – by taking seriously the features defined in this introduction.

Although all the chapters sporadically address several of the features exposed in the preceding section, we could not cover them systematically and had to make choices in order to explore in greater depth analytical points that were particularly important to understand our case studies. Following this, the chapters revolve around four main themes that contribute to defining the specificity of technoscientific globalisation in Global South countries.

The first theme this book explores is uncodified (by governments) practices and processes within the context of technoscientific globalisation. The authors delve into neglected aspects of digital capitalism to uncover the intricacy of informal practices within global technological value chains and technology-driven capitalist accumulation. Their arguments highlight the complexities of power relations and the ways in which technological capitalism is articulated within existing hierarchies and forms of exclusion.

Henry Chávez and María Belén Albornoz explore how migrants in Latin America divert the use of platform technologies, specifically focusing on the grey areas around (interchangeable) driver profiles and on the innovative ways in which migrants use them. Chávez and Belén Albornoz reveal how platform companies take advantage of informal and illegal labour workforce and social vulnerabilities to ensure the functionality of their technologies. By doing so, the authors shed light on the power dynamics and exploitative practices underlying the operationalisation of platform technologies – without neglecting to highlight the practices of resistance to such dynamics.

Javed Mohammad Alam, studying migrant workers in a South Asian context, explores how digital technology is adopted by Indian migrants in the Gulf countries, particularly to send money back home and maintain connections with

their families in India. He highlights how the migrant condition and experience encourage the adoption of financial and digital technologies back in their home countries, showcasing the ways in which migrants engage with and use digital technologies for financial purposes. This brings him to insist upon the contribution of unskilled migrants to the global circulation of knowledge and expertise.

The second theme explored in this book is the power dynamics and constraints triggered by international inequalities within technoscientific globalisation. The authors delve into digital capitalists' and other global actors' participation in technology-driven capital accumulation, invisible and free labour, and data extraction. Their arguments highlight the complexities of power relations and the ways in which dominant actors shape technoscientific practices, especially in the digital and pharmaceutical sectors.

Jessica Pourraz and Allison Felix Hughes analyse how Ghanaian scientists have managed to build expertise in air pollution with imported low-cost sensors (LCS), which they adapt to the local setting and which thus compete with the highly technical and expensive measurement instruments from the Global North considered as the 'gold standard'. By exploring how Ghanaian scientists carry out LCS calibration to make the devices accurate and to ensure the validity of the data produced, the authors show how calibration work is, in turn, appropriated and valued on the market by LCS companies who sell their devices to other Global South countries. In doing so, the authors highlight the free and invisibilised contributions of Ghanaian actors to technological air monitoring infrastructure, showing the power dynamics between local actors and technology owners from the Global North.

Grounding their study in the context of the COVID-19 epidemics, Koichi Kameda, Denise Pimenta, and Gustavo Matta analyse how the vaccine was initially supplied to Brazil and document the public health authorities' subsequent journey towards achieving full production autonomy and vaccinal sovereignty. By analysing the benefits of technological transfers for the countries and actors from which the technology originates – such as Sinovac in China and AstraZeneca in the UK – they illustrate how technological transfers serve the interests of specific actors and result in the emergence of new actors in the Global South. The authors also highlight the role of local values and nationalistic

ideologies in driving Brazil's efforts to achieve vaccine autonomy and cope with international inequities, exploring how these factors shape the development and use of technology.

The case study presented by Thibaut Serviant-Fine shows how China has taken up heparin production during a period of public health crisis and global procurement outsourcing, a process that has entailed a shift in the supply of farmed pig materials for the production of biological drugs. His chapter shows how the increasingly important role played by China has subsequently been put into question during zoonotic episodes, coupled with anxieties on the part of rich countries' governments about the growing power of Chinese firms in global markets. The chapter addresses the entangled role of procurement practices, animal product sourcing, and geopolitical relations in the fabrication of contemporary globalisation. By analysing the increasing and contested role of China, the author nuances the predominant image of South-to-North extractive circulations and supply circuits to demonstrate how technological and regulatory change at a global scale can also arise from actors not located in the Global North.

The third theme explored in the book is the local adaptation and adjustment practices surrounding globalised technoscientific tools. Drawing on the growing STS scholarship on non-Western countries, including the Global South, the authors examine how local actors creatively engage with and transform technologies to meet their specific local needs. By going beyond the dominant narratives of technological expansion from powerful sites in the Global North, the contributions highlight the active role of local actors in shaping technoscientific practices. The case studies explored by the respective authors shed light on different aspects of the local adaptation and innovation of digital and pharmaceutical technologies.

Marine Al Dahdah and Mathieu Quet's chapter documents the Mauritian logistics industry through the prism of its digital turn. The role of logistics is to manufacture 'seamless' commodity flows, and digital devices have been increasingly mobilised in order to perform this function. However, manufacturing seamlessness digitally requires continuous efforts of adjustment between global standards, hegemonic tools, and local resources. The chapter therefore

examines the adaptation of digital software to meet local needs in Mauritius, emphasising the efforts of a local IT company to patch global platforms and local firms' environments in order to cater to the specific requirements of regional logistics. By doing so the chapter explores how digital technologies contribute to stabilising logistical flows at the cost of permanent patching work.

Studying pharmaceutical technologies in Chad, Ilyass Mahamat Nour Moussa shows how transnational actors such as international organisations play an essential role in the global integration of the Chadian pharmaceutical market by supporting the securitisation of medicine flows. In his case study, the author examines how the Chadian Ministry of Health seized the opportunity presented by a development programme funded by the World Bank, intended to reduce gender inequality in the Sahel countries, to set up a laboratory for controlling the quality of industrial medicine. By taking seriously the agency of the Chadian actors to bypass the norms implemented by international organisations, the author helps us to think about how local players are appropriating, repurposing, and circumventing standardised apparatuses to fit their specific needs – which reflect key dynamics of technoscientific globalisation 'from below'.

The final theme explored in the book relates to alternative value-making strategies and specific market fabrication within the context of technoscientific globalisation. The authors dig into the creation of markets in the Global South and investigate how in this context technology answers specific demands as much as it fashions expectations. By looking at the emergence of specific technological markets, the authors encompass a wide range of actors, corporate formations, strategies, and practices of capitalism that do not exist *per se* in the Global North. These different ways of shaping and forming markets are also supported by alternative regulatory strategies, values, and representations, which are also scrutinised by the authors.

Yves-Marie Rault-Chodankar shows how business practices in the Indian generic drugs industry contrast with the strategies of the IP-capital-rich industry in the Global North. He highlights companies' use of inventive copying to gain patient loyalty in low-income markets, to diversify their manufacturing capacities through national and international certifications to cater to diverse production needs, and to develop local distribution networks through multiple types of

relationships with suppliers, wholesalers, retailers, and doctors. Rault-Chodankar considers whether the capitalist model proposed by Indian generic companies establishes a structured alternative to IP-based pharmaceutical globalisation.

Cecilia Passanti's contribution investigates the collaboration between public administrations and IT companies in developing technological tools to secure voting and democracy in Africa. Although biometrics are used worldwide for various purposes (migration control, passport issuance), they are particularly developed for and within Global South contexts in the case of elections. This is especially true in Africa, where many countries have formed long-term relationships with the IT industry to create, since independence, the material conditions for democracy, citizenship, and public participation. Passanti analyses the structured organisation of labour required to produce electoral biometric artefacts in Kenya and Senegal, which involves the daily work of institutions and individuals at both national and transnational levels. In doing so, she highlights how these technologies travel and become global through the reproduction, in many sites, of situated social relations of production.

Aamod Utpal investigates the processing of peanut butter to make a humanitarian good to address food security needs. The author examines how Global North actors, by redefining peanut butter as a medicine, have created a new market for ready-to-use therapeutic food (RUTF) producers, the majority of which are Indian. He explores the ways in which technological transformations influence market shaping and dynamics, and questions how the Indian localisation of RUTF participates in shaping specific answers and critiques to the product itself.

By addressing these themes, the book aims to uncover the agency of local actors, power dynamics, and the transformative potential of technology in shaping societies and markets in the Global South. By focusing on the experiences and innovations of actors from the Global South, we seek to challenge the ethics and implications of globalised industries, thereby encouraging critical discourse on alternative models of innovation, development and participation (Jasanoff 2004; Tyfield 2012), and contributing to a more inclusive and nuanced understanding of technoscientific globalisation.

THINKING TOGETHER, MAKING STS GLOBAL

This edited volume is the outcome of the activity of a group of young researchers united by a shared interest in analysing the production, circulation, and appropriation of scientific and technological objects in Africa, Asia, and Latin America. Coming together in 2019 at the initiative of Mathieu Quet (who was initially the only tenured scholar in the group) to think about science and technology in the Global South, our collective has been mostly composed of eleven scholars who were attached at one moment of their career to the Centre Population et Développement (CEPED) research unit in Paris, part of the broader Institut de Recherche pour le Développement (IRD).

More than half of our fellows were born and raised, and studied, in Global South countries (Chad, India, Brazil and Ecuador). The remaining five are natives of France and Italy, two of whom are the only women left of the group. At the time of publishing, there are only two permanent researchers, who turn out to be two of the three French white male scholars of the group. The rest of us are PhD candidates and/or post-doctoral research fellows searching for permanent positions and less precarious futures. Along this vibrant journey, two colleagues had to leave academia due to the lack of professional opportunities. One joined an NGO, and the other became a bartender: research can definitely lead to everything.

At the very beginning of our collective, we aimed to create a collaborative space for our heterogeneous group located in different classes, races, genders, levels of seniority, professional trajectories, and geographies (Harding 2004). We faced issues with bringing ourselves up to speed, especially when knowledge, language, theories, and epistemological frameworks mostly originate from Europe and the US. The difficulties experienced by our two Indian members in navigating French academia and visa administration without any prior knowledge in French illustrated the complexities of a supposedly postcolonial world in which it remains extremely hard for Southerners to get visas and housing in the face of systemic racism and due to massive differences in living cost between their countries of origin and Europe. The arrival among us of a Chadian PhD candidate, fresh off the plane in France and with no English skills,

further illuminated some of the major issues entangled in epistemic inequities and injustices, not only because English dominates the academic world but also because there had been no opportunity in Chad to study STS at master's level. It also made communication within the group more complicated and forced us to imagine and implement alternative translation practices – with which we fondly experimented.

We met regularly between 2019 and 2024 to discuss the inner workings of what we call 'technoscientific globalisation from below'. Applying critical reflexivity to our methodological practices allowed us to address the imperial legacy of extractive research practices (Liboiron 2021: 1). Through our research, we embraced decolonising approaches by aiming to bring to light historically silenced voices, to acknowledge and present the people we are writing about as knowledge holders and, beyond this, knowledge makers (Thambinathan and Kinsella 2021). By being attentive to the power relations between us, as colleagues, and between us as researchers and the people we met during our fieldwork, we critically reflected on our own practices, sharing the responsibility to open up space for decolonising visions (Thambinathan and Kinsella 2021). This was made possible by centring the concerns and worldviews of Global South individuals when studying the globalisation of technological goods in poorer, non-hegemonic contexts (Smith and Hanson 2012). Basing our method upon the collection of empirical work, we aimed at giving a voice to the plethora of actors from developing and emerging countries whose active role in the production, circulation, regulation, appropriation, and consumption of technologies is critical to current globalisation processes – even though it is frequently dismissed and silenced. By doing so, we intended to curb the perpetuation of inaccurate stereotypes about Global South countries regarding technological globalisation.

From 2021, we started to organise, once a year, short-duration stays, from three days to one week, during which we experienced more fully an academic life organised around collaborative work, writing, and living. We worked hard during the day to craft the chapters of this book while it was still a project, but as a group we also self-organised in informal and pleasant ways: deconstructing hierarchies and tasting French wine, Brazilian caipirinhas, or Indian Old Monk rum during lively apéritifs, cooking together and sharing food, discussing the

merits of Bollywood movies, inquiring about Chadian politics, and often ending up dancing to the tune of whoever had appropriated the Bluetooth speaker.

We also decided to open the conversation to a broader pool of researchers and set up a monthly online seminar entitled 'Technological globalisation from below,' with the support of the CEPED, the Global Research Institute of Paris (GRIP), and the Université Paris Cité. From 2021 to 2024 this seminar became an opportunity to discover, welcome, and listen to the work of researchers in the humanities and social sciences, half of them originating from Global South countries, half of them women, whose research topics were in the Global South and who anchored their studies in the field of science and technology studies (STS). We were trying as much as we could to fight against the imbalance between 'mainstream' and 'peripheral' STS (Invernizzi et al. 2022). We wish to warmly thank these researchers for the great value of their contributions, which deeply informed the reflections presented in this book: Festus Boamah (Dept of Geography, Universität Bayreuth), Xan Chacko (Brown University), Armelle Choplin (Dépt de géographie et environnement, Université de Genève), Kevin P. Donovan (Centre of African Studies, University of Edinburgh), Abena Dove Osseo-Asare (Dept of History, University of Texas), Stefan Ecks (School of Social and Political Science, University of Edinburgh), Christine Ithurbide (CNRS, Passages), Nathalie Jas (INRAE, IRISSO), Sibel Kusimba (Dept of Anthropology, University of South Florida), Joshua Lepawsky (Dept of Geography, Memorial University), Nancy Odendaal (University of Cape Town), Alyssa Paredes (Dept of Anthropology, University of Michigan), Anne Pollock (Global Health & Social Medicine, King's College), Laurent Pordié (CNRS, Cermès3), Rajeswari Raina (International Relations and Governance Studies, Shiv Nadar University), Luisa Reis-Castro (Dept of Anthropology, University of Southern California), Suvobrata Sarkar (Rabindra Bharati University, Kolkata), Puleng Segalo (University of South Africa), James H. Smith (Anthropology Dept, UC Davis), and Gabriela Soto Laveaga (History of Science Dept, Harvard University).

These discussions also permitted us to keep meeting online, as most of us were often doing fieldwork abroad and not regularly in touch with our common host university. More generally the seminar was a place to share and discuss

our concerns regarding the major problem centred on epistemic inequities and injustices. On one occasion we notably received Professor Puleng Segalo from the University of South Africa to talk about their collaborative project to radically transform research partnerships between Africa and the Global North. Their Africa Charter on Transformative Research Collaborations (Gebremariam et al. 2023) is instrumental in repositioning Africa's global science and research ecosystem. It has become an inspirational tool for our collective to question why African ways of being and other knowledge systems in the Global South are often relegated to the periphery, and Euro-Western ways of knowing are centralised as the norm. We want to express our particular thanks to Puleng Segalo for her intervention.

At last, we decided that all these reflections deserved to be published together – and quite soon it appeared we would work with Mattering Press. We wish to thank the publishing team wholeheartedly for their help and support, with a particular shoutout to Anna, who followed the project with much friendliness and dedication. We also wish to thank Tabita Rezaire for accepting that her work would be used on the cover of the book. This means a lot to us as her work has questioned in various ways the coproduction of technology, colonialism, and race. We are very proud to slide our thoughts, literally, in between her visual reflections at the intersection of Afrofuturism and cyberfeminism that more generally irrigate our discussions. Nonta Libbrecht-Carey has played a key role in translating or editing most of the initial manuscript, which has mostly been written by non-native English speakers. With this book, we seek to shed light on the multitude of social actors occupying subaltern positions and contributing through multiple initiatives to innovate, to produce, but also to consume; we hope this intervention indicates how their participation increasingly gives shape to different forms of globalisation. Unearthing these untold stories may hopefully contribute to generating new imaginaries through which to invent alternative futures that are fairer and based on collective needs. The chapters unveil the possibilities, in an increasingly capitalistic world where inequities and hierarchies are still considered inevitable for globalisation, for everyone to have a role. Hence, we dedicate this book to all the actors we met in our respective research sites and who are endeavouring to make the Global

South something other than just a place of extraction, i.e., where innovations and/as alternatives are also conceived.

ENDNOTES

1 The expression 'Global South' – referring mostly to former colonies and poorer countries – marks a divide with the 'North', mostly formed of the richest nations and former Western colonial powers. Although the expression offers a binary and simplistic vision of the world, it tends to indicate structural power asymmetries and helps us throughout the text to take into account the critical consequences of such inequalities. We therefore assume the relevance of 'Global South' and praise the possibility of contestation it brings to the global order (Prashad 2012) in contrast to country nominalism or other categorisations such as the Goldman Sachs–coined 'BRICS' or the World Bank's 'emerging markets', which not only include fewer countries but also focus primarily on perspectives of economic growth.

2 Joseph Needham pictured the history of science as multiple civilizational rivers running into the same ocean of knowledge – science.

3 Data available via the Knowledge Portal on innovation and access to medicines: https://www.knowledgeportalia.org/covid-19 (accessed June 2024).

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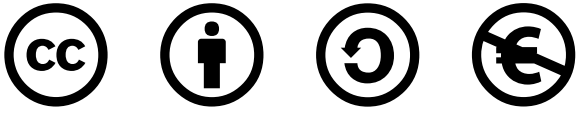

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