The Palgrave Handbook of the Anthropology of Technology

Edited by Maja Hojer Bruun · Ayo Wahlberg
Rachel Douglas-Jones · Cathrine Hasse
Klaus Hoeyer · Dorthe Brogård Kristensen
Brit Ross Winthereik

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"This extraordinarily ambitious and comprehensive volume shows how many things we might have previously considered merely the context for studying technologies are themselves technologies. Through this perspective, we come to learn how technologies facilitate the creation of moral norms, social orders, infrastructures and power. Examples range from datafication and energy to committees, knowledge, gender, authenticity, food and many forms of classification. Such a holistic sensibility is surely apt for the discipline of anthropology, continuing a tradition that recognises that technologies are as much concerned with making people as with making things."

—Daniel Miller, *University College London, co-author of The Global Smartphone*

"Whether you take up this *Handbook* as an introduction or a review, these writings expand and update our conceptual framework for thinking with anthropology about technology. Technologies, in these writings, are inseparable from the knowledge practices, collectives, controversies and infrastructures that configure them and render their significance. Framed as technological, socio-material relations have been incorporated into histories and political economies specific to colonial and instrumentalist logics of development and progress. Locating technology as one among the many tropes, processes and practices that conjoin matter and meaning, this collection opens lines of analysis able to generate radically different stories."

—Lucy Suchman, *Lancaster University, author of Human-Machine Reconfigurations*

"A monument to the unison of hand, book and tool, this ambitious compendium offers resounding proof that the anthropology of technology has come of age. In their sheer richness and diversity, the volume's many contributions show that researching technology, far from a narrow specialism, seeks nothing less than to place human being and becoming in a world undergoing unprecedented, and potentially cataclysmic transformation. From the climate emergency, through the energy transition and public health, to race and inequality, these studies address some of the most pressing questions of our time. Authoritative, wide-ranging and forward-looking, the *Handbook* will be an indispensable source for years to come."

—Tim Ingold, *University of Aberdeen, author of Imagining for Real*

"This is a handbook in the best sense of the word, a convincing expansion of anthropological approaches to technical systems to dozens of contemporary hot topics: energy transition, robotics, digital culture, issues of discrimination, welfare austerity, emerging technologies. The articles analyzing the body, gestures, and objects will provide the reader with excellent theoretical and methodological syntheses, and scores of up-to-date references."

—Pierre Lemonnier, *The French National Centre for Scientific Research (CNRS), author of Mundane Objects*

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Preface

How did this book come into being? In the spring of 2017, we submitted an application to the Independent Research Fund Denmark for a research network on 'The Anthropology of Technology: future technologies, culture, and human practices' following Maja Hojer Bruun's vision to bring together anthropologists widely dispersed across Denmark's universities and other institutions, often working in interdisciplinary research environments. What united us was a common empirical interest in the ways in which technologies (re-)shape political economies, societies, cultures, and identities in different parts of the world. The network kicked off at Aarhus University in May 2018 and has come together on a regular basis for seminars and conferences hosted at each of our respective universities ever since.

Working across robotics, drones, biomedicine, energy, digital data, and infrastructures, our ambitions grew as we received positive feedback from those who took part in our many events, furthering anthropological conversations focused on technology. We determined that one way to further boost the study of technology in anthropology, not just in Denmark but internationally, would be by publishing a Handbook. Why did such an exciting sub-field of anthropology not have its own Handbook? We immediately realised the obligating implications of such an enunciation, not least at a moment when massive societal challenges of climate change, energy transitions, rising healthcare needs, welfare austerity, inequality, discrimination, and political unrest loomed large.

With contributions from no less than 46 scholars from around the world, we are proud to present this *Handbook of the Anthropology of Technology*. The obstacles inherent to a global pandemic have imposed an increased workload and emotional pressure on academics worldwide, the authors in this volume being no exception. Yet, despite immense challenges to upholding writing routines and daily life, they have contributed a diverse and rich set of chapters highlighting different aspects of the anthropology of technology. We thank each one of them for their efforts. There is no doubt that the insights presented will be of great value to future generations of anthropologists.

As anyone who has ever been involved in bringing together a Handbook will attest, doing so is no small task but, rather, one involving countless editorial meetings to design and debate content and structure, globally disseminating invitations to contribute chapters, preparation of a book proposal, meetings with potential publishers, requests for peer reviews of chapter drafts, preparation of feedback, and more. We are eternally grateful to all the contributors and peer reviewers for finding the time to work on, complete, and review the 39 chapters that make up this *Handbook of the Anthropology of Technology*. We are appreciative of your commitment to this collective project and of the result.

Aarhus, Denmark   Maja Hojer Bruun
Copenhagen, Denmark   Dorthe Brogård Kristensen
Odense, Denmark   Rachel Douglas-Jones
                                                               Klaus Hoeyer
                                                              Cathrine Hasse
                                                              Ayo Wahlberg
                                                       Brit Ross Winthereik

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Astrid Oberborbeck Andersen holds a PhD in Social Anthropology from the University of Copenhagen. She is Associate Professor of Techno-anthropology at Aalborg University. Her research centres on human–environment relations, specialising in anthropological perspectives on climatic change and environmental crises with a focus on water politics in Peru and Latin America, and wildlife and ecosystems management in Greenland. The cross-disciplinary politics of knowledge and collaboration on technological and environmental issues are central in Astrid's research. She is currently co-principal investigator of the research project 'Muskox Pathways: Resources and Ecologies in Greenland', and co-leads an environmental humanities research network.

Anne Beaulieu is Associate Professor of Science and Technology Studies and director of the Data Research Centre, University of Groningen, where she leads the research group 'Knowledge Infrastructures for Sustainability' and has developed the minor 'Data Wise: Data Science in Society' (with Gert Stulp). Beaulieu's work focuses on diversity and complexity in knowledge infrastructures. She is co-author of *Virtual Knowledge: Experimenting in the Humanities and the Social Sciences* and of *Data and Society: A Critical Introduction* (2021). Since September 2018, she has been co-coordinator of the national PhD training network of the Netherlands Graduate Research School of Science, Technology, and Modern Culture (WTMC).

Mikkel Bille holds a PhD in Social Anthropology from University College London. He is an associate professor at Roskilde University, leading the project 'Living with Nordic Lighting' (Velux Foundation). His research focuses on the materiality, atmospheres, and social uses of lighting, particularly in Scandinavia and the Middle East. His most recent books include *Living with Light* (2019), *Being Bedouin around Petra* (2019), and *Elements of Architecture* (co-edited with Tim Flohr Sørensen).

Cal Biruk is Associate Professor of Anthropology at McMaster University and the author of *Cooking Data: Culture and Politics in an African Research World* (2018). Biruk's research interests lie at the intersection of medical anthropology, critical data studies, global health studies, and queer studies. Biruk's projects focus on the sociotechnical infrastructures that produce and quantify 'key populations' in Malawi as objects of knowledge, investment, and affect, on the racialised politics of aid economies and audit cultures in southern Africa, and on fitness wearables as technologies that harbour queer potential.

Francesca Bray is an anthropologist and historian of science, technology, and medicine in East Asia, with a particular focus on how technologies serve to weave gender principles into the very fabric of states and government; see, for instance, *Technology, Gender and History in Imperial China* (2013). She is co-editor of the forthcoming *Cambridge History of Technology*, and Emerita Professor of Social Anthropology at the University of Edinburgh.

Maja Hojer Bruun is Associate Professor in the Department of Educational Anthropology, Aarhus University, and convenor of the Danish research network for the Anthropology of Technology (AnTech). Her research centres on emerging digital technologies, spanning robots, drones, urban living labs, and data encryption infrastructures, and in her work she explores collaborative, interventionist, and experimental ethnographic methods. In her current research project she is interested in the forms of knowledge, organisation, and government through which cities are turned into living labs and sites of experimentation, and how people, data infrastructures, and digital devices are enrolled in processes of urban planning.

Mikkel Bunkenborg is Associate Professor of China Studies in the Department of Cross-Cultural and Regional Studies, University of Copenhagen. Working at the intersection of China studies and anthropology, his research has focused on bodies and medicine, on politics and popular religion in rural North China, and on Chinese globalisation as it unfolds through infrastructure construction, resource extraction, and trade in Mongolia and Mozambique. He is currently the primary investigator of a collaborative ethnographic project entitled 'Moral Economies of Food in Contemporary China'.

Stephanie Bunn is Senior Lecturer in Social Anthropology at the University of St Andrews. She has conducted research into Central Asian felt textiles and basketry worldwide and curated numerous exhibitions, including the first-ever

British Museum exhibition of Kyrgyz felt textiles. She is author of *Nomadic Felt*, editor of *Anthropology and Beauty (2010)*, and co-editor with Victoria Mitchell of *The Material Culture of Basketry (2020)*. She coordinated the Woven Communities Project, on Scottish basketry heritage, and is currently collaborating with educational mathematician Professor Ricardo Nemirovsky, Professor Cathrine Hasse, and three basket makers on the Royal Society-funded 'Forces in Translation', researching the relationship between basket work and mathematics.

Alison Cool is Assistant Professor of Anthropology at the University of Colorado. She is a cultural anthropologist whose research focuses on digital technologies, data ethics, and how people think about privacy and surveillance. Her current project, based on fieldwork in Sweden, is an ethnographic study of how experts, professionals, and activists go about the ethical and pragmatic work of protecting and sharing personal data. She also researches and writes about how behavioural economists see the world, and the role of twins as scientific and medical research subjects.

Ludovic Coupaye is Associate Professor of Anthropology at University College London. His research focuses on four interrelated topics: material and visual culture in Oceania; art and aesthetics among the 'Abelam' communities of Papua New Guinea; anthropology of techniques, skills, and materiality; and anthropology of technology and Modernity. His most recent interests are the relationships between 'technology' and 'society' from the angle of technical activities, technical objects, and technical systems. He is the author of *Growing Artefacts, Displaying Relationships: Yams, Art and Technology Amongst the Nyamikum Abelam of Papua New Guinea* (2013).

Mie S. Dam is Assistant Professor at the University of Copenhagen. Her research explores the development of new medical treatments at the intersection between laboratory and clinic. She takes a special interest in how researchers navigate scientific and moral responsibilities as they work to translate science into better human lives. In her current research, she explores personalised modelling and patient selection in cancer genomics. This project is part of the 'MeInWe' project. Her PhD was conducted as part of the LifeWorth project and concerned translation across animal model and human patient in experimental neonatology.

Rachel Douglas-Jones is Associate Professor at the IT University of Copenhagen, where she heads the Technologies in Practice research group and co-directs the ETHOS Lab. She conducts research on questions of ethics and the governance of science and technology, and is currently the principal investigator of 'Moving Data-Moving People', a study of emergent social credit systems in China through the lens of trust. Her recent publications include 'Committee as Witness' (the *Cambridge Journal of Anthropology*, 2021) and 'Bodies of Data' (*Journal of the Royal Anthropological Institute* (JRAI), 2021).

She is the editor (with Antonia Walford and Nick Seaver) of 'Towards an Anthropology of Data' (JRAI, 2021).

Joseph Dumit is an anthropologist of passions, performance, brains, games, bodies, drugs, and facts. Chair of Performance Studies and Professor of Anthropology and Science & Technology Studies at the University of California, he is author of *Picturing Personhood: Brain Scans and Biomedical America* (2004) and *Drugs for Life: How Pharmaceutical Companies Define Our Health* (2012). He works with neuroscientists, artists, and improvisers in Denmark, Germany, and France on multimedia installations for social learning and togetherness.

Christina Dunbar-Hester is the author of *Hacking Diversity: The Politics of Inclusion in Open Technology Cultures* (2020) and *Low Power to the People: Pirates, Protest, and Politics in FM Radio Activism* (2014). She is a faculty member at the Annenberg School of Communication at the University of Southern California in Los Angeles, and she holds a PhD in Science & Technology Studies from Cornell University, USA. Her writing and research centres on the politics of technology in culture, especially media and tech activisms, infrastructures, and envirotechnical assemblages.

Vaike Fors is Associate Professor at the School of Information Technology at Halmstad University, Sweden. Her area of expertise lies in the fields of visual, sensory, and design ethnography. In her pursuit to contribute to further understandings of contemporary conditions for learning, she has studied people's interaction with new and emerging technologies in various research projects. Fors is an experienced project leader of international scientific, applied, and collaborative research projects. Recent publications include the book *Imagining Personal Data: Experiences of Self-Tracking* (2020).

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Gökçe Günel is Assistant Professor of Anthropology at Rice University. Her latest book, *Spaceship in the Desert: Energy, Climate Change, and Urban Design in Abu Dhabi* (2019), focuses on the construction of renewable energy and clean technology infrastructures in the United Arab Emirates, more specifically concentrating on the Masdar City project. Her articles have been published and are forthcoming in *Public Culture*, *Anthropological Quarterly*, *Engineering Studies*, *South Atlantic Quarterly*, *Log*, *e-flux*, and *PoLAR*, among others. Currently, she is working on a book on electricity production in Ghana, provisionally titled *Energy Accumulation*.

Cathrine Hasse is Professor in the Department of Educational Anthropology, Aarhus University, and programme manager of the research programme 'Future Technologies, Culture, and Learning'. She is the author of *Posthumanist Learning* (2020) and *An Anthropology of Learning* (Springer 2015). She has been coordinator of several EU projects (e.g. REELER—Responsible and Ethical Learning in Robotics) as well as Danish projects exploring processes of learning with technology. She holds a PhD in cultural learning processes in physics from Copenhagen University (2000). Her writing centres on learning as a conceptual-material change of environments.

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Klaus Hoeyer is Professor of Medical Science and Technology Studies, Department of Public Health, University of Copenhagen. He is a social anthropologist whose work focuses on the interaction between patients, health professionals, and larger organisational and regulatory processes when new medical technologies are being introduced. His research focuses on the drivers for and implications of intensified data sourcing in healthcare.

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Christo Sims is an associate professor in the Department of Communication, and an affiliated faculty member in Science Studies, Ethnic Studies, and the Design Lab, at the University of California, San Diego. His first solo-authored book, *Disruptive Fixation: School Reform and the Pitfalls of Techno-Idealism* (2017), won the 2018 Best Book Award from the Communication, Information Technologies, and Media Sociology section of the American Sociological Association. He is currently a member of the Institute for Advanced Study in Princeton, New Jersey, where he is working on a book project about how monopolistic technology corporations are deploying avant-garde architecture as a political technology.

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The Anthropology of Technology: The Formation of a Field

Introduction

Maja Hojer Bruun and Ayo Wahlberg

Technology, defined anthropologically, is not material culture but rather a *total* social phenomenon in the sense used by Mauss, a phenomenon that marries the material, the social and the symbolic in a complex web of associations.
—Bryan Pfaffenberger, *Fetishised Objects and Humanised Nature: Towards an Anthropology of Technology*, 1988, p. 249

Technology embraces all aspects of the process of action upon matter, whether it is scratching one's nose, planting sweet potatoes, or making jumbo jets … technologies are—like myths, marriage prohibitions, or exchange systems—social productions in themselves.
—Pierre Lemonnier, *Elements for an Anthropology of Technology*, 1992, pp. 1–2, 11

The shift from the classical concept of *tekhnê* to the modern concept of technology has brought about a profound change in the way we think about the relation between human beings and their activity. The image of the artisan, immersed with the whole of his being in a sensuous engagement with the material, has given way to that of the operative whose job it is to set in motion an exterior system of productive forces, according to principles of mechanical functioning that are entirely indifferent to particular human aptitudes and sensibilities.
—Tim Ingold, *Eight themes in the Anthropology of Technology*, 1997, pp. 130–131

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> Once seen as producing worldwide homogenization and generalized accultura-
> tion, cosmopolitan science and technology are now viewed in terms of their real
> or potential contribution to the formation of hybrid cultures and to processes of
> self-affirmation of their selective and partially autonomous adoption. … [N]ew
> languages are needed that allow different groups of people (experts, social move-
> ments, citizens' groups) to reorient the dominant understanding of technology.
> —Arturo Escobar, *Welcome to Cyberia: Notes on the Anthropology*
> *of Cyberculture*, 1994, pp. 215, 221

Anthropos and *techne* are inseparable when it comes to the study of humans and
their societies. From its very origins as a discipline, anthropology has recorded
and researched human-technology interfaces in efforts to account for and
understand forms of social organisation and practice as well as systems of belief
and meaning throughout the world. Whether approached in terms of the tools
and dexterous capabilities that were seen to separate humans from other spe-
cies or the technical systems that allowed for subsistence and the reproduction
of society, human ingenuity and practice involving the development and use of
various kinds of technologies has been a definitive object of ethnographic
inquiry.

Today, two decades into the twenty-first century, anthropological approaches
to studying technology are thriving. In this Handbook, we have brought
together 39 chapters to demonstrate that while there is no single 'anthropol-
ogy of technology', there is a set of approaches that constitutes a field of
enquiry. This field is informed by just over a century of anthropological
thought, the history of which illuminates as much the changing landscapes of
technological advance as it does the anthropological theories that have been
used to make sense of technologies in development and use. We begin this
chapter by cataloguing a plethora of definitions of technology, each of which
has informed this collection in different ways. From there, we provide readers
with a historical exposé that takes us from early evolutionary studies of technol-
ogy via critiques of it by those who championed diffusionist understandings to
more contemporary notions of socio-technical systems and infrastructures.
With the advantage of digital search technologies and global journals, our view
of the history of the place of technology in the discipline is shaped by technol-
ogy itself. Once we have situated the anthropology of technology historically,
we move on to explain the logic of how we have structured the chapters that
follow. Finally, we end this introduction by recapitulating why it remains so
relevant and important to mobilise anthropological studies of technology at
the present time.

The Handbook is organised around what we see as some of the most impor-
tant characteristics of anthropological studies of technology, often in dialogue
with work in archaeology, sociology, history, political science, and, not least,
science and technology studies (STS). Our four thematic sections are dedicated
to: (1) the diverse knowledge practices that technologies involve and on which
they depend; (2) the communities, collectives, and categories that emerge

around technologies; (3) anthropology's contribution to proliferating debates on ethics, values, and morality in relation to technology; and (4) infrastructures that highlight how all technologies are embedded in broader political economies and socio-historical processes that shape and often reinforce inequality and discrimination while also generating diversity. Importantly, all sections and chapters share a commitment to fieldwork, perhaps not always in a conventional sense but always with a focused attention to experiences, embodiments, practices, and materialities in the daily lives of those people and institutions involved in the development, manufacturing, deployment, and/or use of particular technologies. While the Handbook's four thematic sections all have separate introductions, in this opening chapter the perspectives, fields, and approaches covered in the Handbook's first section are woven into our account of the gradual formation of 'anthropology of technology' as a field of enquiry.

Technology and Techniques

Colloquially, technologies are understood as artefacts. This foregrounds their material existence, origin, creation, and use. In classic ethnographies of the introduction and adoption of new or 'foreign' technologies in new settings (e.g. Sharp 1968[1952]; Godelier and Garanger 1979), artefacts like stone and steel axes are singled out and described, at times in deterministic, evolutionary ways. To this day, in popular accounts, technologies are often disembedded from the social and from human bodies, as they come to 'stand out' materially. Perhaps this is because there are still too few narrative repertoires that allow for the weaving together of technology and social relations into integrated wholes, since it would require us to abandon modernity's divide between technology and society (cf. Latour 1993). Or is it because there *is* something immanent in technologies that either lends them special, magic powers (Gell 1992), or makes them disappear, like Heidegger's (1973[1927]) ready-to-hand hammer, which only appears when it breaks down, Merleau-Ponty's (2002[1945]) blind stick or invisible infrastructures (Star and Ruhleder 1996)?

While sociologists or historians of technology usually study the development of a product or innovation in modern science or engineering (e.g. Bijker et al. 1987; Bijker and Law 1992; Bijker 1995; Hughes 1983), and most technical sciences do not consider anything else as technology, anthropologists have worked according to a wider concept. This breadth is reflected in our Handbook, with chapters covering basket-weaving techniques, reproductive technologies, technologies of beauty, and technologies of government. Anthropologists and archaeologists have always shared an interest in the most mundane and taken-for-granted *things* of everyday life, and studied these as technology or material culture: typically baskets, pots, hoes, arrows, or other tools, not to forget pipettes, smart phones, and cars. At the same time, however, anthropologists have recorded a multiplicity of contemporary human technological practices involving all kinds of ephemeral activities and perishable materials that do not leave traces for archaeological excavation. What counts as

technology in particular contexts and for whom are some of the open questions that are brought to various fields of study and fieldwork sites.

Anthropologists have provided several useful definitions of technology that emphasise that if we are to understand technologies, we must go beyond the artefacts and include human bodies, skills, traditions, practices, processes, and socio-technical systems when conceptualising them. We selected four contrasting quotes to open this volume for the distinct perspectives on technology that they offer, founded in three distinct anthropological traditions in France, the United Kingdom, and the United States. These distinctions can be partially understood through the way the terms 'technique' and 'technology' are used in French and English.

In his 1994 encyclopaedia entry on technology, François Sigaut discusses the terms systematically and defines techniques (the preferred term in French anthropology) by referring to Marcel Mauss's proposition: 'We call techniques an ensemble of movements or actions, in general and for the most part manual, which are organized and traditional, and which work together towards the achievement of a goal known to be physical or chemical or organic' (Mauss 2006[1941/1948], p. 149). Those aspects of technology that relate to bodily movements and material actions implicated in techniques often escape the attention of Anglo-American scholars because of the modernist connotations of 'technology' in English (Sigaut 1994; cf. Schlanger 2006). Here, the concept of technology usually refers to the achievements of modern engineering, 'in short, those techniques that are informed by a relatively scientific content and methods' (Sigaut 1994, p. 422).[1] This understanding of technology, as Nathan Schlanger (2006) points out, leads to a hierarchical, or hierarchising, difference between the 'technical' and the 'technological'. In this hierarchy, 'techniques' and 'technical' skills apply to phenomena that are traditional, small-scale, or tacit, while 'technology' refers to phenomena deemed modern, complex, and sophisticated. In this sense, 'technology' did not exist in so-called pre-modern societies, only 'tools' and technical skills. Think, for example, of the difference between basketry techniques and ballistic technology.

Mauss was the first to suggest that there is something fundamentally non-technical about technology. He argued that technology needed to be put back on the research agenda of the social sciences after its confinement to a marginal position during the formation of the modern sciences of the social (Schlanger 2006). Although Mauss had already in his work on religion and magic compared magic and techniques, both of which are *actes traditionelles efficaces* (Mauss 1903; passim in Schlanger 2006, p. 15), it was only after his personal experiences as a soldier during the First World War, and the general recognition of the powers of modern war technologies that followed from the war, that he formulated an explicit programme for the social study of technology. His essay on techniques of the body (2007[1935]) remains the most widely known. Here his point was that there are techniques which do not require extra-somatic instruments, while they always require the body: 'The body is man's first and most natural instrument' (2007[1935], p. 56). Just as importantly, however, as

Sigaut noted, Mauss pointed out that techniques are an ensemble of movements or actions that are organised (sometimes translated as 'effective') and traditional, which here means that they must be learned, taught, and transmitted in collective contexts, either as habitus or through oral transmission. Moreover, techniques are goal oriented, and 'they are felt by the author as *actions of a mechanical, physical, or psycho-chemical order* and … they are pursued with that aim in view' (2007[1935], p. 56). This is the Maussian legacy on which the French anthropologist Pierre Lemonnier (1992, 1993, 2012) builds in his anthropological theories of technology. He argues that techniques *as material actions* are always themselves social phenomena and are always systemic in that all techniques involve the five interacting elements of matter, energy, objects, gestures, and knowledge. This in turn obliges the ethnographer to follow and document the material and social processes that form, for example, through gardening, hunting, farming, building eel-traps, canoes, or smartphones (Lemonnier 2012).

Somewhat in contrast, Tim Ingold has argued that, rather than techniques of the individual body, anthropologists should empirically foreground *skills* through an 'ecological approach, which situates the practitioner … in the context of an active engagement with the constituents of his or her surroundings' (Ingold 1997, p. 110). For Ingold, skills involve the qualities of care, judgement, and dexterity. Hence, he argues that we must attend, conceptually and methodologically, not to techniques (of the body) but to 'making'. A mix of improvisation and imitation, making arises within the form-generating potentials of complex processes of skilled movement. At the same time, as we saw in one of the epigraphs to this introduction, like Sigaut and Schlanger, Ingold too affirms that 'technology' has come to denote modern society's control over nature, adding that to use the term technology is not only to denote a thing but to make a claim: 'technology [is] the means by which a rational understanding of [the] external world is turned to account for the benefit of society' (2000, p. 312). He points out that the images invoked by contemporary uses of the concept of technology—of operators rather than artisans and of exterior mechanisms rather than embodied skills—impact profoundly on the way we allow ourselves to think about technology and technology's role in society (see also Bunn this volume).

Coming from American cultural anthropology, and with an Anglo-Saxon understanding of technology as operative systems, Bryan Pfaffenberger (1988) has argued that anthropologists should focus on interwoven socio-technical systems and systems of meaning. In his 1992 *Annual Review of Anthropology* article on the anthropology of technology, Pfaffenberger introduces the then 'emergent field known as science and technology studies (STS)' (1992a, p. 493) to a broader anthropological audience. In doing so, he draws a parallel between Mauss's 'total social phenomena' and Thomas Hughes's 'sociotechnical system' (1987). While Hughes and other Social Construction of Technological Systems (SCOT) scholars (see Bijker et al. 1987) had already showed that a successful technological innovation depends on the 'seamless'

(i.e. indissolubly linked) integration of technical, social, economic, and political aspects, Pfaffenberger argued that socio-technical systems are *also* embedded in culture, in ritual and mythic narratives. In this view, 'to construct a technology is not merely to deploy materials and techniques; it is also to construct social and economic alliances, to invent new legal principles for social relations, and to provide powerful new vehicles for culturally-provided myths' (Pfaffenberger 1992a, p. 249).While Pfaffenberger formulated a programme for a new STS-inspired anthropology of technology, others would in a sense invert this programme when taking anthropology to STS, generating a string of post-structural analyses of emerging technologies (e.g. Escobar 1994; Martin 1994; Rabinow 1996; Franklin 1997; Downey and Dumit 1997a). In the 1960s to 1970s, the interdisciplinary field of science and technology studies was dominated by the history, philosophy, and sociology of science. However, by the late 1970s and throughout the 1980s, two turns in STS brought this field together with anthropological studies of technology. A series of ethnographic studies of and in laboratories (Knorr 1977; Latour and Woolgar 1979; Traweek 1988), introduced anthropological methods to STS, along with methodological approaches to the cultures, practices, and social relations in the making of scientific facts that have gained influence over the years to form a 'practice turn' or 'empirical turn' in STS (e.g. Mol 2002). In the same period, a 'turn to technology' occurred in STS (Pinch and Bijker 1984; MacKenzie and Wajcman 1985; Akrich 1992; De Laet and Mol 2000) that also drew anthropologists interested in technology (e.g. Pfaffenberger 1988, 1992a). As the chapters in this handbook show, many scholars working with different anthropologies of technology are equally committed to both anthropology and STS, and many debates and research environments overlap.

Working at the intersections of anthropology and STS, Arturo Escobar went on to reformulate anthropological definitions of technology when arguing 'that human and social reality is as much a product of machines as of human activity, that we should grant agency to machines, and that the proper task for an anthropology of science and technology is to examine ethnographically how technology serves as agent of social and cultural production', while at the same time insisting that anthropologists 'start paying attention to Third World technological innovation' (Escobar 1994, pp. 216, 221). Finally, Pfaffenberger's notion of a socio-technical system would also, as we will see, go on to inform anthropological conceptualisations of infrastructure systems (Larkin 2013; Harvey et al. 2017; Anand et al. 2018; Abram et al. 2019).

These different anthropological approaches to conceptualising technology are often seen as in contradistinction to each other. However, it is our contention that it is exactly this multiplicity of approaches that has contributed to the thriving anthropologies of technology that are on display in the chapters that follow. What these approaches to the anthropological study of technology enable is a kind of analytical and methodological scaling on the part of the ethnographer, who can choose to focus on the embodied skills, on the practices/material actions, or on the larger socio-technical systems which *together*