1. Knowledge on knowledge

INTRODUCTION

In this chapter, a brief discussion of the lack of a general concept of knowledge on the one hand, and on the other, the wealth of contributions to its understanding, serve as an introduction to the multiple fields of knowledge studies. Three major areas are reviewed. First, the most prominent streams of the philosophy of knowledge, including positivism, conventionalism, post-modernism, critical theory and pragmatism. Second, the most established sciences of knowledge are introduced, including anthropology, history, biology, psychology, economics, sociology, political science, knowledge and intellectual capital management and science and technology studies. This is complemented by some recent scientific developments beyond these disciplines. Third, alternative ways of knowing are incorporated into the preliminary map of knowns and unknowns about knowledge. Overall, this picture provides a diverse and complex perspective. The case for an integrated theory of knowledge is made.

A WORKING DEFINITION

Knowledge is a night cat.¹ Familiar, yet enigmatic. Ubiquitous, yet furtive. Given its foundational character and explanatory nature, it would be reasonable to expect knowledge itself to be a well-understood phenomenon. Current expressions such as knowledge society, knowledge economy, knowledge cities, and many similar others, seem to take for granted a common understanding on the nature of knowledge as something deeply ingrained in everyday life. A closer look at such concepts, however, reveals that “knowledge” is far from being a well-defined term,² blending a diverse set of frameworks and lacking a systematic foundational work, as largely acknowledged in the literature (Ayer & Marić, 1956, pp. 173–175; Bolisani & Bratianu, 2018, p. 2; Hyman, 1999, p. 433; Nagel, 2014, p. 1; Neta & Pritchard, 2009, Part I; Nozick, 1983, ch. 3; Russell [1948] 1976, p. 5; Tamunosiki & Ariche, 2018, p. 31). There are no standards or international norms, nor a conventional unified theory: the problem of the criterion in defining knowledge prevails today (Chisholm, 1989, pp. 97–100; Davenport & Prusak, 1998a, pp. 1–6; Pritchard, 2013, pp. 20–22).
It is also fair to say that there has never been a greater diversity of contributions to the understanding of knowledge within so many disciplines and from so many perspectives (Nagel, 2014, p. 102). In this section we will be looking at several aspects relevant to a contemporary concept of knowledge, including the efforts to develop a formal definition, the varied perspectives from which this has been attempted, the many different domains in which a particular notion of knowledge has gained ground, and the requirements for an up-to-date, more comprehensive definition of knowledge.

A formal definition has been provided, and in some cases generally accepted, within specific scientific or cultural domains. In fact, there are some precise concepts for specific applications of knowledge, but these are restricted to specialized domains such as knowledge granularity in computer science (e.g., Zhao et al., 2008) or propositional knowledge in epistemic logic (e.g., Hilpinen, 1970). The intention here is simply to provide a couple of examples of the degree of formalization within specific fields of knowledge studies. Thus, Zhao et al. (2008, p. 349) provide an axiom definition of knowledge granularity, which serves a clear purpose in the world of knowledge engineering:

**Definition 2.1** Let $S = (U, A)$ be an information system, $G$ be a mapping from the power set of $A$ to the set of real numbers. $G$ is a knowledge granularity in an information system if $G$ satisfies the following conditions [emphasis added]:

1. $\forall P, Q \subseteq A$ if there exists a bijection $f: U/\text{ind}(P) \rightarrow U/\text{ind}(Q)$, which satisfies $|P| = |f(P)|$, $P_i \in U/\text{ind}(P)$, then $G(P) = G(Q)$ (invariance);
2. $\forall P, Q \subseteq A$, if $P < Q$, then $G(P) < G(Q)$ (strictly monotone);
3. $\forall P, \subseteq A$ if $U/\text{ind}(P) = \{u_i|u_i \in U\}$, then $G(P) = 0$; if $U/\text{ind}(P) = \{\{U\}\}$, then $G(P) = 1$ (boundedness).

We can get $\forall P, \subseteq A$, $0 \leq G(P) \leq 1$ from the above definition.

Another example of a formal expression as applied to a knowledge phenomenon belongs to a promising line of work represented by Daniele Fanelli of the London School of Economics (LSE) (2019, 2022). Building on Claude Shannon’s (1948) “Mathematical theory of communication” and Paul Thagard’s (1988) *Computational Philosophy of Science*, Fanelli has undertaken an ambitious effort to quantify the informational value of diverse knowledge processes and circumstances. Therefore, this is particularly relevant to the kind of operations in scientific practice. Central to his theory and method for knowledge quantification is the $K$-theory, the idea that knowledge,
as a system-specific property can be measured by a quantity symbolized by $K$ and expressed by the function:

$$K(\gamma^n; X^n, \tau) \equiv \frac{n\gamma H(\gamma) - n\gamma H(\gamma | X, \tau)}{n\gamma H(\gamma) + n\gamma H(X) - \log p(\tau)},$$  \hspace{1cm} (1.1)

where each term represents a quantity of information. Accordingly, knowledge is regarded as a system-specific property measured by $K$, which is determined by how much of the amount of information contained in an explanandum ($\gamma$) is compressed by an explanans ($X$ and $\tau$) (Fanelli, 2019, pp. 2–4). Again, the purpose here is merely to exemplify formal definitions within knowledge studies.

Similar logico-mathematical formality is required in other fields dealing with knowledge issues, from information theory to communication systems, from decision-making to artificial intelligence, from fuzzy sets to propositional logic. If we are looking for a more abstract, universal concept of knowledge, even if restricted to formal settings, we can look at the field of epistemic logic mentioned above. Epistemic logic is a subfield of modal logic that deals with reasoning about knowledge. One of the outcomes of this field is what might be regarded as a classical definition of knowledge (Hilpinen, 1970): that of justified true belief (JTB). Even though JTB has been strongly debated after US philosopher Edmund Gettier introduced several borderline counterexamples that marginally limited the generalizability of this definition, it is difficult to find a better candidate for a working definition (Tamunosiki & Ariche, 2018). Rather than endorsing it, the purpose now is to exemplify a logically constructed definition of knowledge.

JTB states that to know that a given proposition is true, one must have justification for doing so, not just believe the relevant true proposition. Thus, an agent $S$ knows that a proposition $P$ is true if and only if:

P is true; and
$S$ believes that $P$ is true; and
$S$ is justified in believing that $P$ is true.

These constraints provided a legitimation criterion alternative to religious or ideological dogma and enabled the reciprocal feedback between philosophy and science. Reactions to Gettier’s counterexamples through to the present have failed to provide a better general alternative. However, this is an area of lively debate, one that is key to integrating a new definition that incorporates a more effective understanding of belief as a behavioural phenomenon. This has become particularly relevant in a post-truth society where the continuity
of much life on Earth, including human, depends on the capacity to effectively align available science, citizens’ beliefs and globalized policymaking.

Therefore, even if fully aware of the logical constraints unveiled by its formal analysis, to move on with our overview of knowledge on knowledge, we will stick with JTB as a working definition of knowledge. In Chapter 4, we will come across definitions of knowledge and knowledge systems that try to overcome several other challenges, besides logical consistency. The Appendix provides several definitions consistent with this book’s perspectives.

**Knowledge Categories**

Actually, the uses of knowledge are quite specific in human affairs such as agreements, education, management, policymaking, law, communications and, of course, everyday usage. Therein, the concept of knowledge tends to be intuitive and generally taken for granted. Even in professional fields and institutional settings, the idea of knowledge is as ubiquitous as it is vague.

To be fair, the lack of a consensual definition is common to many scientific and technical fields – at least at certain stages – and not necessarily perceived as a disadvantage. Some concepts as fundamental as *life* have, according to Scudellari (2021) “more than 120 definitions”. As Curiel (2019, p. 27) claims regarding an area of astrophysics: “within reasonable bounds, the profusion of different definitions is in fact a virtue, making the investigation of black holes possible and fruitful in all the many different kinds of problems about them that physicists consider, although one must take care in trying to translate results between fields”.

At an interdisciplinary level or even within broader fields such as the knowledge economy and society, ideas about knowledge are as diverse as loose and plentiful. Haskel and Westlake (2018, p. 63) notice, for example, how even different related terms such as data, information and knowledge are often used interchangeably when referring to the knowledge economy. In addition, there is no shortage of distinctive categories or distinctions between types of knowledge, whether in philosophy (e.g., procedural vs conceptual in Ryle, 1949); history (e.g., propositional vs prescriptive in Mokyr, 2002); economics (know-what, know-why, know-who and know-how in Lundvall & Johnson, 1994); sociology (extrinsic interpretation vs immanent interpretation in Mannheim; see Remmling, 1961); political economy (e.g., embodied vs disembodied in Keller and Yeaple, 2013); management (e.g., explicit vs tacit in Nonaka and Takeuchi, 1995), knowledge-based development (transitional vs radical in Carrillo, 2006b); and science policy (basic vs applied in the *Frascati Manual*, OECD, 2015a).

Specific knowledge categories have been developed within their own reference frameworks such as knowledge economy (Machlup, 1962); public...
knowledge (Ziman, 1968); tacit knowledge (Polanyi, 1974); vernacular knowledge (Illich, 1981); situated knowledge (Haraway, 1988); knowledge management (Wiig, 1993); social stock of knowledge (Berger & Luckmann, 1966); knowledge systems (Carrillo, 1998); knowledge markets (Davenport & Prusak, 1998b); knowledge cities (Ergazakis et al., 2004); knowledge society (UNESCO, 2005); experiential knowledge (Gorz, 2010); knowledge commons (Hess & Ostrom, 2011); embodied knowledge (Sørensen & Rebay-Salisbury, 2013); shareable knowledge (Greve, 2016); descriptive knowledge (Burgin, 2016); actionable knowledge (Simon et al., 2019); open knowledge (Johnson & Lundvall, 2020); indigenous knowledge (Kanu & Ndubisi, 2020); and knowledge socialism (Peters, 2021), to name some prominent examples.

This diversity of knowledge concepts is not necessarily a problem, just a recognition of the field as we enter it and advance through its different areas. As a matter of fact, there has been unprecedented attention in the last four decades on aspects of knowledge from many different disciplines – the natural and social sciences as well as the humanities (World Bank, 2015). Similarly, contributions from non-scientific traditions or past the confines of the Western European tradition have populated the now quite crowded map of knowledge studies.

It seems fair to say that understanding knowledge has emerged as a major challenge for a global civilization at a time when both a cultural era and a geological epoch are drawing to a close. On the one hand, modernity and its European colonial roots are giving way to truly global epistemic perspectives. On the other, the Holocene and the way of life it made possible, is giving way to the menacing prospects of the Anthropocene. How knowledge is central to this historical landmark is captured in Baucom and Omelsky’s introduction to a special issue of South Atlantic Quarterly, “Climate Change and the Production of Knowledge”: “Perhaps the most difficult to conceive, though, are the ways climate change affects how we think and how we organize that thinking… What does it mean to generate knowledge in the age of climate change?” (2017, pp. 1–2). A similar concern is expressed in Renn’s recent integrated account of the history of knowledge: “What does the world look like if one considers its problems as problems of knowledge, and how does one have to conceive knowledge in order to make this perspective possible?” (2020, p. 10). Thus, the challenges for post-Holocene knowledge societies are multipronged: “Looking ahead, can we displace ‘hegemonic knowledge’ when responding to the Anthropocene challenge? If not, what sort of new hegemonic knowledge do we need to institute? And can we elasticate what counts as knowledge in order to let other voices be heard, so as to mitigate at least some of the epistemic exclusions that hegemony necessarily creates?” (Castree, 2021b, p. xiv).
To meet the knowledge imperative of the Anthropocene, we must be able to overcome the impasse that faces our understanding of knowledge and ability to utilize it. As we shall see, there is an unprecedented level of understanding associated with different aspects of knowledge. What we are lacking is an integration that can take human knowledge capabilities to the next level. Concretely, an integration of knowledge theory seems necessary that satisfies the requirements of:

- ethical responsibility;
- epistemic integrity;
- logical consistency;
- empirical evidence;
- critical examination; and
- pragmatic enablement.

The different disciplines involved have made progress in their respective accounts, but what is urgent is to do this in some integrated way. To advance in that direction, it will be necessary to take into account as many of the inputs that are available as reasonably possible. Some of these might not be compatible under existing explanatory frameworks, but it will be necessary to accommodate as rich a compound as possible. One would be surprised to find substantial points of convergence between, say, object-oriented ontology (OOO) and learning protocols in operant conditioning; social ecological economics and intangible capital systems; indigenous knowledge systems and epistemic justice; Peirce’s semiotic elements and knowledge systems design; critical realism and pragmatism. The urgent circumstances demand an open mind and integrative capacity to articulate the best available resources into a unified theory of knowledge. As Diefenbach (2004) noted in reviewing the variety of available perspectives on aspects of knowledge: “In this sense, taking a knowledge-oriented perspective seriously suggests to take into account competing understandings and interpretations, contradicting perspectives, ideologies, and interests, struggles for power and primacy, dominance and leadership between individuals, within groups, organisations, and societies” (Diefenbach, 2004, p. 562).

This dual challenge has been tackled around the turn of the millennium from many different disciplines and approaches and we might now be counting on the most substantial understanding ever on different aspects of knowledge as a multidimensional phenomenon. Over the next sections of this chapter, we will go through synthetic accounts, both descriptive and critical of some of the most prominent contemporary contributions to an understanding of knowledge. As we advance through the themes of this book, such disparate contributions might begin conforming patterns leading to a field theory of knowledge.
An overview of the role of philosophy in the configuration of the modern understanding of knowledge will be first introduced. This will be followed by an account of the main scientific fields that have tackled aspects of knowledge from a distinctive disciplinary perspective. This account will then expand into contemporary practices derived from the former, such as science, technology and innovation studies, as well as management and policy issues. Finally, a set of contributions outside these traditional realms of knowledge will be included to account for alternative epistemic traditions as well as the generic field of indigenous knowledge systems.

Throughout this book, and particularly this chapter, a diverse set of perspectives and contributions on knowledge will be arranged in order, first, to realize the unprecedented wealth of resources to improve our current understanding of knowledge and, hopefully, also to open new dialogues across these fields. In Chapter 4, the concept of knowledge that serves as foundation to the views presented throughout this book will be introduced.

PHILOSOPHIES OF KNOWLEDGE

Philosophy provides a broad arena for examining the knowns and tackling the unknowns of human understanding. Two branches of philosophical inquiry are particularly relevant to a theory of knowledge.

*Epistemology* is concerned with the nature, methods, validity, scope and justification of knowledge, particularly the distinction between justified belief and opinion. Epistemology is as old as philosophical practice, and a wealth of approaches populate the history of philosophy. While in Western philosophies the philosophy of science galvanized epistemological efforts, a more recent turn is providing more equitable grounds to philosophical perspectives from diverse cultural backgrounds. The realm of epistemology is widening to encompass different forms, means and ends of knowing, including previously disregarded forms of knowledge captured by native, feminist, pragmatic, minorities, post-colonial, Southern, and more-than-human experiences, amongst other.

*Ontology* is a second branch of philosophy bearing a close interdependence with epistemology. Ontology is concerned with the study of being, including existence, reality, becoming, and the categories and relations of beings. While there is a long tradition of ontologies defining the scope of human knowledge (what exists), and particularly of scientific explanation, recent turns in philosophy have brought such interdependence to the foreground. Ontology is undergoing a similar widening of scope to epistemology, being conquered by a democracy of being insofar as humans lose a central and privileged existence to be levelled with other live beings, inanimate objects and conceptual entities as inhabitants of a more-than-human republic. Over recent years, reliance of
Knowledge on knowledge

There is a substantial literature covering the origins and evolution of epistemology over the centuries, up to and including its more recent predicaments. Even a superficial overview of major philosophical schools and authors concerned with the theory of knowledge is well beyond the scope of this book. Instead, a connection will be attempted between some of the most pervasive problems in the philosophy of knowledge and their current manifestations.

There are many different classical texts that would be difficult to ignore for anyone familiar with the field of epistemology. Some recent attempts to provide a broader picture of the state of the art in the field include an accessible introductory work by Noah Lemos (2021); the thorough historical account of epistemology in four volumes edited by Stephen Hetherington et al. (2018–21); as well as Nadler and Shapiro’s (2021) critical discussion of knowledge in a post-modern world. Moser and Vander Nat (2003) have compiled an anthology of classic epistemology texts, while Sosa et al. (2019) have edited another on contemporary epistemology, with proportional emphasis on belief. Other, more specific contributions to the philosophy of knowledge will be referred to through different chapters of this book – in particular, the epistemic traditions alternative to the Western European perspective.

For the purpose of this chapter, it will suffice to identify some of the most prominent epistemic traditions insofar as they have been influential over the last decades, in order to find a productive path thereafter. The epistemological schools that it is necessary to briefly characterize here are **positivism**, **conventionalism**, **post-modernism**, **critical theory**, **pragmatism-cum-critical realism**, and **new materialism**. The reason to single out such a set is that in different ways and proportions these continue to exert relevant influences that will be expressed through the pages of this book, particularly insofar as relevant to a knowledge for the Anthropocene. This brief overview focuses on fresh contributions from each school that might still have currency today. While intense controversies (often just as acrimonious within a given school) have been an important component of the mutual critical process, an attempt is made here to extract some of the most relevant and convergent contributions from several philosophical trends.

**Positivism**

Positivism is perhaps the most influential epistemological framework in the development of the sciences. Its basic tenet is that all warranted knowledge is either derived from experience of natural phenomena (positive) or true by definition (analytic). Positivism is rooted in the Enlightenment reaction to dogmatism and authoritarianism by grounding public life on a democracy of
reason and empirical evidence. August Comte (1853), credited with the consolidation of this school of thought and practice, identified three stages in the evolution of knowledge: theological or fictitious; metaphysical or abstract; and scientific or positive. Later, and moved by a similar reaction to the emergence of Nazism and fascism, a group of socialist and liberal intellectuals known as the Vienna Circle developed the influential logical positivism. This theory of knowledge held that only statements verifiable through direct observation or logical proof are meaningful in terms of conveying truth value, information or factual content. This influential group included Moritz Schlick, Rudolph Carnap, Otto Neurath, Alfred Ayer, Herbert Feigl, and later Willard Van Orman Quine and Carl Hempel. The basic epistemological stands of logical positivism can be summarized as follows:

- The foundation for knowledge is provided by neutral, value-free and objective sensory observation.
- The postulation of non-testable explanatory resources is demarcated as outside the realm of science.
- There is an internal evolution of scientific explanations, where natural sciences and physics in particular play the role model for the rest of natural and social sciences.
- The purpose of science is to enable the prediction and control of all the events that happen, thus producing instrumentally useful knowledge.

After World War II, most of these views came under substantial criticism. The core verifiability criterion was proving increasingly difficult to hold on logical and operational grounds. By the early 1970s, alternative views on the emergence of scientific theories, the logic of explanation and the value of subjective knowledge were gaining ground. The movement as such liquified rather than disappeared, and it had a pervasive influence in the philosophy and practice of science that remains to this day and has been recently revitalized by the challenges posed for a knowledge in the Anthropocene by a corrosive post-truth culture in social networks, the media and politics. Even after Alfred Ayer acknowledged in a famous interview that the main problem with the logical-positivist programme was that “nearly all of it was false”, he remained adamant that it “cleared the ground” for most subsequent philosophy of science and that ultimately it “was true in spirit”. To this day, logical positivism constitutes the most ambitious attempt to establish an internal justification of scientific knowledge, based on formal processes to articulate and validate logical reasoning and empirical evidence.
Conventionalism

A pendular movement in 20th-century theory of knowledge was the shift towards a socially constructed interpretation of reality – conventionalism. As one of the main reactions to positivism, it targeted the notion of a theory-neutral observational language. Consequently, the role of the scientists’ subjective interpretation in knowledge validation was reassessed. The main epistemic stands of a conventionalist perspective are summarized as follows:

- Scientific theories are created by and agreed upon by scientists rather than being verified descriptions of an external reality.
- The acceptability of scientific statements depends on socially sanctioned conventions from scientific communities rather than on universally valid criteria of validation.
- Since a theory-neutral observational language is not available; the truth or falsity of statements is only partially determined by empirical observations.

Probably the best known, and most influential modern conventionalist is Thomas Kuhn. A physicist who drew on historical examples to claim how, in everyday practice, theory construction does not advance through an independent, objective validation. Instead, in his book, *The Structure of Scientific Revolutions* (1962), he introduced the idea that a set of beliefs, assumptions, practices and implicit understandings that he referred to as paradigms shape the evolution of knowledge. The fact that the concept of paradigm has permeated popular language, particularly in areas such as management, consultancy and public policy with such laxity of use owes no little to Kuhn’s own conceptual plasticity.9 Paradoxically, the ambiguity of the term did catch up with a growing trend towards accommodating a plurality of perspectives and it soon passed from an obscure neologism to a lustrous term in several organizational settings.

But by opening the door to epistemic relativism – the idea that science does not seem to conform to an *a priori* rationality standard – since scientific theories are conventional arrangements, the consequences would soon follow. A direct implication is that, in the end, all knowledge is founded upon arbitrary assumptions since any paradigm amounts to social convention. Furthermore, Kuhn’s incommensurability thesis implies that scientists cannot even sustain a rational dialogue across paradigms.

Paul Feyerabend exploited the rejection of rationalism and the emphasis on the role of subjectivism in choosing between incommensurable theories. On these grounds – or deliberate lack of – Feyerabend promoted an epistemological anarchism in *Against Method* (1975) by rejecting the idea of and need for a single, distinctive scientific method, advocating methodological pluralism.
If conventionalism helped temper scientific realism and rationalism, relativism also needs to be carefully dosed. For unbridled relativism entails self-destruction: the reflexive annihilation of the very relativist position. However, conventionalism taken as an alternative paradigm can help to guard against absolutism and check for the social determinants of knowledge claims.

There is, however, a second, perhaps more transcendental unexpected consequence of conventionalism. Conventionalism and relativism were the products of descriptive and historical accounts that happened to undermine the quest for an internal verification rule. In seeking alternative sources of legitimation to fill the vacuum, both Kuhn and Feyerabend hinted at the possibility of engaging behavioural and social science in contributing to the understanding of knowledge validation processes. An exemplarily candid Kuhn writes (1970, pp. 19, 21):

> Let me at once be clear that having opened that Pandora’s box, I shall close it quickly. There is too much about these questions that I do not understand and must not pretend to. But I believe I see the directions in which answers to them must be sought, and I shall conclude with an attempt briefly to mark the trail... Already it should be clear that the explanation must, in the final analysis, be psychological or sociological. It must, that is, be description of a value system, an ideology, together with an analysis of the institutions through which that system is transmitted and enforced. Knowing what scientists value, we may hope to understand what problems they will undertake and what choices they will make in particular circumstances of conflict. I doubt that there is another sort of answer to be found. What form that answer will take is, of course, another matter. At this point, too, my sense that I control my subject matter ends.

The need to prevent an unfettered relativism diluting any possibility of rational outcome, forced Kuhn and Feyerabend to look at human behaviour as a source of external validation of epistemic criteria. Such a perspective could integrate a value-laden theory appraisal with a substantial work on human knowing. This enabled a fruitful dialogue between the philosophy of knowledge and several empirical sciences concerned with aspects of knowledge, as we will see in the section on empirical epistemology.

**Post-modernism**

If conventionalism was like a scalding disinfectant for a wounded epistemology, post-modernism was like an overwhelming venom-countering laxative. Post-modernism is a wide movement characterized by both, a focus on language and a way of using it. It includes prominent figures, as diverse as Jacques Derrida, Michel Foucault, Jean Baudrillard, Richard Rorty and...
Jean-François Lyotard, who systematically demarcated from each other. This is not surprising, since post-modernists opposed knowledge claims assuming general validity or objective character through a process of dedifferentiation. Post-modernism, rather than a consistent approach, is a mosaic of powerful individual stances that played solo but shared a certain tone and style. Post-modernist philosophers demolished institution after institution, category after category, so as to leave – like a modern intellectual Attila\textsuperscript{11} – no conceptual stone upon stone. Some of the favourite targets of their criticism include truth, morality, objective reality, reason, human nature, identity, difference, subject and object, signifier and signified, science, language, progress…and so on.

Rather than designating a distinctive movement, it refers to the end of an era, the negation of modernism as a meaningful worldview. It is considered more as an attitude or stance of scepticism, irreverence, and contempt towards the grand narratives of modernism and progress.

Such perspective entails regarding knowledge claims and value systems as socially constructed discourses. Fuller (2010, p. 101), summarizes the common epistemological post-modernist tenets as follows:

1. Knowledge is subject to progress, both at the collective and the individual level…
2. Any theory, fact and artifact established along the progress of knowledge is understood to be a temporary moment…
3. Epistemic standards are themselves a kind of theory fact or artifact, which is to say, equally subject to change over time…
4. Errors are unavoidable in the quest to extend human knowledge…

From this perspective, the post-modernist epistemic legacy seems to add to the reflexive and critical self-awareness of knowledge theory. On the one hand, the inexorable deconstruction of terms and discourses eliminated all former referential criteria to end up with “objects without purpose, movement without direction and freedom without necessity” (Fuller, 2010, subtitle). On the other hand, this move can be regarded as one step in the demolition of an anthropocentric perspective of history, a demolition that was nourished from internal science through the Copernican revolution, the theory of evolution, operant conditioning, relativity theory and quantum physics, and from external science through the loss of universal, objective, certain foundations through embracing uncertainty, indeterminacy and pluralism in logic, mathematics and scientific methodology (Carrillo, 1983a, pp. 15, 101).

Post-modernism works best as a regeneration station rather than a destination point. The sceptic gaze and open surgery of concepts and discourses might be a dead end but encourages the search for alternative explanations, particularly beyond the boundaries of conventional definitions. A contribution
like that of Baudrillard, for example, in rescuing the significance of evil in any serious analysis of the relationship between knowledge and value, is highly significant. After acknowledging that “[w]e do not know anymore how to name Evil” ([1991] 2001, p. 95), he makes a convincing case for its cultural significance, one that is validated at the dawn of the Anthropocene:

The principle of Evil is not moral; it is a principle of disequilibrium and vertigo, a principle of complexity and strangeness, a principle of seduction, a principle of incompatibility, antagonism and irreducibility. It is not a principle of death, but, quite on the contrary, a vital principle of disunion. Since paradise, with which its emergence has ended, it is the beginning of knowledge. If our expulsion from it is to be blamed on knowledge, let us at least reap all the benefits. Any attempt to redeem the damned part, the redemption of the principle of Evil, can only establish new artificial paradises, the artificial paradises of consensus that do constitute a principle of death. (Baudrillard [1991] 2001, p. 116; my translation from the Spanish version)

Hence, rather than impoverishing our conceptual landscape through a relentless demolition of cultural institutions, post-modernism cleans up the hubris and presses us to seek alternatives, perhaps those we have not yet imagined or the combinations we have not dared to try. Rather than having to choose between the universal laws of modernism and the dead ends of relativism, we can aim at new ways to keep seeking while embracing uncertainty. Richard Bernstein (2011, pp. xiv, 18), sharply targets the disjunctive: “I do think that the spirit of our time is characterized by a movement beyond objectivism and relativism…with a chilling clarity Descartes leads us with an apparent and ineluctable necessity to a grand and seductive Either/Or. Either there is some support for our being, a fixed foundation for our knowledge, or we cannot escape the forces of darkness that envelop us with madness, with intellectual and moral chaos”. As an alternative to the Cartesian either/or, we can advance – perhaps with the precarious balance of negotiating a tightrope, but advancement nonetheless – by “fighting a war on two fronts” (Bernstein, 2011, p. 18).

As Roy Bhaskar (2008, p. 248) put it:

If science is to be possible the world must be one of enduring and transfactually active mechanisms; and society must be a structure (or ensemble of powers) irreducible to but present only in the action of men. Science must be conceived as an ongoing social activity; and knowledge as a product which individuals must reproduce or transform, and which individuals must draw on to use in their own critical explorations of nature.

**Critical Theory**

Critical theory is the brand name of a Marxist-inspired movement concerned with the inherent connection between values, power and knowledge. Also
Knowledge on knowledge

known as the Frankfurt School, it aimed at critiquing and changing society as a whole. Leaders of the Frankfurt School include Max Horkheimer, Herbert Marcuse and Theodor Adorno, who were joined by Walter Benjamin and Erich Fromm. Later, Jürgen Habermas became a prominent member. Critical theory is based on a reflective assessment and cultural critique aimed at revealing and challenging power structures. Since this might sound like post-modernism, we can start by contrasting both epistemic stances.

Best & Kellner (1991) carried out an assessment of post-modernism – that is, “the contributions and limitations of these perspectives which present themselves as...hyperradical and hypernew” (p. ix). They identify the following three problems with post-modernist epistemology (p. 290):

- failing to provide a language to critique issues of autonomy, rights and justice;
- being individualist in emphasizing desire and pleasure; and
- being irrationalist in rejecting all theory and commensurable critique.

However, there are also some shared tenets, which Best and Kellner (1991, p. 215) summarize as follows:

Both attack the traditional division of labour which establishes fixed boundaries between regions of social reality, and both utilize supradisciplinary discourses. Both carry out sharp critiques of modernity and its forms of social domination and rationalization. Both combine social theory, philosophy, cultural critique, and political concerns in their theories and unlike more academic theories some versions of both attempt to orient theory, practice, and discourse towards politics. Both... have engaged in heated polemics against each other, and have been synthesized with feminist theory.

Let us then look at the specific contributions from the Frankfurt School, whose influence continues to be felt today.

According to Max Horkheimer, one of the initial leaders, a theory is critical to the extent it improves the condition of humankind (and now the Earth system) by seeking “emancipation from slavery”, acting as a “liberating... influence” and working “to create a world which satisfies” its “needs and powers” as a whole. ¹² Given such a broad purpose, many critical theories have been and continue to be developed. Reacting to the atrocities and scale of both World Wars and their aftermath, including the globalized world order that followed, they have emerged in parallel with social movements that address several dimensions of domination of humans by humans as well as of other creatures and the environment by humans. Critical theories provide the descriptive and normative grounds to leverage social consciousness and praxis with the purpose of increasing freedom and decreasing domination. Critical theorists insist that social enquiry ought to combine philosophy and social
science to achieve practical effect in a distinctive moral sense. Their goals are not just the immediate and local instrumental changes but advancing in a true human emancipation.

Clearly, critical theory is driven by a strong commitment to develop a consciousness and responsibility about the harrowing circumstances of real men and women across the world. It is primarily an axiological stand with clear epistemic, ethical and political overtones. Due to the major turn-of-century global calamities of unsustainable growth, rising inequality and digital domination, a major focus of critical theory has been the evolution from capitalism into more consensual and decolonized societies, by furthering democratic capabilities. Such a stance continues to have close resonances with the pragmatist philosophy described below.

Habermas’s work, as a contemporary expression, has focused on epistemology and social theory, from the converging grounds of critical theory, pragmatism and action theory. In his *Knowledge and Human Interests* ([1968] 2015), he argued that since Hegel’s critique of Kant, a disconnect has prevailed between science and philosophy, an issue of enormous relevance to a knowledge for the Anthropocene (p. 47):

> If we take as our basis the materialist concept of synthesis through social labour, then both the technically exploitable knowledge of the natural sciences, the knowledge of natural laws, as well as the theory of society, the knowledge of laws of human natural history, belong to the same objective context of the self-constitution of the species. From the level of pragmatic, everyday knowledge to modern natural science, the knowledge of nature derives from man’s primary coming to grips with nature; at the same time it reacts back upon the system of social labour and stimulates its development. The knowledge of society can be viewed analogously. Extending from the level of the pragmatic self-understanding of social groups to actual social theory, it defines the self-consciousness of societal subjects.

Contrary to the incommensurability thesis of post-modernists that inevitably forbode all meaningful language and social construction of knowledge, Habermas’s major contribution is the *theory of communicative reason*, a balancing act between a reaction to positivism, an avoidance of relativism and a commitment to bounded rationality and human emancipation. He contends that the humanization and democratization of society depends on the institutionalization of the potential for rationality enabled by human communicative competence. Habermas ([1968] 2015) identifies three knowledge domains, each resulting from a specific drive along human evolution:

- empirical-analytical science, addressing human interest in the interdependence with and control over, the natural environment;
- historical-hermeneutic science, responding to practical need for interpersonal and social symbolic interaction; and
• self-knowledge required to deal with the emancipatory interest to systematically diminish communication distortions.

Several of the issues addressed by critical theory will resonate through the pages of this book. Insofar as knowledge involves a consensus amidst an interplay of social interests, the role of values and the need for their clarification becomes paramount. Bringing to the forefront ethical and political considerations in epistemic theory, rescuing commensurability from the Babel of relativism, consolidating natural and social sciences with the humanities, and opening the door to alternative scientific approaches to deal with different human necessities will echo in later chapters.

Pragmatism

While critical theory resists giving up on realism and rationalism despite the simultaneous siege by conventionalism and post-modernism, it lacks the epistemic grounds for some assertive interpretation that can overcome original positivist stances that it also rejects. Critical realism, represented by Roy Bhaskar, tried to conquer a middle ground. Bhaskar (2008, p. 47) claimed that, instead of discovering general quantitative laws, the purpose of science is “the production of the knowledge of those enduring and continually active mechanisms of nature that produce the phenomena of the world”. He argued that experimental science makes sense only if such mechanisms exist and operate both outside and inside experimentation spaces. For critical realists, truth must be something else than the outcomes of language games, without being absolute. Hence, Bhaskar’s synthesis entails an attempt to reconcile a metaphysical realism and an epistemological relativism. This attempt to gain a middle ground becomes a Catch-22 situation, since the unavoidable demand on some preference criteria for validating the outcomes of the critical realist practice would entail either a super-idealism or an essentialist realism, both equally untenable (Johnson & Duberley, 2013, p. 156).

Andrew Sayer, another critical realist, addressed this conundrum by trying to establish descriptions and causal explanations through access to the natural and social realities beyond discourses while keeping in check the fallacies of naive empiricism, idealism and unbound rationalism. Such an attempt was auspicious for effective knowledge systems, since it entailed establishing subject–object transactions that involve causality in non-foundational terms. This achieved an alternative synthesis of social constructivism and ontological realism, a solution that brought critical realism close to pragmatism.

Pragmatism is a philosophical tradition that, in very broad terms, understands knowledge of the world as indistinguishable from acting upon it. While, compared to other epistemological schools, it is hard to identify a common the-
A modern guide to knowledge

oretical body explicitly shared by its main representatives; nevertheless, pragmatism is relatively well understood and better applied by its followers. This philosophical school started and consolidated in the United States and over the years spread to other world regions. The first generation of pragmatists features prominently Charles Sanders Peirce, William James and John Dewey. Peirce was clearly the main philosophical figure, while James and Dewey resonated with him in other arenas of science and public life (psychology and education, respectively). The core tenet was the pragmatic maxim – that is, a rule for clarifying hypotheses by tracing their practical consequences. For the so-called classic pragmatism of Peirce, Dewey and James, an immediate target of the maxim was the concept of truth.

Peirce was a polymath whose career was mostly as a practising scientist, and most of his academic work was in logic and mathematics. However, his most transcendental work was in philosophy, notably his theory of categories and his subsequent semiotic theory that we will revisit in conceptualizing knowledge systems (Chapter 4).

Peirce’s pragmatism is a method of clarification of conceptions of objects. Pragmatism begins with the idea that belief is that on which one is prepared to act. Peirce’s method equates a conception of an object to conceivable implications for that object’s effects for informed action. It is a method of sorting out conceptual confusions by sorting out their practical differences.

Regarding the clarification of the concept of truth, Dewey defined it as “processes of change so directed that they achieve an intended consummation” (1929, p. 161). The key element is the link between thought and action: “To call action of thought in constituting objects direct is the same as to say it is miraculous. For it is not thought as idealism defines thought which exercises the reconstructive function. Only action, interaction, can change or remake objects. The analogy of the skilled artist still holds. His intelligence is a factor in forming new objects which mark a fulfilment. But this is because intelligence is incarnate in overt action, using things as means to affect other things” (ibid., p. 158). In Dewey’s terms, a knowledge claim possesses warranted assertability if it helps people effectively deal with their realities.

As an alternative to the two classical foundational alternatives of rationalism – based on deduction – and empiricism – based on induction – Peirce introduced an active or abductive genesis of theory, with no prior assurance of truth, complemented by a deductive application of the contingent theory plus an inductive testing of the utility of the provisional theory. While deduction allows the clarification of practical implications, induction fulfils an evaluation of the capacity to anticipate future experience and abduction provides heuristic grounds to a process of enquiry.

This pragmatic solution is stressed by William James’s treatment of truth: “Truths emerge from facts, but they dip forward into facts again and add to
Knowledge on knowledge

them; which facts again create or reveal new truth (the word is indifferent) and so on indefinitely. The ‘facts’ themselves meanwhile are not true. They simply are. Truth is the function of the beliefs that start and terminate among them”.14

At the dawn of the Anthropocene, the unprecedented, sudden, uncertain and rapidly shifting realities to be confronted will require fresh, fast response from every community. The pragmatist approach to knowledge provides a basic value-grounded rationale for a realist decision-making.15 In fact, knowledge and value overlap significantly, like two sides of a coin: *pragma* is the Greek etymological root for *deed* or *action*. Pragmatism’s stance before all knowledge claims is both sceptical and anti-authoritarian except for those claims that demonstrate contributing to increasing an overall world value. Shook and Solymosi (2013, p. 1367), conclude that “each new generation rediscovers and reinvents its own versions of pragmatism by applying the best available practical and scientific methods to philosophical problems of contemporary concern”.

Hence, new generations of pragmatists have continued to evolve this broad approach but with a key stance on knowledge and progressive social ideas – from Willard Van Orman Quine, Hilary Putnam, Donald Davidson and Richard Rorty, to Sidney Hook, Susan Haack, Daniel Dennett and Stephen Toulmin. The influence of pragmatism has now spread internationally (Festl, 2021) and permeated the scientific and philosophical fields of psychology, sociology, political science, aesthetics, bioethics and meta-ethics, as well as the applied fields of public administration, policymaking, international relations, conflict resolution and research methodology. And it has naturally spurred political action in movements such as Latino struggles (Pappas, 1998), feminism (Seigfried, 1996) and *sumak kawsay* in South America (Lalander, 2016), as well as the revindication of African Americans (Du Bois, 1903) and Native Americans (Pratt, 2002).

A Pragmatism–Critical Realism Synthesis around the Anthropocene

Several authors have noticed some close points of contact between pragmatism and Marxism. Godfrey-Smith (2013, p. 5) finds Dewey’s concept of the materiality of knowledge through action “reminiscent of Karl Marx in his Theses on Feuerbach”. Gunter Remmling (1973, p. 143) suggested that Marx was much closer to Pragmatism than to European Continental philosophers of his time. Similar claims are made by de Sousa Santos, along the lines of the reinterpretation of reality (2018, pp. vii–ix) when asserting the consolidation of the *epistemologies of the South*. Johnson and Duberley (2013, p. 160) also
find such vicinity of principles in Marx’s appraisal of Feuerbach, referring to Thesis II:

The question whether objective truth can be attributed to human thinking is not a question of theory but is a practical question. Man must prove the truth, i.e., the reality and power, the this-sidedness of his thinking in practice. The dispute over the reality or non-reality of thinking that is isolated from practice is purely a scholastic question. (Marx [1845] 1998, II, p. 568; original emphasis)

Roberto M. Unger, from an explicit Marxist stance, advocates for a radical pragmatism that denaturalizes society and culture. He claims that we should “transform the character of our relation to social and cultural worlds we inhabit rather than just to change, little by little, the content of the arrangements and beliefs that comprise them” (2007, pp. 6–7). His central thesis is that “the connection between thought and practice is most intimate and fully realized only when our minds are addressed to our own affairs – the concerns of humanity” (ibid., p. 31). We will come back in Chapters 2 and 3 to Unger’s (2019) contribution to the understanding of the knowledge economy.

Today, humanity’s affairs revolve around one overarching topic: the Anthropocene. A pragmatist perspective on the climate emergency has been advanced by Thomas Alexander (2013), who suggests that human beings’ inherent need is to experience meaning and value – another axiological account of knowledge. In revitalizing Peirce’s primacy of aesthetic values, he advocates for an imaginative view of intelligence, to which we will turn at the end of Chapter 10. Bruno Latour, a major reference in contemporary philosophy, is taking a key role in syndicating, in the face of the Anthropocene, a former diaspora of philosophical thinking and political action, under a pragmatist perspective.16 Advocating for a move “from matters of fact to matters of concern”, he argues that social criticism must incorporate empiricism, to pursue the “cultivation of a stubbornly realist attitude – to speak like William James” (Latour, 2004, 233).

Hence, in seeking a value-centric culture that recovers an emphasis on the truly important things for every community, a pragmatic–critical realism seems particularly well suited to address the drastic and fast-changing realities the Anthropocene may bring. Johnson and Duberley (2013, p. 174) synthesize what can be regarded as the ontological and epistemological stands before a knowledge in the Anthropocene:

Pragmatic–critical realism articulates an overt recognition of the active and projective role of the epistemic subject whose engagements are bounded by the tolerance of reality. Any knowledge is thus evaluated in the context of how successfully it may guide action towards the realization of particular objectives which express particular interests: that is in terms of what it does for, and to, various groups of
human actors. This leads to an explicit consideration of how different bodies of socially constructed knowledge are particularly adequate in terms of varying ethical, moral, ideological and political purposes. If knowledge is evaluated in terms of how successfully it may guide action towards the realization of particular interest-laden objectives, this will necessarily entail those conducting such critique reflecting upon the partisan nature of their own constructs and thereby make the implicit explicit. Research and discourse embracing such a position must entail epistemic reflexivity on the part of participants. This behoves the subject to reflect upon, address and reshape their conceptual choice in terms of the values, mores and goals which they are projecting on to the phenomenon of interest by engaging with it. It would support the notion that there is no preordained route along which any knowledge unfolds since any outcome is influenced by the action of social and political processes. (Original emphasis)

A Natural Turn into “New Materialism”

A core amendment to the former synthesis could be “various groups of human and other-than-human actors”. One perspective missing in overcoming the dichotomy between subject and object is an explicit integration of the human and the natural. In fact, the overcoming of all dichotomies so entrenched in Western culture between the material and the immaterial. This is what the philosophies of the new materialism deliberately aim at. A loosely connected set of authors rather than a distinct movement – also identifiable as speculative realism – shares this central concern with the unity of matter. Hence, despite the many branches of new materialists and speculative realists, they all share a rejection of anthropocentrism in its two main expressions in continental philosophy: philosophies of access and correlationism. The latter refers to “the idea according to which we only ever have access to the correlation between thinking and being, and never to either term considered apart from the other” (Meillassoux, 2008, p. 5); the former concerns those philosophies that give priority to human beings over other animate or inanimate entities.

Some of the variations of this broad school are speculative realism (Quentin Meillassoux), object-oriented ontology (OOO; Graham Harman, Levy Bryant, Timothy Morton), transcendental materialism (Iain H. Grant, Eugene Thacker), and transcendental nihilism (Ray Brassier). In parallel, vital materialism (as an alternative designation of new materialism) builds on authors such as Manuel DeLanda, Gilles Deleuze and Félix Guattari, as concerned with “the ontological implications of more inclusive and dynamic theories of mind and materiality” (Grusin, 2015, pp. vii–viii). Other traditions converging in this contemporary philosophical space are actor–network theory (ANT) and the social studies of science movement as well as another broadly characterized movement: (critical) posthumanism (Donna Haraway, Rossi Braidotti). Altogether, an overarching concern for all these thinkers is the non-
A modern guide to knowledge

Human turn (Grusin, 2015). Melinda Benson (2019) identifies some landmarks of new materialism and its relevance for a knowledge for the Anthropocene:

New materialism is particularly helpful in the context of natural resources and environmental law because it reveals ontological assumptions about the material world, i.e., what is “natural” and what is not.

According to the old materialism, knowledge is the product of investigation (usually by deductive reasoning or the scientific method) of reality. By contrast, knowledge is seen by new materialism as a dynamic reflection of the particular arrangements of matter. When the other (the observer) influences where something actually goes (the observed), the idea that matter is inert or predetermined goes out the window. Ontology (what is) and epistemology (how we know what is) are not two separate things. The implications of this collapse of ontology and epistemology are profound. There are no binaries; there are ongoing, dynamic relations. “It is through specific agential intra-actions that the boundaries and properties of the ‘components’ of phenomena become determinate and that particular embodied concepts become meaningful.” Reality is relational.\(^\text{17}\)

From a new materialist perspective, any sense that humans are separate or exceptional is simply false. Decentering the human, new materialism broadens the conception of agency – both what it is and who has it. New materialists extend agency to not only other sentient beings but to everything that influences and interacts, as well as the processes by which interaction occurs. In this sense, within this concept of agency there are no “individuals” \textit{per se}. There are networks and assemblages… In fact, from this perspective, humans are not even \textit{human}, as such. They are (as with all materiality) temporal expressions of ongoing entanglements… What does new materialism tell us about the Anthropocene? It means that, despite a new label, we have always profoundly influenced (and been influenced by) the earth system, simply by being a part of it. It is true that over the past fifty years humans have “changed ecosystems more rapidly and extensively than in any comparable time in human history”. But those actions cannot be isolated from a myriad of human and nonhuman actions. We have been, and continue to be, since our creation, part of an interconnected, complex and dynamic web of materiality. Our perception of the material world as solid and changing is just that – a perception. A richer account of the material acknowledges the limits of human perception, including perceptions that are shaped and informed by cultural norms and historically contingent ontological accounts. (Benson, 2019, pp. 256, 258, 259–260; original emphasis)\(^\text{18}\)

Demoting the human from the centre of history, in fact from the centre of being, paradoxically enhances the possibility of a continued co-evolution with and within the material world. A new materialism perspective, therefore, consolidates pragmatism–critical realism in focusing on the new priorities to be demanded by the Anthropocene. In the section “New materialism on matter and what matters”, Ralph Dolphijn (2021) points out some core agenda items:

Today, this is what new materialists mean when they focus on how matter comes to matter… The most prominent theme of our time concerns without doubt “the...
Anthropocene”, a term…[that]…marks the times in which humanity is the geologi-
cal force responsible for fundamental changes in the biosphere, when it is more and
more problematic to stick to Modernist Humanism.

Performing the ecological through both science and the humanities, New Materialism
therefore shows how fundamentally such dualisms are to be seen as the condition
for truth in our times, how they are shaped and how they shape their environment,
in other words, how they matter.

By not accepting Kant’s model of thinking (thinking as a response to an outside)
but by starting from imagination, from creativity, from the wild, a rethinking of
subjectivity, and – much more important – a rethinking of subjectivity in nature,
can start immediately. Starting from “that which matters” (in the double sense of the
word), New Materialism frees itself from the ruins of modernity and, with the arts,
is able to show us the world we have been blind to for so long. The micropolitics
of that which matters have a lot to say to us, in times where we humans are more
and more confronted with responsibilities for which we need to think beyond the
human, beyond what counts as “human knowledge”. Obviously, we need every bit
of our imagination to imagine the world otherwise. (Dolphijn, 2021, pp. 148, 149,
151–152; original emphasis)

Before moving on to continue exploring the relationship between philos-
ophy and science, let us point to some developments from contemporary
philosophy, which, without coming directly from epistemological grounds,
are making significant contributions to an understanding of knowledge for
the Anthropocene (cf. García-Meza, 2021): (1) an acknowledgment of the
material base of a more-than-human world by overcoming the dichotomy
between the sensory and symbolic realms of experience; (2) a demotion
of human agency from a self-assigned protagonism on time, meaning and value;
(3) an emergence of a “flat ontology” that grants equal existential status to all
beings; (4) a decolonization of areas where diverse forms of supremacism were
taken for granted, such as in gender, race and geography; (5) a search for new
terms of understanding between humans and Earth; (6) an acknowledgement
of the Anthropocene as a hyper-complex reality beyond the sense-making
capacity of individual intellects; and (7) a trend to integrate action and value
through a pragmatist perspective that balances critical analysis with bounded
rationality and realism.¹⁹

The Referential Expectation and the Circularity Constraint

Epistemology in general and the philosophy of science in particular have been
assigned a foundational role for knowledge, expecting these to settle issues on
demarcation, validation and justification of knowledge. They are expected to
provide the grounding for an architecture of human understanding. Assuming
this wider interpretative framework, philosophy of science has been regarded
A modern guide to knowledge

as the science of the sciences (Flint [1904] 2008, Part I) or primary epistemics (Goldman, 1986, p. 378). Philosophy and science became established as autonomous, interdependent fields precisely by the foundational character of the former in advancing knowledge. As Richard Rorty (1979) famously put it: “The eventual demarcation of philosophy from science was made possible by the notion that philosophy’s core was ‘theory of knowledge,’ a theory distinct from the sciences because it was their foundation… Without this idea of a ‘theory of knowledge,’ it is hard to imagine what ‘philosophy’ could have been in the age of modern science” (p. 315; original emphasis). Rorty was highly critical of this legacy, since, given the apparent incommensurability of different geo-temporal contexts in the history of science, philosophy can no longer act as an arbiter “to underwrite or debunk claims to knowledge made by science” (ibid.). Such a role has recently been recovered from alternative epistemic perspectives.

However, one of the first realizations in following up on such a meta-analytic role for philosophy is the inescapable circularity that such expectation creates. As it happens, any theory of knowledge makes some assumptions about the conditions under which knowledge occurs. This move is counter to a solid theoretical grounding of epistemology upon any scientific knowledge field, because, logically, science cannot legitimize itself. Thus, certain epistemological knowledge of the conditions on which warranted knowledge occurs presupposes certain epistemological knowledge of the conditions on which warranted knowledge occurs and so forth (Johnson & Duberley, 2013, p. 4, fig. 1.1).

In the world of planning, the analogy is used of fixing the plane while in flight, as there is only so much that can be accomplished by correcting the function without affecting the structure and so on. Hence, we are left with a limited and never certain margin of operation to improve the scientific foundations while keeping in check the epistemic assumptions and vice versa, and to carry out these reciprocal checks and balances as frequently and thoroughly as possible.

In practice, everyone subscribes to a set of principles regarding what constitutes warranted knowledge – that is, epistemological stands that operate as criteria for reliable knowledge. The best we can do is to be aware, open and critical about our assumptions, as well as of available alternatives, and of the implications for the potential outcomes of the scientific advances that in turn feed back on those assumptions.

Knowledge Reflexivity

Knowledge studies have gained momentum through the application of scientific explanation to knowledge as a natural phenomenon: scientific knowledge
on knowledge. Such a reflexive move has generated a feedback process within modern philosophy that has in turn provided wider epistemic frameworks. The reflexive turn in science and knowledge at large has spurred several movements – for example, second-order science (extrapolation of second-order cybernetics into designing scientific systems); scientometrics (measurement and analysis of scientific production); and metascience (self-awareness movement about the constraints of scientific research and the means to overcome those). We will now focus on two major reflexive movements: on the one hand, empirical epistemology and the science of science movement, and, on the other, science and technology studies.

As the case of neoclassical economics exemplifies, assumptions about human behaviour should be taken as such until they are proven consistent with available empirical research. Otherwise, such assumptions operate more as dogmas than sound explanatory bases. Likewise, in the case of knowledge studies, for every epistemic perspective there is an underlying theory of behaviour, explicit or not. Reflexively, all psychological explanations depart from epistemological assumptions, whether explicit or not. As Wood (1940) pointed out, every epistemology requires sound psychological bases, and psychological approaches to knowledge require sound epistemic grounds. Empirical epistemology departs from an awareness of such challenge.20

**Empirical Epistemology and the Science of Science**

Several scientific disciplines have ventured into specific aspects of knowledge phenomena, complementing philosophy of science with a science of science perspective. In the 1960s, the science of science movement, based on the progressive social perspectives of John D. Bernal, undertook a critical reflection of science as a matter of social concern (Bernal, 1967). Leading figures such as Derek de Solla Price, Charles P. Snow and Maurice Goldsmith advocated for “the examination of the phenomenon of ‘science’ by the methods of science itself” (Goldsmith, 1965, p. 10). The science of science movement set the ground for the social responsibility of science movement, as well as the consolidation of the sciences of knowledge. Similarly, the post-normal science approach led by Jerome Ravetz (1979, 1990), contextualized knowledge in a VUCA world.21 Naturalized epistemology (Quine, 1969, 1995; Kornblith, 2002), or empirical epistemology (Carrillo, 1983c; Charles, 2013; Kosso, 1991) complements the former review of epistemological schools with the factual inputs and theoretical insights from scientific disciplines that have delved into aspects formerly restricted to philosophical analysis. Rather than encroaching upon the latter, empirical epistemology has contributed to the understanding of knowledge by furthering philosophical inquiry with new realizations and perspectives. This approach is fundamental to an integrated
theory of knowledge, complementing attempts at comprehensive accounts from the fronts of *socio-politics of knowledge* (Stehr, 2003a), *social epistemology* (Fuller, 2007), or *history of cognition* (Renn, 2020).

In the following section, the most prominent sciences of knowledge are reviewed, showing how some areas of empirical epistemology evolved into full-fledged disciplines within the major realm of knowledge studies. The section on sciences of knowledge is complemented with the contemporary field of science and technology studies or science, technology and society studies, plus some areas of knowledge studies that, while not yet consolidated as stand-alone fields, provide relevant inputs from new scientific perspectives.

**THE SCIENCES OF KNOWLEDGE**

This section explores our current understanding of knowledge as an object of scientific inquiry. A brief account is provided of each of the mainstream sciences of knowledge. Given the size constraints of this chapter, the more nuanced concepts, issues and authors are just pointed out through references.

**Anthropology of Knowledge**

Like all sciences of the human, anthropology deals with knowledge (Crick, 1982, p. 287). Fredrik Barth set the subfield’s coordinates in terms of a comparative perspective on human knowledge across cultures. He identified three such coordinates: a substantive corpus of assertions; a range of media of representation; and a social organization (Barth, 2002). Barth leans on a structuralist approach towards the social construction of reality. Such an approach unfolds into the wider scope of *cognitive anthropology*, where cognitive psychology theories and methods provide the bases for dealing with knowledge socialization as well as cultural innovation and generational transfer. The 2015 special issue of *Social Anthropology*, “The Cognitive Challenge” (e.g., Regnier & Astuti, 2015), provides an overview of this approach. The main challenge for the anthropology of knowledge is set by Soren Klausen as “finding an appropriate level of description” by balancing a proper epistemological perspective with locally situated practices (2020, p. 204).

**History of Knowledge**

Not surprisingly, history has the longest tradition amongst the sciences of knowledge, with deep roots in the history of science. *History of science and technology* was established as a discipline by pioneer figures such as George Sarton (see Stimson, 1962), John Bernal (e.g., 1971) and Gerald Holton (e.g., 1988). When the focus of the field widened to include other forms of...
Knowledge on knowledge

understanding such as ancient scholarship and native knowledge as well as other social agents, settings and practices for knowledge creation and transfer, the history of knowledge field emerged (Lässig, 2016; Van Doren, 1992). This field is now gathering momentum, as exemplified by three current programmes. First, Burke’s (2015) socio-cultural account of institutions and processes that gave rise to current techno-determinism. Second, Renn’s compilation of studies conducted at the Max Planck Institute for the History of Science, woven by a cognitive-evolutionary narrative (Renn, 2020). Third, a contemporary perspective on knowledge as an encompassing cultural phenomenon developed by the Lund Centre for the History of Knowledge, drawing on a wider array of explanatory objects and processes (Östling et al., 2020). Other initiatives testifying to the vitality of this field include the History of Knowledge Center (ZGW) in Zurich, the Journal for the History of Knowledge and the book series Studies in the History of Knowledge from the University of Amsterdam.

Biology and Knowledge

In this case, there is no discipline in the same institutional sense as in other branches of knowledge sciences. However, there have been several developments across biological sciences that deserve attention. Genetics is concerned with inheritability issues of thinking and verbal behaviour and the epigenetic factors that determine their expression (Hermo et al., 2014). Neuroscience, besides studying the anatomy and physiology of the nervous system at different levels of analysis (e.g., molecular biology and cytology), also deals with the resulting development and behaviour functions. According to Kandel et al. (2012, p. 5), besides mapping specific neural correlates of behaviour, “the last frontier…is to understand the biological basis of consciousness and the mental processes by which we perceive, act, learn and remember”. While cognitive neuroscience deals with the biological processes underlying cognition, behavioural neuroscience is the application of biological principles to the study of psychological processes, such as learning, memory, language, thinking and decision-making. In his 1967 Biology and Knowledge, Jean Piaget – a biologist by training – explored the relationship between neurogenesis and psychogenesis (Parker et al., 2014). Piaget developed his genetic epistemology, a structuralist view of cognitive and linguistic development that is still influential. Biologists Humberto Maturana and Francisco Varela (1980, 1987) developed the concept of autopoiesis to denote the self-generating and self-maintaining capacity of living systems, which has influential cognitive implications. More recently, Catherine Malabou, in exploring the wider perspectives for neuroscience before climate change, makes a compelling case for an integrated science of knowledge for the Anthropocene: “Could it be that new histories of mental-
ities, which could bring together the geological, biological and cultural dimensions of historical (non) awareness, may open a new chapter for Anthropocene studies?” (Malabou, 2017, p. 52).

Psychology of Knowledge

Different psychology schools have provided alternative accounts of science, including structuralist and personality psychologies (Feist & Gorman, 2012; Goldman, 1986; Osbeck et al., 2010). However, two dedicated research programmes spanning over several decades stand out for their significance for knowledge sciences. Both programmes satisfy the empirical requirement of “actually engag[ing] the subjects in a specifically scientific task” (Fuller, 2019, p. 73). The first is the behavioural economics programme, of high relevance to environmental decision-making. The second is the knowledge systems programme, particularly relevant to an integrated science of knowledge. Both originated within behavioural research and grew to influence the broader fields of knowledge management, knowledge economy and knowledge society.

**Behavioural economics** has become a prominent field in economic theory and policy development. **Prospect theory**, proposed by Kahneman and Tversky in 1979, exhibited the sub-optimality of human choices, empirically challenging the psychological doctrine of neoclassical microeconomics. Simon (1957) developed a **bounded rationality** framework where human information processing is limited both in knowledge and computational capacity. Nobel laureate in economics Daniel Kahneman (2011) has become a leading figure in psychology and economics, where his views on judgement and decision-making have spurred substantial research. **Nudging**, a familiar element in contemporary policy design, has become one of the most visible fields of applied behavioural economics (Thaler & Sunstein, 2008).

The field of **knowledge systems** is a more recent development but consistently evolved throughout the present day. For disambiguation, the term knowledge systems as used in **knowledge management (KM)** and **knowledge-based development (KBD)** is different from that used in software engineering (Stefik, 2014) and other areas of computer science. In KM and KBD, knowledge systems are defined as value arrays aligning the relevant attributes of knowledge objects, agents, and contexts to enable effective understanding and action (Carrillo et al., 2019). In an extensive sense, knowledge systems include “the practices, routines, structures, mindsets, values and cultures affecting what and how knowledge is produced and used, and by whom” (Fazey et al., 2020, p. 2). Knowledge systems are applied to a wide range of situations and at different levels of analysis.²⁴

Knowledge systems research and practice has its origins in the application of **experimental analysis of behaviour (EAB)** to the understanding and devel-
development of scientific practice (Carrillo, 1983a; Morales & Carrillo, 2008) and an agenda for empirical epistemology (Carrillo, 1983b, 1983c). The UK’s Assessment of Performance Unit (APU) – tasked with developing methods of assessing and monitoring school achievement (Johnson, 1989) – became a rich empirical ground to study the acquisition of scientific patterns of behaviour from 1983 through 1986. Later, from 1989 through 2014, the Center for Knowledge Systems (CKS) at Tecnológico de Monterrey, Mexico, was the basis for an R&D programme on KM, intellectual capital (IC) and KBD, combining research with an intense consultancy practice for both private (Carrillo & Galvis-Lista, 2014) and public organizations (Carrillo, 2016b) over a quarter of a century (see later in this chapter). The demanding contractual commitments helped develop a KM and IC process framework and a capital systems framework that allowed a continued model and processes testing in practical situations (Carrillo, 1998, 2002). Initiatives including the World Capital Institute;25 the knowledge cities movement (Edvardsson et al., 2016); the international Most Admired Knowledge City Awards (MAKCi) (Chase & Carrillo, 2007; Garcia, 2008, 2021); the annual Knowledge Cities World Summit (KCWS) (Michelam et al., 2021); the Comunidad Iberoamericana de Sistemas de Conocimiento (CISC);26 the International Journal of Knowledge-Based Development;27 and a KBD agenda including the ongoing programmes Knowledge for the Anthropocene (Carrillo & Koch, 2021) and City Preparedness for the Climate Crisis (Carrillo & Garner, 2021), all sprouted from this agenda. Chapters 4 and 8 will introduce CKS theory and practice on KM and KBD, respectively.

On parallel grounds, a study involving 175 authors undertook a critical appraisal of the capacity of existing global knowledge systems to deal with major challenges such as climate change (Fazey et al., 2020). After identifying a deep misalignment between the challenges of the Anthropocene and the current knowledge establishment, they sketched out the attributes of knowledge system for life. This later study was based on a second-order science framework (Hodgson, 2021). Chapter 9 of this book compiles some of the best available criteria for designing knowledge systems for the Anthropocene, while Chapter 10 deals with some of aspects of policy implementation and cultural transformation.

The development of behavioural economics and knowledge systems may prove a fruitful contribution to a science of knowledge. Effectively tackling the climate emergency (which effectively means stopping anthropogenic biosphere degradation and achieving progressive restoration and the required cultural transformation with the least possible suffering and loss of lives) relies on understanding and nurturing the appropriate human response.

In The Age of Surveillance Capitalism, Shoshana Zuboff courageously exposed the Faustian power for prediction and control commanded by the oli-
A modern guide to knowledge
gopoly of digital companies controlling the Internet behavioural surplus. Her work echoes Karl Polanyi’s warning on the vulnerability of climate and human behaviour if left unchecked at the hands of capital: “The commodity fiction disregarded the fact that leaving the fate of soil and people to the market would be tantamount to annihilating them” (Zuboff, 2019, pp. 345–346). In seeking a knowledge for the Anthropocene, unless the link between climate and behaviour is understood and exposed, the same questions about surveillance capitalism raised by Zuboff remain unanswered: Who knows? Who decides? And who decides who decides?

**Economics of Knowledge**

This is one of the most active areas in knowledge studies and a core topic of this book. Chapter 2 offers a closer look at how mainstream economics has tackled knowledge, while Chapters 3 and 4 develop an alternative approach based on a different understanding of the relation between knowledge and value.

**Sociology of Knowledge**

Another pioneer discipline in knowledge studies, the *sociology of knowledge*, deals with the relationship between human symbolic behaviour and its social context. Like other areas of knowledge studies, it has its origins in the *sociology of science*. Seminal figures in describing the terms of relation between science and society include Emile Durkheim (1858–1917), Max Weber (1864–1920) and Robert Merton (1910–2003). Since the early 1900s, Durkheim ([1912] 2008) addressed the social origins of language and logical thought, moving ahead of recent dilemmas on the social construction of knowledge and the relevance of collective consciousness. The classic 1918 lecture by Weber, “Science as a vocation”, anticipated the reflexive turn in knowledge studies. In the early 1970s, Robert Merton outlined four ideal attributes of scientific behaviour that for decades became a hallmark of a *scientific ethos*: universalism, communism, disinterestedness and organized scepticism (Merton, 1973, Part III).

*Social constructionism* has been a major stream of sociological approach to knowledge. Until recently, the dominant view of knowledge in social studies of science held that our understanding of the world is socially constructed rather than individually acquired from an independent reality. Social constructionism has a long record in the history of thought. However, Max Scheler’s *Problems of a Sociology of Knowledge* ([1924] 2013) laid out a number of “axioms” on the cultural genesis of public knowledge. The work of Karl Mannheim, in turn, stressed the roles that ideologies and utopias play as social
interpretative frameworks (Remmling, 1961). But it was Peter Berger and Thomas Luckmann’s (1966) publication of *The Social Construction of Reality: A Treatise in the Sociology of Knowledge* that consolidated social constructionism. Of special relevance to knowledge for the Anthropocene is the concept of *social stock of knowledge*. This approach acknowledges the existence and relevance of modes of knowing beyond theoretical and scientific knowledge – modes that are significant for everyday life, such as values, beliefs, myths, roles, institutions, division of labour, proverbs, conventions, routines, customs, procedures, practices, and so forth. Michel Foucault, in his examination of “madness” and “illness”, treated reason and knowledge themselves as social constructions. Another influential contribution by Foucault was his analysis of knowledge and power (see Chapter 7). He claimed that our lives are ruled by a dominant logic built through knowledge discourses.

Social constructionism has evolved to assimilate inputs from critical accounts of institutionalized knowledge, such as Marxism, feminism, decolonization and other movements, as reviewed in Doyle McCarthy’s *Knowledge as Culture* (1996). With the subtitle “The New Sociology of Knowledge”, this book aims to “reestablish at the forefronts of the sociology of knowledge the problem of the functions of knowledge in public life and politics” (pp. 2–3). Paying attention to the inter-determination between knowledge and society and to the resulting power dynamics, leads to the critical assessment of the political dimension of such interplay – a recurrent theme throughout the book and constantly reappearing in Chapter 7. Also, the work by Karin Knorr-Cetina (1981, 1999) emphasizes the interplay between epistemology and social constructionism.

Rather than a proper field of its own, social aspects of science have evolved into a wider and more interdisciplinary field of science and technology studies or science, technology and society studies to be reviewed later in this chapter. This dynamic field of the social sciences and the humanities now encompasses some of the areas here depicted as separate sciences of knowledge, with links to technology and engineering (Felt et al., 2017).

**Political Science and Knowledge Policy**

The political–economic dynamics of the knowledge society has been dissected by Nico Stehr and others (Adolf, 2018; Stehr, 2017). Anticipating the political struggles of a knowledge for the Anthropocene in *The Power of Scientific Knowledge*, Grundmann and Stehr (2012) look at the complexity of policymaking throughout knowledge production and distribution processes. In his work too, Stehr comes across a key realization for knowledge policies: “knowledge gains in *distinction* on the basis of its ability to change reality” (Stehr, 2009, p. 21; original emphasis), where changing reality is not restricted
to transforming the environment, but also achieving any significant level of behaviour change that improves the space of possibilities. This is also the sense in which the World Capital Institute regards knowledge as the most important leverage to human action\textsuperscript{29} (including, thinking, imagination and other forms of verbal behaviour). Contrary to a commonly held view in KM, knowledge is not merely the capacity to act per se. Instead, it is a state shift in the space of possibilities resulting from understanding a value context and making appropriate decisions regarding it.

Science policy studies have advanced in the direction of integrating the cultural, political and economic drivers of knowledge policy choice and implementation (Lane et al., 2011). The field of science policy and innovation studies deals with the received processes through which knowledge transitions from research to actionable knowledge (Simon et al., 2019). The fact that a nation’s actionable knowledge requires more than a superior research capacity and knowledge base infrastructure can be exemplified by the spectacular failure by the United States in coping with the COVID-19 pandemic. So far, the country that still has the largest installed capacity in R&D, and the most sophisticated health infrastructure, is one of the hardest hit countries in the world regarding the total number of COVID-19 cases and deaths (as of 14 February, 2022).\textsuperscript{30} The picture emerging from the international capacity to coordinate a global vaccination campaign is no less disheartening.\textsuperscript{31}

Globally, the lack of alignment of the very knowledge system that was supposed to leverage development has impaired social capacity to act. The global knowledge ecosystem is subdued by the capital structure through a tight network of financing, commercialization, privatization, standardization, ranking and incentives. Such an impervious control mechanism results in a globalized, meta-national scheme of intellectual homogenization (Schmidt-Wellenburg & Bernhard, 2020). From a next-generation science policy perspective, creative knowledge construction can only be achieved through influence rather than power, through three “designs”: meta-governance; concertation and assemblage; and capability and capacity building (Kuhlmann & Rip, 2019, p. 21).

Knowledge and Intellectual Capital Management

Over the turn of the millennium, the fields of KM and IC (see Chapter 4) entered the scene at the organizational level and evolved into knowledge-based development (KBD) at the macro level a decade later. KBD has had an influence predominantly at the city-region level of analysis (urban KBD) through the better-known category of knowledge cities (Chapter 8).

Unlike other specialized fields of knowledge studies, KM, IC and KBD are applied fields dealing with problem-solving and change delivery. The technical base of these two fields stems mostly from procedural schemata subject to
the test of solution delivery. The early stages of KM and IC in the late 1980s involved mainly applied programmes with emerging models and practices largely developed by mid- and large-size consultancy bureaus that were only internally documented. The very process of managing KM expertise reflexively required ever more sophisticated models, methods and, above all, more stringent empirical testing of the relative efficacy of alternative practices. When KM and IC entered the academy by the mid-1990s, the professional centre of gravity gradually shifted from consultancy firms to graduate programmes and research centres. The Journal of Knowledge Management (JKM), the pioneer and to this date the highest-ranking journal in the field, started publication in 1997. By 2021, around 30 specialized journals served the field (Serenko & Bontis, 2021). Professional practice, theory building, technical development, systems modelling and empirical testing act as communicating vessels of an active ecosystem (Gaviria-Marín et al., 2018).

The knowledge systems perspective presented throughout this book draws on a theoretical–practical environment built up in the former context (Chapter 4). The above-mentioned CKS was created in 1992. During its 25 years of existence the CKS team experienced the mix of an intense consultancy practice (achieving full financial solvency throughout that quarter-century) and an equally intense research activity. The CKS senior faculty developed a graduate KM curriculum that has served as a basis for programmes throughout several countries.

This brief CKS profile serves to exemplify the benefit of working on knowledge systems within an environment that is not only conducive to reflection and study, but also intensely responsive to expected outcomes from applied projects (Antonacopoulou, 2007; Lambe, 2014). According to Renn’s (2020) synthesis of the multilayered evolutionary processes of knowledge construction throughout history, in looking for fittest knowledge for the Anthropocene we should not look only at institutionalized knowledge sciences; we should also look at all other relevant forms of knowledge, particularly those that will be required by and developed within the social structure of most communities in the upcoming circumstances. Such knowledge domains have been formerly characterized in the classical idea of phronesis, as well as in the above-mentioned concept of social stock of knowledge (Berger & Luckmann, 1966) and the concept of vernacular knowledge developed out of idiosyncratic values (Illich, 1974, 1981). Besides the best explanations and standardized techniques, we are also seeking for the sets of contextualized, actionable knowledge that might be best fit for likely extreme and chaotic scenarios (Kirchhoff et al., 2013; Mach et al., 2020).

We may thus capitalize on the existing wisdom about the design of knowledge systems (Bennet & Bennet, 2014; Fazey et al., 2020). Basically, such design involves operationalizing the attributes of knowledge objects, agents
and contexts to obtain the maximum alignment between those attributes (Carrillo et al., 2019), as will be explained in Chapter 4. Once a strategic map is available, the alignment between attributes can be improved systematically through KM and IC processes (Carrillo & Galvis-Lista, 2014).

Science and Technology Studies

The *internal* or *realist* and *external* or *post-modernist* perspectives of science (Carrillo, 1983a, p. 19), have become highly interdependent over recent decades, often through a love–hate relationship (also referred to as the “science wars”) at the borderline field of *science and technology studies*, or *science, technology and society* (both STS) (Felt et al., 2017). STS has been characterized by some core stands, including the strong conviction that scientific and technological knowledge is *constructed*; that scientific issues are also *translated* between research and policy; and that identity categories such as ethnicity and gender become diluted by the received scientific ethos (Howell, 2017, p. 50). Tensions between the internalist effort to assert the social value of science before the public eye and the externalist efforts of STS to critically expose the vulnerability of scientific practices to power and ideology, may prove valuable at the end as animosities reside and a common challenge emerges.

The bitter disputes became irrelevant as sciences and the humanities came to terms with the Anthropocene. Constructivists are now keen to stress the role of scientific evidence before climate change, while scientific approaches to the Anthropocene have opened up to wider perspectives on agency, gender, techno-determinism, colonialism, and so forth. The sociotechnical and the natural-material approaches have found common ground on materiality, ecology and nature. Such shared bases, where both approaches no longer see themselves as two cultures but as the single irreducible arena of the climate crisis, has brought several STS scholars to the frontline of the philosophical framing of the Anthropocene, such as Bruno Latour (2018) and Donna Haraway (2016).

Haraway aims at integrating a view of scientific practice as “contestable text and a power field” (Haraway, 1988, p. 577) with what she describes as *feminist empiricism* (ibid., p. 580). Latour goes further to become critical of the dominant logic in STS, to ask “Was I wrong to participate in the invention of this field known as science studies?” He suggests that, to regain relevance, social critique needs to embrace empiricism and realism (Latour, 2004, p. 233). Recently, Latour has served as a bridge between the natural and the social sciences and humanities of the Anthropocene (Latour & Weibel, 2020), joining others pursuing that goal (Bhaskar et al., 2010; Castree, 2013, 2021a; Castree & Braun, 2001).
Other Studies of Knowledge

Besides the consolidated fields of knowledge studies reviewed above, there are other important contributions from different areas of science that provide significant inputs to a general theory of knowledge despite not being established as independent disciplines. Without being exhaustive, the following deserve attention.

- **Knowledge in physics.** There have been several developments regarding information as an elementary physical variable or relating knowledge as a fundamental process. These include John Wheeler’s (1990) ontological attribution by information (*it from bit*) and Seth Lloyd’s attempts to calculate the universe’s computing capacity, looking at it as a monumental quantum computer (Lloyd, 2007). Cesar Hidalgo (2015) has undertaken a universal theory of information, from atoms to societies, building on Austrian physicist Ludwig Boltzmann’s views on entropy.

- **Information theory and cybernetics.** Originally proposed by US mathematician Claude Shannon, information theory is a mathematical rendering of information as a natural phenomenon, with wide applications. A recent emphasis on information processes has brought this field close to KM, through the work of Doede Nauta and Winfried Nöth, who draw on Peirce’s ideas to develop a semiotic information theory (Nauta, 2019). *Management cybernetics*, a field introduced by Stafford Beer, is also closely related. Stafford Beer developed the *viable system model*, of special significance to a knowledge for the Anthropocene (Zermeño, 2021).

- **System dynamics.** This mathematical modelling visualization method to tackle complex systems originated by Jay Forrester is another development that resonates at both the organizational and urban levels. The 1972 Club of Rome study *The Limits to Growth* (Meadows et al., 1972) – a precursor of global environmental consciousness still relevant today – is perhaps its best-known application. *Systems science* includes complexity and cybernetics, that deal with aspects relevant to a knowledge for the Anthropocene, such as emergence and adaptation, chaos theory and systemic interaction, under the common framework of *systems thinking* (Hodgson, 2019, 2021).

- **Computer science and artificial intelligence (AI).** According to Peter Denning (2000, p. 9), the core question of computer science is “What can be automated?”, a matter of high relevance to the understanding of knowledge. Can knowledge be automated? The famous Dartmouth Proposal (a call for the 1955 event that presumably brought the founding of AI) opened with an adamant conjecture: “that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it” (McCarthy et al., 2006). The field
of AI has evolved since then with varying fortunes in trying to emulate or overcome human capacities such as reasoning, knowledge representation, planning, learning, natural language processing and perception. Today, AI’s applications are as ubiquitous and impressive as worrisome are its social, political and ethical implications (Renda, 2019; Zuboff, 2019).

- **Consciousness and time studies.** Amongst all knowledge objects, the most difficult to grasp is also the closest to our attention: ourselves. The first of three aphorisms said to be incised at the forecourt of the Temple of Apollo at Delphi was “Know thyself”. This has been probably the most daunting task ever to human understanding. The contemporary form of such challenge is captured by the hard problem of consciousness studies. This problem is concerned with explaining that which we experience as we experience it, such as our feelings. But the structural constraint of self-reference knowledge faced by all epistemological frameworks immediately surfaces when looking at consciousness, making the subject logically and experimentally slippery. Nevertheless, a race is on to determine neurological correlates of experience as well as other empirical grounds for its qualities (Damasio, 2021). Advances on consciousness studies might bring potential reformulations of other phenomena such as thinking, time, identity, and along with these, major implications for many other fields from physical to behavioural sciences.

**FORMS OF KNOWING**

In characterizing the behaviour of the very first living organisms, Damasio (2021, p. 11), states: “Even more surprising, living organisms responded intelligently to what they sensed. Responding with intelligence meant that the response helped the continuation of their life. For example, if what they sensed posed a problem, an intelligent response was one that solved the problem”. Coming back to the core question regarding knowledge for the Anthropocene: will we respond intelligently? Will we be able to understand our predicament as a species and exhibit the appropriate responses for a dignified survival? Tragically, the signs of collective intelligence at the November 2021 COP26 Summit, looked rather dim.

We seem to have trouble in at least two major fronts for acting intelligently before the climate crisis. One is the tension between the survival mechanisms that served the adaptation of our species over most of its existence and the collective responses required for an organized global action. The other is that our level of consciousness, our current understanding of knowledge and intelligence, seem to be below the required level to act efficiently (Chapters 8 and 10). As Robert Sternberg recently cautioned: “After all, someone blessed with intelligence has, by definition, what it takes – don’t they? We have things
Knowledge on knowledge

exactly the wrong way round. The lesson of research by myself and many others over decades is that, through historical accident, we have developed a conception of intelligence that is narrow, questionably scientific, self-serving and ultimately self-defeating” (Sternberg, 2021, n.p.). As an alternative to the nativist and culturally biased IQ appraisal of intelligence prevalent in our Westernized global culture, Sternberg rescues the concept of adaptive intelligence as “something you can learn, and that can change through life. It is constantly updated by your interactions with your environment” (ibid.). Consequently, rather than the achievement scores we use to gauge our intellectual capabilities at school and work, the first criterion for adaptive intelligence becomes “what one has done in one’s life, individually or collectively, to make the world a better place to live... Adaptive intelligence is about creating a future, not only for ourselves, but also for future generations” (Sternberg, 2020, p. 38). This concept of intelligence is close to the 360° intelligence model (Carrillo & Olavarrieta, 2009), to be further discussed in Chapters 4 and 10.

From the adaptive intelligence perspective, we can ask to what extent Western civilization and its distinctive economic culture are in fact intelligent. Conversely, we can ask whether there are alternative cultures that have proven in the past or still do in the present to be more adaptively intelligent. In doing so, we can allow an open look at alternative knowledge systems developed under alternative adaptive coordinates. This line of inquiry has become established as an important field of knowledge studies.

Indigenous Knowledge Systems

The label indigenous knowledge systems (IKS) comprises the areas of studies of traditional knowledge (ICSU, 2002), indigenous knowledge (Kanu and Ndubisi, 2020) and cultural heritage (Sullivan, 2016). Although IKS is now a consolidated field, it had been neglected for years despite relevant conceptual contributions such as vernacular knowledge from Ivan Illich (1981) and Lebenswelt (lifeworld) from Jürgen Habermas (Fairtlough, 1991). Both precursor concepts have been synthesized as experiential knowledge by André Gorz (2010, p. 30), a concept that goes back to the idea of phronesis (practical wisdom) in classical Greece (Nonaka & Toyama, 2007).

Contemporary IKS carry a distinctive agenda, clearly driven by post-colonial epistemologies and politics. The full recognition of IKS is at the core of epistemic justice (Ndlovu-Gatsheni, 2020, 2021).

Earlier in this chapter, reference was made to Berger and Luckmann’s (1996) consolidation of social constructionism. Of particular relevance at this point is the concept of social stock of knowledge. Such a concept acknowledges the existence and relevance of modes of knowing beyond the scientific
and theoretical ones and that are just as significant for everyday life, including beliefs, values, myths, proverbs, routines, institutions, conventions, customs, roles, practices, division of labour, procedures and so forth. The social stock of knowledge also includes forms of knowledge transmission such as rituals and oral tradition, as well as knowledge contexts such as herbalism, midwifing, and more recent ones such as home economics and do-it-yourself (DIY). Also, relevant here is Donna Haraway’s concept of situated knowledges mentioned above (Haraway, 1988). Drawing on Marxist perspectives and a “feminist empiricism”, Haraway advocates for a realism that transcends the received scientific objectivism and is grounded in the contextual space of knowing agents, a perspective that feels particularly adequate to a knowledge for the Anthropocene:

“[O]ur” problem, is how to have simultaneously an account of radical historical contingency for all knowledge claims and knowing subjects, a critical practice for recognizing our own “semiotic technologies” for making meanings, and a no-nonsense commitment to faithful accounts of a “real” world, one that can be partially shared and that is friendly to earthwide projects of finite freedom, adequate material abundance, modest meaning in suffering, and limited happiness. (Haraway, 1988, p. 579; original emphasis)

In a broad sense, most knowledge systems work insofar as they are at once localized and permeable, endogenous and exogenous. Each of these attributes shows a continuous distribution. Also, all knowledge systems occur under very specific contexts of significance and in precise spatiotemporal coordinates. Therefore, all knowledge systems – either African or European, Northern or Southern – can be conceived of as “indigenous” or “localized” in a wider sense (Carrillo, 2015, p. 2; Marsden, 1994). Hence, IKS enable the understanding and regulation of multidirectional and multidimensional knowledge transfer processes in a globalized world (Batra et al., 2013; Galan et al., 2020; Polónia et al., 2018). Such a realization seems particularly in order for an Anthropocene knowledge agenda (Breidlid & Krøvel, 2020; Hall & Tandon, 2022, p. 9; Tom et al., 2019). All these globalized and diachronic knowledges (Castree, 2018) can be integrated in creative new ways rather than being demarcated and insulated (Braidotti, 2017; Kimmerer, 2013) and further leveraged by artistic imagination (Buckland et al., 2017).

From that perspective, IKS are just part of a wider decolonization process from circumstances such as gender, racial and geopolitical constraints, amongst others, regarding the possibilities for a knowledge for the Anthropocene (de Sousa Santos, 2018). Rather than a green colonialism aiming at standardizing “diverse ways of thinking about the environment into a single knowledge system” (Ulloa, 2017, p. 112), we should embrace a “willingness to reimagine contemporary change discourse, to allow for the emergence of other knowl-
edges” (p. 117). Such a process of decolonization can be regarded as a prerequisite to a knowledge for the Anthropocene: “What would it mean, then, for the imperative to decolonize an overly Westernized world if we were to ask, ‘what kind of planet is this that enables multiple forms of human collective, that makes many-world worlds possible, that proliferates telluric spirits and earth beings?’” (Clark & Szerszynski, 2020, p. 167).

PRELIMINARY CONCLUSION

Throughout the years, knowledge as an object of study has been approached from many different perspectives. Sprouting from the philosophical traditions of epistemology or theory of knowledge, the 20th century witnessed the emergence of specialized studies of science materializing into diverse disciplines. Psychology, sociology, history and political science spawned subdisciplines eventually converging into the broader field of science, technology and society studies. Over the turn of the millennium, the area of knowledge studies or sciences of knowledge built on the former to include not just other fields of academic research such as cybernetics, physics, computer science and management, but most distinctively, other knowledge practices such as ancient, indigenous, pragmatic and non-institutionalized ones. Hence, in identifying the best stock of knowledge available to confront the Anthropocene, we are counting on a set of frameworks to understanding knowledge of unprecedented richness and diversity. These are being nourished not only by several disciplines and specialized research fields. These are also being nourished by different cultural traditions, epistemologies, social contexts and political frameworks, and even developmental and historical stages. The first challenge in advancing towards a unified theory of knowledge that best leverages the human predicament before the Anthropocene, is mapping out of the broader field of knowledge studies and building collaborative transdisciplinary bridges across these. Socializing what is known to some and collaborating on what is unknown to all.

NOTES

1. Having come across a feline characterization of knowledge in modern life, I realized cats do have a history in casting our efforts at understanding the world. The cover of Chalmers’s (2013) appealing introduction to the philosophy of science depicts a cat with a cynical look and a jingle bell round its neck: he hinted at a reference to Nabokov. There is, of course, Schrödinger’s cat in quantum physics that may be both dead and alive. And Cheshire’s cat in Alice that now you see, now you don’t.
2. Checking several recent contributions to aspects of knowledge in the modern world, all provide only context-specific notions of knowledge, if at all. Van
Doren’s (1992) cumulative perspective of the history of knowledge makes no attempt to define its subject. While Davenport and Prusak (1998a, p. 5) grant that “[m]ost people have an intuitive sense” of what knowledge is, their “working definition” takes an introspectionist perspective: “Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information”. Mokyr’s (2002) account of the historical origins of the knowledge economy claims in the Introduction to be based on an evolutionary “theory of useful knowledge” and does contribute a characterization of propositional vs prescriptive knowledge, but he provides no definition of useful knowledge. Renn’s (2020) The Evolution of Knowledge glossary entry for “knowledge” reads “The capacity of an individual agent or of a group to solve problems and mentally anticipate or perform corresponding actions” (pp. 426–427), followed by a cognitivist account of knowledge structures and derived socioeconomic processes; his index entry on knowledge as a “common good: concept and definition” (directed to pp. 9–11 and 426–427) leads to no formal definition. Similarly, the entry for “knowledge system” is “Knowledge amalgamated by the connectivity of its elements within their mental, material and social dimensions” (p. 427), which adds little to his simpler index reference to pp. 65–69, where the notion of “loose collections and assemblies of knowledge elements held together by cultural practices” or “packages of knowledge” is offered instead (p. 66). But this is not just a recent situation. From the 120 index entries under “knowledge” in Karl Popper’s (1972) Objective Knowledge, none contains a definition. The same happens with Archie Bahm’s (1995) Epistemology: Theory of Knowledge. The point is that, generally, the concept of knowledge seems to be obvious enough to be taken for granted. Acknowledging this ambiguity forces the provision of at least a referenced working definition, if not a substantive one.

3. To provide miscellaneous examples, see Bokma et al. (2019); Kanis et al. (1994); Kröger (1997); Al-Madhari and Keller (1997); Silverstein (2011); Trifonov (2011).


5. In Volume 3 of his monumental Method, Edgar Morin (2018) provides a rich selection of inputs to the understanding of knowledge, but more as a piece of his own methodological architecture than as a monographic account of the current knowledge on knowledge.

Santayana, Herbert Simon, Boaventura de Sousa Santos, Julian Stanley, Nico Stehr, Stephen Toulmin, William Newton-Smith, Willard Van Orman Quine, Francisco Varela, Alfred Whitehead, Ludwig Wittgenstein and John Ziman. I am grateful for my very early acquaintance with the ideas of Mario Bunge, Carl Hempel, Edgar Morin, Ernst Nagel and Henri Poincaré that motivated my interest in the philosophy of science. I am indebted to Phil Johnson and Joanne Duberley, whose *Understanding Management Research* (2013) is as lucid as it is committed to a truly epistemic spirit.

7. Some insider controversies are those between post-modernists such as Derrida–Foucault, Rorty–Foucault, Derrida–Lyotard, Rorty–Derrida, Rorty–Lyotard. One intellectual dispute I had the opportunity to follow up at the philosophy department of the LSE was around epistemic progress compiled in Lakatos and Musgrave (1970) and continued in Radnitzky and Andersson (1978).

8. See “Ayer on logical positivism: Section 4”, an interview by Bryan Magee (2008), retrieved 6 March, 2022 from https://www.youtube.com/watch?v=4cnRJGs08hE. See especially minutes 5:30 through 10:15 for a candid account of the movement, its numerous technical failures and the continued validity of its ethical and epistemic legacy.


10. Conventionalism and relativism are both unexpected outcomes of a reality check, rather than a purposeful epistemic stand: “‘anything goes’ is not a ‘principle’ I hold…but the terrified exclamation of a rationalist who takes a closer look at history” (Feyerabend, 1975, p. vii).

11. Popular mythology has Attila saying about his horse’s steps: “There where I have passed, no grass will ever grow again” (O’Sullivan, 2020).


13. See Johnson and Duberley (2013), fig. 7.1.


15. Consider Nico Stehr’s definition: “I would like to define knowledge as the capacity for societal action (capacity to act), as the possibility ‘to get something going’” (Stehr, 2012, p. 6; original emphasis). Such contingent capacity had been stressed in my own qualification of the operant nature of scientific knowledge: “‘Practical’, therefore, strictly implies action rather than [economic] worth; that is, operation on the environment” (Carrillo, 1983a, p. 46; Spanish in the original and original emphasis). Note that “environment” here refers to its broadest sense as medium of existence.

16. “The essential political point is that the Earth’s reaction to human action looks like an aberration in the eyes of those who believe in a terrestrial world made up of Galilean objects, and it appears self-evident to those who see it as a concatenate of Lovelockian agents… In both cases, it is a matter of positive bodies of knowledge, and yet these do not involve the same scientific adventures, the same laboratories, the same instruments, the same investigations, nor are the same
researchers heading toward each of these two attractors” (Latour, 2018, pp. 80, 81).

17. The inner citation is from Barad (2003), p. 813.


19. For further discussion, see Chapter 18 in Carrillo and Koch (2021).

20. Jacob Kantor’s (1941) review of Wood’s book is sceptical of an approach that remains purely on the speculative side, on aspects for which substantial experimental evidence is available: “When philosophers reject variables derived from observable interactions of organisms (the scientist studying the behaviour of other organisms and things) in favour of cognizing subjects, the suspicion becomes strengthened that philosophical sophistication amounts to nothing more than the acceptance of the traditional propositions of philosophy teachers” (p. 893).

21. VUCA world (volatile, uncertain, complex and ambiguous) has now been updated in the management culture as BANI world (brittle, anxious, nonlinear and incomprehensible). See Chapter 7.


23. Changes in gene function that do not involve alterations in DNA sequence but respond to behaviour and environment. See also Chapter 3 on Smail in the section “The addictive basis of consumer behaviour” and Chapter 6’s discussion of Smail’s approach to culture in the section “Addictive economic behaviours”.

24. For example: Abelson (1979); Cornell et al. (2013); Hall and Tandon (2017); Howells and Roberts (2000); Malhotra (1992); Röling (1992); Werr and Stjernberg (2003).


28. The most common expression knowledge economy, aiming to describe the way economic culture is transformed by knowledge, will be used throughout the book. The alternative expression knowledge economics is used here in consistency with this section, to refer to the academic discipline of economics as applied to knowledge issues.


30. World Health Organization, retrieved 14 February, 2022 at https://covid19.who.int. As later data emerged (June, 2022), it became clear that the while the US still tops the list of countries with the most cases and deaths, this might be a relative rather than absolute position. The main reason is the lack of reliable death toll figures amongst countries. Comparisons are now focusing on excess deaths and deaths per capita (see the World Mortality Dataset at https://github.com/akarlinsky/world_mortality; retrieved 9 July, 2022). However, the main point remains that the US has been disproportionally and unnecessarily hit given its huge installed health capabilities (see Galvani et al., 2022).

31. The Guardian (2021, 21 March), “The great global vaccine divide”, retrieved 6 March, 2022 at https://www.theguardian.com/australia-news/audio/2021/mar/22/the-great-global-vaccine-divide?CMP=Share_iOSApp_Other. However, international cooperation has happened in areas beyond the commercial scope of
major pharmaceutical companies, as mentioned in Chapter 3 in the section “An Anthropocene global economy”.

32. An early report on the emergence of the KM field (Skyrme & Amidon, 1997) mentioned the CKS as the first dedicated R&D unit identifiable in the KM and IC world (Amidon, personal communication).

33. The CKS was a campus-level R&D unit at the Tecnológico de Monterrey main campus. The whole Tecnológico de Monterrey system includes 31 campuses across Mexico. In 2014, a major reorganization based on national-level schools resulted in the transformation of CKS into a national R&D group (the Knowledge Societies Research Group) ascribed to the School of Social Sciences and Humanities.

34. A key indicator for the CKS capital system over its 25 years in the financial capital category was holding a liquid reserve ≥ 1.5 times its annual payroll.

35. In a ranking exercise for the 20th anniversary of the Journal of Knowledge Management, the CKS ranked second amongst the 50 “most productive and influential universities and institutions publishing in the JKM” (Gaviria-Marín et al., 2018, p. 1666).

36. These include the KMCI education programme in the USA and graduate programmes in the universities of Deusto, País Vasco and Extremadura (Spain); Católica de Lima and Nacional de San Agustín (Peru); and of Caxias do Sul and Santa Catarina (Brazil). At Tecnológico de Monterrey it was applied at BSc, MA, MSc and doctoral levels.

37. The “science wars” refers to a controversy between, on the one hand, some post-modernist and conventionalist critics of institutional science based on a social construction perspective and, on the other, defenders of scientific realism coming mainly from natural science. Such, often acrimonious, confrontations took place roughly through the last decade of the 1990s and the first of the 2000s. The heated debate peaked with the “Sokal affair”, the publication in 1996 of a concealed parody paper by physicist Alan Sokal in the journal Social Text deliberately aiming to expose the lack of rigour of social constructionists. Sokal later revealed the hoax in another publication. The debate waned progressively, although it still reverberates in several circles with a more open stance from both sides actually enabling interdisciplinary collaboration (Youdell et al., 2020).

38. Leon Olivé (1988) developed the idea that “the apparent disharmony between theories that favor the social dimension of knowledge and those that defend a realist theory of science is based on narrow interpretations, no less of the sociology of knowledge, and in general of what a social theory of knowledge should be, as of the thesis of scientific realism” (from the 1993 English edition, p. 3).

39. The Black Hole Information Paradox arising from Stephen Hawking’s approach to information at black holes’ event horizon has fundamental implications to reversibility and knowledge. Recent progress looks close to sorting out this puzzle (Musser, 2022).

40. But see Mayumi’s (2017) accusation of Shannon’s misuse of thermodynamic entropy (note 17, Chapter 8).

41. For Damasio’s evolutionary perspective on the emergence of consciousness, the prominence of knowledge is clear: “Once being and feeling are structured and operational, they are ready to support and extend the sapience that constitutes the third member of the trio: knowing” (2021, p. 29; original emphasis).

42. Machlup, in Knowledge and Knowledge Production (1980, Volume I of his magnus opus) provides a complementary account of knowledge at no cost:
“A constant stream of knowledge is received without any effort and without any sacrifice on the part of the recipients or anybody else simply as a result of people being alive, awake and conscious of what goes on around them and inside them... They include, or are the same as, what Bertrand Russell meant by ‘individual knowledge’, what William James meant by ‘knowledge-of’ or ‘knowledge by acquaintance’, and what Alfred Schütz meant by ‘private, subjective knowledge’” (pp. 178–179).