



In this part, leading proponents of different approaches to geographic understanding make ‘cases for’ different philosophical and theoretical leanings. Some illustrate their arguments with short examples and others argue their case through logic. Although it is far from comprehensive, this first part covers a large swathe of philosophical and theoretical perspectives. It is not intended to offer the student a guide to philosophies in geography, but rather to highlight some of the tensions between various ways of knowing.

We do not go out of our way to suggest a linear sequence between these ways of knowing, nor do we attempt to smooth out differences. Although each way of knowing entered the discipline at a particular time and for a particular set of reasons and there are important connections, each philosophical underpinning continues to influence geographical research in different, conflicted ways. Some of the influences maintain a relatively unchanged currency, while others have transformed into different ways of knowing. This part of the book offers practical insight into how philosophies inform work and how research questions are always based on assumptions and choices between different ways of knowing.

The chapters are loosely arranged in chronological order. Using this broad framework as a pedagogic experiment, we introduce the chapters in three ways. The chapters on positivism, humanism, feminism and Marxism (2, 3, 4 and 5) are grouped together because the authors articulate very focused, albeit quite different, intentions. We call these ‘Singular Intentions’. Rather than having a specific intention, the chapters on structuration theory, the animal and realism (6, 7 and 8) each articulate a basis for understanding our geographical world that is not simply a product of the human mind. We call this ‘Geographical Knowledge in Relation to the World’. Finally, postmodern geographies, poststructuralist theories, actor-network theory, postcolonial theory and geohumanities (Chapters 9–13) offer arguments for how knowledge is not easily patterned. We call this ‘Beyond Structure’.

Obviously there are important connections and conflicts between all these chapters, and they could have been grouped in a myriad of ways. Students are invited to find other ways that these chapters relate to each other, because there are clearly many.

Singular Intentions

In the first chapter of this part, Rob Kitchin (Chapter 2) refers to positivist geography as a set of philosophical approaches, because within the set are elaborated multiple



ways of knowing in geography. There is no single positivist approach; rather, there are multiple positivistic ways of knowing. As with positivism, the following three chapters each describe a set of philosophical approaches designed with a particular intent. The approaches of positivism are tightly circumscribed around a perceived need to apply scientific principles, rigour and analytic reasoning. The singular intent of positivist geographers, then, is to apply the principles of science to geographic understanding.

The two most common forms of positivism are based on verification (logical positivism) and falsification (critical rationalism). In the former, deductive reasoning is used to formulate theory, and then set and test hypotheses. The latter is based on attempting to undermine theory by identifying exceptions.

Advocates who feel that geography tends towards unsystematic and analytically naive inquiry have propelled a concerted focus on spatial science from the 1950s onwards. Kitchin points out that with the exception of some spatial scientists there is rarely a meaningful engagement with philosophy by those who embrace science in human geography (but see Chapter 14 by Harvey).. This thought is articulated further by Fotheringham in Chapter 25. Kitchin argues that scientific principles applied to quantitative data are seen as factual, objective and universal in nature. He notes that this has led feminist geographers to criticize some spatial science for harbouring alleged hidden, masculinist underpinnings. Few spatial scientists today would claim allegiance to the central tenets of positivism, but they do see their approaches as sensible, robust and, above all, scientific. Its influence on contemporary quantification (Chapter 14 and 25) and GIS (Chapter 24 and 26) and on the practices of individual geographers (see Chapters 15, 16 and 19) is profound.

In Chapter 3, David Seamon considers the emergence and continued relevance of humanistic geography as a loosely structured movement that developed out of a critique of what was regarded as the obsessively narrow focus of positivistic human geography on human decision-makers as rational economic actors whose behaviour could be predicted and modelled. Rather, Seamon shows how the singular intent of humanistic geographers has been to demonstrate the importance of individuals' experiences, beliefs and attitudes, as well as aesthetics, in shaping the decisions that we make and the ways that we engage with the world. Here, he illustrates how the emphasis within humanistic geography has been on uncovering meanings, values and interpretations in order to incorporate a more complex understanding of human reality into geography. In doing so he highlights the way that humanists drew on a range of philosophies from the humanities (e.g. phenomenology, existentialism) as well as interpretive traditions from disciplines such as anthropology, art and architecture. The implications of this for geographical practice are explored by Paul Rodaway in Chapter 27, where he reflects on the development of people-centred methodologies in geography. The influence of humanistic philosophies on the practices of individual geographers, who may not call themselves humanists, is reflected in the work of Vera Chouinard (Chapter 19) and Lawrence Knopp (Chapter 21), as well as, more explicitly, in the work of David Ley (Chapter 16) and Robin Kearns (Chapter 18).

The singular focus on the intentional and experiential agent in humanistic geography (Chapter 3) and geography in the humanities (Chapter 13) are the subjects of conflict with other approaches that have sought to highlight how individuals' choices are constrained by social structures such as patriarchy (Chapter 4) and capitalism (Chapter 5), and with those that have attempted to tease out the complex relationship

between agency and structure (Chapter 6). Poststructuralism (Chapter 10 and 10a) and postcolonialism (Chapter 12) have challenged humanism's very notion of the intentional agent and the universal claims that follow from this. In addition, the link between geography and the humanities has been reinvigorated of late by GIScience (Chapter 14), which offers a novel transition between technology, science and art, with a focus on individual creativity rather than aggregate explanation.

In Chapter 4, Deborah Dixon and John Paul Jones focus on the ways that feminism has recovered various geographies of gender, first by critiquing and contesting masculinist ways of knowing and then by elaborating its own epistemologies. Most importantly in terms of practice and transformation, they point out that the purpose of feminism is to generate ways of knowing that improve women's lives. Feminist geographers use multiple theories and methods to better understand the sources, dynamics and spatiality of women's oppression and to suggest strategies of resistance. The singular intention of feminists, then, is to better women's lives. To aid this endeavour, their primary focus is on day-to-day social and spatial activities.

Beginning with the myriad of processes through which women geographers and their ways of knowing were marginalized in nineteenth- and twentieth-century Anglo-American geography, Dixon and Jones make a case for how feminism challenged, and continues to challenge, the masculinist bases of the discipline. They show that a large part of the early ostracizing of women's knowledge was based on the patriarchal practices of the discipline – paternalism, misogyny, sexual discrimination, gender-coded language – and the kinds of things geographers studied (e.g. distributions of economic activities). Feminist geography not only critiques these bases of the discipline, but also offers an epistemology that transforms geographic ways of knowing. For example, traditional objects of analysis such as regions, landscapes and places are researched with questions that probe the spatial dimensions of gender divisions of labour. Feminism also introduces new objects of analysis, such as homes and bodies. New epistemologies focusing on difference, gender as social relations and gender as a social construction enable feminists to push geography in new, transformative directions that influence methodologies, practices, lived experiences and discursive meanings. In this latter regard, the chapter links in important ways to Kim England's (Chapter 29) discussion of feminist methods and methodologies and how those, in turn, produce feminist geographies. The webs of meaning between ways of knowing and ways of doing are circular and often are mutually reinforcing.

In many ways Marxism parallels positivism as a reaction to less theoretically informed empirical studies in geography. Like feminism and positivism, there are multiple variations in geographic thinking that derive from classical Marxism. Indeed, some claim that a large part of feminism's focus on the exploitation of women comes from Marxist sensibilities. Henderson and Sheppard argue in Chapter 5 that, in the same way that feminism focuses on making women's lives better, the root of Marxism is to bring about 'more just conditions for human flourishing'. Marxism is largely focused on making sense of the geography of capitalism, and its singular intent is to establish spatial justice.

Henderson and Sheppard argue that, although established some time ago, Marxist theory is far from anachronistic. That said, many practitioners prefer to call themselves post-Marxists. Henderson and Sheppard argue that many of the tenets of classical Marxism are now subsumed within other ways of knowing, such as realism, structuration theory and poststructuralism (Chapters 6, 8, 10 and 10a). Further, they

suggest that the appellation 'post' refers not to the demise of Marxism but rather to approaches that acknowledge the ongoing influences of a critical way of knowing.

In their attempts to explain the world, Marxists argue that the positivistic bases of science and social science reduce it to a series of stable and well-defined entities connected by causal relations. As an epistemological basis of Marxism, dialectical reasoning traces how the relations between things are constantly changing, altering the entities themselves. Henderson and Sheppard note that at all scales, from humans to the world economy, objects of analysis are internally heterogeneous and always at risk of being torn apart by the very relationships that bring them into being. They go on to note that dialectical reasoning of this kind is not alien to the sciences. The focus of Marxism, however, is primarily on production, consumption, value and exploitation, the accumulation and circulation of capital and class conflict, with attending concerns about political identities and culture industries. Because Marx was concerned with material change and the transformation of people (see here Chapter 28 where Samers and his colleagues look at the legacy of Marxism for political activism within geography) and his emphasis was the social aspects of individual being, Henderson and Sheppard make the claim that he is a contemporary thinker. They are concerned that geographers de-emphasize Marx's focus on the formation of capital and class by looking primarily at gender, race and sexuality. And so this chapter raises conflicts with Chapter 4. Henderson and Sheppard argue that geographers need to understand, first and foremost, the intersections between social processes as articulated through the circulation of capital and the social construction of commodity production and distribution.

Constructing Geographical Knowledge in Relation to the World

According to Isabel Dyck and Robin Kearns (Chapter 6), structuration theory, as constructed by Anthony Giddens, elaborates a bridging point between humanism and Marxism, but it is also related to the behavioural perspective elaborated through time geography. Giddens' intent is to unravel the complexities between human agency (see, for example, Chapter 27) and structural constraints such as those elaborated by Marxism (Chapter 5). Time geography points to the possibility of larger societal structures (known as constraints) within which individual behaviours are articulated. Structuration theory constructs society as neither independent of human activities nor their product. Rather, the interdependence of structure and agency is derived through space and time connections. Structure is seen as rules and resources such as those elaborated through institutions; human agency is based on the idea that individuals are perpetrators of events and that there is always choice. Human interaction with institutions is always in space and time and so there is always a spatial and temporal dimension to how social systems change. Dyck and Kearns elaborate structuration theory with relatively straightforward examples involving mothering and health geography. They note that poststructural concerns with difference and identity have tended to divert attention away from the rules and resources through which structure is realized. Argued here is a need to engage with structuration theory as a way of elaborating power relations that stretch over time and space globally.

In Chapter 7, David Lulka documents the erosion of a self-evident human-focused world. To do so, he raises the specter of the non-human (also the posthuman and the

more-than-human) and humanity's dependence on what he calls the vastly variegated materials that comprise the world at large, and then focuses on the rise of animal studies in geography. Lulka challenges geographers to attack the human-animal dichotomy by re-conceptualizing the relationship between landscape and body. This tack, he argues, offers geography a new bestial body to probe, and it offers animal studies spatial methodologies for understanding interspecies relations. This chapter dovetails with Harrison's work in Chapter 10, and what he calls a poststructural ethics that questions the hegemony of the human.

In Chapter 8, Andrew Sayer takes a slightly different view on how knowledge is constructed. The philosophy of realism, he argues, is not about constructing some basis for reality but rather about assuming that the world is always there and always different from the way philosophers and theorists attempt to get to know it. In short – and this is probably the biggest difference between realism and the behavioural research articulated through time geography in Chapter 6 – Sayer argues that the world cannot be got at by systematically researching the processes of knowledge formation. He would suggest further that the views expressed in the positivism of Chapter 2 have difficulty entertaining the idea that knowledge can be fallible. Sayer sees social constructions, like those developed in Chapter 5, as wishful thinking unless we are willing to accept that they may not work or make a difference. Realism, then, is about understanding, first and foremost, that the world is mostly independent of our thought processes, and although those thought processes and how they construct the world are important, they are not omnipotent.

Beyond Structure

At some point in the not too distant past, postmodernist geographers argue, the known and structured bases of modernity began to unravel. This might have happened with Auschwitz, as suggested by Theodor Adorno and Giorgio Agamben, or with the destruction of Pruitt-Igoe (the public housing experiment in racial differentiation in St Louis), as suggested by David Harvey (1989). In Chapter 9, David Clarke argues that postmodernism throws into doubt reason as a monolithic and driving concept of western society. Reason, facts and science are not pillars of understanding but simply matters of faith like everything else. Stories are just stories that help us along in the world, and not metanarratives (big stories) with claims to truth and authentic reality (e.g. modern medicine). Metanarratives, argue some postmodernists, are invoked simply as a way for science to legitimate itself because of the belief that universal knowledge is possible and grants privileged access to truth. Instead, postmodernists argue, the world is inherently complex, confusing, contradictory, ironic and so forth, and they want to keep it that way.

Geographers have had a lot to say about postmodern spaces; indeed, Clarke avers that we should be quite proud of the confusion we've instilled in the larger academic debates on the relations between space and time (see Chapter 6). David Harvey, Ed Soja and Mike Dear have been particularly successful in confusing traditional understandings of urban space. Clarke notes further that David Harvey's *The Condition of Postmodernity* (1989) is one of the most famous books on postmodernity. Ironically, a Marxist metanarrative works well for Harvey's analysis and, as is pointed out by Henderson and Sheppard (Chapter 5) and Clarke, this way

of knowing seems capable of staving off more contemporary discourses that seek to undermine its credibility.

The problem with postmodernism, notes Clarke, is that it tends to delegitimize social critique and progressive political activism more than neoliberal capitalism and neoconservatism. And so, perhaps, the postmodern moment may be, in actuality, a further engagement with capitalism rather than something radical and transformative. It may also, as Clarke notes, signal the start of an interregnum or a limbo. To the extent that postmodern theorists today tend not to like the term 'postmodern', affectations that focus on a critique of, and engagement with, late capitalism are perhaps better laid at the feet of other 'poststructuralists' (see Chapter 10 and 10a).

Paul Harrison in Chapter 10 (and Aitken's postscript in Chapter 10a) and John Wylie in Chapter 30 argue that we need to divest ourselves of the constraints of any kind of structural understanding. The problem with postmodernism is that it also divests itself from critical and radical perspectives in favour of whimsy and planned depthlessness. Poststructuralist theories, and particularly those derived from a wider continental tradition (e.g. Foucault and Derrida), move human geography forward because they are primarily critical methods for assessing – in deep, archaeological ways – the insidious power relations embedded in institutions, beliefs and political arrangements. Harrison argues further that poststructuralism is more radical than ways of knowing based on Marxism (such as feminism, realism and structuration theory) because it does not offer a base or a focused intention. And it does not position radicalism as a metanarrative.

Poststructuralism differs from preceding ways of knowing in other, interesting ways. In this introduction, we suggest that Chapters 2, 3, 4 and 5 offer singular intentions and Chapters 6, 7 and 8 offer a singular base. Poststructuralism, according to Harrison, offers neither a particular diagnosis of how the world is organized nor a systematic alternative. Poststructuralism is anti-essentialist and, as such, it offers a particular concern with radical otherness and difference. Moreover, while poststructuralism is often characterized in terms of the need to be endlessly critical and therefore overly negative, Harrison is at pains to emphasize the affirmative nature of poststructuralism and its deeply ethical nature. Here, he highlights the writing of Derrida on deconstruction. Later, in Chapter 30, Wylie demonstrates the importance of Derrida's notion of deconstruction, as well as Foucault's articulation of discourse analysis as forms of geographical practice. In a postscript to Harrison's chapter, Aitken reinforces his focus on poststructuralism's contribution to flexible ontologies, difference and anti-essentialism, ethics and the politics of aesthetics. It has continued critiquing approaches to space with particular emphasis in understanding mobilities, dislocation and surprise. In recent years, poststructural-leaning geographers have picked up on and reworked a number of the approach's contexts ranging from biopolitics to political economies.

Actor-network theory (ANT) shares the anti-essentialist approach and ontological flexibility of poststructuralism. Like poststructuralism it aims to understand the complexity of the world. In Chapter 11, Fernando Bosco shows how ANT provides a framework for tracing connections and relations between a variety of actors – both human and non-human (discursive and material objects) – in which geographies are understood to emerge from, or are the effects of, these relations. Here ANT offers a radical reading of agency, seeing it not as the property of intentional human actors (contrast Chapters 3 and 7) but rather as the product of things coming together, such that non-human actors (like a fencepost or a pen) might be understood to have agency.

Bosco draws attention to the way that ANT uses the term ‘actant’, rather than ‘actor’, to distinguish the fact that it attributes no special motivation to individual human actors. Like other relational approaches, ANT is an attempt to escape dualisms such as structure–agency which so preoccupy Dyck and Kearns in Chapter 6, and it is not limited by the Euclidean understandings of space that underpin positivistic approaches (Chapter 2).

Postcolonialism, like poststructuralism, is concerned with the complexities of identity, difference and representation. In Chapter 12 Clive Barnett identifies postcolonialism’s origins in the writings of intellectuals in the mid-twentieth century – the time of anti-colonial struggles against European domination. He argues that relations of colonial subordination are embedded in systems of identity and representation. Here, like Harrison (Chapter 10) and Wylie (Chapter 30), he draws on Foucault’s notion of discourse to explain the power of cultural representations. From a Foucauldian perspective, postcolonialism does not adhere to any singular way of structuring ways of knowing.

Barnett is at pains to stress the intertwined nature of western and non-western histories and societies. He dwells at length on Said’s book *Orientalism* – which demonstrates how western notions of identity, culture and civilization have drawn on imaginings of the non-west or the ‘Orient’ in a cultural process of ‘othering’ – to address the relational constitution of representations and identities. He then reflects on some of the broader moral and philosophical concerns raised by postcolonialism in relation to universalism, cultural relativism, and cross-cultural understanding/representation. Like poststructuralism, postcolonialism problematizes textual practices, such as reading, writing and interpreting, and the ways that textual meanings are produced.

In many ways, Chapters 9, 10, 11 and 12 might be thought of as articulating the death of philosophy (but see Aitken’s postscript, Chapter 10a) or, at the very least, a deterritorialization. The chapters that end this section are an interesting re-territorialization, in that they not only rekindle spatial theory and philosophy outside of geography, but also suggest an interesting convergence with GIS.

Although the connection between geography and the humanities dates back to the beginnings of the twentieth century, the influential ‘spatial turn’ in the humanities began in the 1990s. At that time, academics in art, theatre, English, history, and so forth looked to geographers for theories, methodologies and inspiration. At the heart of the spatial turn is a philosophical argument about the need to rebalance academic discourse from its overbearing emphasis on historicism toward a more balanced perspective in which the importance of space is re-injected into our collective ways-of-knowing. In Chapter 13, Trevor Harris documents a number of ongoing engagements, initiatives and projects interfacing geography and a variety of humanities disciplines. He notes that the conceptual convergence of geography and space with the humanities has produced an eclectic mix of methodologies and a kaleidoscope of intellectual and artistic outputs. Importantly, the spatial turn has spurred three unlikely bedfellows: art, social theory and GIS (see Chapters 2, 13, 25 and 26).

Francis Harvey’s chapter on spatial technologies (Chapter 14) takes to task the seeming immiscibility of Geographic Information Sciences and geo-technologies (including spatial data infrastructures and remote sensing) on the one hand, and theory and philosophy on the other. He argues that the gap between the spatial tools and their application is reminiscent of the underlying dissonance between material and mind

expressed in the seventeenth century by Descartes. He likens geographers' wariness over assessing the implications of this gap to the problematic divide between realism and idealism, pointing out that GIScientists tend not to look at this divide theoretically or philosophically because they rest on the laurels of science and technology's apparent material successes. He cautions against this kind of arrogance, and raises Nietzsche's concept of nihilism as a way of understanding the gap. Harvey notes that nihilism does not refer to abject meaninglessness, but may be understood as either a passive acceptance of the material/mind gap, an active attempt to destroy the gap or an apathetic – what he calls an 'armchair' – perspective. Harvey argues that by excavation of the gap between tool/application and the material/mind duality in geography, a convergence may be possible through which ontological and epistemological commitments and responsibilities are re-engaged.

What we have done with this introduction to the book's first set of chapters is contrive a respectful parsing of the ways in which geographic theories and philosophies fit singular, worldly and less structured ways of knowing. In largely dismissing an evolutionary pedagogy to the way we come to know geography, we are suggesting a radical new way of understanding focused on the tensions in our discipline. Whether the reader is comfortable going this far or not, it is clear that no one way of knowing has any more or less legitimacy than any other, that many talk past each other as much as they align themselves, that each competes in academia and in society to say something of worth, and that there is significant tension and conflict that is not just based on the logic of a philosophical argument.

2 Positivist Geography

Rob Kitchin

Introducing Positivism

Positivism is a set of philosophical approaches that seeks to apply scientific principles and methods, drawn from the natural and hard sciences, to social phenomena in order to explain them. Auguste Comte (1798–1857) is widely acknowledged as the father of positivism. He argued that social research prior to the nineteenth century was speculative, emotive and romantic and as a result it lacked rigour and analytical reasoning. Unwin (1992) details that Comte used the term ‘positive’ to prioritise the actual, the certain, the exact, the useful, the organic and the relative. In other words, he posited that it is more useful to concentrate on facts and truths – real, empirically observable phenomena and their interrelationships – rather than the imaginary, the speculative, the undecided, the imprecise. What Comte demanded was the objective collection of data through common methods of observation (that could be replicated) and the formulation of theories which could be tested (rather than as with empiricism, where observations are presented as fact). Such testing would be systematic and rigorous and would seek to develop laws that would explain and predict human behaviour. As such, Comte rejected metaphysical (concerned with meanings, beliefs and experiences) and normative (ethical and moral) questions as they could not be answered scientifically. Like with most other ‘isms’ and ‘ologies’ there are various different forms of positivism. The two most commonly discussed are *logical positivism* based on verification and *critical rationalism* based on falsification.

Logical positivism was developed by the Vienna Circle (a loose collection of social scientists and philosophers) in the 1920s and 30s. Like Comte, they posited that the scientific method used in the traditional sciences could be applied directly to social issues – that is, social behaviour could be measured, modelled and explained through the development of scientific laws in the same way that natural phenomena are examined. Such a view is called naturalism and is underpinned by a set of six assumptions as detailed by Johnston (1986: 27–8):

1. That events which occur within a society, or which involve human decision-making, have a determinate cause that is identifiable and verifiable.
2. That decision-making is the result of the operation of a set of laws, to which individuals conform.

3. That there is an objective world, compromising individual behaviour and that the results of that behaviour, which can be observed and recorded in an objective manner, on universally agreed criteria.
4. That scientists are disinterested observers, able to stand outside their subject matter and observe and record its features in a neutral way, without in any respect changing those features by their procedures, and can reach dispassionate conclusions about it, which can be verified by other observers.
5. That, as in the study of inanimate matter, there is a structure to human society (an organic whole) which changes in determinate ways, according to the observable laws.
6. That the application of laws and theories of positivist social science can be used to alter societies, again in determinate ways, either by changing the laws which operate in particular circumstances or by changing the circumstances in which the laws will operate.

The Vienna Circle significantly extended Comte's work, however, by formulating rigorous analytical procedures centred on verification. As such, they sought to define precise scientific principles and methods by which social behaviour could be measured and social laws verified (the extent to which scientific theories explained objective reality). The mode of measurement they advocated was one centred on the precise quantitative measurement of facts (e.g. heights, weights, time, distance, wage). These measurements allowed the statistical testing of relationships between variables as a means to test (verify) explanatory laws. Because the method focuses on known facts that are easily collected across large populations (e.g. using the census), it is possible to test and verify laws against very large sample sizes. Here, a deductive approach is employed, wherein a theory is formulated and hypotheses are set and then tested. In cases where the data does not support the hypotheses, the theory can be modified, new hypotheses set and the data re-analysed. A cumulative process is thus adopted, wherein theories are extended and built up in a structured and systematic manner through the incorporation of new findings and the rejection and resetting of hypotheses. Given that samples are often not perfect, complete verification is understood to be impossible, and logical positivism thus deals with weakly verified statements understood in terms of probabilities (the statistical likelihood of occurrence) that it aims to strengthen (Johnston 1986). By increasing the strength of probability that a relationship did not occur by chance and is potentially causal, hypotheses can be tested, and theories deductively constructed. In this way, logical positivism provides a method for gaining an objective knowledge about the world. Objectivity through the independence of the scientists is maintained through conformity to the following five premises (Mulkay 1975, cited in Johnston 1986: 17–18):

1. *Originality* – their aim is to advance knowledge by the discovery of new knowledge.
2. *Communality* – all knowledge is shared, with its provenance fully recognised.
3. *Disinterestedness* – scientists are interested in knowledge for its own sake, and their only reward is the satisfaction that they have advanced understanding.
4. *Universalism* – judgements are on academic grounds only, and incorporate no reflections on the individuals concerned.
5. *Organised scepticism* – knowledge is advanced by constructive criticism.

In contrast to Comte, the Vienna Circle accepted that some statements could be verified without recourse to experience, making a distinction between analytical statements and synthetic statements. Analytical statements are *a priori* propositions whose truth is guaranteed by their internal definitions (Gregory 1986a). Such analytical statements are common in the formal sciences and mathematics, where questions are often solved in a purely theoretic form long before they can be empirically tested. Indeed, theoretical physics almost exclusively seeks to provide solutions (based on known laws and properties) to problems that remain impossible to empirically test (see for example Hawking's *A Brief History of Time*). Synthetic statements are propositions whose truth needs to be established through empirical testing because they lack internal definition and are complex. In addition, the Vienna Circle forwarded scientism (that is the claim that the positivist method is the only valid and reliable way of obtaining knowledge, and all other methods are meaningless because they do not produce knowledge that can be verified) and a narrowly defined scientific politics that argued that positivism provides the only means of providing rational solutions to all problems (Johnston 1986).

Critical rationalism was developed in response to logical positivism and challenges its focus on verification. Forwarded by Karl Popper, it contends that the truth of a law does not depend on the number of times it is experimentally observed or verified, but rather whether it can be falsified (Chalmers 1982). Here it is argued that rather than trying to provide a weight of confirmatory evidence, scientific validation should proceed by identifying exceptions that undermine a theory. If no exceptions can be found then a theory can be said to have been corroborated. The critique of such an approach is that a theory can never be fully validated as a yet unidentified exception might still be awaiting discovery. As a consequence, the approach is difficult to implement except in cases of full sample populations and has not been adopted by many geographers (Gregory 1986b). A variety of other versions of positivism have been proposed and contemporary positivist philosophy significantly extends the work of the Vienna Circle. That said, debates in geography draw on these older forms of positivism mainly because positivist geography itself rarely engages in any deep or meaningful engagement with philosophy and, as such, its underpinnings have not been advanced with regard to new forms of positivism.

Development and Use of Positivism in Human Geography

Positivism is one of the unrecognised, 'hidden' philosophical perspectives which guides the work of many geographers. ... [It remains hidden] in the sense that those who adhere to many of its central tenets rarely describe themselves as positivists. ... While many boldly carry the banner of their chosen philosophy, the name of positivism is rarely seen or heard in the works of geographers who give assent to its basic principles. (Hill 1981: 43)

Until the 1950s, geography as a discipline was essentially descriptive in nature, examining patterns and processes, often on a regional basis, in order to try and understand particular places. From the early 1950s, a number of geographers started to argue that geographical research needed to become more scientific in its method, seeking the underlying laws that explained spatial patterns and processes. For example, Frederick

Schaefer (1953: 227), in a paper often cited as the key catalyst for the adoption of scientific method in human geography, argued that 'geography has to be conceived as the science concerned with the formulation of the laws governing the spatial distribution of certain features on the surface of the earth'. In effect Schaefer drew on the arguments of logical positivism to contend that geography should seek to identify laws, challenging the exceptionalist claims of geographers such as Hartshorne (1939) that geography and its method was unique to that of other social sciences. In other words, geography should shift from an ideographic discipline (fact gathering) focusing on regions and places to a nomothetic (law producing) science focused on spatial arrangement.

The principal concern of the early advocates of geography as a *spatial science* was that geographical enquiry up to that point was largely unsystematic and analytically naïve. Geographers were developing empiricist accounts of the world by simply accumulating facts as evidence for generalist theories. The problem with such empiricist endeavours was that they did not distinguish between casual correlations and accidental or spurious (non-causal) associations. For example, environmental determinist accounts suggested that environmental conditions explicitly influenced society in a casual fashion (e.g. high ambient temperatures caused underdevelopment in tropical countries by inducing idleness among local residents) (Hubbard et al 2002). Moreover, such accounts committed ecological fallacies – that is, ascribing aggregate observations to all cases within an area. However, just because two things are observed in the same place at the same time does not mean that one caused the other or that they apply universally. They need to be tested scientifically. Indeed, most people now accept that ambient temperature may influence human behaviour but it does not determine it, and it has little or no effect on levels of development. For geographers such as Schaefer, geography as a discipline would only gain real utility, and by association respectability within the academy, if it became more scientific. Scientific method would provide validity and credibility to geographic study and it would provide a shared 'language' for uniting human and physical geography.

The Quantitative Revolution

What followed was the so-called 'quantitative revolution', wherein the underlying principles and practices of geography transformed (Burton 1963), with description replaced with explanation, individual understandings with general laws, and interpretation with prediction (Unwin 1992). In order to employ a scientific method, to transform human geography into a scientific discipline concerned with the identification of geographical laws, a number of geographers started to use statistical techniques (particularly inferential statistics concerned with measuring probability of a relationship occurring by chance) to analyse *quantitative* data. Quantitative data was seen as factual, objectively and systematically measured. It was therefore universal in nature, free of the subjective bias of the measurer and analyst. By statistically analysing and modelling these data, geographers hoped to be able to identify universal laws that would explain spatial patterns and processes, and also provide a basis for predicting future patterns and identifying ways to constructively intervene in the world (e.g. altering policy to engender change). So, just as physics and chemistry tried to determine the general laws of the physical world, geographers adopted a naturalist position (a belief in the equivalence of method between social and natural sciences) to try to determine the spatial laws of human activity.

Box 2.1 Spatial models and laws

Throughout the late 1950s and 1960s a whole plethora of geographical models and laws, based on scientific analysis of quantitative data and taking the form of mathematical formulae, were developed using a hypo-deductive approach. For example, early quantitative geographers tried to find a formula that adequately modelled the interaction of people between places. One of these was Isard et al's (1960, detailed in Haggett 1965: 40) inverse-distance gravity model:

$$M_{ij} = (P_i / d_{ij}) \cdot f(Z_i)$$

where M_{ij} is the interaction between centres i and j , P_i is a measure of the mass of centre i , d_{ij} is a measure of the distance separating them and $f(Z_i)$ is a function of Z_i where Z_i measures the attractive force of destination i . This advanced earlier models that did not take into account how 'attractive' each location might be in relation to each other (for example, in climate or amenities).

This transformation in theory and praxis led to a whole variety of different types of laws, most of which did not pretend to be the universal law as portrayed by many critics. For example, Golledge and Amedeo (1968, summarised in Johnston 1991: 76) detailed four types of law being developed in human geography: '*Cross-sectional laws* describe functional relationships (as between two maps) but show no causal connection, although they may suggest one. *Equilibrium laws* state what will be observed if certain criteria are met. ... *Dynamic laws* incorporate notions of change, with the alteration of one variable being followed by (and perhaps causing) an alteration in another. ... Finally *statistical laws* ... are probability statements of B happening, given that A exists' (the first three laws might be deterministic or statistical).

The aim, in short, was to create a scientific geography, with the standards of precision, rigour and accuracy equivalent to other sciences (Wilson 1972). However, as Hill (1981) notes, given that spatial science borrowed the idea of scientific method largely without conscious reflection on its philosophical underpinnings, it is perhaps better to term it positivistic rather than positivist. Certainly, many positivistic geographers (most who would prefer to adopt the label of quantitative or statistical geographers) would balk at the scientism and scientific politics of logical positivism, though they would see the scientific method as the most sensible and robust (rather than the only) approach to geographical enquiry. Indeed, the label positivist geography is one that has largely been assigned by its critics in recognition of the allegiance of its underpinnings, rather than one claimed by its practitioners.

As with all 'revolutions', certain key sites and people were instrumental in pushing and developing the emerging quantitative geography. In the US, geographers such as William Garrison at Washington State, Harold McCarty at Iowa State and A.H. Robinson at Wisconsin trained a generation of graduate students who became faculty elsewhere, where in turn they propagated their ideas (Johnston 1991). In the UK, Peter Haggett at Bristol and later Cambridge was a key influence (along with physical geographer Richard Chorley). Indeed, Haggett's book *Locational Analysis in Human Geography* (1965) was an important text that helped to strengthen the case for quantitative geography. Such was the pace of adoption that by 1963 Burton had already declared that the revolution was over and quantitative geography was

now part of the mainstream. That said, it is important to note that not all geographers were enthusiastic converts to what was increasingly called spatial science, and many continued to practise and teach other forms of geographical enquiry (Johnston 1991; Hubbard et al 2002). Nonetheless, the quantitative turn, and its conception of space as a geometrical surface on which human relationships are organised and played out, did change how many of these geographers conceived the notions of space and place.

Harvey's Explanation in Geography

Despite the rapid growth of quantitative geography throughout the 1960s, as noted, it largely operated in a philosophical vacuum – it focused on methodological form, not the deeper epistemological structure of knowledge production (Gregory 1978). David Harvey's book *Explanation in Geography* was a milestone text for the discipline. Harvey's key observation was that until that point geographers had rarely examined questions of how and why geographical knowledge was produced. And no-one had tried to forward a robust and theoretically rigorous methodological (rather than philosophical) base for the discipline. Harvey's text thus sought to provide such a base by explicitly acknowledging the importance of philosophy to geographical enquiry. In particular, he drew on the philosophy of science (which can effectively be translated as positivism despite the fact that Harvey never uses the term) to construct a theoretically sound ontology and epistemology – presented as a coherent scientific methodology. As Harvey (1973) himself later acknowledged, however, wider philosophical issues were skirted, as his aim was to concentrate on formalising methodology using philosophy rather than philosophy *per se*.

Spatial Science as Implicit Positivism

While Harvey's text was enormously influential, providing an initial, theoretically robust ontological and epistemological base for spatial science, it is fair to say that most geographers employing the scientific method have subsequently paid little attention to its philosophical underpinnings. As such, as Fotheringham (Chapter 25) notes, positivism *implicitly* underpins much spatial science work, in that while research seeks to determine casual relationships and spatial laws through statistical analysis and geographical modelling, there is little explicit appreciation or engagement with positivism or other philosophies. As such, while there is the adoption of a scientific method and the use of terms such as law, model, theory and hypothesis, these are often used without an appreciation of what they actually mean or constitute (Hill 1981; Johnston 1986). Such research forms a major part of the discipline today, despite criticisms levelled at its positivistic underpinnings. For example, nearly all GIS and geocomputational research is practised as spatial science (although it is fair to say that much of it has actually continued the tradition of empiricism, wherein facts are allowed to 'speak for themselves' and are not subject to the rigours of spatial analysis through statistical testing – for example, in most mapping work the maps are allowed to speak for themselves; it is also increasingly rare to see hypotheses stated and then tested). This is not to say that all *quantitative* geography is implicitly positivist (or empiricist). In fact, much is not. Indeed, quantitative geography refers to the geographical inquiry that

uses quantitative data, and such data can be interrogated from a number of ontological and epistemological positions (it is important never to conflate data type with a philosophical approach).

Criticism and Challenges to Positivist Geography

The period of transformation in geography's method opened the way for a sustained period of reflection on ontology, epistemology and ideology of geographical inquiry from the late 1960s onwards. This coincided with a period of large social unrest in many western countries during which many geographers were questioning the relevance and usefulness of the discipline for engaging with and providing practical and political solutions. Consequently, numerous geographers started to question the use and appropriateness of the scientific method and its new, philosophical base of positivism from a number of perspectives. It is important to note here that many of these critiques were not of using and analysing quantitative data per se, but rather of the positivist approach to analysing such data – it was a critique of ontology, epistemology, method and ideology, not data type.

The critiques of positivistic geography came from many quarters. For some, such as Robert Sack (1980), positivistic geography was a form of spatial fetishism, focusing on the spatial at the expense of everything else. Spatial science represented a spatial separatist position, decoupling space from time and matter, which he argued meant that it had little analytical value – determining spatial patterns would not tell us why such patterns exist or why they might change over time because it fails to take account of social and political process.

Marxist and radical critiques developed the latter point. By rejecting issues such as politics and religion and trying to explain the world through observable facts, radical critics noted that spatial science was limited to certain kinds of questions and was further limited in its ability to answer them. It treated people as if they were all rational beings devoid of irrationality, ideology and history, who make sensible and logical decisions. It therefore modelled the world on the basis that people live, or locate their factories and so on, in places that minimise or maximise certain economic or social benefits. Critics argued that individuals and society are much more complex, with this complexity impossible to capture in simple models and laws. As a consequence, Harvey (1973: 128), in a notable turnaround, condemned positivistic geography just a few years after writing its 'blueprint': there is 'a clear disparity between the sophisticated theoretical and methodological framework we are using and our ability to say anything meaningful about events as they unfold around us.' For Harvey, spatial science could say little about issues such as class divisions, Third World debt, geopolitical tensions and ecological problems, because it was incapable of asking and answering the questions needed to interrogate them. Moreover, it was noted that positivistic geography lacked a normative function in that it could seek to detail what is and forecast what will be, but gave no insight into what should be (Chrisholm 1971). For Harvey and others, the only way to address such issues was to turn to radical theories such as Marxism which sought to uncover the capitalist structures that underpinned social and economic inequalities and regulated everyday life, and to transform such structures into a more emancipatory system.

Accompanying radical critiques, from the early 1970s humanist geographers similarly attacked positivism with regard to its propensity to reduce people to abstract, rational subjects and its rejection of metaphysical questions (Buttimer 1976; Guelke 1974; Tuan 1976). In effect it was argued that spatial science was peopleless, in the sense that it did not acknowledge peoples' beliefs, values, opinions, feelings and so on, and their role in shaping everyday geographies. Clearly, individuals are complex beings who do not necessarily behave in ways that are easy to model. Humanistic geographers thus proposed the adoption of geographical enquiry that was sensitive to capturing the complex lives of people through in-depth, qualitative studies.

In addition, both radical and humanist critics questioned the extent to which spatial scientists are objective and neutral observers of the world, contending that it is impossible (and in the case of radicals undesirable) to occupy such a position. Geographers, it was argued, are participants in the world, with their own personal views and politics, not privileged observers who could shed these values while undertaking their research (Gregory 1978). At the very least, researchers make decisions over what they study and the questions they wish to ask, and these are not value-free choices.

This argument was supplemented by feminist geographers such as Domosh (1991), Rose (1993) and McDowell (1992), who argued that spatial science was underpinned by a masculinist rationality. That is, positivism was defined by man's quest for a god's-eye view of the world, one which was universal, 'orderly, rational, quantifiable, predictable, abstract, and theoretical' (Stanley and Wise 1993: 66), and in which the knower 'can separate himself from his body, emotions, values, past and so on, so that he and his thought are autonomous, context-free and objective' (Rose 1993: 7). They argued that geographical enquiry had to reject such rationality and become much more sensitive to power relations within the research process, and the geographer more self-reflexive of their positionality, supposed expertise, and influence on the production of knowledge. In other words, geographers had to give up the pretence that they could necessarily create a master, universal knowledge of the world and accept that knowledge will always be partial and situated (from a certain perspective). What this meant in practice was that feminist geographers largely dismissed quantitative geography as a viable means of feminist praxis.

In turn, this feminist critique opened the door to a wider debate on the relationship between feminism epistemology and spatial science in a special forum of *Professional Geographer* (1994: Should women count?), which in turn helped (alongside texts such as Pickles 1995) to fuel the development of critical approaches to GIS in the late 1990s and early 2000s. Critical GIScience draws off feminist, postmodern and poststructuralist theories to rethink the *modus operandi* of spatial science (see Curry 1998, Kwan 2002, Harvey 2003). In many senses it is an attempt to reposition quantitative geography by providing it with a radically different philosophical framework to positivism, one that is more contemporary and robust to traditional criticisms of spatial science and which enables it to address questions that previously it avoided or was unable to tackle.

Positivist geography today

Despite the criticism levelled at geographical work underpinned by positivist reasoning, implicit positivism remains strong within human geography. A very large number of geographers argue that they are scientists, employ scientific principles and reasoning,

and seek laws or mathematical models that purport to explain the geographical world. Many, as Stewart Fotheringham notes in his chapter, give little thought to the philosophical underpinnings of their scientific method and are not interested in philosophical debate and critique, shaking their heads in frustration and disbelief at ongoing philosophical discussions and ‘wondering what is happening to the rest of their discipline’. Of course, much of the rest of the discipline are shaking their collective heads at the philosophical naivety of spatial scientists. Questions around what geographers should study, how they should study it, and for whom are important because they define the discipline and its praxis – philosophy is a core, inescapable feature of geographic research (see Hill 1981, Hubbard et al 2002). To ignore such questions, or to take them as self-evident, means that implicitly positivistic geography has weak and unstable underpinnings (much of it backsliding into empiricism) and leaves it vulnerable to critique for which it has little response. To simply argue that those who criticise positivistic geography do not understand its bases, or lack the required skill to practise and therefore understand it, or are damaging the discipline by engaging with wider philosophical debate is a weak and deflective response that fails to tackle any of the criticism levelled at it.

This is not to say that all spatial science lacks theory; rather, much of it lacks a fundamental and robust ontological, epistemological and ideological base. It also does not mean that their work is not useful or valuable; it most patently is or it would not be practised, commissioned or used by policy makers and business. However, by ignoring wider philosophical debate spatial scientists often fail to make a robust case for their approach to new generations of geographers, who are often seduced by the criticisms levelled at positivism and quantification more broadly (and this will continue to be the case unless addressed). Instead they rely on the commercial and policy cache of GIS to make implicitly positivistic geography sustainable. As the debates in GIScience illustrate, however, the implicit positivism underpinning GIS use is open to challenge, with an acknowledgement that the employment of the scientific method can be practised from more critical perspectives.

That said, despite critique and its seeming shrinkage in importance in the discipline, the future of positivistic science seems relatively assured. Just as GIS gave fresh impetus to spatial science in the 1990s, new technological developments seem set to provide a significant boost to its fortunes in the present decade. Over the past few years a data revolution has been taking place that has now reached a tipping point: we have entered the age of ‘big data’. Big data involves enormous, dynamic, interconnected digital data-sets relating to people, objects, interactions, transactions and territories. Big data is commonly characterised as being large in volume, high in velocity (in real-time) and wide in variety (with the majority of the data unstructured in form – text, images, audio, rather than simply numbers) (Laney 2001; Zikopoulos et al 2012). It is also relational (linked to other data) and has a fine granularity (related to individual people, objects, transactions as opposed to being aggregated). Ever more data are being produced by software-enabled technologies such as computers, digital cameras and smartphones, as well as sensors and processors embedded in buildings, vehicles, and environments; non-digital objects are being made machine-readable through devices that can scan various kinds of barcodes and radio frequency identifiers; social media users are generating massive volumes of volunteered information through exchanges such as Facebook or Twitter posts, as well as through online searches, browsing sites or purchasing goods and services (Kitchin and Dodge 2011). Every interaction and transaction that utilises

software and ICT generates data. Importantly for geographical analysis, much of this data is georeferenced, referring to particular places or located in space through the GPS traces of mobile devices (Goodchild 2007). Moreover, the data are generated in real time. The result is data that can provide very detailed views of large systems in flux and can potentially enable sophisticated spatio-temporal modelling.

The scale, timeliness and variety of the data now being produced is startling and is growing rapidly. For example, Gantz and Reinsel (2011) estimated that the ‘amount of information created and replicated on the Internet will surpass 1.8 zettabytes (1.8 trillion gigabytes)’ in 2011 stored in ‘500 quadrillion files ... growing by a factor of 9 in just five years’ and ‘more than doubling every two years’. They predict that in the next decade, ‘the number of servers (virtual and physical) worldwide will grow by a factor of 10, the amount of information managed by enterprise datacenters will grow by a factor of 50, and the number of files the datacenter will have to deal with will grow by a factor of 75, at least’.

The challenge is to analyse and extract value from these massive, dynamic and varied datasets. For some, the approach required is quite empiricist. For example, Chris Anderson (2008), Editor in Chief at *Wired* magazine, has declared that big data signals ‘the end of theory’, arguing that ‘the data deluge makes the scientific method obsolete’. Anderson’s argument is that big data inherently speak for themselves, producing meaningful and insightful knowledge about social, political and economic processes and complex phenomena; that all that is required to provide such insights is sophisticated data management, mining and correlation analytics that can reveal patterns and make sense of the data deluge. He concludes:

Petabytes allow us to say: ‘Correlation is enough.’ We can stop looking for models. We can analyze the data without hypotheses about what it might show. We can throw the numbers into the biggest computing clusters the world has ever seen and let statistical algorithms find patterns where science cannot. ... Correlation supersedes causation, and science can advance even without coherent models, unified theories, or really any mechanistic explanation at all. There’s no reason to cling to our old ways.

Similarly, Prensky (2009, original emphasis) argues: ‘scientists no longer have to make educated guesses, construct hypotheses and models, and test them with data-based experiments and examples. Instead, they can mine the complete set of data for patterns that reveal effects, producing scientific conclusions *without* further experimentation.’ In essence, Anderson and Prensky are contending that the analysis of big data can float free of theory, with the weight of evidence, revealed through data analytics, providing deep insight into the world. Under this scenario, what might transpire in the long term is the continuation of spatial science as implicitly positivist at best, and implicitly empiricist at worst.

What such reasoning fails to appreciate is that the algorithms underpinning data analytics are based on scientific reasoning and are refined through scientific testing – and that science is laden with ontological and epistemological assumptions, as with any other science, including empiricism. In other words, data analytics do not arise from nowhere or within a scientific vacuum; rather, they arise from science method, and this method is predominately positivist in its formulation.

In contrast to those promoting data analytics shorn of scientific method are those who argue that big data will usher in a new phase of computational social science that

analyses data which has enormous breadth, depth, scale and timeliness and is inherently longitudinal, rather than the much smaller, one-time, snap-shot datasets that characterise existing quantitative data sets and qualitative research (Lazer et al., 2009). Here, big data presents untold possibilities for a new wave of positivistic models that address some of the critiques levelled at it previously: the data are finely granulated and much more exhaustive, algorithms and models are much more refined and sensitive to context and contingency, and computation is so powerful that it is possible to produce highly sophisticated spatio-temporal models of social and environmental processes and, given the size and range of the data sets, it is possible to more quickly hone hypotheses and be confident in their veracity. Such data-intensive science will enable geographers to analyse bigger and more complex systems more efficiently and effectively and to advance an understanding of society rooted in analysis underpinned by the scientific method. Such an approach is implicitly positivist in its underpinnings. The emergence of big data and computational social science thus has the potential to breathe new life into quantitative geography and positivistic forms of geographical analysis.

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