Chapter 6
The Imprecise Wanderings of a Precise Idea: The Travels of Spatial Analysis

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The text for our chapter is a schematic map based on one originally published in a geography undergraduate primer in quantitative methods (Fig. 6.1). By text we mean an object, here a diagram, which can be critically interpreted, or "read," to then be used to shape the structure of an argument. "Quant Geog airlines flight plan" first appeared in the opening chapter of Peter Taylor's (1977) introductory statistics textbook, *Quantitative Methods in Geography*. It was a brilliant piece of cartography because it was a map of a disciplinary idea: geography's quantitative revolution. Maps of this kind have rarely existed in geography, in spite of a disciplinary obsession with cartography. The American geographer Carl Sauer, professor at the University of California in Berkeley, famously said: "Show me a geographer who does not need [maps] constantly and want them about him, and I shall have my doubts as to whether he has made the right choice of life" (Leighly, 1963, p. 391). The maps that interested Sauer were of tangible objects, often everyday ones, such as fence posts, grave markers, or barn types. For Sauer those objects, and the peculiar material form they took, bore the impress of a wider, shaping culture. By mapping the geography of those objects, one mapped also the geography of the larger culture that gave rise to them.

The map found in Fig. 6.1 is not of an ordinary tangible object, but of an extraordinary intangible idea: *spatial analysis*, or *spatial science*, or the *quantitative revolution*. These were all names given to the movement in Anglo-American geography during the second half of the 1950s to refashion geography in the likeness of physical science. As an intellectual movement, it was defined by the use of a formal mathematical vocabulary to reduce complex geographical patterns to simpler relations,

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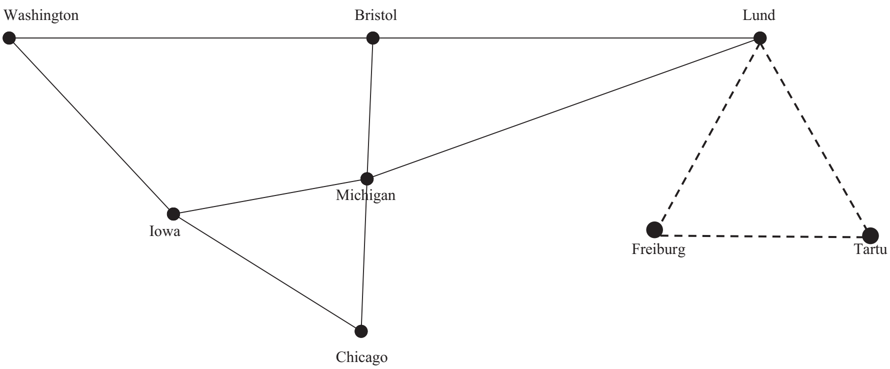

Fig. 6.1 Quantgeog airlines flight plan (Adapted from Taylor, 1977, p. 15)

permitting identification of an underlying (theoretically defined) causal structure. Taylor's map shows the geography of that intellectual movement, depicting the specific places where it was formulated and practiced, as well as its travels, represented by the lines connecting the sites. Taylor's figure, then, like the cartography of Sauer and his students, was a cultural map, in this case a map of geography's intellectual culture.

Our paper is a series of footnotes to Peter Taylor's map. We want to understand how the geography inscribed within Fig. 6.1 arose. Why were those places on his map and not others? And what did those places provide that was unavailable elsewhere? To answer these questions, we draw on science studies, especially on recent works within that field concerned with "putting science in its place" (Livingstone, 2003). Science studies has increasingly emphasized the geographical constitution of knowledge, the fact that knowledge is always from somewhere. In this standpoint, the field contradicts the orthodox, rationalist account of science that renders the place of inquiry irrelevant (Shapin, 1998). Rationalism is "the view from nowhere" (Nagel, 1986). It averses that emphasizing place undermines scientific inquiry's credibility. For example, "[i]t was the end for cold fusion when people decided it only happened in Salt Lake City" (Kohler, 2002, quoted in Livingstone, 2003, p. 2), as one commentator noted.

In contrast, we argue that placing ideas should be the very first act in interpreting knowledge (Barnes, 2004). That is why Peter Taylor's map is so important. His map, however, applies only to the post-World War II period. We suggest that spatial analysis existed long before World War II, accreting complex geographies and mobilities. These other geographies, and other maps, also need discussing.

The paper is divided into two main sections. The first draws on science studies to fashion some of the conceptual tools needed to make sense of the geography of ideas. In particular, we elaborate on Thomas F. Gieryn's (2002) text on "truth spots" and Kevin Hetherington's (1997) book on "heterotopias" to understand why certain places are sites for the development of big ideas. We also consider the writings of Bruno Latour (1987, 2005) on intellectual mobility to fathom the processes necessary to move a big idea from one place to another. The second section provides a geographical genealogy of spatial analysis. The first part is concerned with spatial analysis's origins with the ancient Greeks, and its revival, after a significant lag, during the European Enlightenment by Bernhardus Varenius (1622–1650), who also inspired Isaac Newton's (1642–1727) interest. The second part is concerned with the institutionalization of spatial science after World War II, when some in the discipline claimed that spatial analysis was not just *a* big idea in geography, it was *the* big idea.

The View from Somewhere: Place and the Spatial Mobility of Knowledge

Our conceptual framework derives from science studies, the interdisciplinary body of work from the late 1960s that insisted the social went all the way down in shaping scientific knowledge. Science studies was a reaction to rationalism, which conceived of knowledge as the purified product of a disembodied mind, or a "brain in a vat" in Hilary Putnam's (1981, p. 7) arresting image. By dogged brain power alone *Truth* would be revealed, with rationality assumed to be universal and the source of Truth with a capital "T." Consequently, *where* rationality was applied was irrelevant. It could be Heidelberg or Hong Kong. It did not matter because the same conclusion would be generated in both places. Adding geographical information might provide background color, but it would (and could) not change the rational outcome.

Also denied by rationalism was spatial process. There was no process, geographical or otherwise, involved in arriving at Truth under rationalism. Once premises were stated, and the correct logic was applied, Truth instantaneously followed, believed by everyone everywhere. Truth occurred *just like that*.

Opposing this rationalist view, science studies contends that place is utterly critical to the formation of ideas, as is their geographical mobility (Nye, 2011). Ideas are not titrated on to the page drop by drop from a distilled rationality, but are a consequence of grounded social practice embedded within place. In this understanding, geography is not mere background atmospherics, but provides for the very possibility and shape of new ideas. It is not the view from nowhere, but the view from somewhere. Likewise, there is a process to truthmaking that necessarily extends over space and time. Truth is not accepted instantly and everywhere because of an overarching rational proof. Rather, ideas take time to establish a hold, traveling and circulating at different speeds. Moreover, as they travel they change form, serendipitously interacting with other ideas, creating hybrids. There is no "just like that" acceptance of big ideas. It is more complex and muddied; processual, not instantaneous; and rooted in the stickiness, fallibleness, and frailty of human interaction at a distance.

This anti-rationalist position, in which geography figures large as an integral component of intellectual production, has been worked out theoretically in different ways, and often by non-geographers.[1] We elaborate here on two aspects: (a) place and knowledge and (b) the spatial mobility of knowledge.

Place and Knowledge

What makes a place suitable for generating new knowledge? And once knowledge is generated there, how does it gain the credibility necessary to be accepted in other places?

Hetherington's (1997) Foucault-inspired notion of heterotopia addresses the first question. He argues that for a place to generate ideas, it must be sufficiently open, flexible, and porous to permit new beliefs and concepts to emerge and germinate. Such qualities correspond to Hetherington's (1997) definition of a heterotopia as a place of "alternative ordering. Heterotopias organize a bit of the social world in a way different to that which surrounds them" (p. viii). A heterotopia must be constituted to accept difference, to allow elbowroom for alternative ideas, to provide opportunities for open discussion, and to offer the means for dissemination. Only when one or more of these conditions hold will alternative orderings have an opportunity to come to fruition and to remake the surrounding outside world in their likeness. Hetherington's (1997) example is the Palais Royale in eighteenth-century Paris. It was a heterotopia because of its alternative internal ordering. There were no rigid rules about what could be said, and no rules about who could speak to whom. It was a place that made possible novelty and creativity. As a result, it was able to contest the established order of the (surrounding) *Ancien Régime*, "becoming the focus for other interests and hopes for social change" (p. 51) in a revolutionary France.

The second question of what makes knowledge stick to a place is taken up by Gieryn (2002), who addressed it in his notion of a "truth spot." A truth spot is a place that gains sufficient credibility that those professing knowledge from there are able to assert that their claims "are authentic all over" (p. 118). Accordingly, such places "escape place …; place achieves placelessness" (p. 113). One of Gieryn's (2002) examples is the Princeton Plasma Physics Laboratory, which "pursues cred-

[1] The anti-rationalist position, at least within science studies, is seen in two distinct bodies of work—social constructionism and actor-network theory. The social constructionist version suggests that scientific knowledge is constructed on the basis of the social interests of the scientist. The actor-network version, however, casts doubt on whether "the social" exists as an independent sphere, suggesting that scientific knowledge is the result of many agents, several of which are nonhuman. In a debate between David Bloor (1999), the most well-known proponent of social constructionism, and Bruno Latour (1999), the leading proponent of actor-network theory, differences were sharply drawn. Subsequent commentaries, however, in emphasizing the shared history of the two approaches point to considerable overlap between the two camps (Nye, 2011; Rheinberger, 2010).

ibility for its claims without recourse to place" (p. 125). Gieryn argues against this assertion, however, showing exactly how the trick of making place disappear is achieved with the claim that the results at the Plasma Laboratory in Princeton are replicable anywhere else in the world. Not true says Gieryn. They can be replicated only if all other laboratories *are identical* to Princeton's. As Nancy Cartwright (1999) puts it, replicability is achieved "primarily inside [various kinds of] walls . . . within which conditions can be arranged *just so*" (p. 2). Only when one place is arranged *just so*, that is, made to be identical to another, can results be replicated. But this is not the same as claiming that results are "authentic all over" (Gieryn, 2002, p. 118) and certainly does not prove placelessness. In fact, it suggests the reverse; that is, it takes considerable effort to undo geographical difference. It is realisable only artificially, by constructing one place as the mirror image of another (see Latour, 1987, pp. 248–253).

The larger point is that place is a critical component in the construction of knowledge. While certain rhetorical strategies may be deployed to disguise and diminish that role (and uphold rationalism's view from nowhere), it is done by a sleight of hand. A stubbornly enduring somewhere remains crucially important.

Spatial Mobility of Knowledge

Ideas, however, do not remain fixed in place, but instead are constantly circulating, dependent on people and material constraints (Latour, 1987, p.137). Furthermore, that very movement changes ideas, reshaping them and forging new entities. This has multiple causes: ideas come into contact with other ideas on route, are interpreted differently at different points along their circulation, and are put to diverse uses at the various sites to which they travel. Spatial mobility not only transfers knowledge, it transforms it.

A useful and well-known scheme for tracking the movement and transformations of knowledge is Bruno Latour's idea of "centers of calculation" (Latour, 1987, chapter 5). He emphasizes in all his works the processual character of knowledge acquisition involving the ceaseless travel and circulation of people, books, instruments, material bits of the world, and social artifacts such as institutions and strategies of governance. Knowledge is never instantly true, but becomes true through the enormous amount of work involved in establishing and maintaining networks of circulation. In Latour's vocabulary, Gieryn's truth spots are centers of calculation. They are key nodes in extensive geographical networks enabling them both to receive knowledge and to distribute it, producing action at a distance. Figure 6.2, taken from Latour's (1987) book *Science in Action*, portrays the process as cumulative, with more and more information and things brought back to the center as a result of increasingly expansionary geographical crossings and re-crossings.

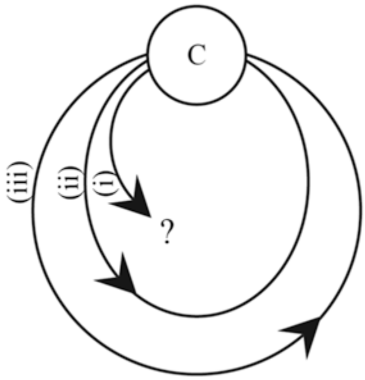

Fig. 6.2 Centers of calculation (Adapted from Bruno Latour, 1987, p. 220)

A History and Geography of Spatial Analysis

Like all ideas, spatial analysis did not just drop from the heavens, but was grounded in a rich, earthly geography. It was always the view from somewhere, traveling between one place and another.

The Early Years

The beginnings of spatial science were with the ancient Greeks, and in particular the work of the first- and second-century Hellenized Egyptian (and Roman citizen), Claudius Ptolemy, based in Alexandria. Classical Greek geography identified three components of study: *topos*, *choros*, and *geos*. *Topos* was the study of place; *choros* the study of the region; and *geos* the study of geography, that is, of the entire face of the earth (Curry, 2005; Lukermann, 1961). Lukermann (1961) and Curry (2005) persuasively argue that the critical difference among the three terms is their "mode of geographical knowing" (Curry, 2005, p. 681). *Topos* and *choros* emerged from an oral culture, with place and region told in a narrative of words. *Geos*, in contrast, arose later and was associated not with words, but with numbers.

Geos and its connection to numbers were elaborated especially by Ptolemy in his eight-volume *Geographia*. He believed that the task of *geos* was to "secure a likeness" of the earth's configuration, which required that space first be translated into "a surface divisible by a mathematical grid" (Curry, 2005, p. 685). As Ptolemy wrote:

> Geography … is concerned with the quantitative rather than with qualitative matters, since it has regard in every case for the correct proportion of distances, but only in the case of the more general features does it concern itself with securing a likeness, and then only with respect to configuration. … Geography by using mere lines and annotations shows positions and general outlines. For this reason, while *topos* and *choros* does not require the mathematical method, in *geos* this method plays the chief part. (as quoted in Lukermann, 1961, p. 208)

Although Ptolemy did not use the term spatial analysis, he clearly was gesturing toward it in his account of geography (*geos*). Implied in his work were mathematical transformations; the identification of more basic elements such as "lines" and "position"; and the recognition of an explainable spatial order—the world's "configuration." More specifically, one of Ptolemy's aims in *Geographia* was to improve cartographic projections so as to depict more accurately the earth's surface. The first volume of the *Geographia* contained the methods that Ptolemy developed and volumes 2–5 consisted of an atlas of the known world (Berggren & Jones, 2000).

It was from the starting point of Alexandria that spatial analysis began its travels. Over the next thousand years or so, Ptolemy's *Geographia* was lost and found several times. Finally translated into Latin in 1406, *Geographia* was published in Bologna in 1477 using engraved illustrations and maps. Bernhardus Varenius studied this Latin edition while living in Amsterdam during the late 1640s, in preparation for publishing his own geography text, *Geographia generalis*, in 1650. The adjective in the title is critical, linking the work to Ptolemy's *geos* and his implied spatial analysis (Lukermann, n.d., p. 10). Varenius defined general geography as "that part of mixed mathematics where one explains the state of the earth and its parts, which concerns quantities; its configuration, its position, its magnitude and its movement with the celestial appearances, etc." (Varenius quoted in Lukermann, n.d., p. 10). So, like Ptolemy's geography, Varenius's general geography required mathematizing space, finding universal spatial elements, and recognizing general principles of spatial order, which were "then appl[ied] within special or regional Geography to their respective areas" (Varenius quoted in Lukermann, n.d., p. 16).

Isaac Newton (1643–1727), perhaps the all-time greatest analyzer of space, recognized the virtues of Varenius's book. In 1669 Newton was appointed Lucasian Professor of Mathematics at Cambridge with the stipulation that the chairholder provide instruction in geography. Newton subsequently corrected and amended Varenius's text for his students, arranging for its publication in 1672 (and in revised form in 1681; Warntz, 1989).

The elements that now compose the big idea of spatial analysis—mathematizing space; identifying universal spatial components, such as points and lines; and articulating general principles of spatial order—have thus existed not only for centuries but for millennia. Moreover, the idea did not just have temporal duration but also spatial location, being found in some places and not others. Details about Ptolemy's life remain sketchy, but it is almost certain that his entire adult life was spent in the Egyptian capital of Alexandria, which was the seat of ancient learning and certainly one of the most significant truth spots in the ancient world. Associated with its celebrated library, which at its height contained a million volumes, was a research institute (likely the world's first) that supported a who's who of ancient scholars, including Euclid, Archimedes, and Ptolemy. To use Latour's vocabulary, Alexandria was a "center of calculation" (Latour, 1987, p. 215) attracting people and wealth, as well as objects, texts, and ideas, which were collected, classified, and sometimes reconstituted—before being circulated, as was the case with Ptolemy's papyrus scrolls, *Geographia*.

After having been lost for more than a millennium, *Geographia* was discovered in fifteenth-century Italy, translated into Latin, and published. Scholarship, although not completely moribund during the intervening Middle Ages, was at least severely controlled by church authorities. An intellectual revival came in the Italian Renaissance, which had its foundations in an earlier period with flourishing Arabic science and key centers of learning and translation such as the libraries in Toledo (Lindberg, 1992). Contemporary Italian scholars turned to forgotten ancient texts, including Ptolemy's, republishing them, and setting them on new travels. It also made sense that one of the travels of *Geographia* would be to Amsterdam, where it was put to use by Varenius in the first half of the seventeenth century. This period was the Dutch Golden Age, the zenith of the Dutch Empire, with Amsterdam the wealthiest city in the world. Just like ancient Alexandria, Amsterdam in the seventeenth-century became a global center of calculation, as well as the world's busiest port. If ever there was a place where a new geographical textbook should be written and have purchase, it was here. Ultimately, Isaac Newton would take up Varenius's text at the University of Cambridge in the second half of the seventeenth century, in part because of the conditions of his appointment, in part because of his own analytical disposition. He was less concerned with the book's "special geography," as Varenius called it, than its general geography, which as an intellectual project fitted perfectly with the Enlightenment's scientific revolution, to which he was a prime contributor: mathematical, reductionist, and nomothetic.

In sum, producing spatial analysis took an enormous amount of work and effort. It did not emerge simply because of its own rightness, shining by its own light. It was constructed in a process involving complex geographical travels centered around particular heterotopias, truth spots and centers of calculation. Furthermore, geography was just as crucial during the second half of the twentieth century, when the ideas of Ptolemy, Varenius, and Newton were joined with new concepts, techniques, and technologies to define the modern version of "spatial analysis."

The Later Years

Spatial analysis gained its contemporary prominence from the title of a book, *Spatial Analysis: A Reader in Statistical Geography*, edited by Brian Berry and Duane Marble (1968). The term had been first used in 1959 by William Garrison (1959), but only in passing, and was not systematically applied until the 1968 collection. The 37 essays in *Spatial Analysis* applied statistical and mathematical models to geographical problems; located key spatial axioms, elements, assumptions, and behaviors; and above all pursued explanations of spatial order.

How they got there was another story. Berry and Marble (1968) argued that the spatial analytical approach had been unaccountably omitted from the discipline when it was first institutionalized in European and North American universities during the late nineteenth century. But by the late 1950s, spatial analysis had been refound, its concomitant, universal rationalism impossible to ignore any longer.

Consequently, as Berry and Marble (1968) wrote, geography "move[d] back to the mainstream" in a "flush of revolutionary change" (p. 4).

We would like to suggest using Peter Taylor's map that the return of spatial analysis to geography was less the result of the ineluctable power of rationality than a series of contingent historical factors in concert with the peculiarities and singularities of particular places and the mobility of knowledge between them. Because of the need for brevity, we illustrate our argument by focusing on only three of the places found in Taylor's figure (Fig. 6.1): two in North America, Seattle and Iowa City; and one in Europe, Lund.

Seattle and Iowa City

That spatial analysis came to America after World War II and first found a footing in the two early truth spots of Seattle and Iowa City was largely a result of a wider reconfiguration of postwar social science as practiced in the United States. World War II had produced in the United States a new model of academic inquiry, "big science," which involved: team-based research; high levels of investment; interinstitutional and interdisciplinary cooperation; specific instrumental goals; a predilection for mathematical models rather than high theory; and the use of the computer (Barnes, 2008). The big science model was originally pioneered during World War II in the physical sciences in truth spots such as Los Alamos National Laboratory or the Radiation Laboratory at the Massachusetts Institute of Technology. But the approach quickly jumped across disciplinary divides. By the second half of the 1940s it was found in some social sciences, such as economics and psychology.

When Berry and Marble (1968) said that geography was joining the mainstream, they meant the model of mainstream science. And geography was indeed a field for which spatial analysis seemed uncannily fitted. Up until that point, the mainstream was *topos* and especially *choros*, or as Varenius put it, a "tedious . . . Special Geography" (Lukermann, n.d., p. 7). In 1939, Richard Hartshorne even wrote a dense, closely argued, 400-page-plus book with the definitive title, *The Nature of Geography*, to make a philosophical case for tediousness. His argument was that geography could never be on par with physical science, because the stuff of geography's study—places and regions—were unique assemblages found nowhere else. Any talk of general theories or principles, or even models, was therefore a disciplinary nonstarter. As Hartshorne (1939) wrote, geography "is essentially a descriptive science concerned with the description and interpretation of unique cases …" (p. 449). Ptolemy, Varenius, and Newton would have rolled over in their graves. But Hartshorne was a powerful disciplinary gatekeeper and bypassing him would be difficult. However, the forces of change represented by the new mainstream model of science were also imposing and implacable. Slowly, but inexorably, a modern version of spatial analysis emerged in a process dubbed geography's "quantitative revolution." In the course of that revolution, geography increasingly joined the mainstream, and in so doing recouped the earlier traditions of *geos* and *Geographia generalis*.

The truth spots for spatial analysis could not, at least initially, be existing centers of calculation for geography, which were controlled by regionalists such as Hartshorne. They needed to be heterotopias, open to new ideas and means of reordering, which meant either newly formed sites (lacking prior traditions) or ones marginal to the extent that the regional geography establishment in the United States did not know or care about them.

This was the case at the University of Washington in Seattle, located on the distant, periphery of the Pacific Northwest. In *annus mirablis*, 1955, though, a group of talented, energetic, and ambitious graduate students serendipitously arrived at "UDub's" geography department, where they ended up working primarily with William Garrison, a young assistant professor who had arrived in 1950 from Northwestern University in Illinois. Garrison, the person who first joined the terms "spatial" and "analysis" as a single phrase, was a U.S. Air Force navigator in the Pacific Theater during World War II and trained in statistics, mathematics, and synoptic weather modeling. As a graduate student in geography during the late 1940s Garrison was a teaching assistant for Clarence Jones at Northwestern University, a dyed-in-the-wool *topos* and *choros* man. His teaching work for Jones was not a happy experience, with Garrison later saying about Jones's lectures: "they led me to keep asking: 'What's the theory? What's the theory? What's the theory'" (Garrison, 1998, p. 1). Specifically, "a systematic approach was in order …" (Garrison, 1979, p. 119).

It was a systematic approach, the new mainstream science approach, which Garrison pioneered with his graduate students in the late 1950s. His project involved a team of researchers funded by both the Office of Naval Research (ONR) and the federal government working with graduate students as well as faculty from other departments. The research goals were narrowly defined; evaluating highway development and road-system efficiency. Modeling was the order of the day, especially urban models, such as central place theory (which we will say more about below), and the gravity model. These models were tested using rigorous data analysis, deploying statistical techniques taught by Garrison in the first quantitative course ever offered in the United States in the field of geography: Geography 436, Quantitative Methods. There were also the machines—initially Friden calculators—but later an IBM 650 computer housed in the attic of the chemistry building. Lacking, however, were both a programming language and a hard drive. By using a technique of "patch wiring," according to a graduate student at the time, Waldo Tobler (1998), "it was possible to store two bits of information on the rotating magnetic drum if you were lucky" (p. 2).

The resulting volume, *Studies of Highway Development and Geographic Change* (Garrison, Berry, Marble, Nystuen, & Morill, 1959) was a remarkable text, unlike anything else published in English in the name of academic geography up until that time. Crammed with calculations, data matrices, statistical techniques, cost curves, and demand schedules, even its maps were subverted, overlaid with numbers, arrows, starburst lines, and balancing equations. But in another respect the book's spatial analysis was unremarkable, simply a recouping of the earlier tradition we have described.

The other early truth spot was the University of Iowa at Iowa City. Its key advantage was that it was a new geography department with the added benefit of being headed not by a geographer, but by an economist, Harold McCarty. In the late 1930s McCarty had even hosted August Lösch, a German economist who had come to Iowa to collect data for his book on central place theory. McCarty, appointed founding geography department head in 1946, subsequently hired like-minded faculty, including Kurt Schaefer, a left-wing German émigré economist. Schaefer had fled Nazi Germany in the 1930s, going first to the United Kingdom, where he was a researcher at the London School of Economics, before later immigrating to the United States.

McCarty viewed geographers primarily as hewers and drawers of empirical data, which once collected would be handed over to economists, who, using their theories, would explain what had been found. As at the University of Washington, McCarty gathered around him a group of graduate students to assist in carrying out this empirical work and to take the message of quantification back out into the geographical world. While serendipity played some role in determining which graduate students ended up in Iowa City, McCarty also actively recruited, using a trip to New Zealand in 1961 to persuade bright Antipodean students to join the cause.

McCarty was the first human geographer to use a regression equation in his study of industrial linkage. Funded by the ONR, he created a team of assistant professors and graduate students to carry out similar work. Their version of *Studies of Highway Development* was *The Measure of Association in Industrial Geography*, completed in 1956 (McCarty, Hook, & Knos, 1956). In addition, Kurt Schaefer provided intellectual legitimation, publishing in 1953 a blistering attack on Hartshorne's regionalist approach argued from the standpoint of logical positivism. Schaefer died just before his article appeared in print, so he was not able to respond to Hartshorne's (1955) own vigorous defense. But it did not really matter, because the fight had been won before Hartshorne even picked up his pen. As powerful as he was, Hartshorne could not, Canute-like, turn back the rushing tide of spatial analysis as it swept with increasing force through the field of geography in the United States to establish within a decade the network seen on the map in Fig. 6.1.

Lund

Lund is on the Quant Geog airline schedule because of the work done there by Torsten Hägerstrand, particularly his study of spatial diffusion, *Innovationsförloppet ur korologisk synpunkt*, later translated into English as *Innovation Diffusion as a Spatial Process* (1953/1967). That work deployed formal modeling and the statistical analysis of numerical data, which in turn attracted the attention of William Garrison and his students in Seattle. Donald Hudson, chair of the Department of Geography at the University of Washington, wrote to Hägerstrand on 9 December 1957: "The work carried forward in your department has come to our attention, particularly … [what] you are doing in the development of theory in human geography."[2] Hägerstrand was consequently invited to Seattle for the spring quarter (March 30–June 13) academic term in 1959. Two early truth spots were thus linked. But how did Lund become a truth spot in the first place? And where did the kind of theory that Hägerstrand practiced and Garrison and his students found so interesting come from? Although Lund and Seattle are located on the same flight plan, our suggestion is that the processes by which each got there were quite different and reflected precisely their peculiar geographies.

Lund was neither a peripheral geography department in the same way as the University of Washington at Seattle, nor a new department like Iowa's. Swedish social sciences also did not experience the kind of new rigor that swept American social sciences in the postwar period. Nonetheless, Hägerstrand at Lund came to spatial analysis early on, indeed, even before the Washington and Iowa groups. In large part Lund achieved this through its role as a center of calculation attractive to people and ideas. Especially important, we suggest, were Lund's direct and indirect links to Freiburg, in southwestern Germany, and Tartu, in Estonia.

In 1937 the German geographer Walter Christaller, author of *Central Places in Southern Germany* (Christaller, 1933/1966), published his Habilitation thesis, *Rural Settlements in Germany in Their Relation to Community Administration*. At this time he also began a short career as lecturer at Freiburg University (Preston, 2009). There Christaller founded and worked at the *Kommunalwissenschaftliches Institut* (Institute for Municipal Studies), chaired by the professor of constitutional, administrative, and financial law, Theodor Maunz, who rationalized concentration camp imprisonment in his writing and was in charge of the *Referent für Judentum in der Rechtswissenschaft* (Jewry in Legal Studies). It was within this Freiburg setting that Christaller began developing a new form of applied geography called *Kommunalgeographie* (municipal geography). Here Christaller effectively wedded the abstractions of spatial analysis taken from German location theorists such as von Thünen and Weber with Nazi applied planning practices (Barnes, 2012; Rössler, 1989).

Three years later, Christaller was recruited by Konrad Meyer, head of the Planning and Soil Office of Himmler's Reich Commission for the Strengthening of Germandom (for details see Barnes, 2013). The aim of the office was to provide the Third Reich with areal plans (known as the *Generalplan Ost* or Master Plan for the East) for its eastern conquests. That plan, according to Rössler (1989), was developed for Himmler as a detailed policy for the settlement and administration of the newly acquired eastern territories. It was to build a "truly German and Aryan community" (p. 426) through settlement construction. At least at one of the Nuremburg trials the *Generalplan Ost* was a central topic of discussion. Rössler (1989) writes, Meyer was brought to Nuremberg in 1946 accused in case 8, which was called the *Volkstumsprozess* [the racist policies trial].

> The line of defense was to show that the work of Himmler's planning office was only to produce scientific planning studies which never were realized in any form. (p. 427)

[2] Donald Hudson to Torsten Hägerstrand, 9 December 1957. Papers of Torsten Hägerstrand, Lund University.

The key problem in the trial, according to Rössler (1989), was that there was no discussion of how the "new" land was acquired. It became part of a new German East primarily by the liquidation of the Jewish population who previously owned and inhabited it.

There is another point to make that brings us to Lund. Although many geographers in Germany and elsewhere ignored the work that Christaller pioneered during the 1930s because it was outside the traditional *Landeskunde* with its regional approach, not all geographers did. One of the first references to Christaller's thesis on central place theory was in Edgar Kant's (1935) dissertation, *Bevölkerung und Lebensraum Estlands* (Population and Living Space in Estonia), published 2 years after Christaller's dissertation. The book presents a mixture of ideas circulating at the time, blending geological, biological, demographic, racial, and geometrical discourses to provide a holistic interpretation of the Estonian Lebensraum and population. It built primarily on the Swedish geographer Sten de Geer's concept of *Baltoscandia* (the Baltic region) (de Geer, 1928).

Unlike Christaller, who struggled throughout his life to be accepted by academia, Edgar Kant forged a distinguished academic career. Within a year of finishing his dissertation, he was made professor of economic geography at Tartu University. His interests were as much applied as they were academic. He produced, among other things, a social geography of the cities of Tallinn and Tartu, mapping the various ethnic and demographic segments of the cities. When the Red Army annexed and occupied Estonia in autumn 1939 (a consequence of the Molotov–Ribbentrop Pact signed between the Soviet Union and Nazi Germany), Kant remained in the country, albeit in hiding because of fear of deportation to Siberia. Two years later Germany invaded the Soviet Union, and within days the *Wehrmacht* occupied Estonia. Kant then came out of hiding, with the Nazis appointing him rector of the University of Tartu, a position he retained until September 1944. At that point, with the Red Army approaching fast, Kant again fled Tartu. In a letter to his former supervisor, the Finnish geographer Johannes Gabriel Granö, he described his night time escape by motorcycle to a secret hideout on the coast. There a motorboat was persuaded to wait for one more passenger.

The same year that Christaller began work in Freiburg, a young student, Torsten Hägerstrand, arrived from his native Småland for undergraduate study at the University of Lund. Although Hägerstrand initially had set his mind on studying ethnography, he found his interests better met by geography. In 1947, Hägerstrand enrolled in the doctoral program of Lund's Department of Geography. By then, Edgar Kant, who had been taken directly to Sweden in that motorboat, was now working in the same department, initially as an archivist, later as a research fellow. But because of his poor Swedish (one of the few European languages he could not speak), he was assigned a research assistant, Hägerstrand.

Hägerstrand says Kant was the critical impetus for his research on diffusion and migration that culminated in his 1953 dissertation. One of Kant's first publications in exile was "Den inre omflyttningen i Estland i samband med de estniska städernas omland" (1946) [Internal Migration within Estonia and its Relation to the Urban Hinterland]. In the paper, Kant shifts markedly away from politically fraught concepts such as Lebensraum, and instead emphasizes statistics and models of spatial analysis. The formalistic language of spatial analysis and its joining to applied geography was transposed or translated for a new truth spot across the Baltic Sea.

Gerd Enequist, Professor of Human Geography at Uppsala, Sweden, who had read Kant's work on Estonia and central place theory, invited Kant to speak at the symposium on *Tätorter och omland* [Central Places and the Hinterland] held at Uppsala in 1950. Enequist later said that: "My direction was in many respects determined by Christaller, who I discovered through Edgar Kant, whose work on town systems in Estonia I reviewed in 1936" (Enequist quoted in Buttimer, 2005, p. 178). Anne Buttimer later commented that the 1950 Uppsala symposium "was the first occasion during which he [Kant] became known among Swedish colleagues. He was accompanied by an entourage of devoted students—Bergsten, Dahl, Godlund and Hägerstrand—the budding makers and shapers of mid-twentieth-century human geography [and society] in Sweden" (p. 178). The circle was completed by the invitation to Christaller to be the opening-day, plenary speaker at the 1960 International Geographical Union (IGU) conference in urban geography organized by Hägerstrand at Lund (Norborg, 1962). That event, more than any other, was a celebration of the arrival of spatial science, and featured alumnae of both Iowa and Washington among its participants (Barnes, 2012). The various truth spots of spatial analysis had come together, but the routes they took to get there were quite different.

Conclusion

The purpose of our chapter following the science studies literature of the last 40 years was to show how the disciplinary articulation of geographical ideas became caught up in events played out geographically on the ground. It is not ideas on the one hand and the geographical world on the other. Rather, ideas are from the beginning thoroughly suffused by and intertwined with the world. They are worlded. We sought to show this for the idea of spatial analysis. Further, we brought to that task a specifically geographical conception of worlding, relying on the three notions of heterotopia, truth spots, and centers of calculation. As we noted, however, none of these ideas were devised by geographers, in spite of their geographical purchase. Surely this needs to change. Geographical ideas need to be developed to understand the geography of ideas. There is a need for an intellectual geography, or a geography of ideas to complement the established fields of intellectual history and the history of ideas.

In concluding we would like to return to the map at the beginning of the chapter, Peter Taylor's "Quant Geog airlines flight plan." It is a remarkable figure, tracing the movements of an idea between centers of calculation or truth spots. It suffers, however, from the common problem of all cartographic representation. It cannot properly describe the often topsy-turvy, unforeseen, and unpredictable routes that ideas travel. A map represents a moment frozen in time and space. What we have attempted to do in this chapter is to augment Taylor's map by overlaying it with many overlapping descriptions and narratives–historical, biographical, place-based, and geographical. We aimed to create an intellectual palimpsest, and the basis for a different kind of map. This map joins often contradictory and simultaneous movements of people, objects, and ideas in time and space. It is an intellectual historical geography or a geographical history of ideas.

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