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Chapter Twenty

The Field

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"Field" as a spatial term and concept has a deep and varied history in warfare, agriculture, sport, and territorial rule. Its application to science is more recent, dating roughly from the time when the institutions, categories, and practices of science were taking their modern shape in the middle decades of the nineteenth century. Although the term's detailed history has yet to be worked out, Google Ngrams of usage in English-language books afford a rough silhouette of that history. The term "field science" first came into steady use around 1870, after a few initial bumps, and increased with marked ups and downs to an apogee around 1960 before declining. "Field method" and "field methods" followed a similar, if smoother, trajectory. (A related usage, "field naturalist," appeared in the 1830s with the first wave of amateur field clubs, in Britain.) Despite the occasional deployment of "field" as a category of analysis for earlier periods (e.g., Cooper 1998; Te Heesen 2005), the idea and the category became necessary only when the laboratory form of organization and practice escaped its limited domain in chemistry and was adopted by disciplines of all sorts, thereby becoming the premier place where high-status, modern science was carried out. That rise is reflected in the use of the term "laboratory science," which appeared in the 1880s and grew steadily to a plateau about 1930.

In this great spatial and epistemic reorganization, "field" became the "other": the not quite modern kind of science that was associated with amateur field activities and practices that were not properly quantitative, experimental, hypothetico-deductive, and analytically rigorous. Before the laboratory revolution of the 1840s to 1880s there was no call for such a categorical distinction, because laboratory modes of organization and practice were not yet the universal default. The pecking order of sciences did not yet depend crucially on place. Once the new world of scientific disciplines and careers had arrived, however, the distinction simply described the new reality: that the science that filled journals and made careers was the science done in places designed specifically for the purpose, especially labs, museums, and experimental gardens. And when ascendant social practices call forth new social categories, new categories will be

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created as well for practices now recast as outmoded or second best. "Field" was one such category.

This epistemic hierarchy of place long outlasted the historical situation that created it. The connotation of "field" as it emerged in a world of labs was less "not-lab" than it was "*pre*-lab," and pre-lab less in the sense of historical precedence than of methodological procedure. In the modern view, field practices of collecting and describing were "mere" preliminaries to proper science. The field was a useful, even essential, source of raw materials, but it was a place to which one resorted in expectation of moving expeditiously to places designed for science. Another mirror concept of field as "post-lab" developed in the later nineteenth century. Here the field was where the "pure," universal knowledge produced in custom-built places was "applied" in particular situations. Whether conceived as pre- or post-lab, "field" became epistemically secondary. And despite the mixed and varied realities of field science, a historically rooted hierarchy of place has persisted.

The Field as Category and Place

What, then, is "field" exactly, and how is the concept best used? "Field" as applied to science is a portmanteau category, encompassing all the diverse natural and social places where science is done—forests, prairies, mountains, deserts, caves, marshes, agricultural and pastoral landscapes; villages, cities, suburbs, encampments, roads, and paths; as well as the world's layered elements of water, earth, and air from tectonic or ocean depths to outer space. For scientists, "field" means, operationally, the particular place in which each works: it is an actor's category. As an all-encompassing term, in contrast, "field" is not an actor's but a historian's category: a frame for comparative analysis of place and practice across the field sciences. Scientists do not experience "field" in general, only some particular field, so find little meaning in a concept of the whole picture. Historians, in contrast, concern themselves with all fields, so find the generic rubric of use.

It is usual to think of "field" in contrast to "lab"—*Webster's Dictionary* defines this usage as "the sphere of practical operation outside a laboratory, office, or factory"—and historically that makes sense. However, the contrast misleadingly suggests a static and cleanly dichotomous view. Field and lab are not separate or incompatible worlds—far from it. Many, perhaps most, field sciences have a lab, office, or museum side as well (Kohler 2006; Brinkman 2010) and practitioners of lab sciences may routinely go afield. There is no clear-cut distinction between built and natural places. Social scientists treat and use cities as both laboratory and field (Gieryn 2006). Built environments can be field as well: for example, expeditionary ships and encampments (Rozwadowski 1996; Sorrenson 1996; Pang 2002; Adler 2014). Field labs may be opened to local conditions of sun, shade, and weather (De Bont 2015; Vetter 2012); and indoor labs can be "naturalized" to mimic particular natural conditions, if imperfectly (Kohler 2002b; Kingsland 2009). As Christopher Henke and Thomas Gieryn (2008, 364) note, "'placeless' places are not necessarily 'faceless' ones." Nor do research methodologies cleanly distinguish field and lab. Intensive observation is, to be sure, the prevalent method of field science, as experimental setup and manipulation are hallmarks of lab science. Yet exact measurement and experiments can be done in the field: they just take more ingenuity and improvising to arrange than in places designed for the purpose (Kohler 2002a).

The distinctive meaning of field in science thus lies not in any characteristics of place or of use as such, but rather in place and use combined. Places have meaning as they are imagined, selected, and used for scientific (or other) purposes; uses have meaning as they are deployed in one sort of place or another. "Field" is not an essential, but a relational category—as it is also in "fields" of battle, sport, or agriculture. Fieldwork is in some cases best treated as a kind of land use: a unit of place and human activity, as in environmental history.

One defining characteristic of field places is that they are multipurpose: because they are inhabited or used by diverse actors whose pursuits range from complementary to science to competitive with or even hostile to it. Field scientists interact with landowners, farmers, mineral and timber harvesters, hunters and fishers, travelers and recreationists, indigenous peoples, and reclusive sects, among others; and may be accepted, ignored, or ejected. And, through varied use, field places tend to become in time more multipurpose (Alagona 2012; Bocking 2012; Lachmund 2013). Knowing a place scientifically may also make it more attractive to those pursuing ends of recreation, resource extraction, or social "improvement," as scientists may be attracted to places already partially known through these other uses. Examples include parks, preserves, field stations, fishing grounds, and ethnic enclaves. Many of the distinctive features of science in the field follow from the human diversity of places both natural and social.

For example, access is a far more complicated matter in the field than in sole-purpose places, which are easily opened to approved users (scientists, their helpers) and closed to others. There are the sheer logistical problems of travel to and residing in distant or inhospitable places. Human communities may resist being subjects of study by strangers who come to reside among them, and animal communities are often elusive and sometimes dangerous up close. Scientists' own communal mores have impeded access. Because work in the field can be rough hand-labor, it was once considered demeaning for men of science and best left to practical occupations of collectors, taxidermists, or fishermen. Before going afield, zoologists and ethnographers among others had first to persuade the world that the field was a legitimate and proper place for their professional labors (Kuklick 1997, 2011; Kohler 2006).

All places have politics, and in science that is especially the case in the field, where the politics of competing uses is not an externality, as in labs, but an inextricable element of the objects and the methods of scientific study. This is self-evidently so in sciences of human communities but is also so in places of "second nature," in which humans are actors in natural phenomena (Schneider 2000; Buhs 2004; Henke and Gieryn 2008, 365–9). The ecology of any place of rich and contested pickings may include harvesters, foragers, residents, developers, recreationists, officials, and activists—along with scientists. Leave their politics out of the science of such places, and the science is incomplete.

A further consequence of diverse use is that, in the field, vernacular practices and meanings may enter and reshape those of expert science—a categorical breach that rarely if ever happens in places of single use. For example, field scientists have drawn on vernacular sources of epistemic authority: like the heroism of explorers that once gave authenticity to the scientific reports of glaciologists and lone anthropologists, whose unwitnessed science could only be taken on trust (Hevly 1996; Kuklick 1997; 2011). No one would risk life and limb to get facts and then not tell them truly: that was the logic of authenticity. Field biologists have, over time, shared the means and ends of science and outdoor recreation with amateur naturalists, bird watchers, and collectors of various things (Barrow 1998; Alberti 2001).

Such cases are hardly rare: practices of mining have been adapted to ends of stratigraphic geology (Rudwick 1976), of hunting and camping to taxonomy and ecology (Kohler 2006), of social services to social survey (Bulmer, Bales, and Sklar 1991). This mixing of defining activities has blurred the categorical boundaries between science and not-science, and made scientific identity more open-ended and mutable than it is in single-purpose places. Gatherers of data are mistaken for gatherers of other kinds (foragers, pleasure seekers, spies), and observers of human communities assume or are assigned roles that their subjects can make sense of.

A second defining characteristic of the field is that phenomena there are studied in the situations in which they normally play out. In the field the essential unity of activities and situations is self-evident, as it is obscured in single-purpose places. The design of lab, museum, office, or factory is precisely to isolate phenomena from the messy situations that impair experimental, cause-and-effect analysis of one variable at a time. The premise of science in the field, in contrast, is that phenomena are by nature situated and cannot be removed from the situations that give them pattern and meaning. Situated field study shifts the focus from our own tidy experiments to nature's (*and* our own) messy ones. Collectors as well, though they remove things from the field for study indoors, attach precise accounts of objects' situations—in labels and field notes—because without these the objects' meanings would be lost.

In the field, situated observers and collectors strive to be intimately involved in the places and phenomena they observe: inside their objects of study, so to speak. In behavioral sciences of the field, observers become "participant observers," and the ethnographic term is widely applicable. Participation entails being on the spot, observing and recording who is doing what with whom and in what situations. It may also mean active participation in the goings-on, though usually in a limited way. The ideal is for observers to know situations, actors, and activities as intimately as their subjects do. In the case of human communities, residents in turn may become participants in the science, assisting in gathering and interpreting field data, as in paleontology and anthropology (Knell 2000; Schumaker 2001) or, more recently, in agricultural field trials, where field hands collect and grade "data" (saleable produce), and farmers decide when experiments end (Henke 2000). Such transgressions of the rights of expertise are difficult in "placeless" places. Where access is controlled and contexts are eliminated—as in labs, offices, and factories—the idea of situated or participant science is unthinkable. That fundamental difference is what makes the field a real and useful category.

Doing field science is for the same reasons unusually "experiential": that is, it is experienced not as different and separate from other activities of everyday life but as another such activity. As field practices borrow from vernacular activities, so are they experienced as continuations of everyday life. As scientists reside in the places they study, so must they experience their work as residents do. Scenes of science are also scenes of life. Geologists' visits to the special sites where deep buried history has been laid bare may be experienced as quasi-religious pilgrimage (Rudwick 1996). Ethnographic surveys, specimen collecting, and ecological study may feel like recreation or exotic travel—science as a vacation (Kohler 2007; Anker 2007). Work in deep-ocean vessels, polar stations, expedition ships, observatories, and space stations may be experienced as adventure, extreme sport, or quasi-monastic retreat. The experiential quality of field science is one of its most distinctive features, and so far one of the least studied.

Although historians may envision the field as postcards, actual field experience is more typically cinematic. Fieldwork is a seasonal to-and-fro between field and laboratory or museum—a scientific transhumance. As situations and objects move, observers move with them; and the sciences of large scale or deep time—taxonomy, stratigraphic and tectonic geology, biogeography, geophysics and the sciences of ocean and atmosphere, social and ethnographic surveys—are of necessity sciences on the move. The field is thus a category of people and things in place *and* in motion.

When place first became a topic of serious interest to historians of science, in the 1980s, it was for the specific, epistemic, purpose of deconstructing the universal claims of scientific knowledge: by showing in vivid particularity how knowledge presented as placeless and disembodied—what everyone knows—was in fact created by someone, someplace, for some reason. Initially it was laboratories that were thus used to deconstruct disembodied science—not surprisingly, since historians then mainly studied lab science; and because exposing the placelessness of labs as a discursive fiction was the acid test of deconstruction (Henke and Geiryn 2008). Putting field science in its place would have been too easy and obvious. So, when historians took up the field sciences, in the 1990s, place was a central concern but less for its epistemological use (that case had been made) than for its concrete uses in cultural, imperial, and global history, and in studies of vernacular knowledge practices and the politics of uses and abuses of nature. This range of topics has since attracted scholars of diverse sorts to field science, including historical geographers, students of literature and the arts, and environmental historians. The epistemic monoculture of deconstruction has become the polyculture of field studies.

Many Fields

Historians' interest in the field as place and practice has taken them into a widening range of scientific disciplines. Pioneering studies of field and place were, not surprisingly, of sciences traditionally associated with fieldwork: natural history (Allen 2004), geology and paleontology (Rudwick 1985), anthropology (Stocking 1983), and ecology (Tobey 1981; Cittadino 1993). This initial range of interest is apparent in the topical volumes from the mid-1990s that marked the wider recognition of "the field" as a category (Jardine, Secord, and Spary 1996; Kuklick and Kohler 1996a). A follow-up survey (Vetter 2010) takes in a different and a wider range of disciplines, including archaeology, oceanography, climatology, horticulture, and human ecology. Ethology is another apt subject for study of field as place (Burkhardt 1999; Montgomery 2005; Rees 2009).

The diversity of field sciences may be lumped for comparative analysis into social-historical types: mapping, surveying, observing, collecting, and expeditioning are some that have been proposed (Edney 1997; Knell 2000; Kohler 2007; Endersby 2008). Expeditionary sciences are an especially rich group, because of their

Figure 20.1 Field party for the US Geological and Geographical Survey of the Territories (Hayden Survey) in camp at Red Buttes, Wyoming, 1870. Photograph by William Henry Jackson. From USGS Photographic Library, photo jwh00282, libraryphoto.cr.usgs.gov/index.html.

association with European and American exploration and expansion (Naylor and Ryan 2010; Dritsas 2011; Nielsen, Harbsmeier, and Ries 2012; Kennedy 2013). Based at first on wind, water, wood, and animal power, but increasingly fueled by fossil-carbon technologies—ships, railroads, trucks, planes—expeditioning created vast infrastructures and landscapes of hybrid places that, like older outposts or encampments, are equally built and field environments (Sorrenson 1996; Vetter 2004). It is in such border places that the mingled nature and culture of the field are best studied (Figure 20.1).

The geographical scope of "field" has likewise expanded: from the "natural laboratory" of protected areas (Rumore 2012) to the "living laboratory" of heavily humanized landscapes (Tilley 2011); and from the tropics (Christen 2002) to the poles (Bravo and Sörlin 2002; Benson and Rozwadowski 2007; Powell 2007; Bocking 2013; Farish 2013). This horizontal expansion of "field" has been matched by vertical extension, as ocean (Rozwadowski 2005; Doel, Levin, and Marker 2006) and atmosphere (Fleming, Jankovic, and Coen 2006) have become prime areas for scientists, and thus for history. *Verticality* is a key emerging concept for thinking about place in the field. Whereas a horizontal view takes students of place across airy landscapes of towns, forests, farms, and ranches, the vertical view upward or downward takes us away from human habitation into depths and heights in which no one lives (for long) yet which are vital to global economy and polity (Braun 2000; Bigg, Aubin, and Felsch 2009).

The investigation of vertically differentiated places—mountains, seas, space—has been conducted not only *by* human observers but sometimes *on* human subjects (including the field scientists themselves) at such places as the Chilean Andes, Mount Everest, Sealab II, and Skylab (Tracy 2012; Heggie 2013; Karafantis 2013). And places that are imagined but not directly experienced—paleo-environments, deep sea, and even distant planets—have been transformed by empirical study into places in the "field" (Rudwick 1992; Rozwadowski 2005; Lane 2011). Studies of "extreme" places extend and complicate the more traditional concepts of place derived from the "second natures" of ethnographers' villages, cities, and working rural landscapes. In a world of diverse "fields" the categorical divide between natural and social sciences fades, as do distinctions between history of science, historical geography, and environmental history.

Places and Practices

As the places of field science have diversified, so have its tools and practices. Although physical instruments have long been used by field scientists, the tendency in modern times has been to better adapt these to actual situations in the field. The reason for going afield, after all, is to study phenomena in the natural or social contexts in which they normally play out. In field biology, for example, early efforts to import laboratory instruments and experimental procedures had mixed success. Yet, by the mid-twentieth century an array of robust hybrid instruments and practices had been developed; for example, devices for remote sensing and tracking of animals on the move (Kohler 2002a; Kohler 2002b; Lewis 2004; Benson 2010).

Nonetheless, the particularity of place and time in the field makes it virtually impossible to exactly replicate measurements or observations. This circumstance has entailed a "fieldworkers' regress," in which interpretations can always be contested and attributed to uncontrolled variability of place. In noisy places it is easy to redefine signal as noise. For example, a controversy among primatologists over the meaning of infanticide seemed closed for a time, yet kept reopening (Rees 2009). Epistemic uncertainty of place may thus be used in skirmishing over scientific turf, even where facts are reasonably secure. Environmental and conservation science is another multiuse and multidisciplinary area conducive to open-ended contests over practices and meanings (Bocking 2012).

Accounting methods constitute another family of practices that depend less on physical instruments than on the paper tools of data management: inventory, counting, sorting, tabulating, and calculating (Te Heesen 2005). The story here is less one of adapting lab tools to field conditions than of intensifying accounting tools that had always been the stock-in-trade of taxonomic and geographical science. In a world of humanized, working landscapes, few places escape the web of human inventory and accounting (Höhler and Ziegler 2010), and practices of commerce and science mingle in ways that are both productive and less wholesome. Key concepts of ecology, such as carrying capacity and beneficial fire, have emerged from range and forest management, even as these worldly practices became more ecological (Young 1998; Way 2011). Cetologists' field practices came to depend on the whaling industry (Burnett

2012); while commercial whaling has been disguised as science. Accounting and economic practices of ecosystem ecology and cost–benefit econometrics are, together, core practices of stream and landscape restoration (Brock 2004; Lave 2012). A newer and growing family of field practices is one that might be called "surveillance" practice. These range in scale from radiotelemetry of wildlife at local sites to surveillance of the entire globe, especially of the places where people do not live yet highly value—oceans, poles, lithosphere, atmosphere, space. Unlike older types of hands-on survey and inventory, surveillance practices are more typically hands-off and unseen, performed by sophisticated machines that are remotely and often covertly controlled, such as satellites, cameras, or sensors. They are further removed from immediate experience by computer analysis and mathematical modeling. Though remote, surveillance practices are practices of place—global place—and they may be fundamentally changing the meaning of field and fieldwork (Edwards 2010; Launius, Fleming, and DeVorkin 2010; Howe 2014). In glaciology, for example, a concept of polar warming based on local field observations gave way to a concept based on computer modeling (Sörlin 2011). Yet, however striking the shift to mathematical modeling, climate science still requires local field sites that have "barely enough data to test models or theories," as in vast swathes of Antarctica (Howkins 2011, 190). Whether place is becoming less important in surveillance sciences, or just important in new ways, remains to be seen.

Practitioners

Finally, historians of field science have extended the range of their interest in practitioners to include those who were once regarded as marginal to science or even outside it. Women scientists were the first such group to move from the wings to center stage, as known and unknown individuals were taken up and reasons for their relative invisibility explored (Oreskes 1996). Cases range from field naturalists to primatologists and eugenics fieldworkers (Bonta 1991; Bix 1997; Strum and Fedigan 2000). Arguably, women were historically more central players in field than in lab sciences, because field environments were once less stringent in matters of social identity and participation (Kuklick and Kohler 1996b, 10–13). Where, when, and for whom this generalization holds true needs further study.

Historians have also examined the role played by lay practitioners, whose forms of knowledge derive from personal life experience in particular places. These ways of knowing are variously termed vernacular, local, residential, folk, or indigenous, depending on the situation; however, the best catch-all term may be "experiential," since all derive from the experience of daily living (Vetter 2011, 131–4). Visiting taxonomists will know from work in collections how to classify plants or animals, yet depend on residents with experiential knowledge of the locale to find them. Visiting ethnographers and sociologists likewise depend on informants with a living knowledge of local societies. Because field scientists deal firsthand with phenomena in context, they can put to their own use the varied experiential knowledge of hunters, farmers, ranchers, fishermen, mariners, prospectors, naturalists, collectors of local facts and artifacts, and others who live where visiting scientists work (Burns 2008; Reidy 2008; Vetter 2008; Keiner 2009; Frehner 2011). Learning from individuals with experiential knowledge has been especially critical in cross-cultural and colonial encounters (Green Musselman 2003; Fan 2004).

In the study of ephemeral phenomena such as earthquakes or extreme weather events, resident observers have the advantage over experts, who cannot be everywhere at once and cannot make careers from rare occurrences (Coen 2013; Valencius 2013). Politics has in some cases enabled local residents to achieve status as practitioners of "citizen science" (Fan 2012), as scientists have used fieldwork to help create national, regional, or "creole" political identities (McCook 2002; Naylor 2010; Shen 2014). Field scientists also may attain through intensive local work a kind of experiential knowledge that, combined with the "cosmopolitan" knowledge of books and classrooms, forms what might be termed "residential science" (Kohler 2011). Varieties of expert vernacular science constitute a developing area in history of science, and the field sciences afford exceptional opportunities for their study.

Conclusion

The expanding scope and popularity of field science constitute one of the most notable developments in contemporary history of science. Always a substantial and respected, yet somewhat ghettoized subject, field sciences are now center stage in the study of general issues such as lay practitioners, situated and big-data practices, and place. Why this trend occurred when and how it did we cannot say, but James Secord has pointed to a likely explanation when he argued that *materiality* is what underlies all modern sciences and their histories. "The key," Secord writes, "is our new understanding of scientific knowledge as practice. All evidence from the past is in the form of material things" (Secord 2004, 665). And, one might add, it is material things *in place*. For what is more material than place, and where is place more vital to science than in the field? Where are tools, practices, and identities more powerfully shaped by material situations? It is perhaps little wonder that field sciences have moved into history's limelight.

And if, in a world of anonymous global information, place becomes the one attribute that reliably makes science credible, then field science is likely to remain in the limelight as a model of authentic, situated practice (Henke and Gieryn 2008, 369). Once the "view from nowhere" and then the "view from everywhere," science may come to be the view from somewhere. Many labs, factories, offices, and museums are "truth spots." *All* the field is somewhere.

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