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INTRODUCTION

I.

I live in Colorado, in the shade of the Rocky Mountains, at a mile in elevation. And I sleep each night on an ancient ocean bottom. Six-foot-wide clams once filter-fed here; ammonites, curled in their spiral shells, sailed through the water column; and pleiososaurs, carnivorous underwater reptiles, paddled the murky depths of an inland ocean that extended from the Gulf of Mexico to the Arctic. Just south of here you can find ancient shorelines where dinosaurs traveled in herds: the sandstone ridges containing the footprints of their passage and the bones of their dead survive to tell the tale. Far to the west a string of volcanoes once rumbled: the ash from those eruptions turns our dirt roads into a tire-grabbing gumbo after a rain (GL:CH1).

Stand at the rim of the Grand Canyon and let your eye fall upon the Supai Formation, a brick-red, sparsely vegetated set of cliffs over five hundred feet thick. The Supai is made up of cross-bedded sandstones, red shales, and lenses of limestone. In the geologist's eye, these kiln-dry cliffs become near-shore mudflats baking under a tropical sun, crisscrossed by lazy, meandering rivers. Nor are such wonders limited to exotic locales. Go to Chicago and watch the Cubs play at Wrigley. While sitting in the bleachers, consider: eighteen thousand years ago what is now Wrigley Field lay beneath a sheet of ice two miles thick. This is geology—disciplined visions of past worlds drawn from the rocky palimpsest of the Earth.

This is also geology: not far from my home, in the offices of the United States Geological Survey in Lakewood, Colorado, teams of Earth scientists analyze data to help lawmakers and communities address questions of environmental policy. USGS scientists research the likelihood of natural hazards: when will the Mississippi River

seek out a new channel, abandoning the port of New Orleans? How will the next major earthquake affect Los Angeles or the San Francisco Bay Area? Other scientists investigate energy or mineral resources, questions of water quality and quantity, and global climate change. Will declining mineral or energy reserves force the United States into questionable foreign policy decisions? How much longer will farmers in the High Plains be able to draw upon the Ogallala aquifer? This is geology in the public interest, traversing the boundaries between science and politics.

Finally, this too is geology: it is June 1997, the first summer of the Southwest Earth Studies Program. Ten undergraduates, half each in the sciences and the humanities, have come to study acid mine drainage in Colorado's San Juan Mountains. The drainage from abandoned mines is the American West's greatest single water quality problem. We attend a three-day conference on acid mine drainage that claims to make a special effort to speak to the concerns of local citizens. But the first two days of the conference are anything but community-oriented—we are inundated in graphs and statistics. Day 3, consisting of a field trip to old mine sites and damaged streams, consists of more of the same. We watch as the scientists place instruments into pools of rust-colored water, generating numbers expressed in obscure codes. The students look dubious. One turns to his friend and comments: "It just looks like sin up here."

Geopoetry, geopolitics, and geotheology are three loci of our relation to the Earth. Each of these sites disrupt the categories that have governed western culture since the birth of the modern age. Accepting the disciplinary boundaries of the academy, we proceed by ontological dogma—assuming that science, politics, economics, religion, and aesthetics are essentially discrete activities that can be examined in isolation from one another.¹

The divergence between this parsing of knowledge and the challenges we face is becoming visible everywhere, but it is especially evident within geology. A complex set of forces—population growth, shifting cultural consciousness, advances in science and technology, and ever more pressing environmental issues—have made geology a prime site for the challenging of our accustomed categories of thought. Defying categories, geologic insights today often function simultaneously as scientific statements, political truths, and poetic and metaphysical incantations.

Geo-Logic explores this disruption of the categories of our intellectual and institutional lives. It is an ontological investigation with practical import. The problems facing society today require us to

question the intellectual taxonomy that has trained us to think ever more deeply within the same old ruts. Reordering the categories of our thinking and our institutions—even more, learning to think across categories—will help us create new conceptual and social spaces for addressing our environmental challenges.

Consider the term “geology.” Once identified exclusively with the study of the solid Earth, the term today has lost ground to “Earth sciences.” The latter expression is meant to highlight the need for an integrated study of air, water, soil, rock, ice, and biota. Of course, few researchers in the Earth sciences address all of these concerns, but they all understand that the logic of their research requires them to go beyond the study of the solid Earth. Whether we are speaking of carbon cycles or the health of an estuary, the environment is an interrelated whole whose processes flow across disciplinary boundaries. Life becomes lithic (e.g., limestone), while tectonics influences patterns of evolution. To put the point differently, the terms “Earth sciences” and “environmental sciences” today represent a distinction without a difference. The fields have grown together—even if the former term still carries the tinge of its historical focus on resource exploitation. Our understanding of the Earth must be holistic across both space and time.

Clearly we must welcome this new, larger, Earth-scientific sense of the discipline; but we should hold on to, rather than discard, the older term. For “geology” remains the more fundamental expression. Our relationship to the Earth cannot be encompassed by science alone: “geology” opens up possibilities that an exclusively scientific approach to the Earth closes off. In ancient Greek, *Gé* or *Gaia* evoked the rich, earthy soil that sustains life; Mother Earth, the sheltering source and tomb of life; and one’s *patria* or homeland. Our environmental questions require an account of the Earth that acknowledges all of these dimensions, an integrated *logos* of *Gaia*, an account of the planet that is our home.²

The meaning of the three terms introduced above—geopoetry, geopolitics, and geotheology—will become clearer as the argument proceeds; but perhaps some confusion will be avoided if I offer a brief account here. “Geopoetry” underscores the claim that the reasoning process within field sciences like geology shares as many characteristics with the humanities as with the laboratory sciences.³ Geologists are poet semioticians, treating rock formations as stony verse, conjuring past worlds from the layers of an outcrop.

By “geopolitics” I do not mean the fact that politics have become international in scope, but rather that geology today lies at

the center of political concerns, whether the issue is climate change, endangered species, natural resources, or the siting of roads and landfills. In response, Earth scientists are being drawn into new social roles. Unsettling our traditional understanding of their responsibilities, scientists must develop skillful means for navigating the realms of politics and culture.

And by “geothology” I wish to emphasize that while environmental ethics has dominated discussions of environmental value, our relation to the Earth involves much more than questions of rights and obligations. Our response to nature includes the recognition that nature makes claims upon *us*. Our attraction to nature is in many cases grounded in a sense of awe and reverence before the tremendous forces and mysterious processes that have formed our world. If we wish to fully describe our interests concerning nature, we must retrieve the marginalized language of metaphysics and theology.

The Earth supports and sustains us, nourishes our children, receives our dead, and is the source of all our productions. Understanding our relationship to the Earth in all its facets is one of humanity’s most basic challenges. Used in this more original sense, geology belongs as much to culture as to nature, and should be as deeply rooted in the humanities and in our public lives as in the sciences. To effectively grapple with our environmental challenges we must cross the boundaries that have separated the humanistic and scientific parts of geology; for while scientific facts concerning the state of our environment are crucial, facts alone cannot motivate the cultural changes that need to occur. Our environmental crises are fundamentally philosophical and spiritual in nature, and are more likely to be exacerbated than cured through the exclusive pursuit of Earth “science.” Reordering geology in these ways will help us create the social and political spaces where researchers and the larger community can come together to address the future habitability of our planet.

II.

Geo-Logic does not only aim to redefine the conceptual space of the Earth sciences. This argument also seeks to redirect the humanities by bringing philosophy and the humanities into the field.

To see the opportunity facing us, consider Kai N. Lee’s *Compass and Gyroscope*.⁴ Lee is concerned with helping society develop the

skills and institutions needed to reconcile economic growth, environmental justice, and ecological sustainability. Framing his discussion in terms of the close of the age of Columbus and the recognition of natural limits to society's activities, Lee's argument relies upon the metaphors of compass and gyroscope. His compass highlights the role of the sciences in providing us with reliable knowledge about the environmental effects of public policy decisions. His gyroscope emphasizes how democratic institutions stabilize society by limiting conflicts within the confines of open political debate. For Lee, the compass of science and the gyroscope of democratic debate are the two navigational aids we need to chart an environmentally sustainable future.

We must, however, add a missing third term to this debate—philosophy, or more generally, the disciplines of the humanities.⁵ Lee rightly emphasizes the fundamental roles of science and democratic debate in mapping a sustainable future. But without the decisive contributions of the humanities our other efforts will be abortive. We can see why by revisiting Lee's metaphors. A compass can provide us with a sense of orientation; but it cannot tell us what our direction should be. Similarly, for open political debate to create the gyroscopic balance needed for societal stability, it must be supplemented by the inculcation of public virtues. The humanities provide a context for understanding the facts of science, and order and deepen public conversation through their hard-won wisdom.

The humanities make—or at least, *could* make—decisive contributions to both science and society. Scientists do science; it is not the task of scientists—at least, it is not their primary responsibility—to provide an epistemological and political analysis of what they have uncovered, or an account of the metaphysical implications of their work. Understanding how lab results or computer models play out in the endlessly complex, open-ended world we live in is (or should be) the work of philosophers, historians, and social critics. Philosophy in particular is well suited for uniting the insights of science with economic, political, ethical, aesthetic, and religious perspectives.

A similar point applies to the gyroscope of political debate. A stable democracy requires a populace that is educated in democratic virtues—open-mindedness, respect for evidential reasoning, and a commitment to pluralism—and that appreciates the metaphysical intuitions of different individuals. Statecraft requires soulcraft: the traditional concern of the humanities with the cultivation of the soul—what the Germans call *Bildung*, the moral and

aesthetic instruction that forms the basis of a mature individual—is essential for tempering political debates. The point of public discourse is not merely to proclaim one’s views, but rather to understand and be educated by the views of others. The ancients understood this conversational give-and-take, based in a common commitment to fair, free-spirited dialogue, as one of the central ways that rationality expresses itself in our lives.

Some will suggest that the roles I give to the humanities have already been assigned—to the social sciences. The social sciences contribute a great deal to society, and to environmental questions in particular, but the substitution of the social sciences for what are essentially humanistic concerns has also caused much mischief. As the name implies, the social sciences are based upon the assumption that we can take a “scientific”—that is, an objective, value-free, and quantitative—approach to human affairs. And indeed we can. But doing so to the point of excluding the approaches of the humanities impoverishes both our personal and political lives. The social sciences view values in the same way that economics treats consumer preferences: as brute facts to be described, but not to be evaluated in terms of their worthiness, or as liable to reformation through *Bildung*. But this dodges the essential point: some values are better than others.⁶ The upshot is that the social sciences have taught us to treat our metaphysical, aesthetic, and theological concerns as curious cultural artifacts rather than as possibly true accounts of reality.

For an example of the contribution that the humanities can make to society—and of the remarkable ways that geology and philosophy can play off of one another—consider Stephen Pyne’s *How the Canyon Became Grand*. Pyne recounts how Western culture either ignored the Grand Canyon, or saw it as a monstrosity, for hundreds of years after its discovery. Appreciation of the Grand Canyon emerged from the confluence of two nineteenth-century streams of thought: the nascent science of geology and the aesthetics of the sublime. Moreover, Pyne notes that the creation of a geophilosophy was the work of members of the intelligentsia—polymaths such as Clarence Dutton, who married geology, aesthetics, and natural philosophy in order to portray the wonders of the West, and John Wesley Powell, who understood that geology and politics must be combined if democracy was to flourish west of the one-hundredth meridian. Taking works such as the paintings of Thomas Moran to heart, American culture awakened to a unique natural landscape.⁷

Lee’s appeal to compass and gyroscope expresses the modern presumption that the solution to our problems lies in our devising

ever more artful tools. But rather than more instruments, the challenges we face require reflection and a patient commitment to conversation. Science concerns itself with facts rather than meanings; and (despite the libertarian biases of our culture) democratic debate must be tempered by the wisdom embodied within the humanities. We will grapple effectively with the challenges we face—environmental or otherwise—only by marrying the wisdom of the humanities to the insights of science and the deliberations of democratic debate.

III.

As they are currently constituted, the humanities are ill-prepared to play a substantial role in society. A passage at the beginning of Kant's *Grounding for the Metaphysics of Morals* (1785) puts the problem in a historical light:

All industries, crafts, and arts have gained by the division of labor, viz., one man does not do everything, but each confines himself to a certain kind of work that is distinguished from all other kinds by the treatment it requires, so that the work may be done with the highest perfection and the greatest ease. Where work is not so distinguished and divided, where everyone is a jack of all trades, there industry remains sunk in the greatest barbarism. Whether or not pure philosophy in all its parts requires its own special man might well be in itself a subject worthy of consideration. Would not the whole of this learned industry be better off if those who are accustomed, as the public taste demands, to purvey a mixture of the empirical and the rational in all sorts of proportions unknown even to themselves and who style themselves independent thinkers, while giving the name of hair-splitters to those who apply themselves to the purely rational part, were to be given warning about pursuing simultaneously two jobs which are quite different in their technique, and each of which perhaps requires a special talent that when combined with the other talent produces nothing but bungling?⁸

Kant expresses the vision that has dominated our intellectual labors since the mid-nineteenth century: Knowledge, including philosophic

and humanistic knowledge, consists of a series of domains best left to specialists. Kant accomplished this shift in philosophy via his “transcendental turn”: rather than striving to identify the good, the true, and the beautiful, philosophy would now focus on the *conditions of the possibility* of moral, epistemological, or aesthetic claims. Thus in the *Grundlegung*, Kant did not investigate whether a given act was moral, but rather sought to identify the proper criteria for moral judgments overall (i.e., the “categorical imperative”). Rather than a reflection upon the nature of the good life, philosophy became professionalized, a domain governed by experts divorced from public discourse.

This attitude has resulted in whole series of research programs that have been in many ways quite remarkable. But it has also created the current chasms between humanities and society at large. As a consequence, society has lost the very vocabulary for making reasoned judgments about the good, the true, and the beautiful. Moreover, specialization within the humanities has led to systematic intellectual incoherence: lacking anyone tasked with offering a vision of the whole, we are left with experts unable to communicate with one another, or to frame their insights in ways pertinent to the public.

The aping of scientific methodology by the humanities has been a critical error. The analytic research project of breaking everything down to its smallest part, while reasonable within the sciences, has been toxic within the humanities. In form, the expectations surrounding a Ph.D. in philosophy today are no different from those in the sciences: a narrow investigation adding another diminutive brick to the tower forming the Babel of Knowledge. Such specialization contradicts the spirit of the humanities, disciplines that by their very nature are synoptic and global in scope. There will always be room within the humanities for the specialist’s monograph; but the heart of the humanities lies in the work of the inspired generalist who labors to make a useful synopsis of issues of broad concern.⁹

How are philosophy and the humanities linked to the lives of our communities? Educators in business, engineering, and the sciences all have ready answers to the question of societal relevance, but the humanities rely on repeating traditional justifications of their place in the world. Humanists often reply with a question, asking whether everything in life must have a practical outcome. Or they cite the civilizing effect of great literature and the role played by history and philosophy in cultivating the human spirit.

These answers point toward matters that are both true and important, but they do little to address the question of why society should support professors to engage in recondite research on Wordsworth or Kant.

This question can be answered, for the societal challenges we face today are fundamentally humanistic in character, involving questions of history, beauty, personal identity, the sacred, the emplotting of scientific insights, and our response to the inevitable limits of knowledge and planning. Is nature, for instance, best understood as merely the raw material of our manufacturing processes? Are there reasons other than prudence for restraining our constantly expanding consumer lifestyle? And how do we balance the imperatives of expertise and democracy? The humanities have shown a laudable concern with such questions: the problems we face are profound, and nuanced reflection is absolutely necessary. But the humanities are guilty of not complementing these investigations with an account of their pertinence to our common lives. Philosophy is, by its very nature, an exercise in abstraction. This fact should be praised rather than apologized for; the skill of discerning the significant quality within a thousand details lies at the heart of thinking. But even as it embraces the most far-flung abstraction, philosophy must simultaneously retain a regard for the personal or social forces that animate it.

At least since Descartes's *Discourse* (1637), philosophy has prided itself on examining every presumption and prejudice; but both within and outside the academy we find an unquestioned consensus: philosophers spend their time teaching and writing in the university. Whether coming from the analytic or continental school of philosophy, philosophers perform the same set of tasks: introducing nonmajors to subjects such as ethics, and training majors in the traditional disciplinary domains such as logic, the philosophy of science, and political philosophy. Most of these philosophy majors will move on to other fields, often the law, but for those who go on to graduate school, their future is laid out before them: they will become the next generation's professors of philosophy.

In addition to teaching, contemporary philosophers engage in research that issues in the production of articles and books. With the exception of a few textbooks, philosophical writings consist of professional productions written for experts in the various philosophical subfields of specialization. As for writings meant to reach the populace, whether the general public or those in other parts of the knowledge industry, very few philosophers make the attempt. Books like

Alasdair MacIntyre's *After Virtue* are exceptions that prove the rule. Such works are viewed by academics, when they are considered at all, as a sign of a lack of philosophical seriousness.

The upshot of these efforts is a discipline that produces work of great intellectual quality and little relevance to the larger world. It does not seem to have occurred to many within either philosophy or society that philosophers could be doing something other than explaining books and writing scholarly articles within the academy. But is this the only—or best—way to do philosophy? Or can philosophers, *as philosophers*, participate in the political sphere, work in government or business, build a cabin, or go on a hike? That is, can we not merely apply the insights of philosophy to these activities, but engage in these activities *as philosophy*? Is philosophy necessarily tied to *logos* in the sense of words, as Aristotle claimed in understanding truth as a function of language, residing in the truth or falsity of statements about the world? Or might there be a form of *logos* and truth that is incarnate, an embodied philosophy through which one enacts philosophy within the community or the natural world? Could there be a philosophy—and by extension, a humanities—that, without becoming superficially pragmatic, takes on the juxtaposition of Aristotle and climate change, or semiotic theory and geologic fieldwork, in order to see what the effects are on both?

Geo-Logic treats philosophy (and by extension, the humanities) as a practice as well as a linguistic activity. “Practice” is here meant in the Buddhist sense—that wisdom cannot be wisdom if it only consists of a set of propositions. Wisdom must also be embodied, manifesting itself personally and socially in a daily performance. Indeed, until philosophy becomes a practice we can have little confidence in a philosopher’s conclusions. Practicing philosophy means something more than applying the established insights of philosophy to our lives; we must approach philosophy as a yoga—a disciplined and embodied way of being in the world that in turn influences our philosophical propositions. The point is not to dismiss philosophy’s discursive element, but to view the linguistic and the embodied, engaged aspects of philosophy as complementary. In this view of philosophy, philosophers would spend roughly equal amounts of time out in the “field” and in teaching and writing. “The preamble of thought, the transition through which it passes from the unconscious to the conscious, is action.”¹⁰

Consider the way that Buddhism and Hinduism treat these questions. For all their differences (e.g., on the nature of the self,

God, and the cosmos) Buddhist practice and Hindu yogic techniques share a vision largely missing from Western philosophy: both emphasize the unity of our physical and contemplative lives and the practical and embodied nature of wisdom. Buddhism eschews speculation for an insistence upon the lived aspects of wisdom. The Japanese tradition of Buddhism especially focuses on the relation to everyday life through a set of *do* or Ways. Skills such as archery, flower arrangement, tea making, and fencing are all treated as occasions for gaining insight. Zen koans are based upon the belief that reason is an inadequate vehicle for expressing truth: a koan can be solved only through inspiration or action. Possibly the most rigorous of the Ways is judo, which trains the entire body rather than focusing on a particular technique. But even household activities such as washing the dishes and sweeping the floor are occasions for insight. "If a Zen student is sufficiently alive, he can practice the Way in the simplest activities of daily life."¹¹

Similarly, yoga is a five-thousand-year-old Indian philosophical-religious system designed to unite the body, mind, and spirit. Like the word "religion," "yoga" means to tie or bind together: yoga is Sanskrit for "yoke" or "union." Westerners think of yoga in terms of its physical aspect, hatha yoga, in which adepts practice a set of asanas or postures. Within the Hindu tradition, however, physical training and meditation are two aspects of one process. Traditional yoga emphasizes an eightfold system of spiritual development including ethical disciplines (*yama* and *niyama*, restraints and observances), postures, breathing exercises, control of the senses, concentration, meditation, and absorption.

To suggest that Western philosophy, and more generally the humanities, be treated as a yoga implies that the theoretical and the practical be yoked in both our personal and public lives. Rather than the scholar's study, the native home of philosophy lies in the crafts we master: violin, pottery, and dance; scientific fieldwork, salesmanship, and political deal making; and, yes, teaching, writing, and research. Mindful of the practice and care needed to develop such skills, craftspeople of different skills are able to recognize one another. Great skill in any craft requires that we subordinate our desires to the work before us. Dedicating oneself to a craft is the *sine qua non* of freedom. Such craft work is implicit philosophy. Through practicing and eventually mastering such crafts, we create an experiential complement to philosophy's linguistic aspect.

IV.

In addition to the projects of rethinking the nature and roles of geology and philosophy in society, a third point needs emphasis here: *Geo-Logic* is an essay in topical thinking.

Topical thinking begins from both natural and geographical locations—"places" in the literal sense of the word—and from personal and social circumstances, the metaphorical sense of "place" implicit when we ask someone, "Tell me where you're coming from." Imagine you are on a trip to Morocco. Turning a corner in Marrakech, you glimpse a picturesque gathering of Muslim women. You lift the camera to capture the scene, and the group explodes: heads duck, backs turn, and hands raise before faces. Topical thinking begins from places like this, launched from a personal anecdote or a telling example, and acknowledging the circumstances that motivate thinking. From such beginnings, topical thinking follows a nomadic path that traces the implicit logic of a problem wherever it leads: perhaps from politics to sociology, then to economics, ethics, aesthetics, and theology, and finally back again to politics. From the experience of picture taking in Morocco, for instance, one might be led to ask how cameras enframe and objectify others, or to investigate the politics of gender, or to interrogate the role of tourism in intercultural communication—or from one to another of these problems.

Topical thinking organizes knowledge differently from the approach that governs academia, where research is structured in terms of the logical space of disciplines (chemistry, history, and the like). Topical thinking does not, however, abandon the disciplinary structure that defines knowledge today. A disciplinary approach to knowledge is not unreasonable, but it is partial. It needs to be complemented by an approach that remembers that our problems are always extra-disciplinary in nature. A medical patient, for instance, consists of something more than a series of "disciplines" (or systems: cardiac, pulmonary, digestive, and so on) worked on by medical professionals. As necessary as an understanding of these different systems is for treating a patient, medical practice suffers when it loses sight of the fact that it is a transdisciplinary entity (namely, a *person*) that is being treated. Likewise, our environmental problems resist simple division into the categories of environmental science, economics, and ethics. To confront these problems effectively we must understand how these categories relate and flow into one another at a particular location. Topical thinking is a

means for tracing the ontological disruptions that occur when we attend closely to a problem.

Granted, it makes sense to divide a complex issue into parts, simplifying a problem in order to get a better hold of it. But if we never aim for a sense of the whole, seeking to understand the relation between and across the disciplines, we will be left with systematic incoherence: experts misunderstanding one another, and none of these experts able to converse with the public. For example, the United States government has spent more than a decade, and over 4 billion dollars, in a site characterization of Yucca Mountain, Nevada, in order to certify it as a safe repository for seventy thousand tons of the nation's civilian nuclear waste. Congress has mandated that the site must be confirmed safe for the next ten thousand years. Visit Yucca Mountain (a hundred miles north of Las Vegas) and climb down into Trench 14, a place notorious for the controversies it has generated. Are the calcite deposits found in Trench 14 meteoric, the result of rainwater percolating down from the surface? Or are they signs of hydraulic pumping, by which ground water has been forced up from below? If the latter is true, then this location has been affected by wide fluctuations of the water table, raising the possibility that the canisters of nuclear waste could be flooded, causing the nuclear waste to explode.¹² As one talks with government hydrologists, the terms of the debate begin to shift: from the intricacies of data interpretation, to competing hydrological models and computer techniques (each implying radically different accounts of the repository's future), to the relation between the state of Nevada and the federal government, to scientists' ethical obligations to inform the public, to our own responsibilities to future generations. The disciplines simplify—and falsify—the challenge of Yucca Mountain by beginning with the presumption that these questions can be dealt with independently of one another.

Over the last two decades the philosopher Alphonso Lingis has been perhaps the foremost representative of a topical approach to thinking. In a series of works, Lingis has tested the bounds of abstract academic discourse, juxtaposing existential encounters with insights mined from the history of philosophy.¹³ While Lingis's main concern has been the confrontation with foreign cultures rather than with the natural world, his work has emphasized—more through example than argument—that thinking must be seen as a response to, rather than the delimiter of, experience. Like Lingis's work, *Geo-Logic* comes to these questions from the perspective of nineteenth- and twentieth-century continental philosophy, in particular the

existential and hermeneutic perspectives of Heidegger and Merleau-Ponty. Nonetheless, how I use these thinkers may be as foreign to continental philosophers as to those with an analytic background in philosophy.

Given this topical approach, it is reasonable to offer a short account of my own “place” that led to the present study. It was the philosophic attractions of geology that led to my resigning a faculty position in philosophy to return for a master’s degree. The point was not to approach the Earth sciences as a subspecies of the philosophy of science. Rather, I hoped to develop a scientifically informed phenomenology of the Earth that united geologic knowledge with philosophic insight to help us understand how to live on Earth. I had already spent some time in the field with geologists, and had been struck by how their thinking was affected by walking the land and interpreting its signs. Despite their invariably positivistic descriptions of the reasoning process within geologic fieldwork, I found that geologists practiced a type of earthbound phenomenology rather than an activity best described by the covering laws of the philosophy of science.

My intentions, then, were focused on developing a phenomenology of geology. But I soon discovered that geology as a discipline and a social institution was in a state of flux. I also discovered that the motivations of my fellow graduate students were markedly different from what I had imagined. Few of them pursued their course work for financial reasons—a point obvious to anyone familiar with the job market in the Earth sciences. And while I found the geopoetic aspects of their science everywhere within their labors—imagining worlds outside the compass of anyone’s experience—this topic led a decidedly subterranean existence. Not only were the perspectives of philosophy and the humanities unfamiliar to them, they were also highly suspect. For a field suffering its own identity crisis—cuts in funding and a fear that, in the words of the physicist Luis Alvarez, fields such as paleontology may be nothing more than a type of stamp collecting—the last thing geologists needed was someone to draw out the connections between geology and the humanities.¹⁴ Better to emphasize the rigorous nature of the field, and geology’s ties to geochemistry and geophysics.

I found, however, that our interests intersected when they were reframed in terms of epistemology and politics. Scientists are people who go to great lengths to make sense of things. This drive takes a distinctive form within the Earth sciences, where much of the evidence is lost, and what remains is bent, warped, baked, or dismem-

bered. To be a field geologist, one must positively delight in conundrums, much as Sherlock Holmes enjoyed the complexities of his profession. What's more, Earth scientists commonly combine their fascination with epistemological puzzles with serious ethical and political concerns. Typically individuals with a profound feeling for nature (although the forms of this feeling vary widely), they often champion conservationist and/or preservationist stances toward the natural world.

Under the influence of my new colleagues, I soon found myself focusing upon the epistemological and institutional as well as the phenomenological and philosophical aspects of the Earth sciences. Indeed, a new thought came to the fore: we need to understand how *all* the domains of the humanities—epistemology and ethics, aesthetics and politics, metaphysics and theology—manifest themselves in the study of the Earth. My goal at the outset was to develop a geologically informed environmental ethics and a phenomenology of the Earth. But by the time I finished my degree, the goal had become to provide an ontology of the Earth sciences: to describe how the various domains of knowledge (science, ethics, politics, aesthetics, metaphysics, and theology) are revealed within the discipline, and how these domains relate to one another in various environmental controversies.

This ontological reevaluation of geology is being driven by the most pragmatic of conditions. Both natural and cultural forces are changing the role of the Earth/environmental sciences in society, forcing the discipline to take on political responsibilities markedly different from those of its own earlier history, as well as from most other sciences. Whatever might be a scientist's private motivations, the overall role of science in culture has long been as an "enabler"—increasing the range of our power and control through the development of science-based technological development. This explains the massive federal support of science (in 2000, around 40 billion dollars for funding of non-defense-related science), and reflects our society's desire for an ever-expanding power over nature.

In its early years, geology fit within this framework—if not entirely comfortably. As geology emerged as a separate discipline in the early nineteenth-century, the field straddled two roles: its discovery of the history of life profoundly affected how we understand our place in the cosmos, while it also served as a handmaiden to industrial development, providing raw materials for the industrial machine.¹⁵ Certainly both of these roles continue today—although the former, metaphysical issue is too often reduced to stale debates over

scientific creationism. But I wish to emphasize a third role that is coming to the fore: the Earth sciences as herald of local and planetary thresholds. The Earth sciences are becoming the sciences of limit, adding a cautionary note to our plans and ambitions. It is a simple point, but one that has taken us a long time to acknowledge: the world is not infinite. It is foolhardy to assume that we can endlessly exchange cultural for natural capital, escaping from every problem of scarcity or pollution via the development of new scientific and technological insights. Moreover, this question of scarcity is itself a prime example of the transdisciplinary nature of the Earth/environmental sciences. The scarcity we are facing will not be a matter of running up against purely physical boundaries. Scarcity in the twenty-first century will combine physical limits with a complex range of cultural factors such as economics, politics (i.e., questions of justice), aesthetics (quality-of-life issues), and theology (a sense of the sacred). In this third role, the Earth sciences will function as an early warning system for geo-ecological calamities—as the eyes and ears of the body politic. This new role will put especially strong pressure upon the Earth sciences to become a bridge discipline spanning the sciences and the humanities.

V.

To chart this ontological disruption, *Geo-Logic* begins from three places or topoi: (1) the political controversies surrounding acid mine drainage (chapters 2 and 3); (2) the nature of scientific research as it is conducted in the field (chapters 4, 5, and 6); and (3) the challenges facing public Earth scientists as they seek to serve the needs of communities (chapters 7 and 8). In each of these locations I explore how reconfiguring the disciplines of the Earth sciences and philosophy casts new light on our environmental challenges. My claim is straightforward: we are not making good use of our intellectual resources, in large part because of the disciplinary presumptions that dominate the production of knowledge today. Addressing societal problems will require a type of transdisciplinarity that moves both horizontally (across the disciplines) and vertically (between intellectual culture and society at large). To gain a purchase on our environmental problems requires that we break down the divide separating the natural and cultural aspects of geology, *and* that we make philosophy into a cultural practice as well as a linguistic event. Rewriting the disciplines of the Earth/environmental sciences

and philosophy will provide communities with new resources for creating an environmentally sustainable future.

Geo-Logic starts with a hike in the San Juan Mountains of southwest Colorado. Reconceiving the Earth sciences and philosophy begins at ten thousand feet, with the problem of acid mine drainage. Hard rock mining's legacy is deeply ambiguous, leaving us with, on the one hand, picturesque mine works, and, on the other, dead streams and a scarred landscape. The controversy over acid mine drainage is labyrinthine. It leads us to questions that are at turns scientific, political, metaphysical, aesthetic, and even theological in nature. But we shall find our way out of our environmental problems only by exploring each of these passages in all their multidisciplinary variety.

The argument then turns to an investigation of geology's distinctive epistemological status. Epistemology—i.e., the theory of knowledge—seems an arcane subject; but our sense of what counts as real knowledge circumscribes our social and political conversations. The absence of anything like a philosophy of *field* science is telling, for field-based sciences such as geology offer a better account than do the laboratory sciences of both the power and limits of science for addressing societal problems. Scientific reasoning is still too often seen as a mechanical process that provides us with authoritative, even infallible answers—a misrepresentation that damages both science and society. Indeed, with the rise of computer simulations, the positivist spirit, once thought slain, is again in ascendance. In contrast, the reasoning process typified by scientific fieldwork offers an account of reasoning that is more applicable to life's uncertainties. Seldom possessing all the knowledge we would like, we fill in the gaps in our knowledge with interpretation and reasonable assumptions that we hope will someday be confirmed. Field-based sciences exemplify this process, mirroring the complexities we face in our personal and political lives.

Third, *Geo-Logic* moves into the halls and offices of public Earth-science agencies in search of a political philosophy of science. The philosophy of science and political theory have long been considered disjunct domains. Public science agencies challenge this divorce, for they exist to serve the common good, to further societal values such as freedom, justice, and community. Agencies such as the U.S. Geological Survey (USGS), the National Aeronautics and Space Administration (NASA), and the Geological Survey of Canada (GSC) inhabit a space that is at once scientific and political. Yet there is, to date, no political philosophy of public science.

The USGS and the GSC are organizations in transition: much of their traditional work (e.g., geologic and topographic mapping) is ending, and critics ask why private industry cannot take over the functions that remain.¹⁶ This question itself reveals the gap in our culture's thinking about the nature of the public realm, for public science agencies have a critical role to play in an era of environmental limits. Nevertheless, realizing this opportunity will require that agencies such as the USGS and the GSC embrace a wider definition of scientific responsibility—one that charges them with the task of understanding and responding to community values in addition to their traditional commitment to scientific excellence. Exploring the public or political responsibilities of these institutions provides us with a powerful example of how we can create new conceptual and political spaces, freeing both science and society from epistemological prejudices that have stymied our culture's conversation.

We begin by turning to a place where the full range of our geological concerns is manifest: the controversies surrounding acid mine drainage.