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Forms of Knowledge

THE DIVORCE BETWEEN SCIENCE AND THE HUMANITIES

Two things fill the mind with ever new and increasing wonder and awe—the starry heavens above me and the moral law within me.

—IMMANUEL KANT

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OUR DISCUSSION OF brain-based epistemology recognized that there are various forms of truth and different criteria for the validation of each form. In addition to the verifiable truth reached through scientific investigation, there is logical and mathematical truth, and there is truth as established in the writing of history and in law courts. There have been many philosophical approaches to deal with the forms of truth ranging from notions of the synthetic a priori to deep analyses of induction, deduction, and mathematical proof.

The position I have taken is that the naturalization of epistemology must account not only for scientific truth but also for the biological origins in human thought and consciousness of the various other forms of truth. At this point, I want to deal with a long-standing split or divorce between science and the humanities (including the so-called human sciences). After tracing some origins of this split, I will propose an approach to resolving it that is consistent with a scientifically based brain theory. But before tracing these origins, I must point out that when I use the word "science" I refer specifically to Western science dating from its origins in the seventeenth century. Of course, scientific pursuits can be traced back to ancient Egypt, ancient Greece, and even dark periods of the Middle Ages.[1] But the split of which I speak arose in the germ with Galileo and Descartes and was explicitly exposed by the philosophical historian Giambattista Vico in the early decades of the eighteenth century.[2]

The historian Isaiah Berlin traces the divorce between the sciences and the humanities to Vico. This relatively unknown figure challenged the views of Descartes and denied that human beings possessed an unalterable essence. Humans make their own history and understand their own doings in a fashion different than that by which they understand external nature. Our knowledge acquired "from inside," our "second nature," differs from that which we develop from observing the outside world. Instead of the Enlightenment view—a single set of principles applied to all knowledge—Vico applied these contrary thoughts and mounted an attack on the total claims made for the new scientific method. As Berlin indicates, a great debate started "of which the end is not in sight."[3]

Vico's thoughts, which became known only much after his death in 1744, challenged the idea that there was only one set of methods for establishing the truth. From the time of Descartes and Francis Bacon through to the present, one can trace a line of thought that, contrary to Vico, holds up the ideal of a unified system of sciences, natural and humane. Instead of listing all the thinkers on this side (the well-known side reflecting the Enlightenment ideal), I shall first emphasize the other stream in the debate, the one that can be traced to Vico. Then I shall contrast this view to the opposing views held by some modern proponents of reductive or unified science.

A key figure is the German thinker and philosopher Wilhelm Dilthey, who regarded the understanding of human be-

ings as an interpretive matter, one within which notions of physical causation have no place.[4] In his work before 1900 (he died in 1911), Dilthey rejected the notion that humans were essentially rational; instead they exercised willing, feeling, and thinking in various combinations. He assigned the disciplines of psychology, philosophy, and history as *Geisteswissenschaften,* or the human sciences. These were to be distinguished from *Naturwissenschaften,* or the natural sciences, which were concerned with the physical world.

In a manner not far removed from Vico's program, he asserted that descriptive psychology stood at the base of the human sciences. Later, he revised this base to include human history itself, particularly in its sociohistorical contexts. Essentially, Dilthey's positions rested on the notion of hermeneutics, the study of interpretation and its conditions by insiders within a historical culture.

Many modern philosophers have pursued one aspect or another of this stream of the debate. There are, of course, other tributaries of this stream. One might include the differences between science and religion and, more recently, the "science wars," in which postmodernists have suggested the extreme position that science itself has no claim to objectivity but is merely another mode of looking at things, not superior in its truth claims to any other mode.

Rather than pursue these parts of the debate in detail, I wish to make one suggestion that must be considered if the

various views on either side are to be reconciled. It seems to me that, if Descartes's dualism is maintained, there must *necessarily* be a split—the human sciences on the side of *res cogitans* (thinking things) and the natural sciences on the side of *res extensa* (extended things). This may seem curious, because Descartes thought to ground all knowledge starting from *res cogitans.* Indeed, Vico rejected Descartes's position.[5] Clearly the position on consciousness I have already exposed rejects Cartesian dualism. In one interpretation, we might claim that William James also rejected substance dualism in denying that consciousness was an entity or a thing, suggesting instead that it was a process whose function is knowing.[6]

The strains and dilemmas that have emerged from the split have driven thinkers to extreme positions as well as to penetrating observations. The philosopher Alfred North Whitehead was deeply concerned with the issue and indeed constructed a whole metaphysics—the philosophy of the organism—to get around it.[7] Later, the debate flared up when C. P. Snow wrote that there were two cultures or polar groups: literary intellectuals versus scientists.[8] Without indulging in such extremity, the physicist Erwin Schrödinger pointed out the curious fact that the great theories of physics did not contain or address sensation or perception but simply assumed them.[9]

On the side of science, extreme postures were adopted with as much energy as those expressed by historians and hermeneuticists. For example, schools of psychology derived

from John B. Watson and B. F. Skinner put forth the notion of behaviorism, that all mentalistic explanations should be rejected.[10] Some, like Skinner, admitted of mental events but denied mentalistic causes. In the past decade, a view called eliminative materialism has surfaced that actually claims that there are no mental events or processes.[11]

Another philosophical school of thought, logical positivism, proposed in effect that science was the only legitimate form of knowledge. It was "logical" in its dependence on logical and mathematical studies, and it asserted that a priori knowledge of necessary truths could be made consistent with empirical science. Essentially, the claim was that any statements made outside this frame were neither true nor false but meaningless. Unfortunately, there was no way of showing that the assumptions of this school of thought could themselves meet the criteria of meaningfulness. Some of the thinkers emerging from the so-called Vienna Circle, which provided an early impetus to logical positivism, hoped to formulate a completely unified science. The hope of Otto Neurath, for example, was to give sociology a solid scientific status, but he never achieved the dream.[12] Nonetheless, some of his views were cousin to Quine's later notion of naturalized epistemology.

Two other efforts at scientific reductionism have come to the fore in recent times. The most ambitious is one derived from theoretical physics—the hope of constructing a so-called theory of everything (TOE). This is the search for a coherent

formal description (essentially mathematical) that would unify all the four forces of nature—electromagnetism, the weak force, the strong force, and gravity.[13] Some claims have been made that, with string theory, we are well on the way to achieving this goal. Unfortunately, there is presently no single verifiable form of such a theory, and in any event, it certainly would not, in Schrödinger's sense, include an explanation of the sensation and perception necessary to understand it.

Another extreme of scientific reductionism, based on biology rather than physics, has been put forth by E. O. Wilson.[14] He claims that once we understand the so-called epigenetic rules by which the brain is formed and works, we will be able to reconcile human behavior, including normative behavior, by applying these rules. Thus, Wilson claims that even ethics and aesthetics will yield to this reductive analysis, which he calls consilience. The term "consilience" was adopted by Wilson from William Whewell, who used it in his tract *The Philosophy of Inductive Sciences* (1840). By this term, Whewall meant the "jumping together" of facts and theory across disciplines to create a common ground of explanation.

Wilson's statement early on is: "Given that human action comprises events of physical causation, why should the social sciences and the humanities be impervious to consilience with the natural sciences? . . . Nothing fundamental separates the course of human history from the course of physical history, whether in the stars or in organic diversity."[15]

The extremism of this position and of those on the other side speaks to the need for moderation and a different form of reconciliation, to which I now turn. In the course of that effort, I will expand on some of the claims that I have skirted briefly in the above account.

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Repairing the Rift

Art is the objectification of feeling, and the subjectification of nature.

— SUSANNE K. LANGER

CAN WE RESOLVE THE ISSUES that have led to extreme reductionist positions on the side of science and to phenomenology, hermeneutics, and proud humanism on the side of the humanities? Can we repair the rift? As I have said before in considering the Cartesian position, one barrier to repairing the rift was the failure to bring consciousness into the worldview—to naturalize it. That has now become possible, and indeed there is mounting evidence from neuroscience that our cognitive capacities arose in the natural order as a result of evolution. Clearly, these capacities did not stem from logic or computation but instead emerged with the appearance of various brain functions including perception, memory, motor control, emotions, and consciousness itself.

The brain itself emerged during evolution from a series of events that involved historical accidents. Since the human brain and its products developed within a historical context, one might say that the tracing of that development must to some extent involve the same methodology as historians use to trace social change or battles. That is, to some extent, true. But the theory of natural selection, because it is buttressed by molecular genetics and paleontology, allows a historical account of brain evolution that is somewhat more coherent than most descriptions of human exchanges in peace or war.

In one of his essays, Isaiah Berlin makes it clear that the concept of scientific history is untenable for a variety of reasons.[1] First, unlike science, history cannot be described in terms

of general laws. This does not mean that historians do not rely on general propositions. They rely on multiple facts and on the general texture of experience, often involving common sense. There is, in general, however, an absence of the models that are so frequent in scientific pursuits. Moreover, the logic and hypothetico-deductive method central to science is not often applicable to historical events.[2] Even though some claim may be made for such approaches in the human sciences of sociology and economics, they are not readily applicable to most historical accounts. If science is concerned with similarities and laws, history is equally concerned with unique events and differences that often depend on beliefs, desires, and intentions within a given culture.[3] In considering human affairs, the scholar or interpreter must place himself or herself within the fabric of these propositional attitudes. General history is a mix of disparate elements that can be studied within different disciplines but not in terms of some general law. Moreover, there are normative elements related to morals and aesthetics that are involved within historical descriptions. These issues pose daunting challenges to the historian, who may have to understand and interpret events that occurred in a culture other than his or her own.

Berlin makes the claim that scientific and historical accounts represent different kinds of knowledge. He expresses this difference by contrasting the views of an external observer and an actor, a contrast between coherence and interpretation.

While the gifted historian must be able to describe the doings of people in many dimensions, scientists on their side do not depend for their generalizations upon contact with common human experience. History, in Berlin's view, is not and cannot be a science.

From time to time, individual historians have attempted to overgeneralize historical interpretation. The results can seem ludicrous. Take for example, the efforts of Brooks Adams, Henry Adams's brother. In a book called *The Law of Civilization and Decay,* he attempted to interpret history in terms of the growth and decline of commerce, with less than satisfactory results.[4] In more recent times, one may note the grand efforts of Oswald Spengler and Arnold Toynbee, both of whose syntheses have fallen by the wayside. And even Vico, in his effort to describe cultural stages in history as those of gods, of heroes, and of men, succumbed to overgeneralization.[5]

Not all attempts to describe and construe past events are so grandiose or silly. John Lewis Gaddis, for example, has put forth an excellent account of the methodology employed by historians.[6] He is aware of the contingent, incomplete, and irreversible complexities of historical events. In describing approaches to deal with such events, he justifiably decries the linear, overly simplistic analyses of many social scientists. Effectively, his claim is that the complexity of history cannot be fit by a Newtonian model, and he rejects the notion of reductionism as a means of historical analysis. But then he suggests

that what historians do is closer to the procedures of scientists! He bases this claim on the advances made by scientists in complexity theory, chaos theory, fractals, and the like, advances that he feels share the flavor of the historian's methodology.

Unfortunately, the analogy has several flaws. First, although interesting results have been obtained in the analysis of complex systems, scientists are far from having an adequate picture of far-from-equilibrium or irreversible processes. We still lack adequate means for dealing effectively with multicausal processes for which independent variables cannot be discerned. Second, the measurements made in deterministic systems that are chaotic are still *physical* measurements. Although small initial errors in such measurements propagate to yield chaos, they remain quantitative measurements. Historical systems are rarely, if ever, quantifiable in this way. Nonetheless, Gaddis persists in his analogy and respectfully disagrees with Berlin. The methods of historians he so artfully summarizes still remain largely qualitative.

Gaddis makes a defensible claim that there are sciences with a historical flavor. These include cosmology, geology, paleontology, ecology, and anthropology. It is true that scientists in these areas must take account of historical events, and evolutionary theory and natural selection certainly must deal head-on with such events. (One might even consider Darwin a historian!) Moreover, because of their inevitable complexity and limitations on material, fields such as geology and paleontology must deal with incomplete records. Nonetheless, there are powerful scientific theories that *constrain* these fields—astrophysics for cosmology, plate tectonics for geology, natural selection for biology. No such set of constraining theories is available to historians unless one admits a potpourri of weakly based psychological theories—Freudian analysis, socioeconomic models of rational behavior, and the like. Perhaps the closest analogue to Gaddis's suggestion is ecology, where multiple variables recursively interact in complex environments. Indeed, we may conclude that there are bases for calling ecology a soft science. But, even so, ecology can still marshal a set of constraining scientific theories and quantitative methods not available to historians.

If we accept Berlin's analysis rather than Gaddis's, we may ask why the methodologies and aims of science and historical analysis differ. The answer is not hard to find. Historical events are contingent, usually irreversible, and often unique. They involve high-order issues related to cultural idiosyncrasies, linguistic ambiguity, and specific moral or aesthetic constraints. While, as a person, a scientist is necessarily embedded in such a fabric, his or her aim is to supervene over or transcend the accidents of everyday existence and derive a general set of models and laws in whatever subject domain he or she works.

It is of particular interest, however, that these laws themselves do not give rise to science. People pursuing experiments and hypotheses give rise to laws. Science itself, and clearly

Western science, arose within a particular historical context. What factors govern the actual historical emergence of scientific knowledge beginning with men like Francis Bacon and Galileo and going on to the present?

I believe we can help formulate an answer to this question by considering how the brain evolved and how it operates. In the earlier chapters of this book, I mentioned the evidence that the brain and mind arose as a product of natural selection. I concluded that the human brain itself operates as a selectional system with highly variant repertoires of circuits. Subsets of these circuits are selected to match signals from the world of complex events. In a previous chapter, I argued that the brain is not a computer and that the world is not a piece of coded tape. The brain must, in the absence of unambiguous signals, establish regularities of behavior under constraints of inherited value systems and of idiosyncratic perceptual and memorial events. In human beings, such systems and events necessarily involve emotions and biases.

Selectionistic brains themselves show the effects of historical contingency, irreversibility, and the operation of nonlinear processes. They consist of enormously complex and degenerate networks that are uniquely embodied in each individual. Moreover, human brains operate fundamentally in terms of pattern recognition rather than of logic. They are highly constructive in settling on given patterns and at the same time are constantly open to error. This is seen in perceptual illusions

as well as in higher-order beliefs. But as shown by the analysis of learning, error correction is usually available in response to appropriate rewards or punishments.

When we consider modes of thought pursued by selectionistic brains, there is a set of relations between pattern recognition and logic that is both contrastive and a reinforcing.[7] A fundamental early mode of thinking that is highly dependent on pattern recognition involves metaphor. Metaphor is a reflection of the range and associativity of enormously complex and degenerate brain networks. It is pertinent that the products of metaphorical thinking can be understood but cannot be proven as can simile or logical propositions. For example, if I say, "I am in the evening of my life," the statement is understandable but not provable.[8]

Language itself reflects the constructive yet inherently ambiguous and indeterminate aspect of this mode of thought. These features are the result of the trade-off between specificity and range in selectionistic systems that necessarily exhibit degeneracy, a subject I shall address in chapter 10. The diverse repertoires of such systems are never perfect matches to the contents of the domains they must recognize. But after selection occurs across a range of variants, refinement can take place with increasing specificity. This is the case in those situations where logic or mathematics can be applied. We conclude that the necessary price of successful pattern recognition in creative thinking is initial degeneracy, ambiguity, and com-

plexity. In scientific situations, however, the subsequent application of observation, logic, and mathematics can yield laws or at least strong regularities. In the case of historical analysis, qualitative judgment and interpretation are usually the most we can achieve.

Although all of our brain functions and cognitive capacities are constrained by physics and can be understood as products of natural selection, not all of these capabilities can be treated successfully by reduction. As a means to repair the rift, the notion of consilience as proposed by E. O. Wilson is untenable.[9] His idea, for example, that normative systems such as ethics and aesthetics can be reduced to explanation by epigenetic rules of the brain is inconsistent both with the nature of these systems and with how the selectionistic brain works. As David Hume pointed out, "ought" does not come from "is." To assume otherwise is to indulge in G. E. Moore's naturalistic fallacy.[10] Looking at the issue from the side of the brain and mind, epigenetic rules cannot satisfactorily cover the rich complexity and individual history of degenerate networks in the brain. Conscious experiences themselves are enormously complex discriminations in a high-order qualia space, as we have pointed out, and each individual's history and set of brain events are unique. Although there are certainly regularities of intentionality and behavior, they are variable, culture- and language-dependent, and enormously rich. Subjectivity is irreducible.

There is a curiously recursive element in this brain-based

account of how knowledge is acquired. To get science, we need history acting on selectionistic brains. Eventually, this allows the reduction of certain physical and chemical events to general laws. The world order or universe follows physical laws. The remainder of individual and historical events must also follow these laws but cannot be fully explained by or be reduced to them.[11] Irreducible or not, we can agree that all these events are scientifically grounded in the natural order. The evolution of brains and conscious minds occurred by natural selection within the framework of physical laws. So the sequence is clear: following the evolution of *Homo sapiens,* the emergence of language and higher-order consciousness allowed the development of empirical science in the service of the verifiable truth. The application of logic in relation to language and observation of the world, and of mathematics as the study of stable mental objects, profoundly enhanced these developments. Nonetheless, these developments occurred within a specific historical matrix that cannot be reduced to them or by them. Moreover, there is no contradiction in the fact that selectionistic brains capable of higher-order consciousness and pattern recognition could create artistic, aesthetic, or ethical systems within particular historical and cultural conditions. We can conclude that there is no logically necessary divorce between science and the humanities, only a tense relation in which science is admitted as a fundamental but not exhaustive or exclusive basis for grounding our knowledge.

This picture, which is a starting point for brain-based epistemology, is considerably looser than the rigorous developments of epistemological issues by generations of philosophers. It does not, however, exclude these rigorous developments. Rather, it relates them to their ultimate origins in natural and neuronal group selection. In contrast to Quine's efforts at naturalization, brain-based epistemology does not stop at the skin or sensory receptors.[12] It includes more than perception. Indeed, it is based on the analysis by Neural Darwinism of conscious states. The neural underpinnings of such states make human knowledge possible.

It is well to recall that even though all our knowledge depends on our conscious states, these states are necessary but not sufficient for learning. Conscious states themselves appear to have many of the characteristics of irreversible, contingent, and fleeting events. They are unitary but change serially in short intervals of time. They have wide-ranging contents and access to stores of memory and knowledge. They are modulated by attention. Above all, they reflect subjective feelings and the experience of qualia. The evolutionary advantage offered by the emergence of the reentrant dynamic core provided its possessor with vast numbers of sensorimotor discriminations. Qualia are just those discriminations entailed by different core states. They can reflect factual verities as well as illusions and are, in all cases, subject to the constraints of neural value systems.

Given this picture, which is consistent with Neural Darwinism, it is no surprise that rich private experience and external historical events should share properties of both contingency and necessity. The underlying historical processes have complexities that rule out simple reduction of all experience to scientific description. The remarkable event remains: thought within such a system led to the scientific revolution and the generality of scientific laws. It is enough to show how both science and history can be comprehended in our picture of the brain. Divorce is not at issue: the processes that give rise to our understanding comprehend both the sciences and the humanities.

7. Carey, "Bootstrapping and the Origin of Concepts." For a general background, see Dehaene, *The Number Sense.*
8. Another quotation, presumably translated, is: "God created the integers, all else is the work of man." See Bell, *Men of Mathematics,* 477.
9. Edelman and Gally, "Degeneracy and Complexity in Biological Systems."
10. The idea derives from Hume. The naturalistic fallacy was pointed out in Moore, *Principia Ethica.*
11. I use the term "second nature" to refer to the sum of our experienced perceptions, memories, and attitudes individually and collectively. The term is perhaps best encapsulated in the notion of common sense knowledge derived from everyday experience rather than from scientific knowledge. This usage should not be conflated with the distinction between the Manifest Image and Scientific Image drawn by the philosopher Wilfred Sellars. As he puts it, the Manifest Image is the commonsense framework of man-in-the-world, but it also includes correlational and inductive science. The Scientific Image embodies the postulated entities of theoretical science, for example, atoms, molecules, and microphysics. Thus, both images invoke scientific knowledge. Sellars's distinctions were aimed at philosophers. My usage is more modest and is simply intended to contrast our everyday impressions and conclusions with those reached through scientific pursuits. See Sellars, "Philosophy and the Scientific Image of Man." For the kind of contrast between second nature and nature that I have in mind, see Eddington, *The Nature of the Physical World,* ix–xii. This gifted astronomer contrasts the table before him—"strange compound of external nature, mental imagery, and inherited prejudice"—with the scientific description of his table, "mostly emptiness full of speedy electric charges."

12. Boyd and Richerson, *The Origin and Evolution of Cultures.*
13. Huxley, "On the Method of Zadig." In this essay, based on a talk, Huxley points out that "prophecy" is not necessarily a foretelling of the future but rather, as Voltaire points out in his fantasy, "Zadig," it can consist of insights derived from present evidence concerning events in the past.

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FORMS OF KNOWLEDGE

1. G. Sarton, *Appreciation of Ancient and Medieval Science during the Renaissance.*
2. Vico, *The New Science of Giambattista Vico;* Berlin, *Vico and Herder.*
3. Berlin, "The Divorce between the Sciences and the Humanities," 326.
4. Dilthey's *Philosophy of Existence.*
5. Vico, *The New Science of Giambattista Vico;* Berlin, *Vico and Herder: Two Studies in the History of Ideas.*
6. James, "Does Consciousness Exist?"
7. Whitehead, *Modes of Thought.*
8. Snow, *The Two Cultures and Scientific Revolution.*
9. Schrödinger, *Mind and Matter.*
10. Watson, *Behaviorism;* Skinner, *About Behaviorism.*
11. Churchland, *The Engine of Reason.*
12. Otto Neurath was a critical figure in the so-called Vienna Circle and in later life sponsored the Unity of Science Movement and published the *Encyclopedia of Unified Science.* See "Sociology and Physicalism, Erkenntnis 2 (1931–2)" and "Protocol Sentences (1932–3)" in Ayer, ed. *Logical Positivism.*

13. Weinberg, *Dreams of a Final Theory.* Against the notion of a TOE we have Laughlin and Pines, "The Theory of Everything." Laughlin has written an extensive account against extreme reductionism in *A Different Universe.*
14. Wilson, *Consilience.* Stephen Jay Gould wrote an impassioned critique of Wilson's position in *The Hedgehog, the Fox, and the Magister's Pox.* See especially chapter 9, "The False Path of Reductionism and the Consilience of Equal Regard."
15. Wilson, *Consilience,* 11.

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REPAIRING THE RIFT

1. Berlin, "The Concept of Scientific History."
2. Hempel, *Aspects of Scientific Explanation and Other Essays in the Philosophy of Science.*
3. These, in classical terms, are propositional attitudes, states of mind having propositional contents and attitudes toward them. They include beliefs, desires, intentions, wishes, fears, doubts, and hopes.
4. B. Adams, *The Law of Civilization and Decay.*
5. Spengler, *The Decline of the West;* Toynbee, *A Study of History.* These two and Adams may be looked on as metahistorians or bold synthesizers, admirable for their sweep if not for their judgments.
6. Gaddis, *The Landscape of History.*
7. See Edelman, *Wider Than the Sky,* 147–148.
8. Lakoff, *Women, Fire, and Dangerous Things.*
9. Wilson, *Consilience;* Gould, *The Hedgehog, the Fox, and the Magister's Pox.*

10. D. A. Hume, *Treatise of Human Nature;* Moore, *Principia Ethica.*
11. The philosopher Avrum Stroll has argued strongly that there are questions of fact that "even in principle" science cannot answer. See Stroll, *Did My Genes Make Me Do It?*
12. Quine, *Ontological Relativity and Other Essays;* Edelman, *Wider Than the Sky.*

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CAUSATION, ILLUSIONS, AND VALUES

1. Van't Hoff, *Imagination in Science.*
2. Intentionality is considered extensively in Searle, *Consciousness and Language.*
3. Quine, *Word and Object.*
4. Epiphenomenalism is sometimes seen as a cousin of dualism, as an objectionable spooky doctrine. But the color (or more rightly, the spectrum) of hemoglobin which is entailed by the molecule's structure requires no such doctrine. The spectrum is not causal, but the color changes when, causally, oxygen is bound.
5. For an account suggesting that conscious will has many illusory properties, see Wegener, *The Illusion of Conscious Will.*
6. Damasio, *The Feeling of What Happens.*

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CREATIVITY

1. Edelman, *Bright Air, Brilliant Fire,* chap. 8.
2. This quotation has been attributed to a character in E. M. Forster's