I hope to have convinced you that, while the process is arduous, a disciplined mind can be fashioned; and that its achievement represents an important, indeed indispensable, milestone. Alas, a disciplined mind alone no longer suffices. More and more knowledge now lies in the spaces between, or the connections across, the several disciplines. In the future, individuals must learn how to synthesize knowledge and how to extend it in new and unfamiliar ways.

CHAPTER 3

The Synthesizing Mind

"Hell is a place where nothing connects with nothing."

—VARTAN GREGORIAN, CITING DANTE

IN THE WESTERN sacred tradition, the story of human beings begins in the Garden of Eden, when Adam was enticed to take a first bite of fruit from the Tree of Knowledge. For the generations that immediately followed the biblical Adam, knowledge accumulated at a sufficiently slow rate that it could be passed on orally (though perhaps not in apple-sized chunks), from parent to child, and on down to each succeeding generation. But humans are distinguished by the fact that we continue to accumulate knowledge at increasingly rapid rates. Indeed, the Bible itself represents an effort to collate the most important knowledge that had accrued to that point—knowledge heavily skewed, of course, toward religious and moral messages.

Once societies became self-conscious about the knowledge that had coalesced, an occurrence that may have been yoked to the advent of literacy, groups attempted to set down what was known in ways that were clear, systematic, and easily grasped by the next generation. In the Western secular tradition, the pre-Socratic philosophers were the first individuals who sought to order current knowledge. Their successors—Socrates, Plato, and, most especially, Aristotle—strove to collate not only knowledge of how to live but also, perhaps especially, the extant knowledge about the world as it was understood at that time. The books of Aristotle—*Physics*, *Metaphysics*, *Poetics*, *Rhetoric*, among many others—represent the curriculum that had been delineated. No wonder that Aristotle was known for nearly two millennia as The Philosopher. Yet Aristotle was not alone. A formidable line of synthesizers exists in the West, from Aristotle to St. Augustine to St. Thomas Aquinas (in many ways Aristotle's Christian counterpart); and then on to the literary Dante, the prodigiously talented Leonardo, the encyclopedists of the eighteenth century, the *Encyclopedia Britannica*'s micropedia and macropedia of the late twentieth century, and—most recently—the Wikipedia of the twenty-first century. Similar lineages could be traced out in other major cultural traditions.

The ability to knit together information from disparate sources into a coherent whole is vital today. The amount of accumulated knowledge is reportedly doubling every two or three years (wisdom presumably accrues more slowly!). Sources of information are vast and disparate, and individuals crave coherence and integration. Nobel Prize–winning physicist Murray Gell-Mann has asserted that the mind most at a premium in the twenty-first century will be the mind that can synthesize well.

When I wrote about synthesis in the *Harvard Business Review*, I received an evocative confirmation from Richard Severs, a navy captain: "I have been through this wringer. Synthesizing massive amounts of data, intelligence, slants, opinions, tactics, and trying to maintain a strategic big picture was a challenge. You feel it creeping up into your brain like a numbing cold and you just have to choke it down, sift faster, and stay with it. [It's] challenging to be sure, but if you practice it, you develop a good tool for the leadership toolbox."[1]

Yet the forces that stand in the way of synthesis are formidable. In the previous chapter, I argued that it is difficult for most of us even to think systematically within one scholarly discipline or profession—how much more of a burden to master a number of perspectives and then piece them together in a useful amalgam! Adding to this difficulty is the fact that individual cognition is remarkably domain-specific: as a species, we are predisposed to learn skills in certain contexts and to resist—or at least find challenging—their wider generalization and broader application. Few individuals and even fewer institutions have expertise in inculcating the skill of synthesis. And, just to top it off, even when synthesizing is desired and cultivated, we lack standards for determining when a productive synthesis has been accomplished, as opposed to when the proposed synthesis is premature, misguided, or even fundamentally wrongheaded. As turns out to be the case with each of the other minds portrayed here, the mind-that-would-synthesize must grapple with forces that seem to be arrayed against its proper realization.

KINDS OF SYNTHESIS

Against the odds, individuals seek synthesis. Successful examples can be cited. Such syntheses require us to put together elements that were originally discrete or disparate.

Here are the most common kinds, along with some impressive illustrations:

1. *Narratives.* The synthesizer puts material together into a coherent narrative. Examples range from the Bible to a contemporary history or social science textbook. Narratives

exist no less in fiction (Tolstoy's *War and Peace*) than in the nonfictional realm (Gibbon's *Decline and Fall of the Roman Empire*).

2. *Taxonomies.* Materials are ordered in terms of salient characteristics. Consider the Dewey decimal system in the library, the Linnaean classification of plants and animals, a double-entry balance sheet in an annual report. Such taxonomies are often presented in charts or tables. The Russian Mendeleyev succeeded where the alchemists of earlier eras had failed: he was able to produce an ordered periodic table of the elements of the earth. And because he understood the principles that gave rise to their detailed atomic structure, this synthesizing scientist was even able to predict the existence of elements that had not yet been discovered.

3. *Complex concepts.* A newly stipulated concept can tie together or blend a range of phenomena. Charles Darwin achieved such a synthesis in his concept of natural selection; Sigmund Freud developed the concept of the unconscious; Adam Smith introduced the concept of the division of labor. In literary analysis, T. S. Eliot created the concept of the *objective correlative*—the embodiment of an emotion in a particular situation, such that the reader will infer the intended emotion without its being explicitly mentioned. In business, Michael Porter construed strategy as a synthesis of five forces that together determine potential profit. And note the plethora of concepts in financial analysis: the business cycle, price-earnings ratio, the eighty-twenty principle (also known as Pareto's law).

4. *Rules and aphorisms.* Much of folk wisdom is captured and conveyed by short phrases, designed to be memorable and widely applicable. Across societies, nearly everyone learns some version of the phrases "Think first, act second,"

"Don't try to juggle too many balls at the same time," "An ounce of prevention is worth a pound of cure." Such different truths also permeate the workplace. "Great cases make bad law," lawyers are taught. "Diversify your portfolio" is the watchword among investors. Corporate executives favor succinct mission statements, like IBM's "Think" or GE's "Progress is our most important product." And scientists are counseled, "Always replicate an experiment; and the more surprising the result, the greater the imperative to replicate."

5. *Powerful metaphors, images, and themes.* Individuals may bring concepts to life by invoking metaphors. Darwin described evolution as a branching tree and speciation as a tangled bank; Freud saw the unconscious as the region underneath conscious thought, and the id as the horse that could jerk around the ego-rider; Adam Smith characterized the self-regulatory nature of markets through the image of the invisible hand. Metaphors may be presented graphically as well as verbally. Historian of science Gerald Holton points out that synthesizers often base their key ideas on underlying "themata" of which they themselves may not be consciously aware.[2] For example, both Freud and Darwin saw life as a struggle between deadly opposing forces, while Smith envisioned a harmonious society, based on principles of exchange. Corporations create brands—in words, graphics, and jingles.

6. *Embodiments without words.* So far, my examples have been drawn primarily from academic subjects and from daily life. Powerful syntheses can also be embodied in works of art. Consider Picasso's famed *Guernica*, in which the violent forces of the Spanish Civil War are captured in a single cubist-style mural; Hogarth's evocative *Rake's Progress*,

which chronicles the pathetic dissolution of a libertine; and perhaps the most famous synthesis of all, Michelangelo's illustrations of biblical events on the ceiling of the Sistine Chapel. Syntheses exist as well in other arts: Wagner's *Ring Cycle*, Gaudi's unfinished Sagrada Familia Cathedral in Barcelona, Stravinsky's ballet *Le sacre du printemps*, Martha Graham's modernist re-creations of southwestern Native American rituals, Charlie Chaplin's *Modern Times*, and Ingmar Bergman's *Wild Strawberries* spring to mind.

7. *Theories.* Concepts can be amalgamated into a theory. Darwin's theory of evolution combines the concepts of variation, competition, natural selection, and survival until reproduction; Freud's psychoanalytic theory is built on the concepts of repression, infantile sexuality, free association, and the unconscious. Adam Smith's theory of a market economy weaves together ideas of supply and demand, labor, production, profit, and loss.

8. *Metatheory.* It is possible to propose an overall framework for knowledge, as well as a "theory of theories." Georg Wilhelm Friedrich Hegel portrayed an inexorable universal developmental sequence—hence the "meta"—from thesis to antithesis to synthesis; flipping Hegel on his head, Karl Marx viewed economic/material factors as determinant, with ideas emerging as a superstructure. Thomas Kuhn argued that new scientific paradigms are by definition incommensurate with their predecessors: proponents of the new paradigm must wait until the advocates of the once entrenched paradigm have passed from the scene. Philosopher of knowledge Jean-François Lyotard questions the legitimacy of such overarching theories—with the exception of the metatheory that there are no proper metatheories!

COMPONENTS OF SYNTHESIS

So much for the kinds of mental feats that can be termed "syntheses." The achievement of an effective synthesis—even one far less grand than the famous ones just mentioned—is a considerable feat. At a minimum, any effort to synthesize entails four loosely ordered components:

1. *A goal—a statement or conception of what the synthesizer is trying to achieve.* Examples range from Freud's desire to create a psychology of the mind to Picasso's aim of capturing on canvas the destruction of an entire town.

2. *A starting point—an idea, image, or, indeed, any previous work on which to build.* Darwin began his efforts using earlier evolutionary theories, on the one hand, and his observations on the *Beagle*, on the other. Eliot's *Waste Land* drew on his own earlier poetic renderings of desolation and on many, often obscure, texts in a variety of languages and idioms.

3. *Selection of strategy, method, and approach.* Here is where the synthesizer's disciplinary training comes into play. The synthesizer must choose the format of his ultimate synthesis—for example, one of the eight kinds that I just introduced. Then drawing on tools of his discipline, he must proceed, with predictable fits and starts, toward his goal.

   These tools can range from the logical analysis of the philosopher, to the interpretation of texts by literary critics, to the execution of pilot studies by the biologist, to the maintenance of notebooks, sketchpads, and diaries by the draftsperson or the novelist. In developing a business plan, an executive may consult experts, commission studies, run focus groups of managers or customers. There is no guarantor, of course, that the traditional skills of the trade will prove adequate or even appropriate for the proposed synthesis. And

so the choice of tool must always be tentative, subject to revision or even, on occasion, to wholesale rejection.

4. *Drafts and feedback.* Sooner or later, the synthesizer must take an initial crack at a synthesis: the abstract of the paper, the outline of the lecture or chapter, the model for the building or statue, the beta business plan. This first stab can even be a provisional synthesis in itself. We know from the notebooks of master creators—Picasso, Freud, Darwin, Martha Graham—that first drafts are often primitive and yet may contain the crucial nucleus of the final version. Philosopher Charles Sanders Peirce claimed that these preternaturally shrewd guesses involved a special mental power that he termed "abduction."

To ground this discussion, consider the situation of the newly recruited turnaround executive who announces a concrete goal: a review of what has gone wrong in recent years and a concrete plan for correcting course. That will be her exercise of synthesis. Of course, the executive is well advised to do a lot of listening, watching, studying, and conferring—and to avoid badmouthing her predecessors and her new colleagues. Still, she needs a starting point—the best understanding available of what has happened in the company and the viable options. That, indeed, would *be* her default synthesis had she no time or resources whatsoever. The precious months allow her to devise a strategy for reviewing records, accumulating information from present and past employees and informed observers; testing out various options and scenarios; coming to understand the company, its past, and its current competitive landscape. At a certain point, however, she must stop the input and the reflection and turn her attention to the preparation of the best synthesis that she can muster. If she is fortunate, she will have time for feedback and a number of additional iterations. More often than not, however, the clock will be ticking with increasing impatience and she will have to "satisfice" with her second or third draft.

Of the eight formats outlined, what form is the executive likely to use? The most common form of synthesis is the narrative—a form accessible to almost everyone. Powerful images and metaphors are always welcome. Within the narrative form, the executive is free to use aphorisms, concepts, and taxonomies. To the extent that she can embody her synthesis in her own behavior, that is all to the good. But unless she is dealing with a sophisticated audience (or trying to get tenure at a university), she should steer clear of theories. We need not worry that she will be tempted to produce a metatheory!

With respect to the executive, let me be clear: by no means does her task end when a synthesis has been fashioned. The synthesis is but a first step in turning the company around. At least as important is the development of a strategy, the execution of that strategy, the inevitable correcting of one's course along the way. Indeed, while it may be optional for the rest of us, a strategic mind is a necessity for an executive But the strategy of the executive is far more likely to be effective if it is based on a solid, thoroughly vetted synthesis.

INTERDISCIPLINARY SYNTHESES: THE REWARDS, THE RISKS

Perhaps the most ambitious form of synthesis occurs in *interdisciplinary work.* This phrase should not be invoked lightly. We would not consider an individual to be bilingual unless he or she had mastered more than one language. By the same token, it is inappropriate to characterize work as genuinely interdisciplinary unless it entails the proper combination of at least two disciplines. Moreover, at least in the ideal, the two disciplines should not merely be juxtaposed; they should be genuinely integrated. Such an integration should yield understanding that could not have been achieved solely within either of the parent disciplines.

The term *interdisciplinary* is much bandied about these days. It is worth differentiating two distinct forms. Within the academy, as I've just noted, the term *interdisciplinary* is applied to studies that draw deliberately on at least two scholarly disciplines and seek a synergistic integration. Biochemists combine biological and chemical knowledge; historians of science apply the tools of history to one or more fields of science. In professional life, interdisciplinary is typically applied to a team composed of workers who have different professional training. In a medical setting, an interdisciplinary team might consist of one or more surgeons, anesthesiologists, radiologists, nurses, therapists, and social workers. In a business setting, an interdisciplinary or cross-functional team might feature inventors, designers, marketers, the sales force, and representatives drawn from different levels of management. The cutting-edge interdisciplinary team is sometimes dubbed Skunk Works: members are granted considerable latitude on the assumption that they will exit their habitual silos and engage in the boldest forms of connection making.

Each form of synthesis can be done more or less well. Narratives can be incoherent, jerky, or forced—consider an American history text that ignored Native Americans or perseverated on the Puritan heritage. Taxonomies can be premature or illegitimate—consider the many fruitless efforts to array various metals on the part of gold-seeking alchemists over the centuries. Concepts can be misleading—for example, the psychologist's notion of intelligence ignores artistic and social manifestations of intellect. Metaphors can be deceptive—the domino theory of nations falling one-by-one to communism turned out to be wrong. Theories often fall in the face of uncomfortable facts: communism was "the god that failed," and, counter to Marx's predictions, has survived in the least developed, rather than the most developed, countries. Adam Smith's laissez-faire economics has to be "repaired" through Keynesian interventions on the part of the government. And as I've noted earlier, French philosopher Jean-François Lyotard deems the quest for metatheories to be doomed.

The dangers of inadequate synthesis are perhaps most manifest when it comes to interdisciplinary work. To begin with, much activity in the early years of schooling is misleadingly labeled as "interdisciplinary." Children may well benefit from carrying out evocative classroom projects or from pursuing a unit on generative topics like "patterns" or "water" or the "cradle of civilization." But these endeavors do not involve disciplines in any legitimate sense of that term. In making a diorama or a dance, in thinking of water or cities in a variety of ways, students are drawing on common sense, common experiences, or common terminology and examples. If no single discipline is being applied, then clearly interdisciplinary thinking cannot be at work.

Even when students have begun to master the disciplines singularly, there is no guarantee that a combination of disciplines will be appropriately or productively linked. Courses may well and appropriately involve both history and the arts. One can read about the battles of the Spanish Civil War in a history text *and* one can also look at the painting *Guernica*, or read the novels of André Malraux or Ernest Hemingway, without making any particular effort to link or compare these sources. We might term this approach "disciplinary juxtaposition"—a failure to realize the illumination that may accrue when different perspectives are synergistically joined.

Even when genuine efforts are made to link the disciplines, there is no guarantee that the link will be well motivated or freshly illuminating. If, for example, an individual takes artistic depiction too literally and assumes that the novelist Malraux is a reporter, or that the cubist Picasso is a realistic painter, inappropriate inferences will be drawn. Evolutionary psychology makes a lot of sense when it attempts to explain the different behavioral patterns displayed by males and females in courtship or sexual congress; evolutionary psychology strays when it seeks to explicate historical trends or artistic tastes.

Analogous perils can be observed in the professional and business spheres. Take journalism. Reporters, editors, publishers, members of the audience, and shareholders may all be involved in the same broadcast or print outlet; but there is no guarantee that representatives drawn from these different populations will see things in the same way or that they will be able to work together smoothly. Multinational corporations like 3M, BP, or Sony all employ scientists, human resource personnel, accountants, marketers, and IT specialists; but one can expect problems in communication when these disparate experts are all thrown together on a task force and asked to come up with a design for a new recreation center.

Don't get me wrong. Interdisciplinary investigation is very important, and the best interdisciplinary work is at a distinct premium in our era. Our studies suggest that such work is typically motivated by one of three considerations:

1. *A powerful new concept has been developed, and it is inviting and timely to test the reach of that concept.* For example, in recent years, mathematicians have developed theories of complexity, chaos, and catastrophes. These theories turn out to have important applications—both explanatory and methodological—in the physical sciences. But it is legitimate to question whether instructive instances of complexity can be discerned within other sciences (e.g., biology), social sciences (e.g., economics), and perhaps even in the humanities (e.g., political history, art history).

   A parallel instance exists in the business world—the idea of inexpensive disruptive technologies that aid newcomers while threatening to displace the older, larger, and more complacent players in a sector.[3] It is useful for individuals across the business and professional worlds to become acquainted with this concept. It remains an open question to what extent the concept of disruptive technologies applies to different sectors, to different niches within a sector, and to nonprofit entities like universities or nongovernmental organizations.[4] Moreover, what counts as disruptive in the technological sphere might be quite different from what is actually disruptive in the areas of sales or human resources.

2. *An important phenomenon has emerged, and a full understanding of that phenomenon calls for, or even demands, its contextualization.* In most cases one begins to understand the theory of relativity in terms of constituent concepts from physics and mathematics. A broader and more nuanced understanding of relativity may emerge as one acquires familiarity with the history of science in the late nineteenth century; events occurring in other domains, including challenges to orthodoxy in politics and in the arts; and the particular issues with which Einstein was wrestling, ranging from his reading of classics in the philosophy of science to his daily assignments as a patent officer, which included efforts to ascertain the precise moment when a train was arriving at a distant destination.[5]

   A quite different example emerges from the medical sphere. Tests of genetic screening allow an unambiguous determination of who will be struck by a disease like Huntington's chorea and a probabilistic determination of who is likely to contract various cancers. Assuming that the family has not expressed a preference, the question of whether to share this information and, if so, how, is not one that can be left alone to the geneticist or even to the family physician or minister. Ideally, teams composed of geneticists, genetic therapists, physicians, social workers, religious leaders, and ethicists should weigh in on this decision: and yet, there is no guarantee that individuals with different disciplinary training will—or even should—conceptualize this vexing issue in the same way.

Nor is this example remote from corporate life. Suppose a widely heralded new drug turns out to produce toxic side effects in a very small proportion of the population. Alas, the historical record documents a strong tendency on the part of executives to attempt to hide or sugarcoat this finding. But even in those cases where there is consensus to come clean, strong disagreements may persist among experts concerning the way in which the announcement is made, the manner in which physicians and patients are informed, the preparations surrounding the public announcement, and subsequent changes to be made (or not made) in the company's research, launching, and withdrawal of new drugs.

3. *A pressing problem emerges, and current individual disciplines prove inadequate to solve that problem.* Newspapers are filled with reports on troubling conditions—widespread poverty, the spread of fatal diseases, the pollution of the environment, threats to privacy, the ever looming specter of terrorism—that cry out for solution. Such challenges cannot even be understood, let alone addressed, unless several disciplines and professions can be brought to bear. And so, even when the researcher or policymaker would *prefer* to work within the confines of a single discipline, it soon becomes evident that one needs to call on other disciplines—for example, virology, demography, immunology, behavioral psychology, and social network theory in the case of the spread and treatment of AIDS.

Note that none of these synthesizing efforts arises in a vacuum. In each case, there is a motivating goal; an initial stance taken by the synthesizer; a set of tools or strategies that can be employed; one or more interim syntheses; and at least some criteria by which the success of the synthesis can be evaluated. And to repeat: the synthesis is not the same as a successfully executed strategy, but it may well be the essential point of departure.

PROMISING AND OVERPROMISING SYNTHESES

Syntheses are put forth all the time—for example, most textbooks and many trade books (including this one!) are frank efforts to synthesize knowledge about a possibly unwieldy topic so that it can be assimilated by a target audience. Determining what constitutes an adequate synthesis in abstract terms is not possible; as with the proverbial question "Does a string stretch across a room?" the answer must be contextualized. It turns out that arriving at an adequate synthesis is challenging, and anticipating the criteria for a judgment even more so.

As it happens, two books with similar-sounding titles offer me a chance to tackle these conundrums. In 2003, travel writer Bill Bryson published a book with the grand title *A Short History of Nearly Everything*. In about five hundred pages of richly documented text, Bryson attempts to summarize and illustrate what science has discovered about the physical and human worlds. As he charmingly puts it: "For you to be here now, trillions of drifting atoms had somehow to assemble in an intricate and intriguingly obliging manner to create you. It's an arrangement so specialized and particular that it has never been tried before and will only exist this once."[6]

Bryson begins with discoveries about the cosmos, discussing what we know about the universe, how it began, its various celestial bodies, and our place within that firmament; moves on to geological knowledge about the planet earth, covering its size, its age, and its constituent elements, including the tiniest quantum particles; and then surveys findings about human biology, ranging from the origins of life on the planet to its current efflorescence, from single-cell organisms to the most complex of primates, and from

our own origins as single cells to the ten thousand trillion cells that constitute the adult human body. He concludes with the amusing notion that Isaac Newton's monumental *Principia* appeared at about the time that the dodo bird became extinct. As he puts it: "[Y]ou would be hard pressed, I would submit, to find a better pairing of occurrences to illustrate the divine and felonious nature of the human being—a species of organisms that is capable of unpacking the deepest secrets of the heavens while at the same time pounding into extinction, for no purpose at all, a creature that never did us any harm and wasn't even remotely capable of understanding what we were doing to it as we did it."[7]

Bryson's synthesis works for me. He covers a huge amount of ground but in a way that makes logical sense, and constitutes a good story to boot. Rather than dropping a thousand names or a thousand facts, he presents a handful of fascinating, specific stories in detail, draws the appropriate lessons, and discerns links between them. Always, the big picture of the enormous and the infinitesimal, the remote and the intimate, remains at the forefront. And he never loses sight of himself as the well-meaning but hardly omniscient guide, and us, the readers, as the scientifically half-educated, but eager-to-learn audience. That may be because, according to his own testimony, Bryson was not an expert when he began research for this book. Rather (recalling Dante being chaperoned by Virgil), he was the learner, who wanted to understand enough so that he could share his own synthesis with a new cohort of readers. In my view the gentle teacher succeeds.

I am less buoyed by Ken Wilber's *A Brief History of Everything*. Wilber is widely recognized as an intellectual polymath—a largely self-educated scholar who has mastered vast bodies of knowledge in philosophy, theology, science, and psychology (among many other disciplines) and who strives relentlessly to put them together into one overarching theoretical framework. To the best of my knowledge, he is by far the most ambitious synthesizer at work in the English language and by many yardsticks the most successful.

In various works, including the aforementioned book, Wilber attempts to order all of our knowledge into taxonomies, grids, hierarchies. The frames that he uses include going from the physical to the psychological, from the lowest forms of cognition to the highest planes of consciousness; locating all disciplines in terms of their contributions to his holistic view; grouping together dozens of theorists into an overarching frame; and, above all, trying to relate all of these dimensions to the highest realm, the realm of the spiritual—"where Spirit becomes conscious of itself, awakens to itself, begins to recognize its own true nature."[8] By "the spiritual," Wilber is not referring to a particular religion; indeed, as his admirers insist, he has bridged the Eastern and Western concepts of the spirit. Wilber believes he has discerned a remarkable consensus among thinkers the world over, "whether living today or six thousand years ago, whether from New Mexico in the Far West or from Japan in the Far East."[9]

To convey the somewhat problematic nature of the Wilberian enterprise, it is best to give a few examples from his own writings. Asked about the relation between depth and consciousness, he says, "Consciousness is simply what depth looks like from the inside, from within. So, yes, depth is everywhere, consciousness is everywhere, Spirit is everywhere. And as depth increases, consciousness increasingly awakens, Spirit increasingly unfolds. To say that evolution produces greater depth is simply to say that it unfolds greater consciousness."[10] Explicating his procedure, he reports:

> *I simply started making lists of all of these holarchical maps—conventional and new age, premodern and modern and postmodern—everything from systems theory to the Great Chain of Being, from the Buddhist vijanas to Piaget, Marx, Kohlberg, the Vedantic koshas, Loevinger, Maslow, Lenski, Kabbalah and so on. I had literally hundreds of these things, these maps, spread out on legal pads all over the floor . . . I thought that I might be able to find the single and basic holarchy that they were all trying to represent in their own ways . . . [I]t was very obvious that each holarchy in each group*

was indeed dealing with the same territory but overall we had four different territories so to speak.[11]

Without doubt, this is a noble effort; if Wilber did not attempt it, others surely would. Why, then, am I ungratified, unsatisfied? I think it is because Wilber emerges as the ultimate "lumper." He is always poised to see connections; to join theories, stories, examples together; to accentuate their commonalities; to pinpoint their order in a yet greater order. An example of his compulsion to lump comes from this quotation: "In recent times, cultural evolution has been championed, in various ways, by Jürgen Habermas, Gerald Heard, Michael Murphy, W. G. Runciman, Sisirkumar Ghose, Alastair Taylor, Gerhard Lenski, Jean Houston, Duane Elgin, Jay Earley, Daniel Dennett, Robert Bellah, Erwin Laszlo, Kishore Gandhi, and Jean Gebser, to name a few."[12] Far from being an isolated example, statements of this sort appear dozens if not hundreds of times in his voluminous writings.

"Lumpers" are contrasted with "splitters." Splitters make distinctions, enjoy contrasts, always ask, "Why do these *not* connect? What is the difference, what is the *crucial* distinction?" On a continuum of lumpers to splitters, I fall somewhere in the middle. Yet, confronted by one of Wilber's texts, I feel myself strangely antagonistic to lumping. When everything connects to everything else—in, what Wilber likes to term the Great Chain of Being—then one is hard pressed to make priorities, distinctions, illuminating comparisons. It would be difficult to know how to disprove Wilber, indeed, where to start, where to discern the tensions and struggles that permeate Bryson's text but which are inevitably papered over in Wilber's compulsive search for connective tissue. His effort virtually paralyzes the critical mind.

I admit that my preference of Bryson over Wilber is a matter of taste. And I remain grateful to Wilber for opening my eyes to many literatures and to making a place for my own writings in his own vast scheme. For those committed to lumping, Wilber is a prophet. I fear, however, that his syntheses will make sense only for those who already buy his major premise—his organizing themata—that all can be organized into one giant scheme. It is unlikely to win converts among the skeptical, to gain allegiance among the splitters.

WHY SYNTHESIS IS DIFFICULT BUT POSSIBLE

The mind of the young person is characterized by two powerful but contradictory features. On the one hand, preschool children readily discern connections—indeed, they are forever drawing comparisons. A banana is treated as a cell phone (though rarely is the reverse observed—at least, to this point in cultural history!); a stick doubles as a hobbyhorse; parallel lines on the road are called "zebra stripes"; the past tense of *swim* is assumed to be *swimmed.* Comparisons extend beyond single objects or actions. Listening to a march by John Philip Sousa, a five-year-old may compare it to a train ride; introduced to the concept of separation of powers in the U.S. government, the ten-year-old may envision it as a three-pronged seesaw, with each prong in the ascendancy for a time until a balance has been restored.

Given this proclivity to connect, it is not surprising that young persons attempt to integrate or synthesize. The problem, of course, is that many such connections prove to be superficial or even fundamentally wrong-headed. The term *relativity* has been applied both to Picasso's cubism and to Einstein's physics, but neither phenomenon is illuminated by this superficial coupling. *Swimmed* may generalize a rule, but it is not an acceptable past tense. Seesaws (at least the two-legged versions) may tend toward equilibrium, but branches of government can clash or be overpowered. Absent the relevant disciplines, and a metric for judging appropriateness, the human "connecting" proclivity is charming but hardly sufficient. (Ken Wilber might well disagree!)

By the time of middle childhood, the human connecting impulse has been chastened or corralled. Studies of metaphoric capacity indicate that preschool children are more likely than their older counterparts to produce metaphors—charming ones as well as inappropriate ones. Youngsters age six and above exercise a blue pencil. Searching for the appropriate connection or characterization, they revert to literal similarities, while avoiding ones that may entail inexact or illegitimate connections. To be sure, the capacity for appreciating comparisons remains; and yet, with age, most individuals shy away from proposing fresh comparisons. Only poets seem inoculated against the attenuation of metaphor-making proclivities.

An even more powerful force militates against integration. As I've already noted several times, human beings turn out to be creatures that are quite context- or site-specific. We acquire actions, behaviors, thoughts, skills in one situation, and we may master these. However, as we grow older, most of us become conservative (I note exceptions in the next chapter on creative minds). We maintain those features in the settings in which they have been learned, and perhaps we stretch them a bit. But we are loath to apply skills or concepts widely, let alone promiscuously. Speaking more generally, the mind is organized not as an all-purpose computer; it is more precisely conceptualized as a set of relatively independent modules. Just how or when or why these modules should ever connect remains obscure to many theorists of psychology.

This conservatism may be helpful—or at least neutral—to the teacher of individual disciplines. However, it poses a heavy burden on those who would foster interdisciplinary thought or the effecting of powerful syntheses, let alone original creations. In their English classes, young persons may learn how to write effective prose; but if they fail to transport at least part of those lessons across the hallway to history class or to biology lab assignments, then they have missed an opportunity to link compositional strategies. Adolescents may be exposed to causal reasoning in their physics classes;

but if they draw no lessons about argumentation in history or geometry class, then this form of thinking needs to be retaught. Adults at Corporation A may interact comfortably with those on their team and yet clash sharply with team members from Corporation B, with which their organization has recently merged. It is useful to keep in mind that, as a species, we evolved to survive in distinctive ecological niches; we did not evolve in order to have correct theories, to master disciplines, or to transfer lessons encountered in one setting appropriately to others. The young child overgeneralizes; the older child prefers to resist generalizations even when they may be apt.

Professional training only reinforces these tendencies. As the journalist learns to convey the essence of a story to a lay reader in 150 words, her ability to craft lengthier reports, or to speak to highly trained experts, may wane. Asked to collaborate on a book with a working scientist or historian, the journalist may become quite frustrated. As the physician learns to diagnose disease from reading computer printouts, and as she witnesses dozens of deaths in the emergency room, she may become insensitive to individual human suffering. Teamed up on a complex case with a minister or social worker, the physician may have difficulty in communicating with these experts and may strike family members as being remote. The veteran engineer who hits a home run when asked to find a snag in the electronic circuitry may strike out when required to resolve a conflict or manage a division.

Individuals differ significantly in their predisposition to metaphorize, and in their capacity or inclination to transfer lessons from one class or discipline to another. Aristotle deemed the capacity to create apt metaphors as a sign of genius. The anthropologist Claude Lévi-Strauss contrasts the *bricoleur*—the handyman who tackles a problem by fitting together whatever bric-a-brac happens to be lying around—with the scientist, whose preferred approach is deductive. In my own work, I have distinguished between two intellectual

approaches. *Laser intelligence* probes deeply into a topic but ignores opportunities to cross-pollinate; it's perhaps best suited for disciplinary work. *Searchlight intelligence* may not probe as deeply but is always scanning the environment and may therefore more readily discern connections (and identify differences) across spheres. Both types may synthesize, but the contents that they synthesize and the criteria for success will differ.

The novelist C. P. Snow has written evocatively about these contrasting approaches. Surveying the sciences in the 1920s, he identified biology as an area where a wide, synthesizing mentality was appropriate. At a premium were individuals who were able to take into account findings in many spheres and weave them together in a convincing tapestry. But, says Snow, as expertise accumulates, and as a science takes a mathematical turn, the period for broad synthesis comes to an end. As he laments: "[I]n any science less complete than physics, the more general mind still has its uses, though every day the chances grow less."[13] A premium is placed on individuals who can probe deeper and deeper into a narrow area of scholarship and come up with definitive answers, or decisive refutations. As expertise accrues, the laser replaces the searchlight.

I've observed that two very different kinds of individuals are drawn to interdisciplinary work: those who are curious, well informed, and prone to make well-motivated leaps; and those who spurn orderly linear thinking and are attracted to leaps that may be wild or sloppy. This distinction may be observed at the workplace as well as the classroom. Some executives are gifted with the capacity to take in huge amounts of information but then, in John Gardner's felicitous phrase, are able to "unclutter their minds" and focus on what is truly important.[14] Others leap from one half-baked idea to another, never disciplining their thought, and leaving their employees and outside observers increasingly confused.

One might even speculate that various forms of intelligence gravitate toward different forms of synthesis. With reference to the kinds of synthesis mentioned earlier, perhaps the linguistic mind favors a story; the logical mind, some kind of equation or theory; the spatial mind, a chart or architectonic scheme; the bodily kinesthetic mind, some kind of balance between opposing forces. Should this be the case, the question then arises about whether it is possible to effect a master synthesis among differently shaped integrations—perhaps through one's self-knowledge (in my terms, through the exercise of intrapersonal intelligence). If our hypothetical turnaround executive could achieve such a "synthesis of syntheses," she would be fortunate indeed.

THE EDUCATIONAL CHALLENGE

Can one develop a disciplined mind while at the same time keeping alive the potential for synthetic thinking? In truth, the amount of systematic knowledge about how to inculcate a synthesizing mind—as it were, a "synthesis on synthesizing"—is modest at best. Indeed, if someone were to say, "The best thing is to expose young people to individuals of a synthetic bend, to invite young persons to participate in synthesizing efforts, and to give them regular, useful feedback," I might have to concede that this approach is as likely to succeed as any other.

Still, we should be able to proceed beyond this "toss would-be synthesizers into the bath" advice. Indeed, at each developmental stage, certain experiences and tasks may help induce synthetic thinking. I've already noted the strong, indeed ineluctable, tendency of young children to see, make, and even force connections. This cognitive "polymorphous perversity," if you will, constitutes an invaluable deposit in one's intellectual bank, an investment that can be redeemed at many times and in many ways in the future. Diverse neural networks are being joined; and even if those connections go underground for a while, there is every reason to believe

that they endure and can be drawn on in future years. Celebrate, don't censor or curtail, the connections that are effortlessly effected by the young mind.

Alas, under ordinary circumstances, the synthesizing mind achieves little formal attention during the school years. At first the task of acquiring the basic literacies takes center stage; thereafter, the acquisition of disciplinary, or at least subject matter knowledge, becomes the order of the day. Probably the chief "synthesizing nourishment" absorbed by the mind of the nine-year-old, or the fourteen-year-old, comes from the occasional adult synthesizer who is encountered—or from school or mass media presentations that have an integrating flavor. Wide, though admittedly *undisciplined*, reading of books or surfing of the Web may also prove productive in the long run.

I've already noted the role in schools of projects and theme-related curricula. These are well-intentioned efforts to sustain or buoy the potential for making connections. The problem with these pedagogical interventions is readily stated. In most cases educators fail to invoke explicit standards in judging *which* connections, *which* integrations, *which* syntheses are valid, and in which ways they are (or are not) meritorious. To judge a project, one must invoke criteria that come from the appropriate domain—what makes a good essay, a striking mural, a compelling narrative, an effective trademark, a viable business plan—as well as criteria that suit the subject(s) of the project: is this an accurate description of the rain forest, a proper use of the term *rhythm*, a culturally nuanced portrait of a Chinese or Chilean home?

An explicit identification of the constituents of a good project or a viable solution to a problem provides a useful starting point. Models (both successful and not) are essential here. Only if an educator can identify the dimensions that characterize excellent, adequate, and unacceptable projects or solutions is it reasonable to expect students to advance and to begin to engage in timely self-evaluation.

Explicit instruction about forms of synthesis, such as those introduced at the beginning of this chapter, may also be pertinent. Some students, professionals, or executives may arrive on their own at felicitous metaphors or taxonomies or concepts; but many others will benefit from hints about how to create a useful taxonomy, a powerful metaphor, an enlightening concept, a cogent theory. Powerful syntheses involve blends among scripts, frames, concepts that are usually considered separately; as has been demonstrated with respect to mathematical problem solving, there is an art to creating powerful blends or amalgams. Those individuals who can generate several representations of the same idea or concept are far more likely to come up with potent syntheses than those who are limited to a single, often attenuated representation of that idea. Nowadays, instruction along these lines often takes place under the label of "metaknowledge"—coming to understand the building blocks of knowledge in an explicit way. Alluding to this relatively new enterprise, my colleague David Perkins speaks persuasively of the "knowledge arts."

Of special value are useful and supportive critiques of the synthesis, connection, or integration put forth by the student. During the middle years of childhood, educators must keep open the possibilities of connection making and honor the plurality of appropriate connections; at the same time, educators must also identify those syntheses that are lacking or flawed in one or another dimension. With respect to nearly any problem or project, there are responses that are more or less adequate. Students benefit from exposure to different solutions, different methods of arriving at solutions, and different rubrics for evaluation of those solutions. These interventions are by no means restricted to schoolchildren. One reason that I compared Bryson's and Wilber's "brief histories" was to suggest a set of criteria on which putative syntheses might be judged.

Finally, aspiring synthesizers benefit from explicit instruction on strategies. When persons have had some experience in synthesizing, they should be able to step back and identify the major components:

a specific goal or mission; the stance that the synthesizer is going to assume; the set of tools available for synthesizing; the ways in which to produce and get feedback on interim drafts; and the particular criteria on which success is likely to be judged.

Since I believe that physicians should, at least on occasion, heal themselves, let me apply this recipe to the current chapter. My purpose has been to synthesize the existing knowledge on synthesis in order to inform aspiring synthesizers. The stance has been expository—a social-scientific analysis of why synthesis is important, along with proposals about the kinds of cognitive and motivational processes that are entailed in its achievement. I have addressed educators, professionals, and those in the business world. The tools have been a set of lists, garnished with examples drawn from disparate fields. Examples of more or less successful syntheses have been offered. The criteria for success should be provided by you, the consumer of the synthesis. I would expect that a worthy "synthesis on synthesis" should be clear, at least minimally original, reasonably convincing, and potentially useful.

So far, the examples that I have given could have been pursued at any time in recent centuries. The question arises about the extent to which technological tools will support synthesizing efforts in the future. Already in wide use are search engines that enable the user to track various topics and see how they have been related to one another. In the works are tools that allow one to look at one's own previous notes and ideas and to track how these have evolved over time.[15] To the extent that one can spell out the exact steps involved in synthesis, it should become possible to create software that executes this process as well as or better than most of us. I would not hold my breath, however, for computational aids that achieve what Kant or Leonardo did, using only a writing implement and their own considerable wit.

Test makers are beginning to explore synthesizing capacities. In a paradigm used with teaching candidates in France, the test taker is given the opportunity to study four passages on a topic (say, the historical transition from oracy to literacy); she is then asked to provide a succinct summary of points of agreement and disagreement in the texts, and to propose methods of instruction. In a prototype being developed by the Educational Testing Service, students are given a number of sources relevant to a product (e.g., tools usable by left-handed architects) and asked to summarize the data, evaluate the sources, and provide a rank order of their reliability. In an analogous instrument being developed by the Council for Aid to Education, candidates are given a set of documents about crime in a given county and asked to prepare a briefing paper for a mayoral candidate. While these attempts are driven more by empirical considerations than by any theory of synthesis, they should provide useful information for those of us who would like to understand better the processes whereby we human beings synthesize information for ourselves and others. And to the extent that these attempts prove predictive, they may come to be used by admissions officers, executives, recruiters, and human resource specialists.

MULTIPERSPECTIVALISM: AN INTERMEDIATE STEP

For a time, I maintained that genuine interdisciplinary work should await the mastery of disciplinary work. In the rush toward interdisciplinary gold, one runs a risk of integrations that are premature and, indeed, undisciplined. Given the growing importance of interdisciplinary work, however, and the current presses to encourage it—at least at the rhetorical level!—educators need to make sure that if it were done, it were done as well as possible.

In this context, I find useful the concept of *multiperspectivalism*. While the term may jar, the idea appears to be well motivated. A multiperspectival approach recognizes that different analytic perspectives can contribute to the elucidation of an issue or problem. While full-fledged disciplinary mastery may be an unattainable goal, individuals of most any age or specialization can reasonably be

expected to appreciate the complementary strengths of different perspectives.

Take, for example, a high school course on Nazism. Secondary-school students cannot be expected to be scientific or historical disciplinarians. Neither the disciplinary knowledge nor the disciplinary tools will have been consolidated. Yet, these students are likely to acquire a better understanding of the rise of Nazism if they can appreciate the various perspectives that can be donned: genetic explanation of differences between populations, along with the various pseudoscientific claims made by eugenicists; historical explanation of the long-festering factors that created a fertile soil for Nazi beliefs and practices, as well as the contingent factors that led to the Nazis' surprising, largely lawful takeover of the German governmental apparatus in the early 1930s.

Enter multiperspectivalism. The process begins with a student listening to or monitoring disparate perspectives, such as those of the historian and the geneticist, as each attempts to explicate aspects of Nazism. In ensuing phases, the student is initially able to ask pertinent questions of the experts; next, to understand their answers; and ultimately, to provide answers (or, at least, the *types* of answers) that might be formulated, respectively, by a historian or a geneticist. To be sure, the secondary-school student can rarely contribute original knowledge of a historical or scientific sort. And yet, as one who is coming to appreciate the respective strengths of two or more perspectives, she is in a much stronger position to integrate or synthesize these strands of knowing.

The stance of multiperspectivalism proves especially illuminating at the workplace. It is unreasonable to expect that, thrown together for a time, doctors, nurses, therapists, and social workers should be able to master fully the expertise of the other professional roles. Remember the ten-year rule! By the same token, it is unreasonable to expect that, within a corporate context, the sales, marketing, creative, financial, and managerial types should all be able instantly to speak the same language. But if efforts are made to evolve an adequate pidgin, and if each practitioner at least learns to anticipate the concerns of colleagues from a different background, then the prospect of productive goal-directed teamwork is enhanced.

So far, I've spoken about multiperspectivalism in terms of complementary disciplinary backgrounds. But individuals also bring nondisciplinary perspectives to the table. Many projects are enhanced when individuals of different economic, social, ethnic, and/or racial backgrounds roll up their sleeves and work together to find solutions. Studies document that the opportunity to rub shoulders with individuals from significantly different backgrounds is one of the greatest benefits of life at select undergraduate schools.[16] Of course, sometimes such encounters produce clashes. Depending on how effectively they are handled, the clashes can be productive . . . or they can be disastrous.

And what of genuine interdisciplinary thought? I consider it a relatively rare achievement, one that awaits mastery of at least the central components of two or more disciplines. In nearly all cases, such an achievement is unlikely before an individual has completed advanced studies. Yet, given the import of the issues that require interdisciplinary work, much effort will be devoted in coming years to nurturing of the interdisciplinary mind and to the delineation of experiences at school or the workplace that at least convey the power of interdisciplinary thinking. The Theory of Knowledge course, offered during the final year of the International Baccalaureate, represents one promising effort in this regard. Joint advanced degrees, in journalism and law, or in medicine and management, represent other potentially instructive models.

SYNTHESIZING TRACKS?

In the distant past, a comprehensive synthesizing mind seemed within reach. Knowledge accumulated far more gradually; wise persons like Aristotle and Leonardo had at least a rough grasp of the full

panorama of knowledge. (The nineteenth-century English educator, scholar, and poet Matthew Arnold has been nominated as the last individual who could be said to have mastered all extant knowledge—to put it more colloquially, "to have known everything worth knowing.") While there was little formal inculcation of synthesizing capacities, the undergraduate regimen of liberal arts and the final year of college, in particular, when a capstone course was taught by the president, were seen as periods during which individuals were encouraged to find various connections among the fragments of knowledge that they had been accumulating. Perhaps the *consilience*—the unity of all scientific knowledge—about which biologist E. O. Wilson has admiringly written, is coming to replace the role once assumed by philosophical study.[17]

But we live in a time where our most talented minds know more and more about increasingly narrow spheres. The division of labor that Adam Smith noted in the marketplace of commerce has swept the marketplace of ideas as well. And there is no reason to expect that the drive toward specialization will be stemmed—or even that it would be a good idea to put the brakes on heightened "laser" disciplinary exploration.

I discern two primary antidotes. One involves training the range of individuals so that they can participate effectively in interdisciplinary groups. My sketch of the multidisciplinary or multiperspectival perspective is one possible model. Certainly, training institutions could experiment with structures and processes that foster understanding and cooperation among masters of different disciplines. I would not be surprised to learn of commercial software that promises to enhance synthesizing powers—though I'd ask for a money-back guarantee!

The second antidote entails the creation of educational programs directed specifically at certain individuals of promise—for example, leaders for tomorrow. Chief executives and general managers are expected to be able to see the big picture—to look beyond their own background and specialization; to understand the various components in their organization or constituency; to think systemically about what is working, what is not working, and how goals can be more effectively achieved. Programs that enhance their synthesizing capacities—and that yoke synthesizing and strategizing—would be valuable, and one can expect that various consulting firms will offer such a menu of options. Other individuals—for example, those exhibiting a "searchlight" or "bricoleur" intelligence—might be attracted to such programs as well. They could make use of their enhanced skills even if they do not occupy explicit leadership roles. Perhaps, as educator Vartan Gregorian has suggested, we need a specialization in becoming a generalist.[18] Such a specialization would target promising candidates and devote resources toward the enhancement of synthesizing capacities.

Neither of these interventions is likely to be effective, however, unless two conditions prevail. On the one hand, we need role models—individuals who are themselves gifted at multiperspectivalism, interdisciplinarity, and/or synthesizing. In recent years, Jacob Bronowski, Stephen Jay Gould, and E. O. Wilson have elegantly filled that role in biology; in the sphere of management, Andy Grove at Intel, John Browne at BP, John Reed at Citicorp, and Bill Gates at Microsoft are often cited as examples of individuals with wide knowledge and admirable synthesizing or integrating capacities. Bill Clinton, an outstanding synthesizer, recently reflected on this capacity: "I think intellect is a good thing unless it paralyzes your ability to make decisions because you see too much complexity. Presidents need to have what I would call a synthesizing intelligence."[19]

But along with exemplary paragons, we also need criteria that establish the differences between excellent, adequate, and inappropriate integrations. And we must accept that these criteria are mission- or topic-specific. What counts as a good synthesis in evolutionary biology may differ markedly from an integration that is appropriate for the arts or commerce. A synthesis suitable for determining the limits

of complexity theory may bear little resemblance to a synthesis adequate for addressing the eradication of poverty or the control of the AIDS epidemic.

Some syntheses will be straightforward; some will involve a stretch of one sort or another; perhaps the most precious ones involve a creative leap. To the cultivation of the creative mind, we now turn.

CHAPTER 4

The Creating Mind

IN OUR GLOBAL, wired society, creativity is sought after, cultivated, praised. Corporate visionary John Seely Brown has quipped that, in the world of tomorrow, people will say, "I create; therefore I am." When I give talks about intelligence, I am routinely asked about how to nurture creativity. Audiences expect that I will fully endorse creativity and hope that I will (for all time and without charging!) reveal the secret of its attainment.

It was not always so. In most human societies, throughout most of human history, creativity was neither sought after nor rewarded. Just as human beings have a conservative bent, one that militates against educational innovation and interdisciplinary leaps, human societies also strive to maintain their current form. We are stunned by the achievements of ancient Egyptian society but conveniently forget that the society evolved at a glacial pace. We honor innovative scientists like Galilei Galileo but need to be reminded that Galileo was denounced and imprisoned and that Giordano Bruno, his scientific forefather, was burned at the stake. Neither Johann Sebastian Bach nor Vincent van Gogh nor Gregor Mendel received

much appreciation during their lifetimes—and Freud, Darwin, and Keynes received their share of ridicule (more than their share, they might insist!).

In the past, creative individuals in a society were at best a mixed blessing—disdained, discouraged, even destroyed at the time of their breakthroughs, possibly to be honored by posterity at some later point. Our time, our era is different. Almost every task that can be routinized will be, probably sooner rather than later. (Perhaps in fifty years' time, a book like this will be written—and perhaps read as well for pleasure or self-improvement—by a quantum computer.) Virtually all innovation can be communicated almost instantly the world over, available to be built on by anyone with the requisite disciplinary skills, understanding, and motivation. And while most innovations will have a short half-life, those that address a pressing need or fulfill a genuine ardor will spread very quickly and last long. In the technological realm, think of the rapid successes of the telephone, the automobile, the airplane; and in more recent years, the personal computer, the videogame, the Internet, the cell phone, the iPod, the BlackBerry. Think as well of the rise of fast foods, the spread of fashion sneakers, the veneration of pop stars Elvis or Madonna, Brad or Angelina (no last names necessary in 2006!). Those corporations that do not embrace innovation will almost inevitably be muscled out by those that do. Indeed, insufficient attention to innovation may be the principal reason that many of the leading American corporations of fifty years ago (think Sears Roebuck, American Motors, Pan American Airlines, Westinghouse) have either shrunk in size or gone out of business altogether.

CREATIVITY RECONCEPTUALIZED

Viewed most broadly, creation is part and parcel of the fabric of the world. While many of us no longer believe literally in the biblical

story of creation, we recognize that the world is populated by living creatures and living creations, each at least a bit different from the rest. By definition, all human artifacts are initially created by someone. Whether when one thinks of biological or artifactual or conceptual entities, the most appealing "mutants" are most likely to survive and propagate.

Early views of creativity stressed either the role of the divine, or the roll of the dice. Those who formulated theories of creation favored the notion that certain individuals were touched with mysterious inspiration, though occasional iconoclasts (like American poet Edgar Allan Poe) claimed that human creation proceeded according to a strict, explicable, logical formula. Within psychology, views of creativity tended to follow views of intelligence—by a lag of about fifty years. Until recently, creativity has been seen by psychologists as a trait of certain individuals; as such, it should be measurable through paper-and-pencil tests; and an individual deemed "creative" should be able to evince that trait across various performance domains. In the prototypical item on a creativity test, subjects are asked to think of as many uses as possible for a paper clip, or to give an imaginative title to a squiggle, or to choose the target that can be associated with two supplied words (mouse-cottage: both can be linked to cheese). The final tally received on such a measure is believed to reflect creative potential in any domain of knowledge.

This way of thinking about creativity migrated to the world of business. Perhaps the chief guru has been Edward de Bono, the polymath from Malta. De Bono has emphasized the importance of *lateral thinking*—the capacity to shift frameworks, wear different hats, come up with a plethora of ingenious solutions to a nagging dilemma.[1] De Bono deserves credit for highlighting the importance of thinking about thinking—"metathinking" if you will—and for coming up with any number of intriguing problems and offbeat solutions. Yet, his perspective on creativity as a generalizable capacity that can be quickly boosted has distinct limitations.

news: because there is no statute of limitations, you can never know for sure that you have *not* been creative!

FROM COMPUTATION TO CHARACTER

Clearly, the aspiring creator needs a generous supply of intelligence(s), skill, and discipline. Shakespeare was a genius in language and equally brilliant in his understanding of the human condition; the trajectory of growth from his earliest writings to his most mature plays is stunning. Still, that trajectory spans a twenty-year period. Mozart had remarkable musical gifts from early childhood. Even so, the works from his first decade of composing (up to age fifteen!) are mostly curiosities. But by late adolescence, he had already become a world-class composer. John Maynard Keynes was recognized early for his prodigious mind; yet he did not publish his masterwork, *The General Theory of Employment, Interest, and Money*, until he was in his early fifties.[3]

For every talented writer or composer who breaks new ground, however, hundreds are content—or resigned—to be "mere" experts. An expert is an individual who, after a decade or more of training, has reached the pinnacle of current practice in her chosen domain. The world depends on experts. And, indeed, when it comes to surgery or airplane flight or bookkeeping, we are well advised to consult an expert and to be leery of the innovator.

How, then, does the creator differ from the expert? In my view, the difference is not principally cognitive, at least not cognitive in the usual sense of the term. Tested on mastery of a domain, both kinds of individuals should perform equally well. (During his time, few believed that Mozart was a more talented composer than Karl Ditters von Dittersdorf, or the more infamous—if less euphonious—Antonio Salieri.) Intriguingly, prodigies in a domain rarely

turn out to be creators. Since early childhood prodigies have been rewarded for doing precisely what the adults in their domain were doing; and so it requires a remaking of self—a sharp change in goals, orientation, and motivation—to set off in new, uncharted directions. A wit said of Camille Saint-Saëns, an aging musical prodigy who never fully realized his early promise: "He has everything but he lacks inexperience."

The creator stands out in terms of temperament, personality, and stance. She is perennially dissatisfied with current work, current standards, current questions, current answers. She strikes out in unfamiliar directions and enjoys—or at least accepts—being different from the pack. When an anomaly arises (an unfamiliar musical chord, an unexpected experimental result, a spike or dip in the sale of goods in an unfamiliar territory), she does not shrink from that unexpected wrinkle: indeed, she wants to understand it and to determine whether it constitutes a trivial error, an unrepeatable fluke, or an important but hitherto unknown truth. She is tough skinned and robust. There is a reason why so many famous creators hated or dropped out of school—they did not like marching to someone else's tune (and, in turn, the authorities disliked their idiosyncratic marching patterns).

All of us fail, and—because they are bold and ambitious—creators fail the most frequently and, often, the most dramatically. Only a person who is willing to pick herself up and "try and try again" is likely to forge creative achievements. And even when an achievement has been endorsed by the field, the prototypical creator rarely rests on her laurels; instead, she proceeds along a new, untested path, fully ready to risk failure time and again in return for the opportunity to make another, different mark. Creative activity harbors more than its share of heartaches; but the "flow" that accompanies a fresh insight, a breakthrough work, or a genuine invention can be addictive.

EDUCATING THE CREATOR ACROSS THE AGE SPAN

From these formulations, an educational regimen follows. It deviates from the trajectory of the disciplinarian approach, though it bears similarities to the emergence of the synthesizer. An individual on a strict disciplinary track masters the key literacies; as soon as practical, she commences a regular and systematic mastery of disciplines like mathematics, science, and history. She will presumably become an expert in short order (read: a decade). But too strict an adherence to a disciplinary track operates against the more open stances of the synthesizer or the creator. Options need to be kept open—a straight trajectory is less effective than one entailing numerous bypaths, and even a few disappointing but instructive cul-de-sacs.

Members of one age group need little pressure to assume the creative stance—young children before the age of formal schooling. Given even a modestly supportive environment, youngsters are not only intrigued by a wide range of phenomena, experiences, topics, and questions; they persist in exploring, even in the absence of encouragement, let alone material rewards. Few are the children who are not galvanized by a trip to a county fair, an amusement park, or a children's museum; their playfulness, curiosity, and imaginative powers are palpable. The mind of the five-year-old represents, in one sense, the height of creative powers.

Accordingly, the challenge to the educator is to keep alive the mind and the sensibility of the young child. Artists and scientists have always known this: Pablo Picasso famously declared, "I used to draw like Raphael; it has taken me my whole life to learn to draw like a child."[4] With equal conviction (and equal quotability), Isaac Newton reflected, "To myself, I seem to have been only like a boy playing on the seashore and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary while the great ocean of truth lay all undiscovered before me."

But how to retain a childlike sensibility—what embryologists term *neoteny*—throughout life? So much depends on the messages that exist outside the walls of the school and, for that matter, within the classrooms that serve the mass of children. This point was brought home to me sharply during the 1980s, when I made a number of trips to China and visited dozens of classrooms in several cities.[5] At the time, China was still traumatized by the disastrous Cultural Revolution (1966–1976), and considerable fearfulness gripped the populace. In just about every area of competence, teachers clung to a depressingly constrained notion of what it meant to be an excellent student. From a very early age, young children's behavior was strictly molded along a path designed to yield the expert calligrapher, musician, dancer, mathematician, and the like. Deviations from the disciplinary prototype were strongly discouraged—step-by-step, error-free learning was the preferred route. In a society like China circa 1980, models and experiences of a more open-ended, more creative sort were rare. And so, in addressing Chinese colleagues, I would have encouraged—indeed, I *did* encourage—a regimen that featured exploration, challenging problems, and the tolerance, if not the active encouragement, of productive mistakes.

At the time, China and the United States represented polar opposites. On the street, messages of creativity were rampant in the United States of the go-go eighties—in business, the media, technology, the arts. Everyone wanted to be creative: too many persons believed that they *were* creative, even though they had scarcely begun to master a domain, and even though no expert in the field would have judged them as creative. In schools (and in after-school sites), the compelling need was for the achievement of genuine mastery of a recognized discipline: not only was there no need for educators to wave the flag of creativity; it might even have been counterproductive to do so. Only through the honing of discipline would genuinely creative options ultimately emerge.

Today, of course, China and the United States have moved toward one another, and both are probably more representative of the patterns found around the rest of the globe. There are lots of models of creativity on the streets of major Chinese cities (not to mention Internet links that constantly defy the censors); moreover, due to the influence of economically successful societies in East Asia, the curriculum has become a bit more receptive to the arts, choice, the posing of open-ended questions, and the acceptance of a variety of responses to those questions. (Note, however, that the sinological pendulum of permissiveness continues to swing back and forth, as it has for centuries.) In contrast, in the United States of the early twenty-first century, the messages for creativity endure on the streets, but schools have taken a sharply conservative turn. The United States has moved toward uniform curricula, tests, and standards, while progressively tinted education (which I personally favor) is on the defensive.

Accordingly, a generic formula can be put forth for the nurturing of creating minds in the first decades of life. Following a period of open, untrammeled exploration in early childhood, it is indeed appropriate to master literacies and the disciplines. However, even during periods of drill, it is vital to keep open alternative possibilities and to foreground the option of unfettered exploration. Sluices of creativity can be maintained by exhibiting different, equally viable solutions to a single posed problem; exposing youngsters to attractive, creative persons who model both the approach and the experiences of the creative life; and introducing new pursuits that are removed from the academic treadmill and that reward innovation and look benignly on errors. (As Internet guru Esther Dyson quips, "Make *new* mistakes!") More concretely, in the years of middle childhood, parents should make sure that their children pursue hobbies or activities that do not feature a single right answer. Teachers ought to illustrate the several ways in which a particular math problem can properly be solved or a literary passage can be interpreted; they ought to facilitate classroom visits by charismatic inventors and artists who have gone their own way and achieved success; they ought to encourage youngsters to play games drawn from other cultures or to invent new games on the playground or on the computer.

As I pointed out in my discussion of the synthesizing mind, it is advantageous to develop multiple, diverse representations of the same entity—be it arithmetic multiplication, the nature of political revolution, the current competitive landscape in one's business, the topography of one's hometown, the contours of one's own life. Such multiple representations are grist for new ways of thinking about an entity, problem, or question: they catalyze creative questions and spawn creative solutions. How much more likely is the ten-year-old to make money in her neighborhood if she thinks about a variety of needs, products, and modes of exchange.

As students enter adolescence, they become capable of envisioning possibilities that are quite different from—and may, indeed, invert—their current realities. (I am not speaking here about devouring the *Harry Potter* series; I am alluding to the capacity to appreciate how certain givens in one's own society—say, the legal system—could be fundamentally transformed.) Especially in those settings where such envisioning has not been encouraged, elders have a responsibility to introduce instances and systems that operate according to different rules—utopias, dystopias, alternative numerical systems, counterfactual historical accounts, competing economic systems, and the like. The adolescent mind can take it from there.

If the mind of the young child is charmingly uncritical, the mind of the adolescent is often overly critical—of self and of other. Such hypercriticism can thwart creative efforts. No less than creative faculties, critical faculties need to be honed. In part, this process can be launched in the preadolescent years, when criticism may not sting so sharply. During adolescence and thereafter, students need to be posed challenges where they stand a reasonable

chance of success; they should practice giving and receiving criticism that is constructive; they should learn which criticisms are worth attending to and which are better ignored. Only a masochist craves criticism; but the rest of us must learn to deal with it and, as much as possible, to internalize and anticipate criticism, so that we may ultimately become our first and our sharpest critics. Often, I have observed, these dispositions are developed more readily in art classes than in the standard college-prep curriculum. The disappearance of the arts from many curricula may have unintended negative consequences.

In some domains, like mathematics, chess, and lyric poetry, the heights of creativity tend to be reached early in the adult years. In others, the developmental path to mastery is much longer, but perhaps in compensation, achievements continue to be possible for decades. Philosophers, historians, musical conductors, diplomats, religious leaders, and psychoanalysts go on and on and on. The same can be said of some business leaders—in the year 2006, octogenarians Sumner Redstone and Sidney Harman, and septuagenarians Warren Buffet and Rupert Murdoch come to mind. Those who make fundamental discoveries early in life must somehow retain or regain their early innocence; metaphorically speaking, they must remain youths. Freud once observed, "When I was young, ideas came to me; as I age, I must go halfway to meet them." As the average life span increases, creators (and the societies that value them) will search for new ways—perhaps psychological, perhaps physiological—to retain youthful minds and to catalyze irreverent stances.

What of the fostering of creativity at the workplace? Nowadays, few workplaces worthy of the name would do anything but proclaim themselves as cradles of creativity. Nor do I deny their avowed intentions. But as psychologist Teresa Amabile has amply demonstrated, too many corporations do not have the courage of their convictions.[6] In ways large and small, they signal that too much originality—be it in dress, political views, or business sagacity—is taboo: too expensive, too risky, too divisive. Conventionality is rewarded; deviants are marginalized or fired. Yet other businesses "solve" the problem by spinning off creativity—relegating it to Skunk Works, or allowing only the most recently acquired divisions to march to their own drummer. Experience shows that this divide-and-conquer strategy rarely lasts—if creativity does not infiltrate the DNA of an organization, it is unlikely to be passed on to the next generation. Of course, inappropriate creativity in accounting and financing can be suicidal, as Arthur Andersen and Enron learned shortly after the turn of the century.[7]

The incorporation of creative DNA has occurred over the decades in a few model companies such as 3M. This admired company fills its senior ranks with individuals who are proven creators. Promotions and rewards are offered to individuals who come up with new ideas. The leadership team works closely with "early adapters" and "ingenious users," tapping their ideas and giving them commensurate rewards. Management gives a lot of slack to those who think outside the box. Executives realize at a deep level that creativity is a chancy undertaking that can never be guaranteed—only fostered or thwarted.

Another company obsessed with innovation is General Electric. Under the legendary leadership of Jack Welch, GE went into a whole variety of new businesses and implemented radical methods for promoting the most outstanding product lines and individuals while excising those that did not assume leadership positions. Welch's successor, Jeffrey Immelt, realizes that the next generation of innovation must take place chiefly within the current portfolio of GE holdings.[8] Accordingly, he is leading a search for themes like eco-imagination that cut across the entire company, and for "enterprise" sales approaches that offer a suite of goods and services to an institution, like a hospital, or to a blockbuster event, like the Olympics. Immelt has also set aside $1 billion a year for R&D. He hopes for a thousand breakthrough ideas rather than a hundred,

with a special premium on those ideas that can find resonance in different sections of this multi-industry, multinational corporation.

Occasionally, a wholly new form of business is created. Before the age of the Internet, commerce generally took place face-to-face or through well-established intermediaries, like shopping catalogs or purchasing agents. Once it became possible for any two individuals or entities to be in touch with one another instantaneously, to interact at will for as many volleys as necessary, and to have access to essentially infinite amounts of relevant information, new options opened up. Especially in a nation like the United States, which is friendly to entrepreneurship and recently has had available generous dollops of venture capital, many hundreds of new businesses emerged, each trying in its own, often secretive, way to take advantage of the potentials of the new medium. The United States of the late 1990s was a hotbed of creativity in action.

Then came a bitter shakedown in the period 2000–2001, and suddenly most of those businesses—several thousand by one estimate—were no more. And quite a few others that had been touted as the waves of the future were either diminished in scope (like Priceline) or found themselves reverting to their central, more traditional business core (like Cisco).

It is by no means clear that, in 1995 or even 2000, one could have predicted which of the Internet-based businesses would be riding high in the middle of the first decade of the new millennium. Amazon, Google, and eBay have each had their ups and downs. Yet, at least in retrospect, one can see how each succeeded in identifying a fundamental human desire and in using the Internet ingeniously to fill that need—in present terms, how they identified a crucial domain and created a receptive field.

Starting with the sale of publications, and moving into all manners of goods and services, Amazon made it easy to buy these products while seated at the computer and provided all kinds of user-based feedback to aid in making one's purchase. Amazon knows which

books I would like to own as well as do my friends and families; and it tells the world what other people think of books I have written, even when I'd prefer if the site were to exercise the delete option.

Google responds to the human desire to get information as quickly and reliably as possible—and for free! One need only type in the information that is needed, and a huge number of relevant resources are placed at one's disposable. Initially, sources were ordered strictly in terms of frequency of use, but now Google experts are employing more nuanced measures of quality. On the horizon are plans to digitize all books ever written and to use computer programs that understand requests well enough to be able to provide meaningful responses. Graders of term papers, beware!

EBay is the ultimate shopper's paradise: an electronic bazaar where one can purchase just about anything, or sell just about anything; the user has the ability to make bids, accept them, or reject them. The procedures devised to consummate the purchase are efficient, reliable, and trustworthy. And one can ascertain the reliability of the person—though not, revealingly, the person's real name—with whom one is dealing, because users grade the performance of other users. EBay has also accomplished the considerable feat of creating a community—all over the world, users of eBay feel a bond to one another. And while the handlers of eBay are inclined toward hyperbole on the subject, it is fair to say that the community exhibits a generous amount of self-governance. EBay has created an impressive blend of market-driven mechanisms and democratic procedures. Its openness stands in sharp contrast to the obsessive secrecy that led to the rise of Enron and to Enron's ultimate undoing.

To be sure, generating the creative idea is only part of the story. All sorts of things can go wrong in proceeding from novel idea to effective business. Each of the aforementioned companies has had or acquired skilled management, and each has been willing to make difficult choices and sharp changes of direction when circumstances dictated those moves. Each has also been involved in expensive

litigation, sometimes against other creators of the Internet landscape. Each is ever on the lookout for ways of expanding its business: as leading success stories of the Internet age, each has the license to broaden its ambit of operation and to challenge its chief competitor on its home turf. Each promotes creativity in its employees and its users: Google, for example, gives employees a day a week to work on projects that are not directly linked to revenue. And, finally, each is ever alert to the next, so-called killer application that could threaten to undermine its hegemony in the marketplace—maybe even before you have read these lines! Creative breakthroughs do not last forever.

CREATIVITY BY GROUPS, LARGE AND SMALL

Except in the area of business, most studies of creativity, and most students of creativity, have focused on the minds, the methods, and the motivations of the individual creator. This bias reflects the interest of psychologists, on the one hand, and the romance associated with individual inventive personalities, on the other. Creativity by dyads, trios, or larger groups is seen as anomalous, or simply as the sum of the capacities of the individual members of these groups.

The limits of this focus on the individual are becoming clear. In the sciences—be it particle physics or genomics—a great deal of the most important work is carried on by huge teams, often numbering many hundreds. Artistic productions on the stage or on the screen also involve large ensembles of personalities, often creative, often prickly, often clashing. In the period of mass media, the potential of a work to appeal to millions of persons is at a premium; and sometimes the plug is pulled on a huge work involving representatives of several arts and crafts, if early signs suggest that it will fail to appeal to a sufficiently wide audience. In the area of management consultancy, teams swoop down on a company in crisis, trouble-shoot, and then issue their report and their recommendations. I call these kinds of

collaborations "Hollywood-style"; large numbers of persons, often unknown to one another, must come together over brief periods of time, make the necessary connections, and trust one another to complete the job efficiently and move on to the next assignment—be it making a movie sequel or advising another corporation.

Yet another form of group creativity has recently coalesced—the wisdom of crowds. We see this phenomenon at work in the Google sources that are most popular, the Amazon books that are recommended, the eBay sellers who are most trusted. Open source programming, where dozens of individuals may make contributions to a computer program, is another, often touted instance. Perhaps the clearest—and one of the most controversial—examples is Wikipedia. This twist on the traditional encyclopedia features entries that are originally posted by one or more authors, and then subjected to as many rewrites—and, one hopes, as many improvements—as there are individuals prepared to spend time researching the topic and contributing new verbiage.

The question arises about whether ideas about creativity need to be refashioned to take into account the increasing number of projects and realms where the individual contribution seems less critical, the group mind more crucial. Clearly, the abilities to come to know individuals quickly, to forge a working relationship, to handle issues of conflict and credit, take on added importance. Brainstorming and improvisation come to the fore; personal glory recedes in importance.

My own take on this issue involves a recognition of a continuum. At one end of the continuum, one finds a deep societal issue like the causes of poverty or the pervasiveness of racism, one not open to ready formulation or solution. Solutions offered by the public at large are unlikely to be helpful. In contrast, at the other end of the continuum are issues that reflect the wishes or interest of a particular cohort or of the community at large: in such cases, contributions on the part of many heterogeneous individuals may well

be the preferred route. We can apply this metric to encyclopedias: if we want to know about the appeal of Elvis Presley or *American Idol*, we might turn to Wikipedia; if we want to understand Kant's contributions, we are better advised to read a contribution by a recognized authority in the *Britannica*.

I can add a personal example. Several times in my life, Harvard University has selected a president. When it comes to arriving at a short list, the wisdom of the crowd will be superior to that of any individual nominator. When, however, a decision about the final choice is due, majority vote is no substitute for consulted judgment and wisdom on the part of the most knowledgeable insiders—and the most knowledgeable outsiders.

Even at the "deep problem" end of the continuum, options exist. Some problems and projects are handled better by a small group of individuals who know one another well and who work together regularly over a long period of time. Such shop talk happens in established scientific laboratories, repertory companies, string quartets. Other problems and projects can be handled equally well by groups that are brought together on an *ad hoc* basis: the latter option permits the commissioning of individuals who have the precise talent that is needed, fosters diverse views, and militates against groupthink or falling into a rut.

CREATIVITY GONE AWRY

Of course, the risk of "dangerous" or "feigned" or "false" creativity always lurks in the background. Enron proclaimed itself one of the most innovative companies in the world. And indeed, what Enron purported to do in the 1990s—to deal with futures in the gas industry, to place orders and trade on the Internet, to oversee the privatization of power in many developing nations—represented uncharted pathways in the energy industry. The problem, we all now know, was

that much of the so-called creativity was pseudocreativity—based on false estimates, hopes rather than data, and good (correction: bad) old-fashioned criminality.

Nor is the realm of science immune from false instances of creativity or, if you prefer, instances of false creativity. Take the realm of the physical sciences. In the seventeenth and eighteenth centuries, the conventional wisdom stipulated that substances burned because they contained an element called "phlogiston," a tasteless, colorless substance that was given off during the process of burning until the substance was "dephlogisticated." But phlogiston turned out to be an invention of chemists who were trying to account for a process that they did not understand. Thanks to investigations by Antoine Lavoisier, scientists came to appreciate that combustion occurred when substances (like a fuel) combined with oxygen and reached a certain temperature.

A similar unmasking occurred one hundred years ago. Throughout the nineteenth century, physicists posited a medium called "the ether," through which all manner of light and heat waves were thought to pass. It was left to the experiments of Albert Michelson and Edward Morley, and the theoretical acumen of Albert Einstein, to prove that—like phlogiston—the ether did not exist. Any model of the universe that it implied was superfluous.

Not just our ancestors can be seriously mistaken. One of the most notable claims in recent decades was the highly touted discovery of cold fusion. On March 23, 1989, at a hastily called news conference, Stanley Pons and Martin Fleischmann, two well-known physicists at the University of Utah, announced that they had achieved a remarkable feat. At room temperature, they had compressed heavy atoms of hydrogen inside cold fusion cells: the cells consisted of two metal electrodes, one palladium and one platinum, dipped in a jar of heavy water spiked with lithium salt and connected to a moderate electrode current. The resulting fusion supposedly released a huge amount of energy, an amount that had previously been associated

only with "hot" nuclear reactions at very high temperatures. According to the press release issued at the time, "[T]wo scientists have successfully created a sustained nuclear fusion reaction at room temperature in a chemistry laboratory at the University of Utah. The breakthrough means the world may someday rely on fusion for a clean, virtually inexhaustible source of energy."[9]

This announcement, relayed immediately by the media throughout the world, caused a sensation. The *Wall Street Journal* declared that "scientists working at the University of Utah made an unprecedented claim to have achieved a sustained hydrogen fusion reaction, thereby harnessing in the laboratory the fusion power of the hydrogen bomb. The two scientists said that with no more equipment than might be used in freshman chemistry class, they had triggered a fusion reaction in a test tube that continued for more than 100 hours."[10] It appeared as if essentially unlimited amount of cheap, safe, and clean energy could become available through a simple electrochemical process. Were this claim true, the need for fossil fuels, and the search for hitherto untapped energy sources like those from the sea or the sun, would be unnecessary. A consumer's paradise, at long last.

What happened in the ensuing months was instructive, especially for students of the creative process. Large amounts of governmental and private money were channeled into this line of research, both in the United States and abroad. A smattering of laboratories claimed that they had achieved similar demonstrations. This group, representatives of which persist to this day, might be considered "true believers." However, an ever larger proportion of the scientific community concluded that the claims of cold fusion were simply false. A few experts rejected the claims *a priori*—out of hand—indicating that the alleged findings flew in the face of our well-established understandings of how matter works. Several other leading experimentalists attempted unsuccessfully to replicate the results and became skeptical of the claims *a posteriori*.

Any claim to be creative occurs within a domain—traditional or newly constituted—and the criteria for ascertaining creativity are

critical in rendering a judgment. Pons and Fleischmann were scientists, and their mettle came under severe attack. On scrutiny it emerged that their experiments had not been carried out carefully; the data had been reported incompletely and sloppily; obvious control conditions had not been instituted; indeed, the investigators had made their announcement prematurely, because they were afraid of being scooped by rival scientists at nearby Brigham Young University. Pushed for more details about their studies, so that others could understand and attempt to replicate their results, the two scholars became defensive and offensive. Perhaps most damning, they did not even offer a convincing explanation of *why* they had obtained the results that they claimed to have obtained. Science evolved—or degenerated—into politics. The phenomenon of cold fusion slowly went the way of phlogiston and the ether. Creativity gave way to sleight of hand.

A number of books have been written about the cold fusion episode.[11] Most are critical, though a few still see hope in the line of work pioneered—or perhaps better, popularized—by Pons and Fleischmann. I see the episode as a trademark example of creativity undermined by lack of discipline. Pons and Fleischmann were acknowledged scientists, well respected in their field. I am willing to give them the benefit of the doubt and to grant that their search for cold fusion was motivated by scientific curiosity and that their initial results were sufficiently promising to warrant further investigation.

Once they felt they were on to something of societal significance, however, the Utah researchers lost perspective. Rather than retaining the skepticism of scientists, rather than listening to the doubts that were raised by colleagues (some of whom were initially quite sympathetic to Pons and Fleishmann), the two scientists forgot the core values of their discipline: a search for the way that things actually operate, a respect for the peer review process, a willingness to share methods and findings, a humility that allows one to say that one was mistaken, that one had misinterpreted or overinterpreted the data. In our terms, they forgot about the domain in

which they were working, ignored input from the relevant field, and tried to create a new field of naive boosters. Their failure ruined careers of university administrators, discredited young scientists in their own and in other errant laboratories, and, not least, undermined their own professional standing.

One might object that Pons and Fleischmann were creative but just had the bad luck to be wrong. I disagree. While anything goes in the generation of new ideas, the would-be creator has an obligation to be scrupulous in the completion and validation of work. Undisciplined creativity is creativity undermined. Even if Pons and Fleischmann should prove one day to have been correct in their hypotheses, they should not receive credit for the creative breakthrough. As for the proponents of phlogiston and the ether, it is probably better not to judge them in terms of their fidelity to unnecessary constructs, but rather in terms of their positive contributions, if any, to the science of their time.

CREATING AND SYNTHESIZING

Evidently, parallels abound between the synthesizing and the creating minds. To begin with, both require a baseline of literacy and discipline. Both benefit from the provision of multiple examples, exposure to multiple role models, and the construction of multiple representations of the same general topic. Indeed, no sharp line separates synthesis from creation. Some of the best creations emerge from attempts at synthesis (or synthesis gone awry); and, particularly among experts in training or scholars at the end of their active careers, a synthesis may represent a considerable creative achievement.

Yet, the impulses behind these two mental stances are distinctive. The synthesizer's goal is to place what has already been established in as useful and illuminating a form as possible. The creator's goal, on the other hand, is to extend knowledge, to ruffle the contours of a genre, to guide a set of practices along new and hitherto

unanticipated directions. The synthesizer seeks order, equilibrium, closure; the creator is motivated by uncertainty, surprise, continual challenge, and disequilibrium. We may appropriate a famous distinction put forth by Friedrich Nietzsche. The synthesizer is Apollonian; possessed of a restrained temperament, she proceeds in a harmonious, balanced fashion. In contrast, the creator is Dionysian; of a tempestuous nature, she is poised to wrestle with the gods.

No society can be composed solely of creators; they are by nature destabilizing. History suggests that the "hotter" the creative center, the more rapidly it is likely to spend or extinguish itself. In 1900, Vienna was a center of creative thought; 50 or 100 years later, it would not appear on anyone's list. Yet there is little question that, for the foreseeable future, those societies that know how to nurture and sustain creativity—of both the little-*c* and the big-*C* varieties—are more likely to thrive than those that discourage creativity or those that are restricted to copying what genuine innovators have already achieved and what their successors are likely to surpass tomorrow.

How does the relation between synthesizing and creating play itself out in different settings? In the world of scholarship, it is expected that individuals will have achieved skill in synthesis before they venture into new arenas. At the graduate school where I teach, for example, one often writes a literature review as a qualifying paper; then, once the lit review has passed, one is allowed to write a dissertation, which (unlike the review) is assumed to be an original contribution to the same subdomain. Still, it is clear that certain experts in the making have the creative urge, while many others do not, or are ambivalent about stepping out on a limb. In the arts nowadays, synthesis plays a smaller role than it did in times past. Bach and Mozart saw themselves as masters of a tradition; John Cage and Igor Stravinsky saw tradition as something to be overthrown. Sheer novelty itself is often honored, though perhaps more in the short run than over the long haul. In corporate settings, synthesizing capacities are vital for both managers and leaders, with the leader expected to assume a wider purview in terms of both time span and terrain.

At the level of leadership, the 360-degree searchlight mind is generally more valued than the focused acute-angle laser mind. Even so, it is acknowledged that the most innovative products, sales, or marketing ideas are likely to come from those with a proclivity toward laser thinking—working alone or in consort. Only the rare leader—the transformative or visionary leader—displays genuine creativity. We see this creativity at work when subsequent generations enjoy the fruits and/or suffer the destructions of that leader—be it Napoléon or Mao Zedong, Queen Elizabeth I or Margaret Thatcher.

THREE GUISES OF CREATIVITY IN THE FUTURE

Until this point, the nurturance of creativity has been a human-centered enterprise. A critical mass of persons engaged in creative activity—Athens in the fifth century BC, Florence in the Renaissance, Vienna and Paris in 1900, Silicon Valley in the 1990s—constitutes the optimal formula for ensuring continuing innovation. Sociologist Richard Florida points to certain contemporary urban centers in America—Austin, San Diego, Seattle—that have emerged because they attract individuals who are young, comfortable with technology, socially liberal, engaged with the arts.[12] No doubt, comparable centers are being propagated throughout Europe, Asia, and Latin America. In the years ahead, however, this human enterprise will be complexified by three new players.

As we learn more about human biology—and particularly about the brain and about genes—we will discover those factors that either contribute to or diminish the likelihood of creative lives and creative activities. Perhaps certain genes control personalities or temperament that are receptive to innovation and accepting of turbulence; perhaps certain sites in the limbic system, or certain cross-cortical or interhemispheric connections, are more likely to be activated in individuals judged as "chronically creative" by the relevant fields. Such

discoveries could simply be made and documented as "pure" scientific knowledge. It is far more likely, however, that those who value creativity will seek to cultivate—though hopefully not to breed!—human beings with those biological proclivities. We can be even more certain that those who seek totalitarian control will find ways to eliminate these creative outliers. Instead of burning books, future totalitarian leaders or their brutal henchmen will excise key brain centers or knock out telltale genes. What was once the province of science fiction may well become the realm of science fact.

New knowledge will continue to accrue as well in the domains of artificial intelligence and computer simulation of human intellect. Computer programs will be devised—indeed, programs have already been devised—that yield new works of visual art and music, new commercial designs, new scientific patterns and hypotheses. Those hooked on creative activity will also use computers as intellectual prosthetics—manipulating variables or accumulating massive amounts of data that would have been inconceivable in a precomputer age. Most innovations today—from the architectural designs of Frank Gehry to the decoding of genomes by the company Celera—would not be possible without powerful computers (though Gehry himself still works by hand). Again, there will be a struggle between those who yoke these new forms of intellect for positive ends, and those who use them for purposes of control or destruction.

Neuro-, geno-, and silicon technologies are value neutral. While glossy magazines like to sing the praises of these "new age" developments, computer scientist Bill Joy warns against the destructive potentials of nanotechnology, genetic engineering, and robotics.[13] I share his anxiety that a cloned toxic agent or a computer programmed to fire atomic warheads could wreak havoc on life as we know it. Needed today is a generous dollop of creativity in the human sphere—in particular, in the ways in which we human beings relate to one another personally, carry out our work, and fulfill our obligations as citizens. It is to these moral and ethical considerations that I now turn.