Review Articles

PSYCHOLOGY OF SCIENCE/THEOLOGY OF SCIENCE: REACHING OUT OR NARROWING?

by Robert B. Glassman

Abstract. Formalizing a "psychology of science" today will constrain intellectual freedom in ways more likely stultifying than liberating. We should be more improvisational in seeking ideas from academic psychology to develop a more comprehensive purview. I suggest that a psychology of science should look at systematic theology and empirical theology. Liberal theologians have long experience trying to distill from religion those structural aspects that affirm openness in a search for truth. Science, as well as religion, has its myths and rituals, but theologians are more experienced than scientists at a large mythohistorical scale. There are distortions in the extreme degree to which psychological science has traditionally emphasized empiricism, positivism, hypothesis testing, and falsifiability. I argue for less critical reduction and more creative augmentation. This could include looking outside academia at cognitive competencies of people in trades. Exaggerated parsimony is an old story. This is illustrated by the opposition to David Hartley's 1749 theory of neural oscillations. There is an inexorable "margin of uncertainty" where scientific prediction and control can never outstrip the new uses to which human beings put ideas. Facts and values interact in this margin; theology has long made a home there, but scientists sometimes have been excessive in rejecting the "naturalistic fallacy." There is also often a degree of disingenuousness in psychology's reluctance to take subjective phenomena seriously; here there may be lessons in how empirical theology has handled subjectivity, as well as in taking an honest look at the way much of the methodology of experimental psychology incorporates subjective assessments. Feist's book is a start, but these things need more thought before codifying a psychology of science.

Robert B. Glassman is a professor in the Department of Psychology, Box E1, Lake Forest College, 555 N. Sheridan Road, Lake Forest, IL 60045-2399; e-mail glassman@lakeforest.edu.

[*Zygon*, vol. 42, no. 3 (September 2007)]
 ISSN 0591-2385

Keywords: analogy; behaviorism; cognitive; consciousness; conservatism; creativity; dogma; falsifiability; freedom; humanistic; intellectual history; parsimony; philosophy; progress; reductionism; scale; scientific languages; working memory capacity

---

The Psychology of Science and the Origins of the Scientific Mind. By Gregory J. Feist. New Haven, Conn.: Yale Univ. Press, 2006. 336 pages. Cloth. $38.00.

Open-mindedness is good. We live our lives in subsystems and "levels," often striving to reassemble into greater things (Jackelén 2007; Peacocke 2007). In general, how? This question is particularly exciting because we *can* find answers, although it is unlikely that we will find all of them, partly because analogies often work as heuristics when we compare forms at one scale to other scales. What worked before may work again in a very different context because life is often fractally self-similar—to an extent.

For example, the majority of neurons in our cortex look a lot like trees (Glassman 2002). A general systems reason for this must be that treelike structures fill local spaces well without detailed planning by an outside agent while providing close, dual access both to their internal resources and to the external resources. This is an aspect of emergence. Woody tree branches effectively make themselves available to air and the energy of sunlight. The pyramidal neurons of the cortex, by branching, make themselves available to the "rain" of myriad bits of local informational energy (see V. Braitenberg and A. Schüz's [1998] exquisite examination of cortical fine structure for a related use of this metaphor). Of course, there also are many differences between neurons and woody trees, both in the proximate causes of branching and in the naturally selective influences that led to the particular dendritic patterns.

A closely related general systems example of same-and-different: Proteins also take gracile, branching treelike patterns, but another microscopic living store of organismic structural information, DNA, takes on only linear shape with no branches (Woloschak 2007). These perspectives point to particular problems for additional thought about fundamental information-handling dynamics in living systems, perhaps particularly parameters of stability versus adaptability. Open-minded play, with analogies and disanalogies, is needed to see such deep issues. And they are issues not only of scientific understanding but also of prescription, for example concerning medical ethics with the growing competencies of medical science and practice.

Freedom and Structure

One very general observation about living system structures is that they *constrain*. As the cumulated record of history in a given present, they put

limits on what can happen in the future. By that very virtue, they open up new routes to the future. Good structures are substrates of freedom. With nature's realm of infinite possibilities, a complete lack of structure at all levels allows only for swirling randomness, for waste and void of the most entropic sort. But it also is possible to have structure that is excessively limiting—where things become impacted and grind to a halt or where they endure almost fixedly, for a long, long time at a low ebb, breathing shallowly. Somewhere in between is fecundity, the ground within which agents create new forms of order that lead to still newer forms of freedom and possibility.

Well-defined academic fields, in much the same way as religions, focus resources and give backbone to a collection of ideas. Put aside whether present prevailing premises of a religion or science, or other academic field, have perpetual validity. Whether yes or maybe not, at best an energetic information flow together with healthy limits is imposed on the combinatorially explosive universe of possible envisioned realities.

This is analogous to the way a purposeful organism's skeletal structure enables precise control of movement (Buneo, Soechting, and Flanders 1997). Skeletal limiting of degrees of freedom is so important that an analog is seen in the octopus, whose quintessentially flexible arm achieves fine control of reaching by means of a stereotyped wave of stiffening, restricted to a plane (Sumbre et al. 2006; EurekAlert 2006). But at worst (or at cyclic times) religions and academic fields become overritualized and legalistic, vocally, dumbly. The once healthy backbone becomes arthritic. Narrowing doggedness then stultifies; change and growth become leaden, viscous, sluggish, senescent.

Moreover, imprecision and inadvertent biases are inherent in the fact that language makes discrete units out of multidimensional continua. Modal meanings of words to some extent overcome the parametric particulars of any single reference (Choplin 2002). Also, always necessarily present in any human organization are the clamoring self-interests of participants (us, the vectors of sometimes higher things), often acting with surround inhibition in competitions with each other. This may compromise our collective larger purposes.

The Need for a Theology of Science

Gregory Feist's ambitious book makes learned, informative reference to a wide range of sources relevant to the important task of understanding the psychology of science, including review of other established metasciences (philosophy, history, sociology), historical sciences (archaeology, paleontology, evolutionary theory), and psychology itself. But Feist's declaration of intent to institutionalize psychology of science is premature. It does not see us off sufficiently on paths balancing the freedom to expansively reach against liturgical narrowing and cliquishness. Is it really time to set such

stuff up? Early on, Feist offers an interesting caution (seemingly inadvertent) in describing the book *Social Stratification in Science* (Cole and Cole 1973):

> Cole and Cole analyzed "cumulative advantage". . . in which reward and recognition early in one's career snowballs. . . . As the saying goes, and it is not restricted to economics, "the rich get richer, and the poor get poorer.". . . science is more meritocratic than most any other institution, but at the same time it is not the ideally rational system it might claim to be. Gender, race, age, religion, and institutional affiliation do affect, often in a cumulative way, the reception and impact awarded. (Feist 2006, 22)

To me this implies that we need to be less restrictive, more improvisational, and more open to each other's ideas.

I want to dig in provocatively on this cautionary point about formalizing fields. It may be helpful to develop, simultaneously with psychology of science, a theology of science. There are two reasons. First, the sciences themselves have a religious quality—much more than ordinary scientists themselves see. I recall Langdon Gilkey's acerbic response, some years ago, to a scientist's challenge about the apparent quaintness of theological talk. Somewhere between a chuckle and a guffaw, Gilkey asserted with an "I beg to differ" air that *science* was chock full of mythology! Granting also the larger, nonjudgmental sense of the term *myth* that allows it to include the possibility of vivid metaphorical heuristic approximations to truth, science does indeed have its myths. The second, related, reason is that theology is highly experienced in handling venerable heuristic metaphors. Theology contains unique sources of wisdom.

Systematic sciences are younger in centuries than systematic theologies. Perhaps this is why, among theologians, some seem methodologically self-aware on a broader scale than scientists. Theologians have a special forte in their alertness to doctrinaire localized absorptions. Indeed, the long history of religious monotheism, as well as of theology, may be envisioned in large part as centering on this very problem and on attempts to achieve a wider objectivity and perspective. Major religious revolutions were kindled by dissatisfied theological insights. Many of the nodal points in monotheism's mythohistory represent forceful, eye-opening attempts by heroic figures to transcend distractively absorbing particulars. A sampling of headlines:

- Moses brings the law from the mountain, smashing idols both figuratively and literally.[1]
- Isaiah hears a voice in the wilderness; he urges erasing of the blackboard and leveling of the playing field as preparation to see with clarity.
- Jesus suggests that better than hundreds of confusing regulations, or even ten major commandments, is keeping in mind only one thing: love. Operationally speaking, the love command involves unadulterated openness to the messages of others' ways of being.[2]

- Mohammed declares oneness, in the first pillar of Islam, and asserts a single universal community.
- Martin Luther explains his exasperation with numerous accumulated hypocrisies; once again, let's try to get it right.

As we well know, all such noble attempts at cleansing and renewal flowed readily into new branchings, some of which (always too many) comprised severe co-option by new variations on old particularistic themes, with cliquishness and antipathy. These matters, indeed, are approximately the same as the concern Reinhold Niebuhr thoughtfully developed about politics and religion in history (Gilkey 2001). Things happen. Often they are apparently unintended consequences of participants' following through on the promising glow of new institutions. There always erupt particularisms whose foci of benefits are narrower than the broad appeals that earlier had enticed wide participation. But scientists, no less than religionists, often become "sinners" in their domains, devolving growing separations from the truths they originally sought, as particularistic research styles solidify into schools and harden into old schools.

With their backs turned toward religion in self-absorbed dogmatism, few scientists have tried to grapple with the very different conceptualizations of theology (see Hefner 2007; Henig 2007), itself an orphan from the secular contemporary humanities, to whose styles of thinking it is most closely related. Beyond the issue of scientists' unconscious, implicit mythological backdrops, there is an additional disingenuousness when scientists deliberately ignore religion. When scientists reach toward grander issues in a written piece they frequently do so using the stylistic fillip of leading with a pithy inspirational quotation from literature. However, for them to do so with a religious passage would tend to cause a spasmodic, threateningly raised eyebrow among other scientists. This aversion narrows scientists' world away from some of the deepest mysteries of real existence.

In fairness, it must be acknowledged that scientists might easily become entangled in unfamiliar theological jungles. As a consequence of avoiding all such thought, however, scientists rarely encounter the sophisticated attempts by some theologians to bring important mysteries into the realm of cognitive discourse.

Systematic theology is perhaps the body of theoretical perspective that is most pertinent here. The contemporary standard definition of this field has it as a division of Christian theology (for example, Wikipedia 2007), with roots going far back to such figures as Augustine and Thomas Aquinas. However, the spirit of its enterprise seems much more general; for example, in Jewish tradition it might well include Maimonides ([1194] 1956) and Abraham J. Heschel's (1962) discourse on the prophets. Few scientists have any inkling of the ways in which such systems theologians have bravely stepped up to face the challenge of the narrowness in innocent biblical

literalisms and how they have encouraged healthy growth with frankness, graciousness, and humility.

To a scientist, theological literature often comprises obscure forms of expression alien to anything in our domains. Indeed, from a scientist's viewpoint I would conjecture that some theological locutions, entangled in millennia of meandering references, have genuinely become a jungle of nonsense—sometimes dangerous nonsense of little real cognitive value but easily co-opted as ritualistically formalized markers bounding hostile groups, feeding their antipathies. At worst, religion abets what may be (to God's eye) fundamentally economic sources of alienation from each other.

Not all theological language is merely that. Here are a couple of illustrative insights from Paul Tillich: ". . . language moves in universals. World breaks through environment in every universal. He who says, 'This is a tree,' has grasped treehood in an individual tree and with it a fragment of the universe of meaning" (1963, 62). And, more tendentiously, perhaps recalling the theological revolutionary instances listed above, Tillich's attempt to get at the core of the human search for meaning:

> We have dared to use the almost forbidden word "spirit" (with a small "s") for two purposes: first, in order to give an adequate name to that function of life which characterizes man as man and which is actualized in morality, culture, and religion; second, in order to provide the symbolic material which is used in the symbols "divine spirit" or "Spiritual Presence.". . . immediate experience makes it possible to speak symbolically of God as Spirit and of the divine Spirit. These terms, like all other statements about God, are symbols. In them, empirical material is appropriated and transcended. (1963, 111)

These ways of speaking on Tillich's part seem akin to Heschel's (1955) repeated insistence on ontological significance in a dimension of experience he calls "the ineffable." These points also mark a juncture with the dispassionate efforts of "empirical theology" (Peters 2007) to shed excesses while finding operational significances for the present in venerable theological expressions.

Theological Sophistication

The doorway between our scientist's reflexive impression that god-talk comes from a confused dream world and our scientist's conceptions of the real physical world is at the interface of *is* and *ought*. Typically, scientists shy away at that interface, warning each other not to confuse facts with values. Beware the naturalistic fallacy, my son! Get back to the laboratory bench, comrade! In this we are sometimes disingenuous, because we frequently do lend our work to the world, in a variety of ways, including promises in grant applications, undergraduate teaching, attempts to write for the public, and communications with popular media.

Humans are objects and subjects: Our theory-informed experiences are empirical. Among these, theology can be empirical in ways that overlap

fertilely with science's customary empirical forms. Although historians of mainstream academic psychology often have argued that the introspectionism of the early twentieth century was a failed historical experiment during the march toward laboratory experimentalism, modern psychology relies heavily in most of its subfields on introspective responses of human participants in research. Instances range from traditional psychophysical research on perceptual effects of systematically varied sensory stimuli to probes of motivational preferences, queries on personality questionnaires about one's likely reaction to posed situations, answers to diagnostic questions concerning symptoms of mental illness, affective responses to depictions of human faces (perhaps varied as a function of gender, ethnic appearance, age, and so on), and myriad others.

Theology is used to a closer interaction between is and ought. In science there is a stutter at that point. In behavioral scientists' perseverative insistence on avoiding ambiguous, foggy language there has arisen a hypocrisy of arbitrary rejection of some meanings of *empirical*.

For all the ways in which scientists, particularly those in many fields of psychology, do try to describe and measure subjective phenomena, psychological scientists tend to be sheepish that there is such a thing as subjectivity. Perhaps this is a by-product of our "physics envy." Particularly controversial are efforts by psychologists to cope with issues of freedom and responsibility (Rychlak 1979). Indeed, a couple of decades ago my own objectivist stance, or wish "to remain outside," was narrower than it is now (Glassman 1983). Yet, in widening purview and reaching out to the larger community, psychological scientists must beware of a tendency to glibness. Barbara Ehrenreich (2007) has recently written a pointedly droll criticism of the shallowness in some of the current popularizations of "positive psychology." Religion is a more mature product of struggling constantly at the junction of knowledge and value. Theology stays close, while establishing a metalevel of examination and description. Such work can be empirical. Yes, that empiricism comprises interpretations coexisting with observations perhaps more densely than in any other enterprise except politics, but there is something important here. "Radical empiricism holds that experience includes not only sense perceptions but also feelings in relation to what is experienced. Following William James, it also holds that our initial experience of something is an experience of a whole, and this includes the experience of the person in relation to the whole" (Peters 2007, 100). That statement is a liberal theologian's take on radical empiricism. But fast-moving academic psychology has left James far in its mythohistorical past, except for an occasional nod to a James relic in a glass case. A task for the near future is to reexamine "empirical theology" in light of mainstream experimental psychology's explicit rejection of "introspectionism" together with its widespread implicit acceptance of introspections. In this way we might help psychological science without compromising the

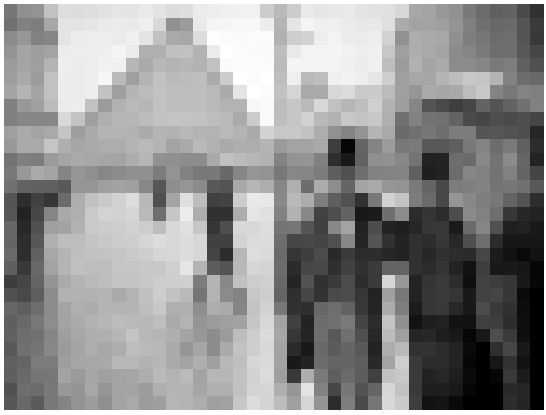
discriminating postures that make science such a powerful set of traditions for growing knowledge.

At the is/ought margin the real world is *inherently* unpredictable. The mathematical chaos theory of the 1990s illustrated in many ways, in the try-it-and-see small worlds of nonlinear systems of cellular automata and other computer simulations, that many complex systems outcomes just cannot be predicted. This "existence proof" applies even more strongly to us, as real living things walking around in our complex living bodies, in the meteorological weather and social "weather" of the real world. In us, the butterfly effect is writ large. Life is quite predictable and quite capricious. Some empirical things we can learn only at the moments of being in them.

Cultivating a Sense of Scale. Being *in* the affairs of social life provides a perspective that does not seem possible from the stylized forms of objectivity of mainstream psychologies. In spirit, we psychological scientists worship objectivity. We are souls at a remove above the world, but we are that while taking physical measurements that put us butt up against things. This is awkward. It makes us like a person trying to describe the architecture of a house by compulsively pressing his nose up against it, brick by brick. Our scientific methodologies have thick lenses to correct for this myopic posture, but our products remain piecemeal, like the observations of the proverbial blind men and the elephant. Our preoccupation with positivism and operationalism, although a crucial distinguishing aspect of what we have to offer as critical thinking, becomes too exaggerated in this thigmotaxic attitude. It is worth trying to mitigate that attitude by experimenting with adapting some of the perspectives of the humanities, particularly theology. The ultimacy of theological viewpoints may provide us with a better sense of scale. By thus pulling back somewhat we may see more, although much of that will be vague, as if through a translucency, or "through a glass, darkly" (1 Corinthians 13:12 KJV).

A nice visual metaphor for this process of temporarily relinquishing close-up precision for wider perspective is in the ubiquitous psychology textbook picture whose large pixels enable it to be recognized as Abraham Lincoln only when seen as a whole, from a distance. Today, inexpensive computer software makes it is easy to replicate that trick with any picture, for example in the following super-impressionistic rendering in only 40 x 30 pixels, which is to say that it is a mosaic of only 1,200 boxes, each of a uniform gray, of a familiar impressionistic painting in Chicago. Close up, it is a congeries of splotches. Step back and it comes alive.

The other example was taken at Corcovado, near Rio de Janeiro, in April 2004. Its significant subject matter would be clear enough at lower than this low resolution of only 60 x 80 pixels. But at this scale we can also just make out the playfully irreverent emulation of the statue's posture by



one of the young tourists at the base. Hold it at a distance and look.

Get a Broad Psychology Education First. Perspective is important. I have just argued that systematic theology and empirical theology can help in achieving scientific perspective. So can a more extensive survey of academic psychology. For many readers, the longer first part of Feist's book, comprising seven chapters about "Psychology of Science," will also be their reintroduction to the field of psychology via selected topics in the subfields of biological, developmental, cognitive, personality, and social psychologies. These chapters, 2 through 6 respectively, are bracketed by broader consideration of the metasciences in chapter 1 and suggested future applications in chapter 7. Readers would do well, before or after, to read the corresponding chapters in a good current textbook of general psychology (such as Weiten 2007 or Gray 2007). If your enthusiasm increases after that additional homework, you are one of us. Next, branch out and dig in with a good textbook in each of the five areas covered by chapters 2 through 6. (Some examples for neuroscience, developmental, and cognitive: Rosenzweig, Breedlove, and Watson 2005; Bear, Connors, and Paradiso 2007; Berk 2003; Ashcraft 2002.)

Although Feist's earnest attempt to establish a strong psychology of science is not fully baked, the Part 1 attempt is important enough to summarize, with sample points and commentary, in Table 1.

TABLE 1

Summary of Part 1 of the Book

Chapter	Example Themes; *Comments*
1. Psychology of Science and the Studies of Science	• There are three stages in the development of a field: Isolation, Identification, and Institutionalization. *I suggest delaying the last phase.* • The context of other metasciences. "The two oldest studies of science, history and philosophy, are not empirically based." *This error fuzzes the distinction between experimental science and broader empiricism. History* is *empirical. Although Feist mentions D. T. Campbell appreciatively he neglects other wise scientists whose metascience emerged naturally, such as R. L. Gregory, H. Simon, G. Gamow, and K. Lorenz.* • Demography: Of American Nobel laureates, 72 percent are Protestant, 27 percent Jewish, 1 percent Roman Catholic. *A striking statistic to probe, not with "political correctness" but graciousness and humility. One possibility: Reaching toward God in controlled ways, we scientists create our own catholicisms, thus filling a need.* • Karl Popper's arguments against psychologism and disdain for metasciences puzzle Feist, in view of Popper's other work. *Although later he cites Richard P. Feynman appreciatively, Feist neglects to mention Feynman's ([1974] 1985) accusation about a "cargo cult" quality of social sciences.*
2. Biological Psychology of Science	• Behavioral genetics and intelligence measurement. *An estimate of 80 percent heritability is mentioned without enough contextualization about environmental context-dependency, a foundational quirk of the statistical analyses.* • Neural development and brain plasticity • Human brain architecture and the question of system specificity. *Feist struggles honorably, but none of us has yet found an apt way to bring together knowledge of functions as described in mind-language and brain-language.* • "Folk" understandings of physics, math, biology, psychology • Frontal lobes; false-belief tasks can be done by four-year-olds but not three-year-olds • Hemispheric lateralization of functions
3. Developmental Psychology of Science	• Domain specificities of knowledge; domain generalities • Children as incipient scientists; development of reasoning • What leads 2 percent of the population to become scientists? Correlates include birth order and religious background. *This good review is too mutely empirical. Self-educate with a developmental psychology textbook, then ask your own questions.*

4. Cognitive Psychology of Science	• Heuristics used by good scientists • Implicit knowing; the uses of intuition • Experts can handle multiple hypotheses at once. • *See extended comments about chapter 4 below in the section "Falsifiability Is a Sacrificial Ritual," p. 667.*
5. Personality Psychology of Science	• Origins and functions of personality traits. *Note that the "trait approach," which bases its claim as science on psychometric testing and statistical analyses, is very different in structure from psychoanalytic or humanistic approaches to personality.* • Genetic contribution to scientific interest; cognitive, social, and motivational traits • Domain-specific scientific interest • Scientific achievement and creativity often correlates with contentiousness.
6. Social Psychology of Science	• Instances of experimenter bias in evaluating "intelligence"—even in the case of "maze-bright" versus "maze-dull" rats • Cultural influences on the evaluation of science • Mentorships, small-group processes, gender
7. The Applications and Future of Psychology of Science	• "Human resource" management; selection criteria. *See my criticism, below.* • Prediction of scientific interest? • Limited relation between IQ and creativity

Each of the titles of chapters 2 through 6, omitting the phrase "of science," is also the title of a chapter in every contemporary general introductory psychology textbook—and there are hundreds—as well as the topic of its own upper-level psychology course in the standard liberal arts curriculum.

For example, *biological psychology*, or *behavioral neuroscience*, ranges from the study of the molecules that make up nerve cells, and the neurotransmitters that mediate communications between nerve cells, to the relationships between attributes of behavior and large brain regions and systems. One asks, for instance, what material properties of the brain (anatomy, chemistry, electrophysiology) are suggested by the fact that human musical sensibility, emotional responsiveness, and ability to grasp and track patterned spatial configurations all are more vulnerable to accidental damage to the right cerebral hemisphere than to the left. Perhaps there is an as-yet-unarticulated characterization on, or "just below," the psychological level that would be the key to seeing the order hidden in the complex details of the miles of neural fibers and tens of thousands of synapses within each cubic millimeter of cerebral cortex.

Developmental psychology ranges from the biology of embryonic development to phases and processes of moral growth, peer relations, language,

and indeed all the topics of general psychology, considered closely with an ontogenetic lens. Among the questions, we ask why human beings are the only creatures having such a long, manifestly asexual immature phase of life—about a dozen years between weaning and puberty. Among the striking, surprising findings is that children between the ages of eighteen months and six years are word sponges during a phase called "fast-mapping." Although this is obvious to a parent, few of us realize that in order to get to a receptive vocabulary of about twenty thousand words by age 6, the child has to learn an average of nine new words every day (Papalia, Olds, and Feldman 2001, 261).

Cognitive psychology, born in the 1960s of the decades-older field of human experimental psychology cross-fertilized with the burgeoning computer revolution, deals unabashedly with mental processes. It comprises a measured relaxation of the fearful positivism that earlier characterized experimental psychology, based on the proof from computer science that interesting outcomes can emerge from complex information processing whose properties are, in principle, knowable in every detail, even though its processes are thoroughly hidden. Much of cognitive psychology is devoted to defining and elucidating the full complexity of structures of human memory. However, perhaps even more so than in other subfields of psychology, there seems to be a missing link between the familiar phenotypes of memory or other cognitive functions and the essayed "machine levels" of description. For example, so many of the theories of cognitive psychology involve flow diagrams of arrows connecting boxes with simple labels. Sometimes this strikes me as a stylized, simplistic house of cards, albeit mortared with copious, quantitative empirical findings.

Personality psychology bills itself as the study of the whole person, with several traditions feeding into it, including psychoanalysis, behaviorism, and such humanistic perspectives as those of Carl Rogers and Rollo May. Perhaps the portions of personality theory that arise out of insights from clinical and counseling practice potentially come closest to the sources of wisdom in theology, about which I argued above. The so-called trait approach to personality is the most thoroughly quantitative, perhaps the most scientific, and includes statistical factor analyses of vast quantities of data obtained from personality assessment inventories, somewhat analogous in structure to IQ tests. I comment further on this approach below, in criticizing Feist's chapter 7 ambitions for an "applied psychology of science."

Social psychology studies individuals as their behaviors are influenced within groups of other people. What causes conformity, obedience to authority, attraction to others, or hostility to others? Why do people sometimes help and sometimes ignore others in need? The social-psychology approach to altruism is decades older than the biological, "evolutionary psychology" approach, which became popular among behavioral scientists during the 1990s and which is now quite familiar to those in the field of

religion and science. Social psychology, indeed, is virtually orthogonal to evolutionary psychology, with its own large body of detailed findings and principles that concern more proximate causation of behavior. A sometimes unfortunate aspect of social psychology, mainly in decades past, is the lightness with which it apparently took ethics of research on fellow humans as subjects, for example in the famous experiments in which people were led to believe that they were willingly giving strong electric shocks to others. Much about social psychology was like the old *Candid Camera* television show, but, instead of the friendly chuckles of that show, the public face of social psychology displayed the distancing expression of insistent positivism.

Still, among the important empirically demonstrated lessons from social psychology is that current attitudes strongly influence one's memory of one's own past attitudes, surprisingly so. Therefore, to some degree our ethical reevaluations of what we did before are merely 20/20 hindsight.

Also, regarding some findings in social psychology one may be tempted to criticize "But that's just common sense" or to repeat the wry cliche "My grandmother could have told you that"; however, many of its findings are eye-opening contradictions of commonsense expectations.

This subfield of psychology could do with a thorough examination from the outside. To begin, pick up a good introductory psychology textbook. I revisit some of these philosophical points of criticism of psychology in more detail below.

The worrisome chapter 7 of *The Psychology of Science*, on applications, demands further comment. With reference to the field of Industrial/Organizational Psychology, Feist discusses "human resource management" and the issue of selection criteria and asks, "How do we choose our best and most creative students, professors, or research scientists for positions in our college, university, industry, and government science departments and labs? . . . Can we predict who will develop an interest in science at an early age? . . . Or, can we predict who will stay in science after choosing that career path?" (p. 146). As a thankful member of an open society, and of a college faculty, I grant that selection criteria cannot be avoided. We self-select and other-select our affiliations. And yet personnel selection criteria are heuristic shortcuts that can easily miss the mark or drift toward misguided, domineering, hierarchical limits on freedom of opportunity. On second thought, let's *not* look for additional circumstances to predict scientific interest or aptitude! Let's share science well, as widely as we possibly can, and let interest emerge freely. The science of statistics deals inherently with groups and is not well suited to accurately locating a remarkable individual. Maybe science should keep its hands off itself in this way.

My worry about heavy-handed overapplication of "science" (or its technological products) to science-personnel decisions is reinforced by Feist's

mention that research on IQ and creativity indicates only a moderate relationship up to a threshold of IQ 120 and little or no relation above that (p. 149). Consider the nature of intelligence-test construction: Psychometrics involves extensively testing the tests, validating them on relevant populations, but there is no getting away from the fundamental limitation that human test writers create the questions. The factors that emerge in the longer run from statistical components analysis may be inherently restricted by test authors' purviews. *Users* of psychometric testing will never see what the *creators* of those instruments could not imagine. Somehow, thankfully, we who are not psychometricians often recognize creativity when it appears before us, but it is always something new.

Our Face in the Mirror: Psychology as Both Subject Matter and Process

Part 2 of *The Psychology of Science*, ambitiously titled "Origins and Future of the Scientific Mind," comprises three chapters: 8, "Evolution of the Human Mind"; 9, "Origins of Scientific Thinking"; and 10, "Science, Pseudoscience, and Antiscience." Among the matters put forth well is that there have been humans, as we know ourselves—inventive, cultured, in massive organized social groupings—for only the past ten thousand years or so (Table 8.4). This is an very short time against the background of the two million years since early stone-age humans (Table 8.3). In chapter 9 we are reminded that our brains became fully prepared for syntactical language only about fifty thousand years ago, we came to formal manipulation of numeric quantities ten kilo-years ago (kya), and we lived in the first city-states nine kya. Calendars can be traced back to six kya in Mesopotamia and Egypt, arithmetical positional notation and written languages to about four kya. It took some hundreds of years at this time for writing to evolve from pictorial toward a smaller, more efficient set of symbols representing elemental units of the sounds of language. "There can be little doubt that language, in its more developed grammatical form, is the sine qua non of cultural innovation and creativity. . . . Because knowledge becomes more cumulative, language speeds up cultural innovation . . . language provides a medium for expressing theretofore ineffable ideas, which can be externalized and eventually become part of cultural knowledge" (p. 180).

Iron making was mastered in Turkey about 1000 B.C.E. In this mere-millennial view, the choices a contemporary generation makes add up to a chance to move closer to greatness—or not. Humans are inherently eschatological.

Success in pursuing greatness may indeed require getting a better handle on the psychology of science. Earlier, Feist pointed out that "scientific thought and behavior provide insight into a very core dimension of hu-

man nature: observation, pattern recognition, expectation and theory construction, hypothesis testing, and causal thinking, not to mention intuition, imagination, and creativity. . . . Psychology simply cannot afford to ignore one of the most important human activities, one that has transformed the very world we live in" (p. 32).

Achieving Objectivity. Torn between the political correctness that pervades much of contemporary social theory and the scientist's inherent need to advance truth, Feist is ambivalent about the concept of progress, alternating his position irregularly. On p. 187: "I also want to make quite clear at the outset that I eschew any notion of 'progression' in human thought and epistemology . . . ," but on p. 219: "First, pseudoscience lacks the cumulative progress seen in science." Later in the same chapter, Feist scoldingly cites a young mother whom his wife had encountered at an educational meeting about science and health. Concerning reports that sugar causes hyperactivity in children, this mom asserted, "That's just the science. I don't believe the science" (p. 226). Shocking. And yet, let's be honest, science teachers; alleged scientific findings, after wide media distribution, often are subject to throat-clearing reversals. Out of the mouths of babes—or young mothers—may come gems of practical wisdom.

One particular shortcoming of health science findings as they reach the media is the typical massive averaging of data over broadly defined classes of people and circumstances, with little attention to possible contingencies or subgroup differences: "Women who . . . should not" and the like. A reasoned cautionary note has recently been raised about such widespread statistical shortcomings of clinical trials (Kent and Haywood 2007). The ingenious statistical methods, which often help us transcend fuzzy intuitive thinking, have their own fuzzy penumbra.

In bewailing the lack of public understanding of science, Feist cites some familiar culture wars. He sees C. P. Snow's famous mid-twentieth–century treatise on "two cultures" as having contributed to an antiscience perspective. Not only do humanists often distance themselves from science, but so also do many social scientists misgauge natural sciences. Thus, Feist acknowledges muddleheaded excursions of some social constructivists and postmodernists. On the last page of the book Feist puts the blame on scientists themselves—he regrets the "arrogance exhibited by those scientists who do not see the value in translating scientific findings for mass consumption." Yet here Feist himself seems glib in failing to fully appreciate the challenge of explaining scientific ideas well. A good psychology of science needs careful acknowledgment that scientists themselves frequently lack deeper understanding. Science practitioners sometimes allow woodenly obedient following of narrow sets of local disciplinary research customs to substitute for insight. Those instances should not be tossed out to the public as readily as now. Too often, news releases about purported

breakthroughs reveal more about news consumers' short memories of the last much-the-same news release than about new scientific knowledge.[3]

The Brittleness of Premature Hypothesis Testing and Doctrinaire Empiricism. Feist often indicates the experimental method, particularly hypothesis testing, as science's essence. But although experimental method pervades science, it is not science's full essence. The essence is broader, higher, and harder to define in a few words; it includes both rational and intuitive thoughtfulness in respecting the lessons granted in interacting with the empirical world. It pained me to read, in the section on "Scientific Attitude," that "the writings of the psychologist B. F. Skinner do as good a job as any of summarizing the scientific mind-set" (p. 214). The problem with that is metonymy. As often in psychology, here an important distinguishing feature is mistaken for the whole. Another frequent metonymical error is often seen in the public dissemination of scientific and medical findings (and their use in public health, education, etc.), when a statistically significant difference between two groups—defined for such a moment according to a single attribute—metamorphoses before our eyes, yet outside of attention, into an implied divisive statement of black and white: "Women are X but men are Z."

To the general public, Skinner is iconic (sometimes with disparagement) of the "science" of psychology; however, as with many icons, the stand-out attributes are a caricature. Not well known outside of academic psychology is that Skinner was an outlier even within the behaviorist movement that he joined and came to represent—to the chagrin of other behaviorists. As well, the extremist brand of positivism Skinner's disciples displayed—their emphasis on pointing the finger at grossly observable phenomena while shunning inference—was often at odds with the hypothesis-testing aspect of science. The equivocal relationship within behaviorism, between science's emphasis on tangible observables and science's affinity for logically examining hypotheses, needs further study by metascientists. Both of these tendencies exemplify the stubborn "hard noses" of science, but these two noses sometimes bump instead of nuzzle.

"*I Was a Teenage Rat-runner*." Perhaps Skinner should be allowed to rest in historical peace. He was the guiding spirit of disciples running my own mid-twentieth–century undergraduate psychology education at Columbia University, where the introductory course in 1959 had a weekly operant conditioning lab—interesting but unbalanced, an example of ritual narrowing. Skinner's public fame perhaps peaked after the 1971 publication of his bestselling "nothing-but" book, *Beyond Freedom and Dignity*. He has since become a convenient, quick referent for what *psychology as a science* represents to many laypersons. Yet I have to admit that Skinner's iconic urging as to the value of observables also provided a helpful counterweight to the foggier creations of some other writers claiming the title

of psychologist. An issue I raised above in complimenting some of theology—the possibility of admitting subjective participation more explicitly into psychological science—needs additional critical examination. Ralph Burhoe, a wise scientist and theologian, included Skinner among the scientists he admired (see Burhoe 1986).

Real Things May Be Unseeable. Behaviorists other than the Skinnerians, in varying degrees, did and do appreciate that *inference about things unseen* is a vital aspect of science. Indeed, this is particularly true of the physics and chemistry that psychologists so wish to emulate. No one will ever see an electron in person. Psychologists and neuroscientists too infrequently realize that the things—*the real things*—toward which good science often drives are not only unseen but unseeable in principle. As a consequence, instead of exercising imagination in searching widely for workable findings and conceptualizations and then honing abstractions into productive metaphors, there is a premature hypostatizing scramble that winds up merely trying to *localize* functions someplace in the brain, or in some handy single-word lexical locus, sanctifying a small piece of ordinary speech. This does not much illuminate something real but succeeds in proliferating ritual paths for graduate students and for minions of secondary empirical researchers. It is a mere holding action, not real progress, when a scientistic denomination polishes its liturgies.

Falsifiability Is a Sacrificial Ritual, Often Excessive. Along the same lines, Feist's doctrinaire emphasis on Popperian falsifiability at a number of points in the book is insufficiently modulated by his acknowledgment that "few philosophers of science today would adhere to Popper's rather strict criterion" (p. 219). "Falsifiability," in and of itself, puts excessive emphasis on the negative, on critical subtraction of ideas. Psychological science today, indeed, indulges too much in impatient polemical refutation and leans too little toward a more communal joining in conjecture and exploration. Intuitions begin in vagueness; their first few essays toward articulation may be tangential in their explicit foci, while carrying important implicit attributes. A good theorist who is also lucky may be able to hit the bull's eye, by himself, in a single long throw, but as a community we ought to play differently, with less egocentric competitiveness.

Indeed, this conclusion may be implied from a further development of ideas presented much earlier in the book, in chapter 4, on the cognitive psychology of science. Among the heuristics used by good scientists, Feist points out, is "confirm early—disconfirm late." This means that before cutting back with Occam's razor, much has to be built up—a fertile realm of possibilities. This consideration fits nicely with Feist's discussion of Michael Polanyi's ideas about tacit or implicit knowing (p. 90) and with his reference to thoughts offered by Henri Poincaré, Albert Einstein, and

Feynman on the importance of intuition and the uses of analogy, metaphor, and visualization in creative theory formation. Feist explains that Charles Darwin's primary analogy was between evolution and the branching of a tree. He sees Darwin's famous delay before publishing *Origin of Species* as due in large part to the long time needed for "making the implicit explicit." Feist notes that scientific expertise enables handling multiple hypotheses at once, whereas the smaller working memory capacity of a novice in a particular field tunnel visions him to considering only a single hypothesis at a time (p. 103; see also Ericsson 1996). But these are not easy matters, and it seems to me that Feist's last two subsection titles in chapter 4 contradict each other: "Novices solve problems and evaluate evidence based more on common sense" and "Experts use 'intuition' and discover analogies." I think these titles say that novices and experts try to do the same thing; it's just that experts know more about their area. If experts are considering multiple hypotheses at once while also using intuition and coming up with analogies, their exploring with open, prepared minds is just plain common sense!

Let us take another run, quickly, through this issue of reducing versus augmenting in sciences. Feist is biased toward the former, and toward doctrinaire skepticism, and away from the scientist's passion to discover something new. He quotes Carl Sagan: "It seems to me what is called for is an exquisite balance between two conflicting needs: the most skeptical scrutiny of all hypotheses that are served up to us and at the same time a great openness to new ideas" (p. 215). He continues by noting that a scientist's "default attitude" has to be "skeptical nonbelief" until sufficient evidence otherwise may accumulate.

But where do hypotheses come from? The problem here, as elsewhere in the book, is a recurrent implicit suggestion of passivity on the scientist's part. The scientist is in the outfield, waiting for a ball to be hit to him. At intervals, Feist recognizes that there is also a creative process that has to be part of science, that there are hunches and conjectures, but he does not adequately empathize with scientists' augmenting-type assertiveness.

Where Are Knowledge and Wisdom to Be Found?

Psychologists of science should dig deeper into the human tendency for scholastic ritualization. Is this tendency a shortcoming of scientific thinking proper or a shortcoming of scientists as human beings distracted by other appetites or aversions?

In the chapter on origins of scientific thinking, Feist reviews the nearly two thousand–year persistence of Aristotle's incorrect doctrine that heavy objects fall faster than light ones. We read again that it was not until Galileo actually did empirical research on the matter, perhaps atop the Tower of Pisa but certainly with various weights and inclined planes, that

the world learned that, but for friction, all falling objects accelerate at the same rate.

Can that familiar historical tale possibly be true? I have argued that theology has something to offer psychology of science. But both of these "ologies" ride a high horse. Scholastic types, liturgically minded academics garbed in fine robes and skilled in rhetoric, really like that story about Aristotle and Galileo. But practical folks? I very much doubt that military engineers from the time of ancient Greece through Galileo's time had false ideas about the behavior of missiles or of rocks dropped from a besieged tower on invaders. There had to be some serious natural selection of memes going on in *that* arena! More generally, craftsmen and tradesmen must have known a great deal of what scientists later "discovered," or finally assimilated, with pompous intonations, into our august Halls of Discourse. Thus, while Feist does make an effort to find roots of science in "folk science," as studied by anthropologists, this effort seems sidetracked by a certain aristocratic classism of emphasizing clean-hands, formalized, garrulous knowledge traditions to the exclusion of our hard-thinking blue-collar antecedents and neighbors in trades and crafts. There are smart plain folks around us.

I am reminded of this snooty intellectual divide whenever, within a short time, I go from leading a class discussion about psychology textbook material concerning cognition (for instance, the interesting but potted examples used to illustrate problem solving) to the densely multifaceted problem solving of carpentry, programming a computer, or creating an amplifier by wiring an integrated circuit chip to a printed circuit board. Each of these amateur activities, sometimes successful, demands intense engagement, all the features of problem solving routinely explained in psychology textbooks, *and more*. I'll bet there always was, and still is, a lot more knowledge to be mined from under wise craftsmen's fingernails.

There is a knotty problem here. To educate people about the value of science we sometimes play the role of drill sergeant in formalized objectivity. In college teaching we run introductory psychology laboratory exercises in which students replicate some of the "classic" findings of psychology —such as the limited capacity of working memory for about seven independent items—while recording quantitative data and systematically examining those data. But, at best, during the same lesson, we put aside the drill-sergeant routine to chat more informally with students about larger perspectives on the issue we have just explored experimentally. Can all interesting questions conveniently be addressed by laboratory methods? Perhaps. And yet, aren't there also breathtaking insights to be gained not only from tradespeople but also via nonscience academic areas including literature, art, history, and theology, even if as scientists we find ourselves compelled to see many of those insights as living within a realm of uncertainty and hypothesis?

Science's Counterpoint between Parsimony and Invention: A Historical Example

Today's psychologists are not alone in hunkering down into formalisms out of fear that, in questing thought, they will trip and fall into a vague mysticism, but psychology is at an intense nexus of that apprehension. This seems to be the result of two related main factors—competing theisms and the mind/brain enigma. The often-quoted final paragraph of Isaac Newton's *Principia* ([1723] 1995) wonderfully illustrates this great scientist's combined attraction and nervous hesitation:

> And now we might add something concerning a certain most subtle Spirit which pervades and lies hid in all gross bodies; by the force and action of which Spirit the particles of bodies mutually attract one another at near distances, and cohere, if contiguous; and electric bodies operate to greater distances, as well repelling as attracting the neighbouring corpuscles; and light is emitted, reflected, refracted, inflected, and heats bodies; and all sensation is excited, and the members of animal bodies move at the command of the will, namely by the vibrations of this Spirit, mutually propagated along the solid filaments of the nerves, from the outward organs of sense to the brain, and from the brain into the muscles. But these are things that cannot be explained in few words, nor are we furnished with that sufficiency of experiments which is required to do an accurate determination and demonstration of the laws by which this electric and elastic Spirit operates. (p. 443)

The hopes for a science of psychology and for a psychology of science are part of an epic story that continued into the mid-eighteenth century, when the British Enlightenment physician David Hartley (1749) published a book that thoughtfully combined moral philosophy and religion with the theory of psychological associations. Associationism's roots go back at least to Aristotle and recently had passed through John Locke, the Reverend Gay, and others. Hartley also intelligently combined these ideas with the earlier conjecture by Isaac Newton and others that underlying neural *vibrations* of some sort might be the material foundation for all the things that minds do. However, worry about contaminating science with fuzzy thinking led another great scientist, Hartley's admirer Joseph Priestley, later to republish Hartley's theory of psychological associations while extirpating the parts about neural vibrations. There was, and remains, considerable debate about whether Priestley was justified (Glassman and Buckingham in press; Smith 1987; Spadafora 1990; Wallace 2003).

About a century after Priestley's revision, the issue was still in play when the eminent British neurologist Henry Maudsley saw a fundamental flaw in thinking about ideas as "mechanical stamps" of experiences (Robinson 1995, 307). And yet, speaking out of the other side of his mouth, Maudsley reached toward a unified conception of mind and matter in a way celebratory of analogy and strikingly parallel to Hartley's well-qualified thoughts about vibrations, their hypothetical corpuscular and "subtle" aether-fluid media, and similarities to light and sound. Maudsley wrote,

> Is it not the fact indeed that the undulatory theory of light was first suggested by the undulations of sound? In like manner, the gulf between the conception of the movements of cerebral molecules of the self-consciousness of will-energy [may] be one and the same seen under different aspects. . . . if the object and the brain are alike pervaded by such a hyper-subtle ether; and if the impression which the particular object makes upon mind be then a sort of pattern of the multifarious undulations [upon] the exceedingly complicated and delicate structure of the brain; —then it is plain we have eluded the impossible difficulty of conceiving the action of mind upon matter. . . . (p. 101)

About the same time, ideas about vibrations were also present in T. H. Huxley's classic study of the crayfish, used as an exemplar and vehicle to elucidate the general character of the science of zoology. The hypothetical vibrations were likened to sound transmission along a wooden rod to a tuning fork (Huxley 1880, 106). Huxley further noted, "the vibrations of the luminiferous ether are brought to bear upon the free ends of two large bundles of nerve fibers, termed the optic nerves" (p. 118).

Also in the late nineteenth century, wisely recognizing the lack of both method and knowledge, James ([1890] 1950) considered materialist approaches to the mind/brain issue while wryly referring to "brain vibration" (p. 129) and expressing respect for the enduring intractability of the problem. He wrote,

> The spiritualistic reader may nevertheless believe in the soul if he will; whilst the positivistic one who wishes to give a tinge of mystery to the expression of his positivism can continue to say that nature in her unfathomable designs has mixed us of clay and flame, of brain and mind, that the two things hang indubitably together and determine each other's being, but how or why, no mortal may ever know. (p. 182)

As this epic continues, it seems more than mere historical accident that the concept of oscillations today underpins much knowledge of neurodynamics (Barlow 1993; Brazier 1959; Glassman 2000; Shepherd 1992; Steriade et al. 1990). In my own hindsight, Priestley was too priestly in pithing Hartley's theory's brain conjecture.

Indeed, there are times when the empirical world shocks our sense of plausibility. Notwithstanding Hartley's disavowal of literal interpretation of his vibration metaphor, "that Nerves themselves should vibrate like musical Strings is highly absurd" (pp. 11–12), the electrochemical oscillations of neurons may transduce into actual mechanical vibrations of synaptic spines! A current neuroscience textbook suggests a close analogy between muscle fibers and the electrically excitable actin microfilament components of neuronal cytoskeleton: "Your neurons are probably squirming around in your head even as you read this sentence" (Bear, Connors, and Paradiso 2007, 35). Others further explain the mechanism of rapid change in cell shape while crediting Francis Crick for the "twitching spine" hypothesis (Smythies 2002, 64; Douglas, Markram, and Martin 2004). The significance of this is that the very structure of the brain, regulating

the strengths of connections among neurons, may change quickly, in fractional seconds of psychological time, as our perceptions, thoughts, and feelings flow from moment to moment.

So it seems today that Newton and Hartley were making good hypothetical sense. They well knew the limits of empirical knowledge and methods of the eighteenth century, yet they saw an important problem that reached beyond. What should a good scientist do? Parsimoniously wield Occam's razor, or daringly—with humility and care—reach out and up?

Conclusion

Oh, Logos: To better know you, must we begin a new "ology"?

The answer to this question, in the Augustinian style, is "Not yet." The thrust of my foregoing comments is that it is not time to bind ourselves by codifying a psychology of science. First we need to gather more contributions and to put them in play.

Humans are creatures having no more than the fundamental conscious capacity of other higher vertebrates; that is, we are capable of awareness of only up to about seven elementary items at once (Glassman, Leniek, and Haegerich 1998). Nevertheless, overall we have evolved capacious mind/brain capacity (Glassman 2002), with long-term memories populated deeply and stabilized by versatile language symbols. We have become the most adaptable of creatures in the way we can allocate and reallocate brain tissue. We variously "boot up" and configure our meetings with each moment—looking out at the world, being in it, and interacting as parts of it. With age and fortunate choices, individuals and institutions grow in wise versatility.

Our enthusiasms, assertiveness, and hesitancies ignite within the small, moving window of consciousness. In the ways we configure each of its dynamic moments we play out our responsibility and freedom. We are many orders of magnitude larger than the shimmering elusive quanta that are our most minute components, but there are also fundamental uncertainties present, independently of quantum-level uncertainty, at our macro level of human existence. These uncertainties coexist in a dance with our many fundamental certainties of time, place, form, and substance. This is because we are the agents of our own continuing evolution. We create new facilities for ourselves, which entail new certainties. We then exploit these facilities, share them, and further exploit them in cooperations and competitions of human systems too complex to be self-perceived and modeled faster than the evolution of reality itself takes place. We keep trying in new ways but never fully achieve the ability to look back at ourselves from the future before that future becomes the present. In living, we never completely see ourselves coming. As individuals and groups, and as a species, we create new uncertainties as quickly as we resolve older ones. And really,

that is how we want it. We spend much of life adventuring in the margin of fact and value.

There are many levels to our habits and choices in structuring each moment. The habits emanate from the membership and history of each of us in a particular culture, subculture, family, educational tradition, and so forth. These multiple embedded and overlapping structures evolve over various time scales, all of them slower than our now-moments of consciousness, with their passing, selected 7±2 working memory chunks (Glassman 2005). When we create a new institution it is a whole new organized level or systematic option at an existing level. Our inherently well-lubricated, fast-acting consciousness then becomes constrained in new ways by virtue of the new institution's affecting our conditional parsings of long-term memory into chunks, schemas, and scripts. We then build any new thoughts with this new, hardened, polished set of thought-bricks. We should ask whether the new institution seems more likely to constrain degrees of freedom in liberating ways or stultifying ways.

We want to think carefully as the twig is bent: Is this sprout, as it grows, likely only to gnarl and bush and become impacted, or is it likely to find new sunlight and flourish? Feist's book contains good resource gathering, but its perspectives remain too narrow. A healthy psychology of science needs a broader ground of more diverse sources of ideas. Among the preparations for a thriving psychology of science should be cross-fertilizing wisdoms from empirical and systematic approaches to theology about how truth-seeking institutions tend to tumble and fumble but, sometimes along the way, evolve well.

NOTES

1. Viewing serious matters with humor is a fundamental strategy of human adaptability. Hebrew Bible aficionados know that Moses' anger at resurgent idolatry at Sinai was not the first disappointment from a dissatisfied stiff-necked people he faced in his long journey of leadership. Michael Wex (2005, 3) offers the following droll commentary:

> Like so much of Jewish culture, kvetching has its roots in the Bible, . . .
>
> So, for example, the Israelites are on the edge of the Red Sea with Pharaoh and his hosts closing fast behind them. God has been plaguing the Egyptians left and right and has just finished killing every one of their firstborn males. The Israelites are understandably nervous, but there's a big difference between being slightly apprehensive and insulting the agent of your deliverance: "And they said to Moses 'What? There's no graves in Egypt, you had to take us into the *desert* to die. . . . What did we tell you in Egypt? Get off our backs and let us serve the Egyptians, because serving the Egyptians is better than dying in the desert'" (Exod. 14:11–12).
>
> This sort of thing constitutes what might be called the basic kvetch. . . .

2. The readiness with which something so good and apparently simple as love ramifies into complexity seems deeply implicit in the thing itself rather than a result of competing evils of some sort coming at it from the outside. Among the excellent examinations of kinds and complexities of love is the frank treatment by C. S. Lewis (1960); the audio book of *The Four Loves*, read by Lewis himself, is worth listening to. Also from Britain, the contemporary debonair romantic comedy film *Love Actually* (Curtis 2004) manages, in a rather uninhibited British way, via diverse stories of longing and hesitation by the characters in the weeks up to Christmas, to say a good deal that is more general about the challenges and complexities human

beings encounter in expressing love. This is an example of how secular arts and literature, in interdisciplinary cross-fertilization, can add thought-provoking leavening, with smiles, to the heavy substance of a religious principle.

3. Reminiscent of Senator William Proxmire's mocking of science years ago with his "Golden Fleece Award" is a recent op-ed piece by humorist Garrison Keillor (2007). It begins, "I see in the paper that the U.S. Department of Education laid out $750,000 for a study that shows that going to art museums and looking at art is good for schoolchildren, which I would have been happy to tell them for, say, $500 and a nice lunch. . . . If the government is paying large sums of money to have the obvious pointed out, then I am your man."

REFERENCES

Ashcraft, M. H. 2002. *Cognition*. 3d ed. Upper Saddle River, N.J.: Prentice-Hall.

Barlow, J. S. 1993. *The Electroencephalogram: Its Patterns and Origins*. Cambridge: MIT Press.

Bear, M. F., B. W. Connors, and M. A. Paradiso. 2007. *Neuroscience: Exploring the Brain*. Baltimore: Lippincott Williams and Wilkins.

Berk, L. E. 2003. *Child Development*. Boston: Allyn and Bacon.

Braitenberg, V., and A. Schüz. 1998. *Cortex: Statistics and Geometry of Neuronal Connectivity*. 2d ed. Berlin: Springer.

Brazier, M. A. B. 1959. "The Historical Development of Neurophysiology." In *Handbook of Physiology. Section 1: Neurophysiology*, Vol. 1, ed. J. Field, H. W. Magoun, and V. E. Hall, 1–58. Washington, D.C.: American Physiological Society.

Bueno, C. A., J. F. Soechting, and M. Flanders. 1997. "Postural Dependencies of Muscle Actions: Implication for Neural Control." *Journal of Neuroscience* 17:2128–42.

Burhoe, Ralph Wendell. 1986. "War, Peace, and Religion's Biocultural Evolution." *Zygon: Journal of Religion and Science* 21:439–72.

Choplin, J. M. 2002. "Magnitude Comparisons Distort Mental Representations of Magnitude." *Journal of Experimental Psychology: General* 131:270–86.

Cole, R., and S. Cole. 1973. *Social Stratification in Science*. Chicago: Univ. of Chicago Press.

Curtis, R. 2004. *love actually* (DVD). Universal City, Calif.: Universal.

Douglas, R., H. Markram, and K. Martin. 2004. "Neocortex." In *The Synaptic Organization of the Brain*, 5th ed., ed. G. M. Shepherd, 499–558 (chap. 12). New York: Oxford.

Ehrenreich, Barbara. 2007. "Pathologies of Hope." *Harpers Magazine* 314 (no. 1881): 9–11.

Ericsson, K. A., ed. 1996. *The Road to Excellence: The Acquisition of Expert Performance in the Arts and Sciences, Sports, and Games*. Mahwah, N.J.: Lawrence Erlbaum.

EurekAlert. 2006. "How the octopus forms an elbow: Human-like movement control helps flexible arms achieve precision." (News release about *Current Biology* article.) *www.eurekalert.org/pub_releases/2006-04/cp-hto041306.php*.

Feist, Gregory J. 2006. *The Psychology of Science and the Origins of the Scientific Mind*. New Haven: Yale Univ. Press.

Feynman, Richard. P. [1974] 1985. "Cargo Cult Science," adapted from Caltech commencement address, in *Surely You're Joking, Mr. Feynman!* Adventures of a Curious Character, as told to Ralph Leighton, ed. Edward Hutchings, 308–17. New York: W. W. Norton. Also at *http://music.ls.huji.ac.il/members/nachum/feynman.html*.

Gilkey, Langdon. 2001. *On Niebuhr: A Theological Study*. Chicago: Univ. of Chicago Press.

Glassman, Robert B. 1983. "Free Will Has a Neural Substrate: Critique of Joseph F. Rychlak's *Discovering Free Will and Personal Responsibility*." *Zygon: Journal of Religion and Science* 18:67–82.

———. 2000. "A 'Theory of Relativity' for Cognitive Elasticity of Time and Modality Dimensions Supporting Constant Working Memory Capacity: Involvement of Harmonics among Ultradian Clocks?" *Progress in Neuro-Psychopharmacology and Biological Psychiatry* 24:163–82.

———. 2002. "'Miles within Millimeters' and Other Awe-inspiring Facts about Our 'Mortarboard' Human Cortex." *Zygon: Journal of Religion and Science* 37:255–77.

———. 2005. "The Epic of Personal Development and the Mystery of Small Working Memory." *Zygon: Journal of Religion and Science* 40:107–30.

Glassman, Robert B., and H. W. Buckingham. In press. "David Hartley's Neural Vibrations and Psychological Associations." In *Brain, Mind and Medicine: Essays in Eighteenth Century Neuroscience*, ed. Harry Whitaker, C. U. M. Smith, and Stanley Finger. New York: Springer.

Glassman, Robert B., K. M. Leniek, and T. M. Haegerich. 1998. "Human Working Memory Capacity Is 7±2 in a Radial Maze with Distracting Interruption: Possible Implication for Neural Mechanisms of Declarative and Implicit Long-term Memory." *Brain Research Bulletin* 47:249–56.

Gray, P. 2007. *Psychology*. 5th ed. New York: Worth.

Hartley, David. 1749. *Observations on Man, His Frame, His Duties, and His Expectations.* 2 vols. London: S. Richardson.

Hefner, Philip. 2007. "Arthur Peacocke's Theology of Possibilities." In Arthur Peacocke, *All That Is: A Naturalistic Faith for the Twenty-First Century*, ed. Philip Clayton, 59–69. Minneapolis: Fortress.

Henig, R. M. 2007. "Darwin's God." *The New York Times Magazine* (March 4), Section 6, pp. 36–43, 58, 62, 77–78, 85.

Heschel, Abraham J. 1955. *God in Search of Man: A Philosophy of Judaism.* New York: Farrar, Straus and Giroux.

———. 1962. *The Prophets, II.* New York: Harper and Row.

Huxley, Thomas Henry. 1880. *The Crayfish*. New York: Appleton and Company.

Jackelén, Antje. 2007. "An Intellectually Honest Theology." Lecture given at the symposium honoring Arthur Peacocke, "Evolutionary Theory and Theology: A Dialogue," 9–10 February 2007, sponsored by the Zygon Center for Religion and Science, Chicago.

James, William. [1890] 1950. *The Principles of Psychology.* Vol. 1. New York: Dover.

Keillor, Garrison. 2007. "Family? Gender? Cowboys? I'll Tell You All about It." *Chicago Tribune* (March 14), Sec. 1, p. 23.

Kent, D., and R. Haywood. 2007. "When Averages Hide Individual Differences in Clinical Trials." *American Scientist* 95:60–68.

Lewis, C. S. 1960. *The Four Loves*. New York: Harcourt, Brace.

Maimonides, M. [1194] 1956. *The Guide for the Perplexed.* Second, revised ed. New York: Dover.

Maudsley, Henry. 1884. *Body and Will.* New York: D. Appleton.

Newton, Isaac. [1723] 1995. *The Principia*. 3d ed. Trans. A. Motte. Amherst, N.Y.: Prometheus.

Papalia, D. E., S. W. Olds, and R. D. Feldman. 2001. *Human Development, Eighth Edition*. New York: McGraw-Hill.

Peacocke, Arthur. 2007. *All That Is: A Naturalistic Faith for the Twenty-First Century.* Ed. Philip Clayton. Minneapolis: Fortress.

Peters, K. E. 2007. "Empirical Theology and a 'Naturalistic Christian Faith.'" In Arthur Peacocke, *All That Is: A Naturalistic Faith for the Twenty-First Century,* ed. Philip Clayton, 93–103. Minneapolis: Fortress.

Robinson, D. N. 1995. *An Intellectual History of Psychology.* 3d ed. Madison: Univ. of Wisconsin Press.

Rosenzweig, M. R., S. M. Breedlove, and N. V. Watson. 2005. *Biological Psychology: Introduction to Behavioral and Cognitive Neuroscience.* 4th ed. Sunderland, Mass.: Sinauer.

Rychlak, Joseph F. 1979. *Discovering Free Will and Personal Responsibility*. New York: Oxford.

Shepherd, G. M. 1992. "Canonical Neurons and Their Computational Organization." In *Single Neuron Computation*, ed. T. McKenna, J. Davis, and S. F. Zornetzer, 27–60. New York: Academic Press.

Skinner, B. F. 1971. *Beyond Freedom and Dignity*. New York: Alfred A. Knopf.

Smith, C. U. M. 1987. "David Hartley's Newtonian Neuropsychology." *Journal of the History of the Behavioral Sciences* 23:123–36.

Smythies, J. 2002. *The Dynamic Neuron*. Cambridge: MIT Press.

Spadafora, D. 1990. "Medicine of the Mind." In *The Idea of Progress in Eighteenth-Century Britain*, 135–78 (chap. 4). New Haven: Yale Univ. Press.

Steriade, M., P. Gloor, R. R. Llinas, F. H. Lopes da Silva, and M-M Mesulam. 1990. "Basic Mechanisms of Cerebral Rhythmic Activities." *Electroencephalography and Clinical Neurophysiology* 76:481–508.

Sumbre, G., G. Fiorito, T. Flash, and B. Hochner. 2006. "Octopuses Use a Human-like Strategy to Control Precise Point-to-Point Arm Movements." *Current Biology* 16:767–72.
Tillich, Paul. 1963. *Systematic Theology. Vol. 3: Life and the Spirit: History and the Kingdom of God*. Chicago: Univ. of Chicago Press.
Wallace, W. 2003. "The Vibrating Nerve Impulse in Newton, Willis, and Gassendi: First Steps in a Mechanical Theory of Communication." *Brain and Cognition* 51:66–94.
Weiten, W. 2007. *Psychology: Themes and Variations*. Belmont, Calif.: Thomson Higher Education.
Wex, M. 2005. *Born to Kvetch: Yiddish Language and Culture in All Its Moods*. New York: St. Martin's.
Wikipedia. 2007. "Systematic Theology." *http://en.wikipedia.org/wiki/Systematic_theology*.
Woloschak, Gayle E. 2007. Discussant in Part III, "A Final Legacy: A Naturalistic Christian Theology," at the symposium honoring Arthur Peacocke, "Evolutionary Theory and Theology: A Dialogue," 9–10 February 2007, sponsored by the Zygon Center for Religion and Science, Chicago.