Irreducible Mind

TOWARD A PSYCHOLOGY FOR THE 21st CENTURY

EDWARD F. KELLY,
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Dedicated to

F. W. H. Myers
a neglected genius of scientific psychology

and to

Ian Stevenson
and
Michael Murphy
two modern bearers of his intellectual legacy

"I had… often a sense of great solitude,
and of an effort beyond my strength"
(Myers, 1893/1961, p. 40)

Preface and Acknowledgments

This book originated from a seminar directed to theoretical foundations of scientific psycholog initiated in 1998 by Michael Murphy under the auspices of the Center for Theory and Research Esalen Institute. By the year 2000 our discussions had advanced to the point where we believed w could demonstrate, empirically, that the materialistic consensus which undergirds practically all current mainstream psychology, neuroscience, and philosophy of mind is fundamentally flawed. W therefore committed ourselves to developing a book-length presentation which would systematical articulate and defend this point of view.

Our general strategy was to assess the overall state of psychology, as it exists here at the beginnin of the 21st century, from a perspective that deliberately but selectively takes into account its fir hundred-plus years of organized scientific effort. The essential driving idea was to step backward, th better to jump forward—"*reculer pour mieux sauter.'* The tactical opportunity for this exercise was be provided by the centennial of the publication in 1903 of an extraordinary book by a large forgotten genius, F. W. H. Myers, titled *Human Personality*. Deeply admired by William James an other leading scholars of that period, this two-volume work is unquestionably a great but neglecte classic of our science. It advances an elaborate but empirically supported theory of the constitutio and functioning of human beings, one that in many ways is sharply at odds with current mainstrea thinking, but one that we believe penetrates far closer to the empirical truths of the matter. By framin the relevant issues in the context of Myers's work, we thought, we would be able to justify and some extent foreshadow what we anticipate will become a major and vitally necessary reworking central parts of scientific psychology.

The basic plan of the book was to be threefold. First, we would provide an exposition of Myers theoretical and empirical contributions. Second, we would systematically and critically examin subsequent research on a variety of empirical topics that were central to the theoretical position developed. Finally, we would attempt to assess, in light of this review, where things now stand psychology and where we need to go. The goal throughout would be not simply to celebrate Myers project as he himself left it, but to carry it forward in the context of relevant substantive an methodological achievements of the intervening century.

The large book you hold in your hands realizes these intentions, to the extent permitted by ou collective capacities and knowledge. We missed our original deadline, which seemed at first to lie in far-distant future, by a full three years. This was due not to lack of effort on our part but to th dimensions of the task, which we seriously underestimated. The book could easily have become larg still. The subjects we discuss are individually complex and deeply intertwined, with ramifications th proliferate endlessly in interesting directions. Most chapters and even parts of some chapters cou easily become books in themselves, and some probably will. Many chapters also deal with issues th lie at or beyond the currently recognized boundaries of "accepted" science, and therefore pose speci challenges for responsible presentation. Despite their intrinsic difficulties, however, these divers materials combine to produce what we think is a compelling demonstration that current mainstrea opinion in psychology *must* change, and in directions that are both theoretically fundamental an humanly momentous. In a nutshell, we are arguing for abandonment of the current materialist synthesis, and for the restoration of causally efficacious conscious mental life to its proper place at th center of our science. We hope to catalyze the emergence of an enlarged and reunified mainstrea psychology, one that does not systematically ignore—as the present-day mainstream does—man large bodies of evidence deeply relevant to our most central and abiding human concerns.

In the interest of effectively promoting this sea-change we have deliberately crafted our book for

primary audience consisting of advanced undergraduate and early-stage graduate students, particular students in disciplines such as psychology, neuroscience, and philosophy. These are the future leade of our field, and we want to reach them before they suffer the "hardening of the categories" that all to often accompanies entry into these highly specialized professions. To do so required that our materi be presented with a level of currency, detail, and rigor commensurate with that of the oth professional materials such persons are exposed to on a daily basis, and we have attempted to me that standard.

This has necessarily involved some difficult tradeoffs, however, for we also wanted our book to b accessible to anyone of good general education and intelligence who is seriously interested in i subject matter and willing to make the necessary effort. We have tried to ease the burden for suc persons in various ways—for example by defining obscure or "jargon" terms, providing interi summaries and abstracts, and relegating many points of more technical or scholarly interest parentheses and footnotes. However, there is no escaping the fact that some parts of the argumen especially parts of Chapters 1, 4, 7, and 9, are likely to present difficulties, particularly on fir encounter. We implore such readers to be understanding and patient with us and persistent in the own efforts, skipping over any particularly challenging sections at first and returning to them lat with a better sense of how everything fits into the overall scheme.

Our book has the outward form of an edited volume but is atypical of that genre. It is unite throughout by a single theme, our collective drive toward a broadly correct, though necessari incomplete, scientific picture of the mind as it relates to brain activity. This generalist impuls contrasts sharply with the extreme specialization that characterizes the sciences and other mode professions, and that is often especially pronounced in edited books. Edited volumes in science ofte address narrow topics and consist of pieces authored in hermetic isolation for small groups specialists interested mainly in talking to each other. That is emphatically not the case with th present work. The book as a whole and its chapters individually take on big issues and seek to engag large numbers of readers. Several chapters include two or more of us as authors, and all we generated not in isolation but in conformity with an overall plan that emerged through grou discussions spanning a period of years.

Our collective professional experience covers a wide range in terms of education, research, an teaching in psychology, psychiatry, neuroscience, and philosophy, and all of us have had th opportunity to read and critique every part of the book, usually in multiple versions. In addition pooling our own professional expertise in this way, we have sought critical feedback on chapter draf from outside volunteer readers including both professional colleagues from various disciplines an more general readers representing a diversity of backgrounds. Their efforts and suggestions have le to numerous improvements throughout the book, for which we are grateful. We are acutely aware tha many gaps and imperfections remain, and we take full responsibility for these. One of our main poin is that what is most urgently needed for further theoretical progress is more and better data of certa critical and specified kinds; this, the greater good, seemed better served by getting the book out no in reasonably finished form than by obsessing further over potentially endless refinements.

Finally, we wish to acknowledge contributions from individuals who have supported this project i various special ways. Among our "test-drivers" we give particular thanks to Carlos S. Alvarad William Barnard, Frank Benford, Lori Derr, Ross Dunseath, Lorin Hollander, Fritz Klein, Jeff Kripa James Lenz, Cory Maxwell, Francis McGlone, Michael Murphy, Margaret Pertzoff, Michael Schaffe Ben Snyder, Ian Stevenson, Pirn van Lommel, and Ray Westphal. Seminar participants who hav contributed vigorously to the interdisciplinary conversations that helped shape the book inclu Richard Baker, John and Alyce Faye Cleese, David Fontana, Owen Flanagan, Arthur Hastings, Sea Kelly, Antonia Mills, Michael Murphy, Gary Owens, Frank Poletti, Dean Radin, William Roll, Bo

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Introduction

Edward F. Kelly

The central subject of this book is the problem of relations between the inherently private, subjectiv "first-person" world of human mental life and the publicly observable, objective, "third-person" wor of physiological events and processes in the body and brain.

Scientific psychology has been struggling to reconcile these most-basic dimensions of its subje matter ever since it emerged from philosophy near the end of the 19th century. Both were fully prese in William James's monumental *Principles of Psychology* (1890b), the earliest English-langua survey of the new academic discipline that is still widely cited today. James explicitly acknowledge the normally intimate association between the mental and the physical, and he systematically an sympathetically rehearsed what little was then known or surmised about the brain. Unlike many of h scientific contemporaries, however, James resisted premature and facile attempts at neur reductionism. When he recognized limitations on the physiological side, he was content to record h psychological observations and await further progress in neurophysiology. The bulk of the *Principl* therefore consists of masterful expositions, relying heavily on sophisticated observation of his ov inner workings, of central properties of mental life such as attention, imagination, the stream consciousness, volition, and—at the heart of everything—the self (Leary, 1990).

James's person-centered and synoptic approach was soon largely abandoned, however, in favor a much narrower conception of scientific psychology. Deeply rooted in earlier 19th-century though this approach advocated deliberate emulation of the presuppositions and methods—and thus, it w hoped, the stunning success—of the "hard" sciences, especially physics. James was barely in his grav when J. B. Watson (1913) published the founding manifesto of radical behaviorism, the logic culmination of this tradition. Psychology was no longer to be the science of mental life, as James ha defined it. Rather it was to be the science of behavior, "a purely objective experimental branch natural science" (p. 158). It should "never use the terms consciousness, mental states, mind, conten introspectively verifiable, imagery, and the like" (p. 166). Its task was instead to identify lawf relationships between stimuli and responses: "In a system of psychology completely worked ou given the response the stimuli can be predicted; given the stimuli the response can be predicted" (167).

Watson's doctrine quickly took hold, and for the next half-century mainstream America psychology deliberately avoided contact with issues of the sort most important to James. It large abandoned the first-person perspective of the investigator trying to understand things from within, an adopted almost exclusively that of an external observer whose task it is to predict and control th behavior of a material object, an opaque "black box," the experiential interior of which psychologic science can and should ignore. Indeed, the success of physical science could be viewed as resulting part precisely from its having in a similar way stripped from *its* subject matter all traces of purpo and teleology. In hopes of carrying through Watson's program of discovering units and laws in term of which all behavior might ultimately be explained, most psychologists thus turned to narrow behaviorist experimental studies—sometimes of humans but more commonly of simpler organism and typically in artificially simplified environments.

The inward dimension of psychology did not altogether disappear, however. The ol introspectionist schools lingered on for a while, and introspection continued to play a significant ro in areas such as psychophys-ics and the mainly European movements known as Gestalt psycholog

and phenomenology. During the same years in which behaviorism was seizing control of the America scientific mainstream, people such as Janet, Freud, Jung, and their followers were elaborating th various schools of depth psychology or "dynamic psychiatry" (Ellenberger, 1970). Even in the darke days of the early behaviorist period—the rabid and monolithic "Age of Theory" (Koch & Leary, 198 —major figures such as Morton Prince, Henry Murray, Gordon Allport, and Gardner Murph steadfastly defended the complexities of human mind and personality against simplistic reductioni onslaughts. More recently, schools of "humanistic" and "transpersonal" psychology have als emerged which openly aspire to bring the deeper parts of human personality back within th framework of scientific psychology. It cannot be denied, however, that for most of psychology's fir century these dissident movements have had to wage an uphill battle at or sometimes beyond th margins of the discipline.

The ascendancy of the behaviorist juggernaut thus essentially fragmented the traditional subjec matter of scientific psychology as envisioned by pioneers such as James, and left the fragments in th care of distinct, poorly integrated, and sometimes even mutually antagonistic professional su specialties. That the deep divisions it created remain with us even today is conspicuously exemplifi by the 1989 schism within the American Psychological Association, which reaffirmed a fundament split between the experimental and clinical dimensions of the field. These divisions represent, w contend, something much deeper than the ordinary process of specialization within an otherwi unified scientific discipline. Rather, they reflect the continuing failure of scientific psychology come fully to grips with the inescapably dual nature of its subject matter—in short, with the min brain problem that lies at the heart of our discipline.

This has begun to change, however, in part because of the maturation of mainstream psycholog itself. The 20th-century co-evolution of mainstream psychology with developments in allied fiel such as neuroscience and philosophy of mind began with progressive refinement, but ultimate rejection, of its original behaviorist formulations, which fell by the wayside as their defects an limitations were progressively identified and articulated. Starting in the 1950s, however, a mo sophisticated form of behaviorism arose, uniting the philosophical doctrine of functionalism with th logical theory of Turing machines and the applications technology provided by the digital compute As described in more detail in the following chapter, this "Computational Theory of the Mind" (CTM liberated cognitive science from the most oppressive strictures of radical behaviorism and h dominated the mainstream ever since. It also is currently driving what appears to many observers an participants to be an ever-deepening and unquestionably successful marriage between psychology an neuroscience.

Any contemporary discussion of mind-brain issues must certainly take into account the enormou advances made during the past century in our understanding of the brain. New manifestations of min appear everywhere to be closely associated with modifications of structure or process in brains. evolution, for example, we see an overall correlation across animal species between behavior complexity and the level of organization of the nervous system. The rapid post-natal ment development of the human infant likewise is associated with massive structural and function changes in its maturing brain. And as human adults we are all familiar with numerous facts—th normal daily fluctuations of consciousness and the effects of mild cerebral trauma induced by alcoh and other psychoactive substances, fatigue, thumps on the head, and so on—that also reflect in general way this dependence of mind upon brain. But what about the details?

In recent decades brain researchers have begun "opening up the black box," deploying formidable array of increasingly sophisticated clinical, pharmacological, biochemical, geneti neurosurgical, electrophysiological, and behavioral methodologies in efforts to understand what brai can do and how they do it. The last 20 years in particular have witnessed the emergence of an enti

family of new “functional neuroimaging” techniques such as high-resolution electroencephalograph (EEG), functional magnetic resonance imaging (fMRI), and positron emission tomography (PET which allow researchers to observe with ever-increasing temporal and spatial precision subt physiological processes taking place in the interior of intact and functioning human brains.

These techniques have yielded a torrent of new information about the brain. Scientists ar philosophers confronting the mind-body problem even as recently as a century ago knew only in relatively global and undifferentiated fashion that the brain is the organ of mind. Today we know great deal more, although our knowledge undoubtedly remains in many respects extremely primitiv relative to the brain’s unimaginable complexity. We know a lot about the structure and operation o neurons and even lower-level constituents. We also know a lot about the *structural* organization of th brain, its wiring diagram, and thanks mainly to the new imaging technologies we have begun to learn fair amount about its *functional* organization, the manner in which complex patterns of neural activi are mobilized and coordinated across spatially separated regions of the brain in conjunction wi ongoing experience and behavior.

The empirical connection between mind and brain seems to most observers to be growing ev tighter and more detailed as our scientific understanding of the brain advances. In light of th successes already in hand, it may not seem unreasonable to assume as a working hypothesis that th process can continue indefinitely without encountering any insuperable obstacles, and that properti of minds will ultimately be fully explained by those of brains. For most contemporary scientist however, this useful working hypothesis has become something more like an established fact, or eve an unquestionable axiom. At the concluding ceremonies of the 1990s “Decade of the Brain,” fo example, Antonio Damasio (1999) encapsulated the prevailing view:

> In an effort that continues to gain momentum, virtually all the functions studied in traditional psychology—perception, learning a memory, language, emotion, decision-making, creativity—are being understood in terms of their brain underpinnings. The mysteri behind many of these functions are being solved, one by one, and it is now apparent that even consciousness, the towering proble in the field, is likely to be elucidated before too long.[1]

That an enormous amount of methodological and substantive progress has been made by scientif psychology in its first century can hardly be denied, and I do not mean to deny it. But what sort of ro conception of human mind and personality has so far emerged from all this effort? There are mar rapidly shifting cross-currents and variations of detail amid the welter of current views, but to th extent that any provisional consensus has been achieved by contemporary mainstream scientist psychologists and neuroscientists in particular, it is decidedly hostile to traditional and com-monsens notions and runs instead along roughly the following lines: We human beings are nothing bu extremely complicated biological machines. Everything we are and do is in principle causal explainable from the bottom up in terms of our biology, chemistry, and physics—ultimately, that is, terms of local contact interactions among bits of matter moving in strict accordance with mechanic laws under the influence of fields of force.[2] Some of what we know, and the substrate of our gener capacities to learn additional things, are built-in genetically as complex resultants of biologic evolution. Everything else comes to us directly or indirectly by way of our sensory systems, throug energetic exchanges with the environment of types already largely understood. Mind an consciousness are entirely generated by—or perhaps in some mysterious way identical with- neurophysiological events and processes in the brain. Mental causation, volition, and the “self” do n really exist; they are mere illusions, by-products of the grinding of our neural machinery. And o course because one’s mind and personality are entirely products of the bodily machinery, they wi necessarily be extinguished, totally and finally, by the demise and dissolution of that body.

Views of this sort unquestionably hold sway over the vast majority of contemporary scientists, an

by now they have also percolated widely through the public at large.[3] They appear to be supported b
mountains of evidence. But are they correct?

The authors of this book are united in the conviction that they are *not* correct—that in fundament respects they are at best incomplete, and at certain critical points demonstrably false, empiricall These are strong statements, but our book will systematically elaborate and defend them. Our doub regarding current psychological orthodoxy, I hasten to add, are at least in part shared by others. The seems to be a growing unease in many quarters, a sense that the narrowly physicalist contempora approach to the analysis of mind has deflected psychology as a whole from what should be its mo central concerns, and furthermore that mainstream computationalist/physicalist theories themselv are encountering fundamental limitations and have nearly exhausted their explanatory resources. Th recent resurgence of scientific and philosophic interest in consciousness and altered states consciousness, and in the deep problems which these topics inherently involve, is just one promine symptom, among many others, of these trends.

Even former leaders of the "cognitive revolution" such as Jerome Bruner, Noam Chomsky, Georg Miller, and Ulric Neisser have publicly voiced disappointment in its results. Chomsky in particul has railed repeatedly and at length against premature and misguided attempts to "reduce" the mind currently understood neurophysiology. Chomsky (1993), for example, pointed out that empiric regularities known to 19th-century chemistry could not be explained by the physics of the day, but d not simply disappear on that account; rather, physics eventually had to expand in order accommodate the facts of chemistry. Similarly, he argued, we should not settle for speciou "reduction" of an inadequate psychology to present-day neurophysiology, but should instead see "unification" of an independently justified level of psychological description and theory with a adequately complete and clear conception of the relevant physical properties of the body and brain- but only if and when we get such a conception. For in Chomsky's view, shared by many moder physicists, advances in physics from Newton's discovery of universal gravitation to 20th-centu developments in quantum mechanics and relativity theory have undermined the classical an commonsense conceptions of *matter* to such an extent that reducibility of mind to matter is anythi but straightforward, and hardly a foregone conclusion.

Several contemporary state-of-the-art surveys in psychology—for example, Koch and Lea (1985), Solso (1997), and Solso and Massaro (1995)—provide considerable further evidence dissatisfaction with the theoretical state of things in psychology and of a widely felt need to regain th breadth of vision of its founders, such as William James. Solso and Massaro (1995) remark in the summing-up that "central to the science of the mind in the twenty-first century will be the question how the mind is related to the body" (p. 306) and that "the self remains a riddle" (p. 311). Davi Leary's (1990) essay on the evolution of James's thinking about the self begins by documenting th remarkable degree to which the *Principles* had already anticipated most of the substance subsequent psychological investigations of the self. He then goes on, however, to emphasize that lat developments in James's own thought—developments completely unknown to the vast majority contemporary psychologists—contain the seeds of an enlarged and deepened conception of the se that can potentially secure its location where James himself firmly believed it belongs, at the ve center of an empirically adequate scientific psychology. From still another direction, Hen Ellenberger (1970) ends his landmark work on the discovery of the unconscious with a plea f reunification of the experimental and clinical wings of psychology: "We might then hope to reach higher synthesis and devise a conceptual framework that would do justice to the rigorous demands experimental psychology and to the psychic realities experienced by the explorers of the unconsciou (p. 897).

As will become apparent, our book wholeheartedly endorses this historically consciou

ecumenical, and reintegrative spirit. Before proceeding with its very unusual substance, however, w must set forth certain methodological principles that have guided us throughout, and that we strong encourage our readers to adopt as well.

First and perhaps foremost is an attitude of humility in relation to the present state of scientif knowledge. Although we humans indisputably have learned a great deal through systemat application of our scientific methods, and are learning more at an accelerating rate, we undoubted still have a long way to go. There is surely a great deal about the physical world in general, let alo brains, minds, and consciousness, that we do not yet understand. Furthermore, our intimate *familiari* with the basic facts of mental life—including, for example, our ability to direct our thoughts to stat of affairs in the external world, and indeed the fundamental fact of consciousness itself—should n be confused with *understanding*, or blind us to the deeply puzzling and mysterious character of the phenomena. The self-assurance, even arrogance, of much contemporary writing on these subjec seems to us wholly unjustified and inappropriate. From this point of view many old scientific boo and papers that purport to explain features of mental life in terms of hypothetical brain process make fascinating reading, because of the many ultra-confident pronouncements they contain which hindsight we know to be false. Future readers of many present-day books and papers about brai mind, and consciousness, we believe, are likely to experience similar reactions.

Second, we emphasize that science consists at bottom of certain attitudes and procedures, rath than any fixed set of beliefs. The most basic attitude is that facts have primacy over theories and th beliefs should therefore always remain modifiable in response to new empirical data. In the forcef words of Francis Bacon (1620/1960), from the beginning of the scientific era: "The world is not to l narrowed till it will go into the understanding… but the understanding to be expanded and opened t it can take in the image of the world as it is in fact" (p. 276).

Although all scientists presumably endorse this idea in principle, there are complications a subtleties in practice, because "facts" and theories are strongly interdependent. As remarked long ag by philosopher F. C. S. Schiller (1905), "for the facts to be 'discovered' there is needed *the eye to s them*" (p. 60). Many of the issues discussed in this book revolve around well-documented empiric phenomena—facts, we will insist—that have been systematically ignored or rejected by mainstrea scientists who find them too discordant with prevailing views to take seriously.

This is a tricky and delicate business, however; for when current scientific opinion hardens in dogma it becomes scientism, which is essentially a type of fundamentalism, a secular theology, and n longer science. As William James (1896) remarked, "science means, first of all, a certa dispassionate method. To suppose that it means a certain set of results that one should pin one's fai upon and hug forever is sadly to mistake its genius, and degrades the scientific body to the status of sect" (p. 6).[4] Although this may seem uncontroversial, even trite, it is easily and often forgotten. Th history of science is therefore replete with the sad spectacle of scientists—sometimes even ve prominent scientists talking about their own scientific specialties—issuing what later prove to l profoundly erroneous judgments. For example, Badash (1972) studied the last third of the 19 century, when a "malaise of completeness" pervaded the physical sciences. James Clerk Maxwe commented in 1871 that "the opinion seems to have got abroad, that in a few years all the gre physical constants will have been approximately estimated, and that the only occupation which w then be left to men of science will be to carry on these measurements to another place of decimals" (50). In 1894 his American counterpart A. A. Michelson declared that "it seems probable that most o the grand underlying principles have been firmly established and that further advances are to l sought chiefly in the rigorous application of these principles to all the phenomena which come und our notice" (p. 52). But the next year brought the discovery of X-rays, and within the deca radioactivity, the electron, quantum theory, and relativity would shake the foundations of physic

knowledge. Misjudgments of this magnitude—and many further examples could easily be adduced—should certainly give pause to anyone tempted to presume that today's science defines the limits of the possible.

Although facts have primacy, not all facts are of equal importance. The ones that should count th most, relative to a given problem, are obviously those that can contribute most to its solution. A usef principle that provides orientation and helps guide the search for such facts was stated as follows b Wind (1967): "It seems to be a lesson of history that the commonplace may be understood as reduction of the exceptional, but the exceptional cannot be understood as an amplification of th commonplace" (p. 238). This lesson has not penetrated contemporary cognitive science, which dea almost exclusively with the commonplace and yet presumes—extrapolating vastly beyond what reality are very limited successes—that we are progressing inexorably toward a comprehensiv understanding of mind and brain based on classical physicalist principles. This serene confiden seems to us unwarranted. It is now evident, for example, that chess-playing computer program represent progress toward real intelligence in roughly the same sense that climbing a tree represen progress toward the moon. This book will apply Wind's principle by focusing upon a variety o psychological phenomena that any adequate theory of mind and consciousness will have accommodate, but that we believe cannot be satisfactorily accommodated within the curre explanatory framework of cognitive science. This in turn will motivate an effort to identify a expanded framework capable of overcoming these limitations.

Our own empiricism is thus thorough-going and radical, in the sense that we are willing to look *all* relevant facts and not just those that seem compatible, actually or potentially, with curre mainstream theory. Indeed, if anything it is precisely those observations that seem to conflict wi current theory that should command the most urgent attention. As James (1909/1986) put it: "Whe was not the science of the future stirred to its conquering activities by the rebellious little exceptio to the science of the present?" (p. 375). Or again (James, 1890–1896/1910):

> Round about the accredited and orderly facts of every science there ever floats a sort of dust-cloud of exceptional observations, occurrences minute and irregular and seldom met with, which it always proves more easy to ignore than to attend to…. Any one w renovate his science who will steadily look after the irregular phenomena. And when the science is renewed, its new formulas oft have more of the voice of the exceptions in them than of what were supposed to be the rules, (pp. 299–300)

The contribution of anomalies such as radioactivity and the photoelectric effect to the rise of quantu theory amply confirms the wisdom of this remark.

To qualify for this navigational role, of course, the relevant facts should also be suitably wel attested, and this caveat provides considerable scope for exercise of personal judgment. Science mu always seek an appropriate balance between liberalism and conservatism in the admission of ne observations, and it tends naturally and appropriately toward conservatism, amplified in proportion the depth to which the new observations appear to conflict with expectations based on curre understanding. Contrary to the popular mythology of science, however, such judgments often fa short of its professed ideals of dispassionate and open-minded evaluation of evidence.

Real science is saturated, like all other human endeavors, with human failings. It is oft portrayed, and likes to portray itself, as reliably marshaling the intellectual virtues of reason an objectivity against retreating forces of religion, authority, and superstition—Galileo's treatment at th hands of the Catholic Church providing a hackneyed example. But especially in more recent time opposition to new scientific ideas comes principally from other scientists, and often on less tha satisfactory grounds (B. Barber, 1961; Kuhn, 1962). Harvey's theory of the circulation of the bloo and discoveries by Lister, Semmelweiss, and Pasteur related to the germ theory of disease and th importance of sterilization in hospital environments were at first bitterly resisted by their medic

colleagues. Lord Kelvin strongly resisted Maxwell's formulation of the laws of electromagnetism, an he never gave up his belief that atoms are indivisible (B. Barber, 1961). Scalp-level recording brainstem evoked potentials is now used routinely to verify the integrity of sensory pathways neonates and major-surgery patients, but its developer Don Jewett has described vividly th difficulties he experienced early on in funding and publishing this work, which conflicted with wh his reviewers thought they knew about the behavior of electrical potentials in biological tissu Wegener's geophysical theory of plate tectonics was similarly ridiculed for decades before beir empirically confirmed. Many other examples of this sort could easily be cited. Pioneer of quantu mechanics Max Planck (1950) was perhaps only slightly exaggerating when he said: "A new scientif truth does not triumph by convincing its opponents and making them see the light, but rather becau its opponents eventually die, and a new generation grows up that is familiar with it" (pp. 33–34).

This issue of scientific resistance has proved especially troublesome for one particular family observations among the many kinds we draw upon in developing the central argument of this book- namely, observations adduced in the course of over a century of effort by workers in "psychic research" and its somewhat desiccated modern descendant, "parapsychology." My co-authors and wish therefore to state immediately and unequivocally our own attitude toward this still-controversi subject. The irrational incredulity that remains characteristic of mainstream scientific opinion in th area seems to us a remarkable anomaly that will provide abundant and challenging grist for the mil of future historians and sociologists of science. Sufficient high-quality evidence has long since bec available, we believe, to demonstrate beyond reasonable doubt the existence of the basic "paranorma phenomena, at least for those willing to study that evidence with an open mind.[5]

Our Appendix contains an annotated bibliography providing useful points of entry into this larg and complex literature. I hasten to add that this literature is uneven and imperfect, like any oth scientific literature, and that our endorsement does not extend to all parts of it equally. What we c insist upon, however, is that this scientific literature is something entirely different from what on routinely encounters in checkout lines at the supermarket or in the flood of sensationalized driv invading our TV and movie screens. The public credulity that enables this industry to thrive deplorable, and we ourselves deplore it, but this has no bearing on the underlying scientific issue as whether psi phenomena really exist as facts of nature.

It seems to us axiomatic that no intellectually responsible person, and especially no responsib scientist, should feel entitled to render opinions on this subject without first taking the time an trouble to study the relevant literature. This axiom is regularly violated, however, and in th connection we wish to comment briefly but more generally on the behavior of outside critics of th field, without being drawn into a discussion that could very easily become a book in itself.

The fundamental issue was incisively framed by American philosopher C. J. Ducasse (1969) a follows:

> Although the evidence offered by addicts of the marvelous for the reality of the phenomena they accept must be critically examine it is equally necessary on the other side to scrutinize just as closely and critically the skeptics' allegations of fraud, or malobservation, or of misinterpretation of what was observed, or of hypnotically induced hallucinations. For there is likely to be ju as much wishful thinking, prejudice, emotion, snap judgment, naivete, and intellectual dishonesty on the side of orthodoxy, skepticism, and of conservatism, as on the side of hunger for and belief in the marvelous. The emotional motivation for irresponsib disbelief is, in fact, probably even stronger—especially in scientifically educated persons, whose pride of knowledge is at stake—th is in other persons the motivation for irresponsible belief. In these matters, nothing is so rare as genuine objectivity and impartiality judgment—judgment determined neither by the will to believe nor the will to disbelieve, but only by the will to get at the tru irrespective of whether it turns out to be comfortably familiar or uncomfortably novel, consoling or distressing, orthodox, unorthodox, (p. 35)

In our informed and considered opinion, the critiques of psychical research that have so far bee offered by outside observers mainly demonstrate the validity of Ducasse's concerns, and routinel

though not invariably fail to meet normal standards of scholarly practice. These tendencies we already fully apparent to William James, who took psychical research far more seriously than mo present-day psychologists realize (James, 1986; G. Murphy & Ballou, 1960; E. Taylor, 1996), and the have scarcely abated in the subsequent century. We will not dwell on these controversies here, bu have included in the Appendix some pointers to recent literature that illustrates their strang character.

We do, however, want to highlight here one particular critical strategy that has been ver commonly and inappropriately employed. Most critics implicitly—and some, like Hansel (1966, 19), explicitly—take the view that psi phenomena are somehow known *a priori* to be impossible. that case one is free to invent any scenario, no matter how far-fetched, to explain away ostensib evidence of psi. Because there are no perfect laboratory experiments—nor, for that matter, perfe "spontaneous" cases involving psi experiences occurring outside of a laboratory—any positive resu whatever can be discredited in this way, and thus any potential accumulation of evidence aborted The extent to which many critics have been willing to pursue this strategy reveals the depth of the emotional commitment to current scientific orthodoxy, and is to us nothing short of amazing. Contra this with the attitude expressed by James (1920): "I believe there is no source of deception in th investigation of nature which can compare with a fixed belief that certain kinds of phenomenon a *impossible"* (p. 248). Can there be any doubt which is the scientifically more responsible attitude?

One further point needs to be drawn out in this connection. Many critics also seem to presume th words like "paranormal" or "supernormal" are synonymous with "supernatural." That is not the cas however. Psi phenomena (and certain other unusual phenomena that we will discuss in this book) ar in our view inconsistent only with the current materialistic synthesis, summarized by Broad (1962) the form of widely accepted "basic limiting principles." They do not obviously or necessarily confli with more fundamental laws of nature, and indeed to claim such a conflict is to presume that w already know all the relevant laws, which hardly seems likely. The authors of this book emphatical do *not* believe in "miracles," conceived as breaches of natural law. Our attitude is that these seeming anomalous phenomena occur not in contradiction to nature itself, but only in contradiction to what presently known to us of nature. The phenomena we catalog here are important precisely because the challenge so strongly the current scientific consensus; in accordance with Wind's principle, they no only *invite* but should *command* the attention of anyone seriously interested in the mind.

Finally, we also wish to make clear immediately that in our view "empirical" research includes b is by no means limited to *experimental* research. Laboratory research using random samples subjects, control groups, and statistical modes of data analysis can be wonderfully useful, b obsession with this as the only valid means of acquiring new knowledge readily degenerates in "methodolatry" (Bakan, 1967), the methodological face of scientism. Laboratory experimentatio certainly does not exhaust the means of obtaining valid and important information. Detailed ca studies of special individuals, such as persons displaying rare cognitive skills or having unusu neurological deficits, have often provided unique insights and indisputably can play a valuable role the evolution of scientific understanding. Pertinent modern examples here are the investigations b Luria (1968) and Sacks (1987) of persons displaying prodigious abilities of memory and calculatio Conversely, the experimental literature itself is replete with examples of supposedly "rigorous laboratory studies which were in fact performed under conditions that guaranteed their failure fro the outset. A good example here is provided by the many superficial studies of "meditation" carrie out by unsympathetic investigators, using as their subjects random samples of undergraduates havin little if any experience or interest in meditation (M. Murphy & Donovan, 1997; M. A. West, 1987; se also our Chapter 8).

With these methodological principles in mind, we turn now to the substance of our book. In ou

opinion, the most systematic, comprehensive, and determined empirical assault on the mind-bod problem ever carried out in the suggested spirit, during the entire long history of psychology, summarized in F. W. H. Myers's (1903) undeservedly neglected two-volume work *Human Personali* (henceforth, *HP*). Myers's friend and colleague William James (1901) declared that "through him fo the first time, psychologists are in possession of their full material, and mental phenomena are s down in an adequate inventory" (p. 16). Gardner Murphy (1954) praised "the heroic accumulation data and amazing integration which the work represents" (p. iv). Ellenberger (1970) described Mye as "one of the great systematizers of the notion of the unconscious mind" (p. 314) and his book as "a unparalleled collection of source material on the topics of somnambulism, hypnosis, hysteria, du personality, and parapsychological phenomena,… contain[ing] a complete theory of the unconsciou mind, with its regressive, creative, and mythopoetic functions" (p. 788). James and various oth writers have suggested that to the extent Myers's views are upheld by subsequent research he cou rank with Charles Darwin in terms of the character, scope, and originality of his contributions. Mye also powerfully influenced many leading thinkers of the day, including both William James and Pierr Janet, but like James and Janet themselves he was soon pushed aside by the virulent behavioris nascent at that period. However, just as James and Janet have undergone a major renaissance in rece years, as their central concerns and ideas have begun to reanimate the psychological mainstream, w believe that Myers's work deserves both wider recognition and careful re-examination for the light can shed on the current situation in psychology.

The balance of our book attempts to further these aims. Chapters 1 and 2 provide essenti background. We begin by reviewing modern developments in cognitive science, calling into questio the ability of physicalist/ computationalist models of the mind in any of their current forms to de adequately with the most basic, central, and pervasive phenomena of mind and consciousness. We als identify a variety of specific empirical phenomena, and a variety of critical aspects of human ment life, that appear to resist or defy understanding in terms of the currently prevailing physicali conceptual framework. The central objective of this exercise is to reduce whatever confidence in th framework readers may initially have, and thus to provide justification for revisiting the broader an deeper framework elaborated over a century ago by Myers, James, and their colleagues.

The following chapter summarizes the contributions of F. W. H. Myers to empirical investigatio of the mind-body relation. It begins with a brief summary of the relevant 19th-century intellectu background that suggests why Myers and his type of synoptic approach were ultimately ignored by th nascent materialist psychology. After outlining the purposes and principles in which Myers's wor was rooted, the chapter goes on to describe Myers's theoretical model of human personality an consciousness, a model that is the most fully worked out example (so far) of "filter" or "transmissio theories of mind (James, 1898/1900; Schiller, 1891/1894), according to which mind is not generate by the brain but instead focused, limited, and constrained by it. The chapter also includes a descriptio of the methodological principles and empirical phenomena which Myers considered essential for fully comprehensive and adequate science of psychology.[7]

The next six chapters constitute the empirical heart of the book. We focus in detail on selecte large classes of psychological phenomena, several of which were investigated in considerable dep by Myers himself, that appear especially challenging to contemporary mainstream views and capab of yielding new insight into the nature of the mind-brain connection. We do not attempt to revie these topics exhaustively, but discuss them selectively in relation to their bearing on this central issu In so doing, we also begin to assess the degree to which Myers's views have been sustained an confirmed, or must be modified or discarded, in light of subsequent work. Following Myers's ow practice, we attempt to lead readers by degrees and without obvious discontinuity from phenomen which, though challenging, are well established and seem at least potentially compatible with curre

orthodoxy, to phenomena which in our view are just as well or nearly as well established, but clear cannot be accommodated or understood without radical revision of our most fundamental theoretic ideas. The principal topics we discuss include extreme forms of psychophysiological influenc empirical and conceptual difficulties with current "trace" theories of memory, psychologic automatisms and secondary streams of consciousness, the family of "near-death" and "out-of-body experiences and related phenomena, genius-level creativity, and the world-wide psychologic phenomenon of "mystical" experience.

In the final chapter we attempt to re-assess Myers's theory of human personality and to draw o additional implications of this book for future psychological theory and research. We underscore th Myers and James made the most comprehensive effort to date to analyze the mind-body relatio *empirically*, and we urge scientific psychology to return to its great central problems with comparably synoptic empirical approach, but supported now by the tremendous methodological an technical advances achieved in the intervening century. We further argue that Myers's theoretica scheme and the empirical phenomena he deployed to support it have held up remarkably well, and many points have been substantially reinforced by subsequent research. Remaining difficulties an weaknesses, however, are also pointed out, together with critical opportunities and problems fo further investigation. Finally, we attempt to show how the theoretical framework elaborated by Mye and James, although certainly incomplete and imperfect, can be reconciled with leading-edg contemporary physics and neuroscience, and prefigures an enlarged scientific psychology that ca potentially overcome the historical fragmentation sketched above.

1. This quotation and others in this book that do not list a page number were taken from sourc published on the internet without specific pagination.

2. Newton's law of universal gravitation, insofar as it implies instantaneous action at a distanc appears to conflict with this characterization of physical causation, and indeed this feature great troubled Newton himself. The idea that matter could influence other matter without mutual conta was to him "so great an Absurdity that I believe no Man who has in philosophical matters a compete Faculty of thinking, can ever fall into it" (Newton, 1687/1964, p. 634). Newton himself presumed th this difficulty could eventually be removed—as indeed it was, more than two centuries later, with th appearance of Einstein's theory of relativity.

3. Just as this introduction was being drafted, a lengthy cover story on "mind/ body medicin appeared in the September 27, 2004, edition of *Newsweek*. This article exemplifies throughout th attitudes I have just described, and it culminates in a full-page editorial by psychologist Steve Pinker, author of *How the Mind Works* (1997), decrying what he terms "the disconnect between o common sense and our best science." Pinker further advises *Newsweek's* massive readership th contrary to their everyday beliefs "modern neuroscience has shown that there is no user [of the brain 'The soul' is, in fact, the information-processing activity of the brain. New imaging techniques hav tied every thought and emotion to neural activity." These statements grossly exaggerate wh neuroscience has actually accomplished, as this book will demonstrate.

4. The degradation feared by James is exemplified by media figure Michael Shermer, editor *Skeptic* magazine, in an opinion piece appearing in *Scientific American* (June, 2002). There Sherm not only overtly embraces scientism, apparently unaware of the generally derogatory connotations this term, but goes on to characterize leading contemporary scientists in quasi-religious terms: "Th

being the Age of Science, it is scientism's shamans who command our veneration."

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5. The popular terms for the main classes of relevant phenomena are "extrasensory perceptio (ESP) and "mind-over-matter" or "psychokinesis" (PK). ESP is sometimes broken into subtypes suc as "telepathy" (direct or unmediated awareness of the mental state or activity of another perso "clairvoyance" (of distant events or objects), and "precognition/retrocognition" (of future/pa events). It is widely recognized by researchers, however, that these familiar terms are unduly theor laden and may not correspond to real differences in underlying process. Many researchers therefo prefer the more neutral terminology introduced by Thouless and Wiesner (1947)—"psi" f paranormal phenomena in general, occasionally subdivided into "psi gamma" for the input side a "psi kappa" for the output side.

6. Statistically knowledgeable readers will recognize that critics of this type are acting in effe like Bayesians who have assigned a prior probability of zero to the existence of psi phenomena (s also Radin, 2006).

7. This chapter provides a useful introduction to Myers, but it is no substitute for the real thin With the hard cover version of *Irreducible Mind*, we included a CD containing the entire text *Human Personality* in Microsoft Reader ebook format, as well as its most significant contempora reviews and translations of all foreign text. This digital version and the reader are freely available the Esalen website (http://www.esalenctr.org/display/hp_ctr.cfm) or through the University Virginia Electronic Text Center (http://etext.lib.virginia.edu).

Chapter 1

A View from the Mainstream: Contemporary Cognitive Neuroscience and the Consciousness Debates[1]

Edward F. Kelly

The central contention of this book is that the science of the mind has reached a point where multip lines of empirical evidence, drawn from a wide variety of sources, converge to produce a resolution the mind-body problem along lines sharply divergent from the current mainstream view.

The goal of the present chapter is to set the stage by sketching the evolution of mainstrea psychology itself over the past hundred years, emphasizing modern developments and assessi critically where things presently stand.

The territory to be covered is vast and complex, so my account will necessarily be telegraphic a selective, and strongly colored by personal interests and experience—hence, "A View…." The cent of perspective throughout is that of a working experimental psychologist, one whose profession experience includes psychology of language, human functional neuroimaging studies using both hig resolution EEG and fMRI methods, single-unit neurophysiological work in animals, and experiment parapsychology. I regret that I can claim only amateur-level acquaintance with relevant contempora literature in philosophy of mind and language, although I recognize its value and unlike most of m fellow psychologists have made significant efforts to acquaint myself with it. The recent upsurge efforts to bring these complementary perspectives simultaneously to bear on our central subje matter in a systematic and mutually informed way seems to me altogether welcome, and lo overdue.[2]

The History of Cognitive Psychology: A Thumbnail Sketch

The following three sections summarize the history of mainstream psychology in the Englis speaking world from the advent of behaviorism to the present. So brief a sketch must necessarily impressionistic, but I believe it is faithful to the main outlines of the subject as it has developed so fa and would be so regarded by most workers in the field. Useful general sources for readers wanti additional historical detail include Flanagan (1991), H. Gardner (1985), and Harnish (2002).

From James B. Watson to the Cognitive Revolution

The history of scientific psychology in the 20th century can be characterized, somewhat cynical perhaps, as a movement toward progressively less unsatisfactory analyses of the mind. I will pa

quickly over the first half of this history. Noam Chomsky remarked parenthetically during a lecture o
linguistics in 1964 that in his opinion the first half century of American experimental psycholog
would end up as a footnote in the history of science. That was a characteristically provocativ
Chomsky remark, but even then it seemed more right than wrong. The historian of psycholog
Sigmund Koch, an early advocate of behaviorism who evolved into perhaps its most ferocious criti
has repeatedly derided the simplistic scientism of the period, and marveled at the degree to whic
behaviorism, having sprung into existence under the banner of a "consoling myth of natural scienc
rigor and systematicity," had so often "proceeded to liquidate its subject matter" (Koch & Lear
1985, p. 942). During its heyday, from perhaps the 1920s to the late 1950s, behaviorism enjoye
extraordinary, almost monolithic, institutional and professional power. Even as late as 1990, th
chairman of psychology at a major American university, in a symposium celebrating the centennial o
the *Principles of Psychology*, characterized James's great book as mainly illustrating what psycholog
should *not* be; its positive attributes consisted mostly of those few scattered passages where James
observations corresponded to truths revealed by *real* psychology—the natural science devoted
analysis and control of behavior (Kimble, 1990).

Certainly one of the chief lessons to be derived here is that entire generations of industrious an
able scientists can be captured by an ideology that is fundamentally unsound. I do not mean to say th
behaviorism was all bad. Its central methodological impulse, emphasizing the importance
systematic empirical observation and measurement, was certainly healthy and remains so today. Eve
on that front, however, the early behaviorist program was unnecessarily narrow. Encouraged by th
verificationist doctrine associated with the Vienna school of logical positivism (Ayer, 1952
behaviorists simply outlawed in principle all reference to anything not directly observable from th
third-person standpoint. Stimuli, responses, and their supposedly lawful connections exhausted th
scientifically legitimate subject matter. Even ignoring the often considerable difficulties in definin
exactly what constitutes "a stimulus" or "a response," however, this methodological asceticism wa
not warranted by any independently established conception of the nature of science. Indee
philosophers of science soon abandoned verificationism in its narrowest construction, recognizing th
even classical physics, the archetypal science, did not hesitate to postulate entities and processes th
could not be observed directly, but only through their lawful connections to other things that could.

The experimental psychology that began to evolve after Watson's 1913 manifesto can be viewe
as a kind of operationalization of 19th-century associationist theories of the mind, in which "idea
were replaced by behaviors, and complex behaviors were imagined as arising from simple on
through processes of conditioning and reinforcement. The bulk of this work was carried out wi
simpler organisms such as rats and pigeons, on the view that everything necessary for scientif
psychology was present there, and in more accessible form. From the principles that emerged fro
such studies, it was hoped, we would eventually be able to build a psychology capable of accountin
for all the complexities characteristic of human behavior. This specifically included what Descarte
had insisted is uniquely ours, and a defining attribute of the mind—our use of language. A fe
mainstream behaviorists such as Edward Tolman and Egon Brunswick suggested that even th
behavior of rats running their mazes might be guided by some sort of inner representation or map, b
these suggestions were largely ignored.

Methodological behaviorism was subsequently reinforced for a time by a companion philosophic
doctrine called logical or analytical behaviorism, which received perhaps its fullest expression in th
influential book by Ryle (1949). It shared Watson's objective of exorcising the mind, "the ghost in th
machine," but sought to achieve this objective by redefining men-talistic terms in terms of ove
behavior, or dispositions to such behavior. Having a pain, for example, was to be construed as literall
consisting in crying out, reaching for the aspirin, and so on. This relentlessly third-person approach

the mind seemed consistent with, and supportive of, the actual practices of behaviorist psychologist but its problems as a philosophic doctrine soon became apparent.[3] It proved extremely difficult practice to specify, in finite detail and without covert reference to other mentalistic terms, th behavioral conditions in terms of which the original mentalistic terms were to be redefined. From more commonsense point of view it also seemed to leave out precisely the things that are mo important to us as human beings—in particular mental causation and our subjective conscio experience. We all know, for example, that *pain* and *pain behavior* simply are not the same thing. Or can have a pain but not show it, or act as if in pain without actually being in pain. For these and oth reasons analytical behaviorism fell generally out of favor, although echoes are still heard today—primary source being Ryle's student Daniel Dennett (1991).

Logical behaviorism gave way in the 1950s and 1960s to a family of positions known collective as identity theory. Its basic doctrine is that the apparent correlation between mental states and bra states is to be interpreted in one particular way. Specifically, it holds that the relevant mental an physical states are in some sense identical, the same things viewed as it were from inside versu outside. This is regarded not as a logical necessity, but as a fact that we have discovered empiricall through advances in psychology and neuroscience, just as we have discovered that the morning st and the evening star are one and the same.

The identity doctrine came in two forms: The first and stronger form, formulated by writers suc Herbert Feigl (1958), U. T. Place (1956), and J. J. C. Smart (1959), holds that mental states can b subdivided into discrete natural kinds or *types*, and that each of these types can be identified with corresponding type of neural process. A stock example is the supposedly general relationship betwee "pain" and "excitation of c-fibers." The weaker form of identity theory claims only that eac individually occurring or *token* mental state is identical with some corresponding brain state. No that type identity entails token identity, but not vice-versa.

Type-identity is a strong and interesting philosophic thesis which implies the possibility o reduction, and for these reasons many physicalists welcomed it; but it is certainly false. Quite apa from the difficulties of isolating appropriate "natural kinds" or types in either mental life or bra processes, it is certain that many such mental types, if they existed, would arise under wildly varyin neurophysiological conditions. For example, linguistic behaviors involve mainly the left hemisphe in right-handed adults, but a mixture of both hemispheres or even mainly the right hemisphere in lef handers. The mind-brain system is in general enormously adaptable or "plastic." For exampl superior general intelligence and linguistic functioning have been observed in a man whose entire le hemisphere had been removed at age 5½ for control of seizures (A. Smith & Sugar, 1975). Full functioning adults are also occasionally discovered who altogether lack major neural structures suc as the corpus callosum or cerebellum, structures that are usually thought to be required for suc functioning. In some well-studied cases of hydrocephalus, normal or even exceptional ment functioning has been found in persons who have only 3–5% of the normal volume of brain tissue (Lewin, 1980). And to take a still more extreme case, high-level forms of learning and memory ar certainly present in the octopus, an invertebrate whose nervous organization is radically different fro ours. It even lacks a hippocampus, the one structure that everyone agrees plays an essential role mammalian memory systems (Chapter 4).

Type identity, therefore, has had little appeal for psychologists and neu-roscientists, wh undoubtedly gravitate in the vast majority—to the extent they think about such things at all—to som sort of token-identity view. This was essentially the position advocated by James in *The Principle* although he disavowed atomism in all forms and took pains to insist that the level at which th intersection is appropriately sought is that of whole momentary states of consciousness and who momentary states of the brain. *Token* identity, on the other hand, has had relatively little appeal f

philosophers. Among other things it creates a new and serious problem: If the same mental state, say certain belief, can exist in combination with different sorts of physical states in brains, what is it abo all those physical states that makes them "the same" as their common mental counterpart?

A philosophic response to this problem is the doctrine known as *functionalism*, first formulated b Hilary Putnam (1967).[4] Having rejected type identity, on grounds that a given mental state mig conceivably occur in extraterrestrial beings, or more relevantly in computers, Putnam went on propose a novel solution to the problem just noted. His basic idea was to re-conceptualize ment states once again, this time not in terms of what they are *made of*, but in terms of what they *do*, the causal role in the functional economy of whatever sort of creature or entity is in question. Just "cutting tools" can be implemented using rocks, metals, or laser beams, mental states are to b conceived as "multiply realizable"—that is, potentially instantiated in a variety of physical form including not only token biological states of one or many brains, but also in computers and oth suitable kinds of complex physical systems. On this view mental states become simply Xs, defined b their causal relations to stimuli, to other mental states, and to responses, and they can be identified similar states to the extent they perform similar roles in their respective causal networks.

I will make only a few brief comments on this doctrine, which in various forms has dominated th philosophy of mind for almost 40 years. First, as originally formulated it was inherently an fundamentally third-person and behavioristic, albeit a refined behaviorism that admits the possibili of complex causal processes—mental causes, in effect—mediating between stimuli and response Like the earlier forms of behaviorism, it initially avoided all reference to consciousness an subjective features of mental life. This was widely felt to be unsatisfactory, however, and a large pa of the subsequent history of functionalism consists of strained attempts to "naturalize" first-perso phenomena of these sorts. Second, although functionalism readily affiliates itself with bo physicalism in general and token identity theories in particular (and in most of its adherents probab still does), such afflliations are not an essential or inherent aspect of the doctrine. J. Fodor (1981a), f example, pointed out that functionalist principles might perfectly well apply to the operations immaterial minds and the like, should any such things exist. Finally, it is fair to say, I think, th functionalism arose not so much *sui generis* in philosophy, but rather as a response to some excitin new developments which had already occurred within scientific psychology itself, and with whic Putnam was certainly well acquainted. In any event, it was the confluence of these streams th defined the emergence of the 20th century's most distinctive contribution to mind-brain theory, th "Computational Theory of the Mind" (henceforth, CTM). I turn now to the psychological dimensio of this story.

By the late 1950s discontent with behaviorism was rapidly spreading, as its inherent limitatio became increasingly apparent. An influential paper by Lashley (1951) had exposed fundament difficulties in the attempt to explain complex behavior, notably human linguistic behavior, in terms linear chains of stimuli and responses. B. F. Skinner, the leading behaviorist, responded to th challenge, but his book on verbal behavior was subjected to a destructive and widely circulated revie by Chomsky (1959). Most significantly of all, perhaps, a comprehensive state-of-the-science revie organized by Sigmund Koch under the auspices of the American Psychological Association and th National Science Foundation resulted in a sweeping, 6000-page, six-volume indictment of the enti behaviorist platform (Koch, 1959–1963).

At the root of these discontents was a recognition that the old asso-ciationist explanato principles, and their behavioral translations, were in principle unable to cope with the hierarchical organized and orderly character of human language and cognition. We needed a richer concept mechanism. And as it happened, possible means of overcoming these limitations were just the becoming available, due to fundamental developments in the theory and practice of computation.

The old concept of a "machine"—and perhaps for most of us still the everyday concept—is that a physical contraption which transforms energy by means of pushes and pulls involving gears, pulleys, shafts, levers, and so on. The fundamental insight underlying the modern developments is the recognition that these physical arrangements are really of secondary importance. The essential attribute of the machine is rather that its normal behavior is *bound by rule*. This insight opened the way to an enormous enrichment of our concept of mechanism, beginning with the contributions of logicians and mathematicians in the 1930s and 1940s and continuing into the present day. These developments, moreover, immediately began to have a profound impact on scientific psychology.

For example, it was quickly recognized that machines can transform data or "information" as well as energy, and that a machine can in principle utilize information about its performance to regulate its own behavior. These ideas had immediate and urgent practical application in the construction of servo-controlled antiaircraft systems during World War II, but possible theoretical implications for the understanding of behavior were also apparent. Rosenblueth, Wiener, and Bigelow (1943), for example, argued that from the point of view of an external observer a device constructed on the principle of "negative feedback" behaved purposively—that is, as a teleological mechanism. Thus mechanism appeared to penetrate one of the last strongholds of old-fashioned vitalist thinking.[5]

These analogies were developed much more systematically by Wiener in his influential book *Cybernetics*, significantly subtitled *Control and Communication in the Animal and the Machine*. In addition to providing a general analytic theory of feedback control processes, Wiener (1961) provided numerous examples of physiological phenomena that seemed to fall within the province of the theory. Nevertheless, the direct applications of cybernetic theory at this level remained relatively limited. The real power of the ideas emerged later on, in conjunction with the extremely flexible application technology provided by the digital computer.

To appreciate the full significance of these developments, it is necessary to follow the generalization of the concept of "machine" to its ultimate development in the hands of the British mathematician Alan Turing and several others. Turing devised an abstract representation that formalized his intuition of the core meaning of "mechanism," as applied to the theory of computable functions. Any computation can be regarded as the transformation of a string of input symbols into a string of output symbols by a sequence of rule-governed steps. A procedure that is guaranteed to lead to the desired output in a finite sequence of steps is called an "algorithm" or "effective procedure." Turing envisioned a machine consisting of a read/write head operating on an indefinitely extendable tape ruled off into squares. The behavior of the machine is completely specified by a set of five-part rules. Given the machine's current state, and the input symbol written in the current square, these rules instruct the machine to change state, write a new symbol on the tape, and either remain where it is or move one square left or right. By altering the number of states, the size of the vocabulary, and the behavioral rules, an immense variety of behaviors can be realized by such devices. In fact, Turing argued persuasively that *anything* that would naturally qualify as an algorithm can be represented by a suitably constructed machine of this sort. He also proved rigorously that he could construct a "universal" Turing machine that would simulate the behavior of any other Turing machine. The intuitive notion of "effective procedure" was thus explicated in terms of the formal notion "realizable by a Turing machine." That this is not an arbitrary result but in a fundamental sense exhausts the meaning of the concept of mechanism is strongly suggested by the fact that other workers such as Alonso Church and Emil Post arrived at provably equivalent results from widely different starting points.

Because of their utter simplicity, Turing machines do even very simple things such as adding two numbers in extremely cumbersome ways. Their significance is theoretical, not practical. But links to brain-mind theory were quickly forged. An influential paper by McCulloch and Pitts (1943) showed

that networks constructed from idealized neurons could in principle implement logical behaviors arbitrary complexity. Both they themselves and other workers further showed that equivale capacities could be realized using richer elements that more nearly approximated the characteristics real neurons. Thus it seemed likely that brains in principle have capacities equivalent to those Turing machines. They might conceivably have additional capacities as well, but if so—and this is th essential point—these capacities may lie beyond the reach of understanding based on computation principles alone.

The final ingredient was provided by mathematician John von Neumann, who in 1947 invented th basic architecture of the modern stored-program digital computer. Von Neumann was entirely famili with the theory of computability, and he was undoubtedly directly inspired as well by McCulloc Pitts, and Wiener, all of whom participated with him in an important series of conferences c cybernetics sponsored by the Macy Foundation (Dupuy, 2000). It was evident to all that vo Neumann's new architecture provided in effect the logical capabilities of a universal Turing machin but now at last in a practically useful form. To the extent that mind and brain are governed b formalizable rules, their activities could now in principle be modeled on suitably programme general-purpose digital computers. To those sufficiently committed *a priori* to mechanistic principle the very existence of any given class of behavior essentially *entailed* the possibility of suc formalization. The relation of mind to brain could be conceptualized as analogous to the relation computer software to computer hardware, and the mind-brain problem would simply disappear.

There were other more specific theoretical results that further strengthened this emerging point view. Consider, for example, some of the early results in theoretical linguistics. Chomsky (1963) an others showed that the possible classes of formal models of language (generative grammars) formed hierarchy, in which the weakest or most highly constrained class (finite-state grammars) was obtaine from the strongest or least constrained class (unrestricted rewriting systems) by the application progressively more severe constraints on the form of the permissible rules of the grammar. Th resulting hierarchy of grammars, it turns out, also corresponds to a hierarchy of classes of automa derived from Turing machines in parallel fashion. Formal results from automata studies thu transferred to the analysis of candidate grammatical theories. Chomsky (1957) was able to show th then-existing psychological and linguistic proposals for theories of language, when formalize corresponded to the weakest or most constrained members of the hierarchy of grammars, and th these grammars were in principle too weak to account for systematic structural properties of man kinds of sentences found in natural languages such as English. He was thus led to his famous theory transformational grammar as the weakest class of theory which is still strong enough to account f the known grammatical facts of language. The result that the corresponding automata are weaker tha Turing machines greatly strengthened the presumption that linguistic behavior might be formalizab for computer modeling.

The central idea that minds, brains, and computers could fruitfully be regarded as variants of more general class of information-processing mechanisms quickly took root, even amon neuroscientists (W. J. Freeman, 1998; von Neumann, 1958). The ground was very well prepare Indeed, these developments seem to me an inevitable outcome of our Western scientific traditio This is not meant disparagingly, however. I have stressed these results about Turing machines and s on precisely to underscore the impressive depth of the theoretical foundation on which all the ensuin developments rest, a foundation which I feel has not been adequately appreciated by many critics this kind of work, such as Edelman and Tononi (2000), nor even by some of its enthusiast supporters, such as H. Gardner (1985).

In practice, the applications came a bit slowly at first. In part this was due to purely technic factors. The early computers were small, slow, and highly prone to malfunction. More importantly,

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