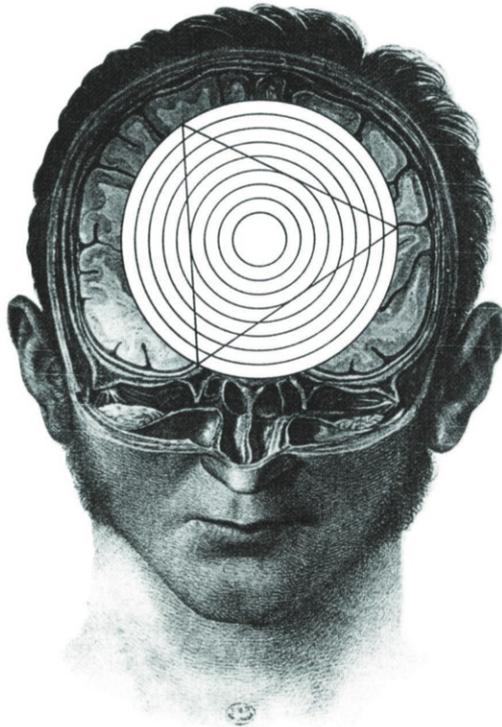


SO HUMAN A BRAIN

Knowledge and Values
in the Neurosciences

Anne Harrington, Editor



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So Human a Brain

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in the Neurosciences*

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Anne Harrington

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Foreword

WALTER A. ROSENBLITH

Footnotes to the Recent History of Neuroscience: Personal Reflections and Microstories

The workshop upon which this volume is based offered me an opportunity to renew contact fairly painlessly with workers in the brain sciences, not just as a participant/observer but maybe as what might be called a teller of microstories. I had originally become curious about the brain by way of my wife's senior thesis, in which she attempted to relate electroencephalography to certain aspects of human behavior. As a then-budding physicist and communications engineer, I had barely heard about brain waves, nor had I studied physiology in a systematic way. My work on noise dealt with the effects of certain acoustical stimuli on biological structures and entire organisms.

This was the period immediately after World War II when many scientists and engineers who had done applied work in the war effort were trying to find their way among the challenging new fields that were opening up. Francis Crick, among others, has described such a search taking place in the cafés of the "other" Cambridge, the one on the Cam. At that time the brain sciences, in his opinion, offered much less promise than molecular biology. However, he was sufficiently attracted by what they might eventually have to offer to keep an eye on them, and several decades later his work turned toward the brain.

This was also the period in which Norbert Wiener's cybernetics and Claude Shannon's information theory generated a good deal of intellectual ferment, and not just in Cambridge on the Charles. Wiener, one of the world's leading mathematicians, pulled together ideas, concepts, and mathematical techniques relevant to a broad range of scientific disciplines. Hence, his book's title: *Cybernetics or Control and Communication in the Animal and the Machine*. *Cybernetics* is a term Wiener coined; it derives from a Greek root meaning "steersman." This book and the Macy Foundation series on feedback and related topics stirred a great deal of interest

among students of the brain and behavior, and among the developing professions in the areas of statistics, computers, automata, etc. Here—or so it seemed to me at the time—were elements of an exciting program for quite a few years.

In 1946, again through an accident related to my wife's work, I traveled from South Dakota to Harvard University, where Professor S. S. Stevens, then director of Harvard's Psycho-Acoustic Laboratory, took me around the lab and hired me as a research fellow a few weeks later. Under Smitty Stevens's intellectually enterprising leadership the Psycho-Acoustic Laboratory's major wartime contributions had been in the area of speech communication. Now he brought in senior scientists such as Georg v. Békésy (who became the 1961 Nobel Laureate in Physiology or Medicine), the neurophysiologist Robert Galambos, and others to join J. C. R. Licklider and George Miller who were now trying to gain a basic understanding of how organisms process information from sensory stimuli to language.

Four years later I left Harvard and journeyed down the river to M.I.T. where the Electrical Engineering Department and the Research Laboratory of Electronics offered me a home appropriate to my background in physics and communications engineering and to my ambition to use computers for Wienerian *Fragestellungen* to analyze the activity of the brain. When I was asked what kind of a professional title I would prefer, I opted for "communications biophysics." Communications biophysics? What's that? Well, I thought I knew. Anyway, the head of M.I.T.'s Electrical Engineering Department affirmed that biophysics was in the Biology Department's domain. I'm not a biologist, having never taken a course in "real" biology. (That's not quite true, but almost true.) Anyway, the department head advised me to go see Frank Schmitt who was at that time the head of the Biology Department.

After I had shared with Professor Schmitt an outline of my program for the study of the electrical activity of the nervous system, he replied, "Aren't you 200 years too early?" I often gently twit Frank—who a decade later played such a key role in the formation and unfolding of the Neurosciences Research Program—on how fast these 200 years went by.

This was midcentury at M.I.T.: the Mid-Century Convocation on the Scientific Implications of Scientific Progress, which brought Winston Churchill to M.I.T., brought a lot of recognition to an institution whose Radiation Laboratory (radar and all that), Servomechanisms Laboratory, and Instrumentation Laboratory loomed large on the world's technological scene. The mood of the time, but perhaps even more particularly the spirit of M.I.T., is best summarized by the title of Vannevar Bush's report to the president entitled, *Science—The Endless Frontier*. In the next decades M.I.T. would undertake a good many pathbreaking efforts, making use of the equipment and of the innovative techniques that came out of World War II. There also flocked to M.I.T. some of the most fertile young minds

from Europe. A fair share of them had been attracted by the Wiener agenda that encompassed both computers and the brain.

Around 1960 the International Brain Research Organization (IBRO) was born. What made the situation favorable for the development of IBRO? Above all, a changed international climate. We were in the period of the Khrushchev “thaw.” At a 1958 conference in Moscow, there had been unanimous support for a resolution proposing the creation of an international organization representing the whole of brain research. The plan to create an independent, nongovernmental organization in the area of brain research was welcomed by UNESCO, which has been supportive of IBRO ever since. But IBRO also established links with the World Health Organization (WHO) and the International Council of Scientific Unions (ICSU). When IBRO was founded, it was relatively small and it elected its members. IBRO was initially composed of seven panels, each of which had the label of a more-or-less classical discipline modified by the prefix “neuro.” Thus the panels were labeled neuroanatomy, neurochemistry, neuroembryology, neuroendocrinology, neuropharmacology, neurophysiology and behavior, and neurocommunication. This novel multidisciplinary paradigm reflected the common conviction that the brain was not the domain of a single discipline. Since then, IBRO has grown considerably and has transformed itself into a membership organization whose growth parallels the growth of the neurosciences in different countries. In 1988 there were approximately 20,000 IBRO members, with half of the membership coming from the United States. IBRO has, in collaboration with other organizations, set up a number of active programs to stimulate international contacts and to help the development of the study of the brain in the third world.

The growth and progress in the sciences related to the brain—both their basic and clinical aspects—did not pass unnoticed at the highest levels of governments. During the mid-1980s the seven economic summit countries held a series of conferences attended by delegates from the relevant fields. They reviewed the state of research and the therapeutical innovations in the neurosciences but did not overlook ethical issues and concepts.

In July 1989 President Bush signed into law a joint resolution of Congress declaring the 1990s to be the “Decade of the Brain.” That resolution estimates that 50 million Americans are affected each year by disorders and disabilities involving the brain. It also estimates the annual economic burden to exceed \$300 billion. The last of 20 “whereas’s” states that the declaration of the “Decade of the Brain” is designed to focus needed government attention on research, treatment, and rehabilitation, and that the president of the United States is authorized and requested to issue a proclamation calling upon all public officials and the people of the United States to observe the decade with appropriate programs and activities.

Such official documents reflect, at least to some extent, society’s current view of the brain, of its role in life and death, of its relation to human intelligence, cognition, behavior, values, thought, addiction, and mental

health. At the Woods Hole workshop “So Human a Brain”—and let us hope this is just a beginning—present and future colleagues shared with those in attendance their current views of their explorations into this variegated territory. They tried to inquire into what it is about the brain that makes us human and how knowledge about the brain relates to the rest of human knowledge. Fields that are as bubbling with research as this one are only too often data-rich and theory-poor. Then they fall easy prey to clever and temporarily fashionable metaphors. The thoughtful way in which this volume has been organized should protect us from the temptation of focusing too hard on increasing the market share of our pet metaphors.

Preface

ANNE HARRINGTON

Humanizing Knowledge and Values

In today's world of brain science, having (or being) an enlightened human brain may require a willingness to tolerate a growing professional "confusion about heroism" (to use a phrase by Ernst Becker [1973]). As little as 30 years ago, the image of the devoted scientist-hero portrayed in Sinclair Lewis's *Arrowsmith* was still a powerful one; scientists and laypersons alike could still dream of science as an "endless frontier" (in the words of the famous postwar report by Vannevar Bush [1945]), and still find the vision of rational control over human destiny a noble one. Today, however, even as politicians and scientists join together in proclaiming the 1990s the "Decade of the Brain," a cacophony of disciplinary truths in the human sciences begins to hint at a more complex story; one whose demythologizing collective message is disturbing enough to warrant a serious hearing by the neuroscientific community.

What are the issues? To begin, it is probably fair to say that, for most researchers of the human mind and brain, the imperative to *know*, to increase objective understanding of human thought and behavioral processes, continues to set the agenda—or at least define the frame—for any larger debates about the meaning and imperatives of humanness in the late 20th century. There is a greater or lesser reticence within this group as to how far new knowledge of the brain should or could destabilize traditional humanistic categories of purpose and value, but the logical priority of "natural truth" over "social truth," of "objective" fact over "subjective" value is still rarely questioned. Certainly, few thoughtful neuroscientists deny that values can and do interact with problem selection, design, and theory modeling in the brain sciences, but this awareness seems in practice to have little impact on the actual production and promotion of new knowledge. In general, successful members of the community of brain scientists today continue, more or less consciously, to adhere to what Jacques Monod referred to as an "ethic of knowledge" in science: a

commitment to the scientific exploration of nature—including human nature—as a first goal independent of other goals (Monod, 1971).

But is Monod's vision the last word on the matter? In the past 20 years, a different community of scholars, with roots in the history, sociology, philosophy, and anthropology of science, has increasingly begun to argue a very different ethic of knowledge. Here, in varying ways, the claim is made that the old ideal of brain science as a form of objective knowledge about humanness has itself been profoundly destabilized by the fact that brain research is no less an expression of our inescapable humanness than any other activity. For these science analysts, the knowledge-claims of neuroscience are believed to be bound up in complex and unavoidable ways with professional agendas, strategies of knowledge-justification, ethics, and cultural imperatives. While opinions differ within this group as to the implications of this challenge to the Enlightenment ideal of transhistorical, transcultural objectivity, the scholars in question at least agree in their tendency to reverse the emphases of the scientists themselves, and to focus on *values* as at least partly setting the agenda of knowledge.

It is too early to decide whether the perspectives on knowledge and values that set the accent for these two broad communities of scholars are as mutually cannibalizing as they sometimes sound, or whether genuine dialogue and cross-disciplinary enrichment is in fact possible. The jury is still out on this issue in part because there has been a tendency for the different voices to proclaim their different truths in self-reinforcing isolation from one another.

This book derived from a collective effort across disciplines to break free of that mold. In the summer of 1990, the newly established Dibner Institute sponsored some twenty leading scholars from the brain sciences and the social sciences (history, sociology, ethics, etc.) for three days of presentation and intensive debate at the Woods Hole Marine Biological Laboratory.

There had never been a workshop with the broad goals and interdisciplinary focus of this one. Not surprisingly, therefore, our group achieved no final closure and signed no formal peace treaties. Indeed, our exchanges over the weekend were punctuated by often revealing moments of uncertainty, conflict, and incomprehension (cf. the analysis of these exchanges by Fortun and Sigurdsson, this volume). As we persisted, however, we did find that our dialogues had begun to converge around the challenge of what it might mean to “humanize” the sciences of the human brain. In other words, we increasingly discovered in ourselves a willingness to explore alternatives to the pessimism of a Tolstoy, who had envisioned the two imperatives—*what do we know?* and *how should we live?*—as mutually alien categories.

This volume represents both a record of our 1990 interdisciplinary encounter at Woods Hole and a retrospective reflection upon it. The volume is divided into five main parts. The first of these is entitled “Knowledge of and by the Human Brain: Limits and Possibilities.” It begins with two attempts from within the neuroscientific community to provide a

methodology and knowledge-base capable of tackling the challenge implicit in the provocation: *so human a brain*. We start with an essay on the peculiarly human functions of intentional signing and speech, examined from the perspective of a leading neuroethologist, Detlev Ploog, who admits that “. . . most neuroscientists, regardless of whether they work at the molecular, the systemic, or at any other level of central nervous functioning, ultimately want to contribute to the understanding of the human brain.” This first section of the volume grows increasingly self-reflective as it progresses. It is proposed that there are certain “semantic” truths of the mind, such as those revealed by dreams, that are inherently irreducible to the terms of neuroscience (Massimo Piattelli-Palmarini).

This paper is followed by an ambitious attempt by Stephen Kosslyn to use the framework of cognitive neuroscience to conceptualize human selfhood and self-awareness—or, more specifically, “what we mean when we speak of the self, and what would be necessary for the self to change.” We are then invited to ponder Paul MacLean’s even more radical suggestion, made in the course of an argument that blends brain science with ethical imperative, that the human brain is destined to an “inability ever to achieve certitude of knowledge,” including those truths it discovers about itself. MacLean challenges us to consider, in a paraphrase borrowed from Ramon y Cajal, that “the universe is but a reflection of the structure of the human brain.” This section of the volume concludes with Jason Brown’s proposal that these biologically given limits on knowledge should be of vital interest to humanists, since they interact in crucial ways with the human world of morality and values.

Part 2, “Values and the Nature of the Neuroscientific Knowledge Game,” advances the case for linking knowledge and values, but from perspectives and knowledge-bases outside of the brain sciences proper. The main concern here is with (in Rodney Holmes’s words) “the kind of knowledge that is sought and found by neuroscience.” Given that it will never be possible to research and know everything that one theoretically *could* decide to research and know, what if it turned out that there was a relationship between the kinds of questions scientists actually did decide to ask—the things they wanted to know—and the professional, ethical, and social contexts in which they worked? These and related problems are explored from very different conceptual and methodological perspectives by Rodney Holmes and Londa Schiebinger.

Schiebinger, writing from a feminist historical perspective, notes that “objectivity in science cannot be proclaimed, it must be achieved”; and that, paradoxically enough, the means to this goal must be “to disabuse ourselves of the notion that science is value neutral.” In other words, objectivity emerges as a political rather than a strictly epistemological goal. Holmes challenges us to become more conscious of the ethic of research that motivates and indeed defines the neuroscientific community as a profession. He writes:

What are the directions of Neuroscience? Are they to write every grant proposal and to know everything there is to know? Even if it is the latter, then what is knowledge—is it all the possible electrochemical information about neurons, or is there some way of defining our goal that will help us decide what information is worth gathering, or what applications are legitimate or not?

Edward Manier and James Schwartz agree with Holmes and Schiebinger about the centrality of questions of human value to brain science research, but they wonder more about what brain science can and cannot say to those questions of “ultimate concern” that give human beings a sense of existential orientation and grounding in the cosmos. Both authors take their starting point from the critical writings of the novelist Walker Percy, but then proceed to diverge radically in their conclusions, point/counterpoint style. Manier sees Percy as “a neuropsychologically well-informed biblical prophet” whose message boils down to an insistence that “the reductionist project [of the neurosciences] should not be trivialized by pre-shrinking the human world.” The “deep sense in which human beings seem ‘lost in the cosmos’ are data which must be addressed by the human sciences.” Schwartz, in contrast, allies Percy with a tendency in the brain sciences to want neatly—diagrammatically—to account for all aspects of human existence, including (or especially) the problem of evil. This sort of sanitizing, he proposes, is sentimentality of the worst kind: in fact, “the Lord’s answer [to Job] out of the whirlwind appears to be essentially correct. . . . We cannot hope to make coherent a cosmos that is ethically incoherent. . . .”

The third part of the volume, “Neuroscientific Knowledge and Social Accountability” adds still another layer of tension to an increasingly complex debate. This section sees the problem of knowledge and values in the brain sciences as intersecting most acutely at the point of *praxis*, and challenges us to articulate an ethic of professional responsibility for both the means and the consequences of brain research. Alan Fine examines the justifications and dilemmas associated with research on fetal neural transplantation, a medically promising but highly contentious field, particularly in the United States where the ethics of abortion are so much under fire. Elliot Valenstein warns of inadequate regulation and control on the development and application of new therapeutics in biomedicine and drives his point home with the cautionary tale of psychosurgery. John Durant tackles one of the most controversial and emotive issues in brain science research today: the ethics of experimenting on sentient animals in the pursuit of knowledge that may advance human values. His argument is that our society is increasingly suffering from a dislocation in sensibility on the issue of the moral status of animals, in part because of “conflicting voices” arising out of the sciences themselves. The presentation of this paper at the Woods Hole conference led to one of the most explosive and riveting interdisciplinary exchanges of the weekend. Some neuroscientists vigorously defended their right to pursue knowledge, while slowly coming to

concede a need to articulate a moral calculus for deciding what sort of research is acceptable; others found sentimentality and anthropomorphism in many of the claims for “animal mind” that contribute to public sentiment against animal experimentation; and still others found antihumanistic implications in the suggestion that “species-ism” is a form of immorality equivalent to racism and sexism. The reader is referred to the reconstruction of these discussions in the thematically ordered dialogues at the end of this volume.

Part 4 of this volume, “Sociohistorical Perspectives on Values and Knowledge in the Brain Sciences,” offers three case-studies in the history and sociology of the brain sciences that raise a range of questions about methodology, language, theory-choice, and epistemology. Here, historical material is employed to focus and elaborate on some of the general theoretical issues and questions that are developed in the earlier sections of the book.

Warwick Anderson explores the social process of “resistances and trade-offs” by which the disorder known as *kuru* underwent a process of epistemological transformation from an anthropologically coherent cultural phenomenon to a neurophysiologically watertight brain disease that would garner its discoverer a Nobel prize. He tells us that “it is on the boundary between a conventional context and another, alien context, that one sees most clearly how each knowledge community struggles to attract phenomena into its own orbit and reinflect them with its own values.” Susan Leigh Star uses the 19th-century localizationist model of the brain to ask questions about what a “sociology of the brain” might look like. She begins by proposing that “we can begin to think sociologically about the brain if we recognize the properties of a large zone of negotiation” within which “people attempt to link their experience of a concrete brain with the abstract representations of mind.” Her sociological concerns begin to become clear as she continues: “What are the properties of this zone? When did it develop? How has it changed. . . ? Who controls it? Whose experiences are included and whose are excluded? Are there gatekeepers, strategies, technologies, routines, and silences?”

Complementing Star’s study of localization theory is my own analysis of the early 20th-century “holistic” reaction *against* mechanistic, localizationist approaches to brain function, particularly in interwar Germany. My concern in this paper is with the way in which disputes over knowledge-claims in the brain sciences of this time period need to be understood as one face of a network of larger disputes over collective cultural and political values. I suggest that

German holistic neurology and psychology, especially after 1918, was not only about discovering or constructing organicist or nonatomistic models of mind and brain; it was also about challenging epistemological rigidity in the natural sciences — and challenging it under the conviction that epistemological reform alone could offer a way out of . . . cultural crisis.

The final part of this volume can be considered an experiment in self-reflexivity. Specifically, it is an attempt to cast some critical light on the clashes of knowledge and values that emerged at Woods Hole as people from different disciplinary worlds attempted—some for the first time—to speak and listen to one another. Entitled “Knowledge and Values across Disciplines: Reconstruction and Analysis of an Interdisciplinary Dialogue,” this section of the book consists of two elements.

It opens with a reconstructed rendering of some of the most interesting “live” exchanges and debates pursued within our group over the course of the Woods Hole weekend. Thematically ordered, with a summarizing argument at each new subject juncture for the purposes of orientation, these dialogues take on board the whole range of issues raised by the individual contributions: neurobiological constraints on human knowledge; consciousness and the human brain; the place of ideology in brain models; the feminist critique of science; the “moral rights” of laboratory animals; the ethics of human fetal neural transplant research; and whether the brain sciences lead to a sense of human meaninglessness.

Following immediately on the heels of these dialogues—and critical to a just reading of them—is a meta-level analysis of the dynamics that generally characterized the exchanges at Woods Hole. Aware that attempts to carry out interdisciplinary work are frequently beset with problems, and wanting better to understand the nature of those problems, I invited historians of science Michael Fortun and Skuli Sigurdsson to attend the Woods Hole workshop as “ethnographic” observers of the “tribes” of action. In their paper, which is based on a critique presented to our group on the final Sunday morning meeting, these two scholars have much to say not only about what was discussed but also about what was skirted or left unspoken—the “silences.” For example, they were disappointed that

[t]here was . . . surprisingly little attention paid to the technological dimension. . . . Is there an independent technological momentum, and how does that relate to the autonomy of research? Put differently, how much of the tacit knowledge in the neurosciences is encoded in the machine environment . . . ? What assumptions are built into the practices and equipment that neuroscientists use without further thought?

It is worth stressing, though, that the imperative to recognize disciplinary “silences” and to work on overcoming them is incumbent not only on the neuroscientific community but also on its would-be critics and analysts. Thus, one clause in the contract for future interdisciplinary work of the sort begun in this volume might be a commitment by those of us interested in the ethics, culture, and sociology of the brain sciences to invest more energy into opening up the “black boxes” that contain the tacit knowledge and values driving our own analytic technologies, central metaphors, epistemologies, and cultural concerns. We do this, not as an exercise in self-contemplation for its own sake, but so that the critique we direct to our neuroscientific colleagues may be tempered with self-awareness, may ring as

clear and true as possible. In an ideal interdisciplinary encounter, there can be no room for any privileged (unexamined) foundation of knowledge and values.

Are the benefits of mutual understanding worth the effort involved in cross-disciplinary communication? We cannot risk anything other than an affirmative answer. It is increasingly clear that Arrowsmith and Jacques Monod represent defunct role models in the complicated world of today's brain science. We need viable alternatives that avoid the extremes of radical subjectivism and of naive scientism alike. Against this background, our interdisciplinary goal of "humanizing" the brain sciences may be understood as a commitment to work together in illuminating the roots joining the tree of knowledge and the tree of life. Ultimately, we may hope that an increasingly sophisticated awareness of interdependence will come to influence both the way we understand the fruits of our neuroscientific efforts, and the way we plan the future horticultural efforts of our society.

Let us have the courage, then, to react to our "confusion about heroism" in creative ways. Let us not close ranks and hunker down in our individual holes of disciplinary certainty, but let us dare instead to be vulnerable, to venture onto the unmapped spaces between the holes, for the sake of a goal and an insight beyond that of our smaller truths. This sort of effort would be a real triumph for the cause of our collective humanness.

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References

- Becker E (1973): *The Denial of Death*. New York: The Free Press.
 Bush V (1945): *Science, the Endless Frontier*. Washington, DC: U.S. Government Printing Office.
 Monod J (1971): *Chance and Necessity: An Essay on the Natural Philosophy of Modern Biology*, Wainhouse A (trans), 1st American ed. New York: Knopf.

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