

Abstract

Against the Materialists: John Carew Eccles, Karl Raimund Popper, and the Ghost in the Machine

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This dissertation analyzes the influence of the philosopher Karl Popper on the scientific research and the speculative writings of the Nobel Prize-winning neurophysiologist John Eccles. It explores the ways in which Popperian principles guided Eccles in a well-known scientific debate and how this success encouraged Eccles to create evolving neo-Cartesian dualist models of the mind/brain interaction. Drawing from their correspondence, autobiographical reflections, as well as publications, it tells the story of the converging intellectual paths that led to the controversial anti-materialist manifesto, *The Self and Its Brain*. Claims have been made for and against Popper's understanding of, and influence on, science; this dissertation is the first to document Popper's direct involvement in the "war" over the mode of neurotransmission. Although other modern scientists have held dualist convictions, the lengths to which Eccles went to combat the prevailing ontological reductionism of mind to brain was unprecedented. This dissertation is the first extended historical analysis of Eccles' career and philosophical ambitions. In exploring their friendship and collaboration, this dissertation explains both the nature and the effects of their partnership. It argues that Eccles used Popper's ideas in at least four different ways: to extricate himself from a degenerating research program, to justify his alternating scientific conservatism and daring, to criticize contemporary society, and finally to combat ontological materialism. It makes the novel

claim that mind was central to Popper's entire philosophy. It also proposes that Popper's shift from falsificationism to critical rationalism and from physics to biology was reinforced by his interaction with Eccles. It argues that the largely negative response to *The Self and Its Brain* was based on a misunderstanding of the authors' intentions. Finally, it puts their efforts in the context of the mid to late twentieth-century debates surrounding the mind-body problem and the progress and limitations of the sciences of the nervous system. More broadly, this is a study of the entanglement of metaphysical commitments about the nature of knowledge and the nature of physical reality with the exercise of science.

PREVIEW

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PREVIEW

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I am also sincerely grateful for the opportunity Yale gave me to study at the graduate level three diverse, challenging, and rewarding disciplines. Genetics, Religious Studies, and History of Science, in addition to developing my analytical skills, have all broadened my perspective on life. Regarding the last of these three, I wish to acknowledge the debt I owe to the late Frederic Holmes whose generosity and example converted me to the history of science, allowing me to combine my love of history (first instilled in me by my undergraduate history professor Robert Bucholz) with my other love for the life sciences (born out of the genetics classes of my undergraduate biology professor Jeffrey Doering).

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The material world has only been constructed at the price
of taking the self, that is, mind out of it...

Erwin Schrödinger, *Mind and Matter*

Synapses encode who we are.

Joseph LeDoux, *Synaptic Self*

Introduction

A Curious Event

To your philosophy and fundamental science I could add neurophysiology and there is no knowing where we might go.

John Eccles to Karl Popper, May 26, 1950

In every philosopher lives something of a reformer.

Friedrich Weismann, "How I See Philosophy"¹

Heresy

In the autumn of 1974 a neurophysiologist and a philosopher of science met in Bellagio, Italy, for conversations about "the deepest of cosmological riddles," the mind-body problem. Like numerous distinguished intellectuals before them, these two 'retired' academics had been invited by the Rockefeller Foundation to let loose their imagination on the shores of Lake Como in a setting former guests of the Villa Serbelloni have described as "the nearest thing to heaven that exists on earth."²

The result of this curious event was *The Self and Its Brain* (1977). Aimed at both scholars and intelligent laymen, this work was intended to be a pioneering attempt at

¹ Eccles to Popper, 26 May 1950. Correspondence, 1932-1987. Box 290, folder 8. Sir Karl Raimund Popper Papers. Hoover Archives. Stanford University. (Hereafter, KP-HAS). Friedrich Weismann, "How I See Philosophy" in A. J. Ayer, *Logical Positivism*, (New York: Free Press, 1966), 375-76.

² "The deepest of cosmological riddles" taken from Popper and Eccles' original proposal to Springer Verlag. Speeches and Writings, 1928-1986. Box 198, folder 9, KP-HAS. The 16th century villa was willed to the Rockefeller Foundation in 1959 by Principessa Della Torre e Tasso. Descriptions of the idyllic setting can be found in John Marshall, Charlotte T. Marshall, and John E. Burchard, *Thoughts from the Lake of Time: a Group of Essays in Honor of the Villa Serbelloni and especially of John and Charlotte Marshall*, (New York: Josiah Macy, Jr. Foundation, 1971), xi, 247, 104, and 153.

bridging the widening chasm between the increasingly esoteric discussions of philosophy of mind and the mounting empirical discoveries of the neurosciences.³ *The Self and Its Brain* was promoted as timely, appearing as it did at a supposed point of impasse between philosophy and science, and as revolutionary, being “the first link between the philosophy of the self and neurobiology.”⁴

The six-hundred-page book was meant to be a model of synthesis, imagination, and analysis. In the first section, the philosopher of science Karl Popper led the reader through the history of the philosophy of mind, demolishing materialist theories along the way and arguing for a three-tiered vision of reality.⁵ In the second section, the neurophysiologist John Eccles summarized the current state of knowledge about the molecular, cellular, and modular components of the brain, illuminating the processes of perception, movement, language, and memory. In the most controversial portion of the work, Eccles detailed experiments suggestive of the interaction between a physical brain and a transcendent mind.⁶ Finally, lending this technical work an aura of relaxed gentlemanliness, the third section consisted of a series of edited dialogs taken from their recorded exchanges in the Bellagian Villa.

³ All previous books on the mind, according to these authors, were badly wanting. Scientific publications typically gave “an account of the brain with almost no philosophical content,” while works on the philosophy of mind usually took “little or no account of the brain.” Springer Verlag proposal. Speeches and Writings, 1928-1986. Box 198, folder 9, KP-HAS. William Uttal describes this trend towards arcane arguments and technical vocabulary in the history of the mind-body question in William R. Uttal, *Dualism: The Original Sin of Cognitivism*, (Mahwah, NJ: L. Erlbaum Associates, 2004), 249.

⁴ From promotional literature for *The Self and Its Brain*. Speeches and Writings, 1928-1986. Box 198, folder 9, KP-HAS.

⁵ The three worlds Popper proposes are those of the external world of objects, the mental world of conscious experience, and the world of ideas and theories. This theory will be fully explored in chapter five. Karl Raimund Popper and John C. Eccles, *The Self and its Brain*, (Boston: Routledge & Kegan Paul, 1977), 16.

⁶ *Ibid.*, 363.

This work was a claim that contemporary science and philosophy had failed to account for the 'self.' Despite the impressive progress made in both disciplines, neither had succeeded, in the opinion of the authors, in offering a satisfactory account of mental processes. Profound mysteries remained regarding perception (how a picture of the outside world is assembled), attention (how decisions about what to focus on are made) and volition (how willed actions are initiated). Popper attempted to provide philosophical justification for belief in a non-materialist theory of the mind. Eccles attempted to provide credibility to the notion that science itself was evermore pointing to a realm beyond its grasp. By proposing a bold speculation with great explanatory power, allegedly supported by the latest experimental findings, and purportedly conducive to more discoveries, *The Self and Its Brain* posed as a legitimate, meaningful proposal, as a genuine Popperian conjecture.⁷ Responding to the challenge of materialist philosophers of mind, Eccles suggested that dualism was a genuine empirical hypothesis.⁸

The overwhelming reaction to *The Self and Its Brain* was one of shock and disbelief. Cartesian dualism, a doctrine long considered discredited by the scientific establishment, was resurrected through the partnership of a Nobel Prize-winning scientist and a world-renowned philosopher of scientific method.⁹ Three centuries after the

⁷ That Eccles saw his mind theories as Popperian is clear from his later work *Evolution of the Brain: Creation of the Self* about which he contended, "The book is not written in a dogmatic manner, but rather in the manner of Popperian hypotheses." Eccles to Popper, 3 July 1989. Incremental material. Box 535, folder 6, KP-HAS.

⁸ On the opposing side, the materialist philosopher U. T. Place, arguing against the idea that materialism was just a metaphysical position, stated, "materialism remains an empirical hypothesis – the hypothesis that there exists, presumably in the brain, a physiological process which satisfies the logical criteria required to establish its identity with the sensation process." U.T. Place, "Materialism as a Scientific Hypothesis," *The Philosophical Review*, 69(1960), 103-104.

⁹ At this time the philosopher of consciousness Daniel Dennett was alleging, "Dualism is not a serious view to contend with, but rather a cliff over which to push one's opponents." D.C. Dennett, "Current Issues in the Philosophy of Mind," *American Philosophical Quarterly*, 15(1978), 252. Nevertheless, the

publication of René Descartes' *Treatise on Man* (written 1634, published posthumously 1663), a speculative anatomy and physiology 'textbook' scandalous at its time for how much of life it posited to be matter in motion, appeared a philosophical and physiological primer scandalous in its time for denying that all of life is matter in motion.¹⁰ Eccles and Popper had revised the science and updated the philosophy of Descartes' thesis to propound the same metaphysical message: consciousness is not a mechanistic process; brain must be in interaction with an immaterial mind.

Despite claiming to be an original and fruitful proposal, virtually no reviewers among the targeted audiences of theologians, philosophers, psychologists, and neuroscientists regarded *The Self and Its Brain* as seminal.¹¹ While all reviewers granted that Eccles and Popper had done a marvelous job of synthesis, most critics balked at their

book did receive good billing simply through these reviewers' first sentences, which, like a refrain, referred to the pair of authors as "the world's foremost living philosopher" and the "Nobel Prize winning neurophysiologist," such as in P. B. Medawar, "Does Mind Matter?," *New York Review of Books*, 26, no. 17(1979) available at <http://www.nybooks.com.ezp-prod1.hul.harvard.edu/articles/7627> (last accessed 16 May 2009). Eccles and Popper were said by one reviewer to "complement each other delightfully." Dorothy Bonn, "Spheres of Influence," *Spectator*, 252, no. 8123(1984), 28.

¹⁰ Descartes' *Treatise on Man* (1663) was regarded by some historians as the "first modern physiology textbook." Cohen of Birkenhead, *Sherrington*, 108. Descartes' works were quickly placed on the Index of Forbidden Books.

¹¹ Eccles and Popper listed their expected audiences in their book proposal to Springer Verlag. Speeches and Writings, 1928-1986. Box 198, folder 9, KP-HAS. Positive reviews came mostly from outside the mainstream science community. The only reviewer, I believe, to call the work seminal was the parapsychologist John Beloff. Although noting some reservations, Beloff suggested that it might herald the start of "a new era." John Beloff, "Is Mind Autonomous?," *British Journal for the Philosophy of Science*, 29(1978), 265-273. The *Journal of the American Society for Psychical Research* called it "a major publishing event...a bold attempt to spell out and come to terms with ultimately unresolvable existential problems." Jan Ehrenwald, "The Self and its Brain," *Journal of the American Society for Psychical Research*, 73(1979), 81-84. In the view of enthusiasts of ESP and telekinesis, the omission of corroborating evidence from parapsychology was the work's chief weakness. G. L. Heseltine, "Self and its Brain," *Journal of Parapsychology*, 43(1979), 341-345.

flights of imagination and faulted their work for insufficient analysis. The kindest reviews suggested that the work might inform future discussions about the mind.¹²

Theologians and non-reductionist philosophers of mind regarded the work with respect, but caution.¹³ Its interdisciplinary attack on materialism was commended. One reviewer hoped that the book was a sign of the coming reunion of science and religion.¹⁴ Another congratulated the authors for proceeding from scientific data to theological implications rather than from religious premises to scientific support.¹⁵ Although some saw it as bolstering the scientific arguments for dualism, many feared that the authors advocated a god-of-the-gaps, a hasty recourse to transcendence that science's inevitable advancement might eventually expose as folly.¹⁶

¹² On the positive side, most did concede that Popper's section presented a good historical survey of the mind-body question, if too quickly disposing of alternatives. Francis Baumli, "Review of 'Self and Its Brain'," *International Studies in Philosophy*, 11(1979), 201-202. Eccles' section was a welcome introduction to relevant and interesting science. Ursula Schubert, Review of "Self and Its Brain [Sic]," *Deutsche Zeitschrift für Philosophie*, 27, no. 5(1979), 654-656. Some saw their dialogs as "original and illuminating." Medawar, *Does Mind Matter?* The book's arguments were deemed thoughtful and well-presented. Alfred Schmidt, "Abschied vom Denkenden Hirn," *Frankfurter Allgemeine Zeitung*, no. 74(1983), L11. The joint effort had generated fresh ideas and assembled compelling data for the tackling of questions of evolution, consciousness, knowledge and the self. H. Schneider, Review of *Das Ich und sein Gehirn*, *Zeitschrift für Allgemeinmedizin*, 59(1983). The authors were congratulated for having recognized the limits of modern science and validating the mysteriousness of consciousness. Gero von Boehm, "Das Gehirn gehört dem Ich," *Die Zeit*, 3 December 1982.

¹³ Eccles' exposure of the current limits of scientific understanding of the brain coupled with Popper's highlighting of the shortfalls of non-dualist theories, dealt materialism a serious blow according to Ursula Schubert, Review of "Self and Its Brain [Sic]" by Karl R. Popper and John C. Eccles, *Deutsche Zeitschrift für Philosophie* 27, no. 5(1979), 654-656. See also Joseph T. Lienhard S.J., Review of "The Self and Its Brain: An Argument for Interactionism" by Karl R. Popper and John C. Eccles, *Modern Schoolman*, 56, no. 3 (1979), 269-276.

¹⁴ Hannes Sauter-Servaes, Review of *Das Ich und sein Gehirn*, *Renovatio (Zeitschrift für das Interdisziplinäre Gespräch)*, 39, no.1(1983), 56-57.

¹⁵ Hermann Fischer, "Theologische Anthropologie in Interdisziplinärem Horizont," *Theologische Rundschau*, 58, no. 1(1993), 1-20.

¹⁶ Cautionary notes were sounded in M.S., Review of "Self and Its Brain" by Karl R. Popper and John C. Eccles, *Review of Metaphysics*, 35, no. 4(1982), 894-896 and Michael Fuller, "'the Firmament Sheweth His Handiwork:' Some Scientists' Reflections on Theology," *New Blackfriars*, 76, no. 899(1995), 535-541.

Most philosophers of mind were sparing in their praise. Although a minority did think it deserved serious consideration, *The Self and Its Brain* turned out to be by far Popper's most controversial book.¹⁷ Most thought it defective, suffering from a serious lack of self-criticism.¹⁸ The result, according to the majority opinion, was the dubious ontology of Popper's Three Worlds, the uncorrected naivetè of Eccles' philosophy, and, ironically, the evasion of the central question of what is mind.¹⁹

The harshest criticism, however, came from scientists appalled at the perplexing behavior of one of their own. Eccles' performance was derisively dismissed as extraordinary antics.²⁰ His speculations were seen as wild and unwarranted and even as downright silly.²¹ Eccles was accused of sins of both omission and commission. The

¹⁷ Praise came from Jean-Francois Malherbe, "Autour d'un vieil aufklaerer de l'espèce pre-Hegeliennne," *Revue Philosophique de Louvain*, 78, no. 40(1980), 562-583. Another reviewer thought that the work at least "puts the case for interactionism as well as it can be put." K. T. Maslin, "Review of 'Self and its Brain'," *Philosophical Quarterly*, 29(1979), 370-371. That it was his most controversial work see Renée Bouveresse, *Karl Popper e t la science d'aujourd'hui: Actes du colloque*, (Paris: Aubier, 1989), 323.

¹⁸ Godfrey Vesey, "Review of 'The Self and Its Brain' by Karl R. Popper and John C. Eccles," *Philosophy*, 54(1979), 249-251. "The deference and mutual congratulation that was probably appropriate in the salubrious atmosphere of the twilit gardens of the Villa Serbelloni looks faintly ridiculous in cold print," stated the most disparaging review. Daniel Dennett, "Review of 'The Self and its Brain,' by Karl R. Popper and John. C. Eccles," *Journal of Philosophy*, 76(1979), 96. On the whole *The Self and Its Brain* was belittled by thinkers on the mind-body problem as "yet another footnote to Plato and Descartes dressed up in antireductionist and neurophysiological terminology." Terrence W. Deacon, "Review of The Self and its Brain by Karl R. Popper and John C. Eccles," *Ethology and Sociobiology*, 10(1989), 467.

¹⁹ Roberto Torretti, "Review of 'The Self and its Brain' by Karl R. Popper and John C. Eccles," *Dialogos*, 13, no. 32(1978), 202-206; Reinhard Werth, "Review of 'The Self and its Brain, an Argument for Interactionism' by Karl R. Popper and John C. Eccles," *Erkenntnis*, 15(1980), 409-416; "Das Gespenst in der Maschine," *Wiener Zbg*, 11 November 1983. Dennett complained that it was neither good science writing (as it didn't go into enough detail to assess the experiments), nor good popular writing (as it is overly jargonesque). Dennett, *Self and its Brain*, 91-97.

²⁰ "The spectacle of these two aged but worthy knights, one a distinguished philosopher of science, the other a distinguished neurologist, riding forth together to slay the dragon of Materialism in defense of the doctrine of Trialist Interactionism is irresistible even if, at the end of the day, the dragon remains unslain and the doctrine collapses into absurdity." U. T. Place, "Review of 'The Self and its Brain: An Argument for Interactionism' by Karl R. Popper and John C. Eccles," *Annals of Science*, 36(1979), 403.

²¹ George Mandler, "Review of 'The Self and Its Brain' by Karl R. Popper and John. C. Eccles," *Science*, 200(1978), 1040-1041; Stuart Sutherland, "Nature of Consciousness," *New Scientist*, 76, no. 1082(1977), 715.

absence of so much data from experimental psychology and artificial intelligence research was judged inexcusable.²² His interpretations of experiments were ruled doubtful.²³ Eccles and Popper's speculations were judged to be too unspecific to generate testable consequences, and, furthermore, to be anti-scientific in their condemning the mind to be forever a black box.²⁴ It was not long before the ultimate scientific insult was hurled at *The Self and Its Brain*, its data was declared out-of-date.²⁵

The scientific and philosophical communities pronounced the book dead on arrival. Scientists were advised to ignore it - and largely did.²⁶ Philosophers, either too uninterested or convinced that the work fell outside the bounds of modern philosophical

²² Bouveresse, *Karl Popper e t la science d'aujourd'hui*, 489; Sutherland, "Nature of Consciousness," 715; Mandler, Review of *Self and its Brain*, 1040-1041.

²³ Mandler countered each of Eccles' claims with the refrain, "It is not the case..." George Mandler, "Review of 'The Self and Its Brain' by Karl R. Popper and John C. Eccles," *Science*, 200(1978), 1040-1041. Eccles' use of diagrams was misleading, "providing an unmechanistic mechanistic model of interaction." Werth, Review of *Self and its Brain, an Argument for Interactionism*, 409-416. Similar criticism can be found in Bouveresse, *Karl Popper e t la science d'aujourd'hui*, 338.

²⁴ "How does [their model of the mind] work, what is its structure, why is it fit for some things and not others?," demanded one scientist. L. Jonathan Cohen, "Review of 'The Self and Its Brain' by Karl R. Popper and John C. Carew," *Mind*, 88(1979), 301-304. Among the most common criticisms of Eccles and Popper's work was the failure to fully appreciate the success of and to equate science with the reductionist program. Elmar Holenstein, "Gehirn und Geist zur Renaissance von Bewusstseinstheorien," *Philosophische Rundschau*, 29(1982), 90-106. This led to their 'unscientific' theory of mind which "removes biological problems from examination." Donald O. Hebb, "View from Without," *Philosophy and Sociology of Science*, 10(1980), 309-315.

²⁵ Eike Christian Hirsch, "Religion and Society," Norddeutscher Rundfunk, Hannover, Germany, broadcast of 4 February 1983, 6p.m. NDR3, a review of two books: Harald Fritzsche, *Vom Urknall zum Zerfall* and Karl R. Popper and John C. Eccles, *Das Ich und sein Gehirn*. Hirsch claims that the recent work by Konrad Lorenz and others in the study of evolutionary biology were making the emergence of mind naturalistically explicable.

²⁶ One reviewer explicitly encouraged scientists to ignore the work, reassuring them that "it is the fruits of your labours which will determine in the end how we should talk about mind and body." Benjamin Rubenstein, "Review of 'The Self and Its Brain' by Karl R. Popper and John C. Eccles," *Journal of the American Psychoanalytical Association*, 28(1980), 210-219. "Nothing, finally has come of [Eccles'] project," concludes Nancey C. Murphy, *Bodies and Souls, Or Spirited Bodies?*, (New York: Cambridge University Press, 2006), 116.

discussion, likewise disregarded the book.²⁷ The book's hostile reception greatly disappointed Eccles, but it did not surprise him. He always thought himself to be in a war against a materialist establishment that was well-practiced in the art of 'inquisitorial techniques.'²⁸ At the Sixteenth World Conference of Philosophy in Düsseldorf, Germany, the book was attacked and Eccles stormed out. Recognizing the growing consensus, Popper publicly lamented at a meeting in Washington D.C. that there was hardly a person who could offer a good word regarding their noble effort.²⁹

To its detractors, *The Self and Its Brain* was completely out of step with the trend of twentieth-century science and philosophy. By the time of its appearance, dualism was to most philosophers of mind an alien mode of thought and to the majority of psychologists an idea dead and buried. Materialist monism, the idea that reality consists of one type of substance subject to the laws of science, had, it seemed, become "something approaching a settled orthodoxy."³⁰ Reductionist movements in the twentieth

²⁷ "Eccles" in H. C. G. Matthew and Brian Howard Harrison, *Oxford Dictionary of National Biography: From the Earliest Times to the Year 2000*, (New York: Oxford University Press, 2004). Daniel Dennett, materialist author of *Consciousness Explained* (1991), offered the following explanation for the deafening silence:

Conceived in Olympian isolation, it makes little attempt to address the issues, solve the problems, or rebut the arguments that most researchers take seriously today and although there are discussions of some recent work, they are for the most part conducted at arm's length, and are so unspecific that I doubt that any writer whose work is criticized will feel obliged to respond.

Dennett, Review of *The Self and its Brain*, 91-97.

²⁸ For examples of this sentiment of Eccles see Eccles to Popper, 7 September 1979. Correspondence, 1932-1987. Box 291, folder 2, KP-HAS; John C. Sir Eccles, *How the Self Controls its Brain*, (New York: Springer-Verlag, 1994), 1; N. F. Mott, *Can Scientists Believe?: Some Examples of the Attitude of Scientists to Religion*, (London: James & James, 1991), 97.

²⁹ Popper, Paper, American Philosophical Association, Hilton Hotel, Washington D.C. 28 December 1978. Speeches and Writings, 1928-1986. Box 208, folder 22, KP-HAS.

³⁰ Rubenstein, "Review of 'The Self and Its Brain' by Karl R. Popper and John C. Eccles," 210-219; Parker E. Lichtenstein, "Self and Its Brain and the Psychobiology of Mind," *Psychological Record*, 29(1979), 141-143; D. M. Armstrong, "Is the Mind More than the Brain?," *Quadrant*, 22, no. 132(1978),

century, including Logical Positivism in philosophy, Behaviorism in psychology, and the continuing program of localization and mechanization of cognitive functions in physiology had in effect, if not in original intent, precluded conceptions of the mind as independent of matter.³¹ Popper and Eccles, in stark contrast, defiantly believed in “the ghost in the machine,” in a transcendent self that guides a mechanistic, material body. Popper saw the ghost as an agent that mediates interactions between the worlds of objects and of ideas, a manifestation of the open (non-determinist) universe. Eccles envisioned the ghost as an ‘influence,’ possibly outside the matter-energy system of the natural world, that tweaks networks of neurons “momentarily poised close to a just threshold level of excitability” in a portion of the brain he dubbed “the liaison brain.”³²

Popper and Eccles’ work was cast as being, not just on the fringes of science, but positively reactionary. Their solution was a peculiar anachronism, backward-looking nostalgia.³³ Positivists could see in this answer to the mind-body problem a return to what the nineteenth-century founder of Positivism, Auguste Comte, called theological

18-22; Oliver Leaman, *The Future of Philosophy: Towards the Twenty-First Century*, (New York: Routledge, 1998), 151; John Heil, *Philosophy of Mind: A Contemporary Introduction*, 2nd ed., (New York: Routledge, 2004), 262.

³¹ Logical Positivism in its denial of essences and favoring of empirical statements seemed to deny the substantiality of the self. Behaviorism in its Skinnerian form denied *de novo* mindful actions, reducing every action to a reaction to internal and external stimuli. Ablation and electrical stimulation experiments in the brain seemed to closely tie sensory, emotional, and learning abilities to specific groups of cells. The notion of a unified transcendent essence appeared unlikely.

³² John C. Eccles, *The Neurophysiological Basis of Mind: the Principles of Neurophysiology*, (Oxford: Clarendon Press, 1953), 265; John C. Eccles, *Facing Reality: Philosophical Adventures by a Brain Scientist*, (New York: Springer-Verlag, 1970), 127.

³³ In the view of several critics, far from advancing knowledge, Popper and Eccles offered primitive non-answers. One bewildered reviewer related about Eccles and Popper’s work that it was a story of a humonculus “who does all the things that are interesting about human action and experience. We are right where we started the next book will have to be about the theory of the humonculus.” Mandler, Review of *The Self and its Brain*, 1040-1041.

ways of thinking.³⁴ “What makes their joint effort so remarkable,” stated one scientist incredulously, “is that it seeks to reverse an all-but-universal trend [of reductionism]...here in 1977 is a book in which two acknowledged leaders of scientific thought condemn this whole trend as misguided and obstructive of progress.”³⁵ What was shocking to critics of *The Self and Its Brain* was not so much the particulars of an improbable theory of a brain region “in which little mental poltergeists pound away miraculously on the synapses,” but rather its attempt to tear down the barrier erected by Enlightenment and positivist philosophers between the permitted and the forbidden, between the realms of science and metaphysics, between seeing nature as entirely material and as partly spiritual.³⁶

Had the authors been obscure eccentrics, the scientific and philosophical communities might have written off *The Self and Its Brain* as a display of solipsistic ignorance. Authored as it was by “the dean of modern neuroscience” and by one of the most famous philosophers of the scientific method, it was called a “travesty.”³⁷ Eccles’ scientific contributions were universally recognized as having helped form “the backbone

³⁴ “One cannot help being reminded of primitive attempts to explain the blowing of the winds...by the presence of activating spirits.” Cohen, Review of *The Self and its Brain*, 301-304. On Comte’s three stages of intellectual development see footnote number 239 in chapter one.

³⁵ D. M. Mackay, “Selves and Brains,” *Neuroscience*, 3(1978), 599. Another reviewer elaborated, “I wonder whether either author fully realizes what a profound departure they are asking us to make with the whole trend of science as we have known it in post Galilean times with its reductionist and analytical terms.” Beloff, “Is Mind Autonomous?,” 269.

³⁶ Quotation is from Dennett, Review of *The Self and its Brain*, 91-97. Frank M. Turner, *Between Science and Religion; the Reaction to Scientific Naturalism in Late Victorian England*, (New Haven, CT: Yale University Press, 1974), 33-34. ‘Metaphysics’ throughout this dissertation refers to transcendent metaphysics, the idea that “what really exists lies beyond the reach of ordinary experience” as detailed in *The Harper Dictionary of Modern Thought*, (New York: Harper & Row, 1988), s.v. “metaphysics.”

³⁷ Uttal, *Dualism: The Original Sin of Cognitivism*, 211.

of mechanistic neuroscience.”³⁸ He had furthered an electro-chemical understanding of synaptic transmission and had even co-authored a pioneering work on the brain with the materialist-sounding title, *The Cerebellum as a Neuronal Machine* (1967).³⁹ Popper, for his part, had received the praise of numerous giants of twentieth-century science, including the biochemist Hans Krebs, the immunologist Peter Medawar, the evolutionary biologist Ernst Mayr, and the geneticist Jacques Monod, all of whom thought Popper had grasped the essence of good science.⁴⁰ Falsificationism has even been recognized by the United States Supreme Court as a standard of good science.⁴¹

³⁸ *Oxford Dictionary of National Biography* (2004), s.v. “Eccles.”

³⁹ John C. Eccles, Masao Ito, and János Szentágothai, *The Cerebellum as a Neuronal Machine*, (Berlin, New York etc.: Springer-Verlag, 1967).

⁴⁰ Popper’s *Logik der Forschung* (1934) was considered an unusual example of a philosophical essay that actually influenced twentieth-century science. *Oxford Dictionary of National Biography*, s.v. “Popper.” Throughout his later career, Popper received letters from grateful experimentalists thanking him for his service to science. The litany is worth citing to give a sense of his perceived importance. Hans Krebs, founder of the biochemical pathway that explained energy harvesting of the cell, called him “one of us,” expanding in a letter to Popper, “your impact on scientific methodology has been growing rapidly in recent years and is still spreading over ever increasing areas, for the benefit of science.” Krebs to Popper, 22 June 1976. Correspondence, 1932-1987. Box 317, folder 8, KP-HAS. Peter Medawar, an immunologist who pioneered the field of immunotolerance, called Popper the greatest philosopher of science ever. Martin Morgenstern and Robert Zimmer, *Karl Popper*, (Munich: Deutscher Taschenbuchverlag, 2002), 179; David Edmonds and John Eidinow, *Wittgenstein’s Poker: The Story of a Ten-Minute Argument between Two Great Philosophers*, (New York: Ecco, 2001), 166. Ernst Mayr, the noted evolutionist, implored Popper to remember, “how many people have been touched, indeed deeply influenced by you...” Mayr to Popper, 24 December 1985. Box 33, folder 1398. Ernst Mayr Papers. HUG(FP) 74.4. Harvard University Archives. (Hereafter, EM-HUA). Jacques Monod, discoverer of the organizing genetic element called the operon, had even pondered writing an essay, which would include “examples in modern biology to illustrate the value of Popperian epistemology.” Monod to Popper, 23 August 1972. Correspondence, 1932-1987. Box 329, folder 23, KP-HAS. Popper’s ideas had implications for an enormous range of fields, among them political science, sociology, philosophy of history, philosophy of science, quantum mechanics, probability theory, evolutionary biology, and the philosophy of mind. His supporters claimed that he made revolutionary advances in many of these areas. David Miller, “Sir Karl Raimund Popper, C.H., F.B.A. 28 July 1902-17 September 1994,” *Biographical Memoirs of Fellows of the Royal Society*, 43(1997), 369. Examples of Popper’s wide-ranging impact are not difficult to find. His influence can be found in the works of the political theorist Frederick Hayek, the legal theorist John Rawls, the educational theorist Henry Perkinson, the art historian Ernest Gombrich, and the human evolutionist Bernard Campbell. W.W. Bartley, “A Popperian Harvest” in Karl Raimund Popper and Paul Levinson, *In Pursuit of Truth: Essays on the Philosophy of Karl Popper on the Occasion of His 80th Birthday*, (Atlantic Highlands, N.J: Humanities Press, 1982), 283; *Columbia History of Western Philosophy*, s.v. “Karl Popper and W.V. O. Quine.” One might also mention George Soros, a pupil of Popper, who was inspired to create the NGO called The Open Society Institute.

Aims of this Dissertation

Why had these two leaders of scientific thought and practice, one a theoretician famous for his insistence on the falsifiability of theories and the other a practitioner who had demonstrated the efficacy of a reductionist approach to the nervous system, engaged in this controversial project to save belief in a transcendent self from the materialism of modern-day philosophy and science?⁴² This dissertation argues that it was the logical outcome of both of their intellectual journeys. This study is an attempt to situate and analyze their extraordinary handling of the mind/body problem, which can only be done by understanding their friendship, careers, and the world they lived in. The focus of this dissertation is therefore much wider than the production of *The Self and Its Brain*. It seeks to be a window onto the progress, culture, and limits of twentieth-century brain science and philosophy of mind.

The first chapter tells the story of the origin of Eccles and Popper's friendship. It describes their personal and professional backgrounds, intellectual formations, the impact World War II had on their thoughts and careers, and what brought them together. Regarding Eccles, it describes the state of the field he entered and sketches his first scientific contributions. Regarding Popper, it attempts to explain why his ideas were

⁴¹ *Daubert v. Merrell Dow Pharms.* 509 U.S. 579 (1993). In the 1993 case *Daubert v. Merrell Dow Pharmaceuticals* the U.S. Supreme Court provided lower courts with a test regarding the admissibility of scientific evidence. At the top of the four-point checklist was a Popperian standard: Were the theories and methodologies in question subjected to rigorous, potentially falsifying tests?

⁴² The, until recently, atheist philosopher Anthony Flew argued for years that the problem with religion is that it did not subject its claims about God to falsification tests. Anthony Flew, "Theology and Falsification" originally published in 1950 in the Oxford periodical *University* reprinted in Anthony Flew, *The Presumption of Atheism*, (London: Elek Pemberton, 1976). Flew relates in this volume that his essay had been reprinted 18 times. In the essay he posed the question, "What would have to occur or to have occurred to constitute for you a disproof of the love (or existence) of God? He argued that religious assertions die the death of a thousand qualifications. He also claimed this to be an open-minded challenge. *Ibid.*, 73-4, 77.

considered revolutionary, especially by Eccles, a scientist trained in a world-famous laboratory. Most importantly, it discusses why Popper's ideas attracted Eccles, what it was that moved Eccles to one day write Popper, "When the history of philosophy of this period is written the full impact of your conceptual thought will shine out as a bright light in the prevailing philosophical atmosphere of darkness."⁴³

The next chapter analyzes how Eccles put Popperism to the test in the historic debate over the mode of neurotransmission. This episode in the history of neuroscience (until now written almost exclusively from the perspective of the winning side) has generated many thoughtful questions about the role of the actors, methods, and theories involved.⁴⁴ Some historians have faulted Eccles for being obstinate, for having had a psychological barrier that prevented him from accepting new facts and paradigms.⁴⁵ Others have placed the blame on experimental limitations.⁴⁶ Still others have posited that disciplinary boundaries caused the war between the 'soups' of the biochemists and the 'sparks' of the neurophysiologists.⁴⁷ This chapter weighs these interpretations. It assesses the firsthand involvement of Popper in the development of testable theories and

⁴³ Eccles to Popper, 31 May 1966. Correspondence, 1932-1987. Box 290, folder 9, KP-HAS. See footnote 115 in chapter five.

⁴⁴ Examples of the scholarship on this episode include Elliot S. Valenstein, *The War of the Soups and the Sparks: The Discovery of Neurotransmitters and the Dispute Over how Nerves Communicate* (New York: Columbia University Press, 2005); Z. M. Bacq, *Chemical Transmission of Nerve Impulses: A Historical Sketch*, (New York: Pergamon Press, 1974); and Horace Davenport, "Early History of the Concept of Chemical Transmission," *Physiologist*, 34, no. 4(1991), 179-190; Joseph D. Robinson, *Mechanisms of Synaptic Transmission: Bridging the Gaps (1890-1990)*, (New York: Oxford University Press, 2001).

⁴⁵ Bacq, *Chemical Transmission of Nerve Impulses*, 106.

⁴⁶ Robinson, *Mechanisms of Synaptic Transmission*, 451.

⁴⁷ Valenstein, *The War of the Soups and the Sparks*, 237.

analyzes the crucial experiment that supposedly decided the debate for Eccles. This chapter also elucidates the reasons for and the uses of Eccles' concession.

Eccles' conversion to the chemical theory of neurotransmission coincided with his entrance into the debate over the nature of mind. The publication of Gilbert Ryle's *Concept of Mind* (1949) roused Eccles to propose his first hypothesis of the liaison brain, the subject of the next chapter of this dissertation.⁴⁸ This section documents the materialist climate that so disturbed Eccles and explores the roots of his rejection of the reductionist program. It traces the origins of his model and analyzes the reasons for its unpopularity and the ways in which Eccles thought it was compatible with modern science. It was at this same time that Popper published his attack on determinism, which could be seen as the groundwork for his future venture into the mind question. This chapter describes how, through Eccles' preliminary effort on behalf of the "ghost in the machine," Eccles got a taste for philosophical confrontation and started to realize the full potential of his budding friendship with Popper.

Chapter four tells the story about Eccles' rising stature and increasing interest in the mind question. It analyzes Eccles' 'golden age,' the era of his Nobel Prize-winning science. It describes the factors that aided his science and assesses the various meanings of the award. It shows how Eccles' Nobel speech was a missed opportunity to highlight the complexity of his science and its Popperian elements. Skeptics have doubted the practical influence of Popper, arguing that Popperian ideas insofar as they have been used by scientists usually have been selectively invoked, only exploited as a means of

⁴⁸ The term 'liaison' he took from Sherrington, who used the word in a title of one of his chapters in *Man on His Nature*, Lecture VIII, "The Organ of Liaison."

supporting one's own scientific position and for discrediting the positions of others.⁴⁹

The case of his former student Wilfrid Rall (also discussed in this chapter) indicates that there is some truth in this charge. Eccles did sometimes wield Popperism as a cudgel to demolish theories that contradicted his own. Nevertheless, Eccles credited Popper with unleashing his scientific creativity.⁵⁰ As his studies in the lower brain regions indicate, Popper's ideas were for him not just "evaluative retrodictions" but "useful prescriptions."⁵¹ Thrown into the spotlight, Eccles used the authority of the Nobel Prize to create a public face that suited his larger goals. During this period Eccles formed ties with organizations that encouraged dialog between science and religion, the prestigious Pontifical Academy of Sciences and the controversial International Conferences for the Unity of Science. Eccles' role in their proceedings is detailed. Finally, this chapter explores the socio-political backdrop to Eccles' last explorations in the brain and to his preparations for full-time occupation with the mind.

Chapter five recounts Popper's nascent dualism, or trialism as he called it. This chapter elucidates why the nature of mind became a pertinent question for Popper, why transcendence became necessary for his fight against inductivism. The chapter begins with a discussion of Popper's growing visibility during the Cold War, his popularity with economists, his debates with neo-Marxians, and his popularity with Western politicians

⁴⁹ Michael Mulkay and G. Nigel Gilbert, "Putting Philosophy to Work: Karl Popper's Influence on Scientific Practice" originally in *Philosophy of the Social Sciences*, 11(1981), 389-407 reprinted in Anthony O'Hear, *Karl Popper: Critical Assessments of Leading Philosophers*, (New York: Routledge, 2004), vol.3, 290-94, 299.

⁵⁰ John Eccles, "World of Objective Knowledge" in Karl Raimund Popper, *The Philosophy of Karl Popper*, (La Salle, IL: Open Court, 1974), 367-8.

⁵¹ Mulkay and Gilbert, "Putting Philosophy to Work: Karl Popper's Influence on Scientific Practice," 305-6.

nervous about their volatile times. It then explores the invention and critique of his Three Worlds hypothesis, how it was an answer to violence, how it furthered his epistemology, how it represented a fundamental change in his methodology, and how it was strengthened by his conversion to Darwinian evolution. Popper's discovery of the Three Worlds reflected a fundamental shift in Popper's thinking: his move from falsificationism to critical rationalism. The implications of this transition are explored. As Eccles' friend Roger Sperry noted, in the 1960s Popper went from believing that evolutionary theory is nothing but a tautology incapable of explaining anything to suddenly believing that evolutionary theory explains almost everything.⁵² Popper turned natural selection into an argument for dualist interactionism. Just as Popper accepted Eccles' Liaison Brain hypothesis, Eccles readily accepted, with a few caveats, Popper's Three Worlds scheme. This chapter discusses why Eccles latched on to Popper's innovations, why Popper appreciated this acceptance, and how this approval helped solidify plans to write a joint work.

Chapter six is the story of the creation and reception of *The Self and Its Brain*. After a fifty-year career, Eccles retired to Switzerland determined to tackle full-time the question that haunted him throughout his life. Surrounded by his library and personal papers, Eccles sought to harmonize modern science with Cartesian metaphysics. Cognizant of his philosophical shortcomings, Eccles successfully cajoled Popper into assisting him.⁵³ This chapter summarizes and critically examines their cooperative effort.

⁵² R.W. Sperry, "Mind-Brain Interaction: Mentalism, Yes; Dualism, No," *Neuroscience*, 5(1980), 199.

⁵³ "I am very conscious of my deficiencies as a philosopher and need a great deal of criticism, as well as constructive help if a really effective new approach is to be accomplished." Eccles to Popper, 21 June 1962. Correspondence, 1932-1987. Box 290, folder 9, KP-HAS. Eccles had called his own "Man and Freedom," his wartime reflections on humanity, "an amateurish bit of writing." Eccles to Popper, 2 July 1945. Correspondence, 1932-1987. Box 290, folder 7, KP-HAS.